Chapter 6: Greenhouse Gas Emissions and Climate Change

A. INTRODUCTION

This chapter evaluates the greenhouse gas (GHG) emissions that would be generated by the operation of the proposed project, and the proposed project's consistency with the citywide GHG reduction goals. This chapter also evaluates the resilience of the proposed project to climate conditions throughout the lifetime of the project.

As discussed in the *City Environmental Quality Review* (*CEQR) Technical Manual*, global climate change is projected to have wide-ranging effects on the environment, including rising sea levels, increases in temperature, and changes in precipitation levels. Although this is occurring on a global scale, the environmental effects of climate change are also likely to be experienced at the local level. New York City's sustainable development policy, starting with PlaNYC, and continued and enhanced in OneNYC, established sustainability initiatives and goals for greatly reducing GHG emissions and for adapting to climate change in the City.

Per the *CEQR Technical Manual,* the citywide GHG reduction goal is currently the most appropriate standard by which to analyze a project under CEQR. The *CEQR Technical Manual* recommends that a GHG consistency assessment be undertaken for any project preparing an environmental impact statement expected to result in 350,000 square feet or more of development and other energy-intense projects. The proposed project would result in approximately 6 million gross square feet (gsf) of developed floor area. Accordingly, a GHG consistency assessment is provided.

PRINCIPAL CONCLUSIONS

GREENHOUSE GAS EMISSIONS

The building energy use and vehicle use associated with the proposed project sites would result in up to approximately 38 to 39 thousand metric tons of carbon dioxide equivalent (CO_2e) emissions per year.

The *CEQR Technical Manual* defines five goals by which a project's consistency with the City's emission reduction goal is evaluated: (1) efficient buildings; (2) clean power; (3) sustainable transportation; (4) construction operation emissions; and (5) building materials carbon intensity.

Specific energy efficiency measures and design elements that may be implemented have been evaluated, and are required at a minimum to achieve the energy efficiency requirements of the New York City Building Code. Furthermore, design elements that may be implemented as part of the proposed project would reduce the energy demand by up to 44 percent below this requirement. Therefore, the proposed project would support the goal identified in the *CEQR Technical Manual* of building efficient buildings.

The inclusion of a 200 to 400 ton capacity ground source heating and cooling system (Design Option 1) is under consideration for each of the project sites. The system would reduce on-site natural gas consumption required for heating through the use of ground source heat pumps (GSHP) to transfer heat to and from onsite ground bores. Furthermore, electric boilers would be used for supplemental heating in order to eliminate the demand for on-site natural gas consumption. Implementation of Design Option 1 could decrease net building energy GHG emissions by approximately 6.3 percent, representing approximately 3.4 percent of the total potential GHG emissions for the proposed project.

Additionally, the inclusion of a cogeneration system (Design Option 2) is under consideration for each of the project sites. If included, the system would produce electricity on-site while providing heat as a byproduct, and would reduce the electricity demand from the grid while burning natural gas on-site. The heat produced would offset some or all of the natural gas required to provide heat and hot water. Implementation of Design Option 2 could decrease net building energy GHG emissions by approximately 2.2 percent, representing approximately 1.2 percent of the total potential GHG emissions for the proposed project.

The proposed project would also support the other GHG goals by virtue of their proximity to public transportation, reliance on natural gas, commitment to construction air quality controls and the fact that as a matter of course, construction in New York City uses recycled steel and includes cement replacements. All of these factors demonstrate that the proposed project would support the GHG reduction goal.

Therefore, based on the commitment to energy efficiency and by virtue of location and nature, the proposed project would be consistent with all of the City's emissions reduction goals, as defined in the *CEQR Technical Manual*.

RESILIENCE TO CLIMATE CHANGE

The Bronx, Brooklyn, and Queens sites are not within projected future flood hazard areas and therefore are not evaluated for resilience to climate change.

The Manhattan Site is located within the Coastal Zone Boundary and is within projected future flood hazard areas identified by New York City.[1]

Based on conceptual plans, it is expected that the ground-floor elevation of the proposed project on the Manhattan Site would be approximately 18 feet NAVD88, which would be higher than the New York City Panel on Climate Change (NPCC)'s "high" future 2100 base flood elevation (BFE) of 16.25 feet. In addition, to the extent feasible, future design development for the building on the Manhattan Site would account for future flood levels and locate critical mechanical features such as heating, cooling, electrical, and telecommunication on building floors above NPCC's "high" future 2080s BFE of 14.8 feet or 2100 BFE of 16.25 feet. Those critical features that require an elevation below the BFE (such as water/sewer service and potentially other features conveyed below ground to a building's cellar level) could be dry-floodproofed either from the outset of the building's construction or at such time as the BFE reaches the proposed site, projected to be the 2080s or later. Similarly, vulnerable features (habitable space above the building's lowest floor, such as detention housing) would be located above the future BFEs by the 2080s or 2100. In addition, the proposed detention facilities would be equipped with emergency electrical generators

[1] NYC. *NYC Flood Hazard Mapper*. Accessed 6/13/2018.

and fuel storage to provide power for several days of power outages, as well as food supplies for seven days of operation. In the event of a power loss, the proposed facilities are intended to remain fully operational.

B. GREENHOUSE GAS EMISSIONS

POLLUTANTS OF CONCERN

GHGs are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. The general warming of the Earth's atmosphere caused by this phenomenon is known as the "greenhouse effect." Water vapor, carbon dioxide (CO_2), nitrous oxide (N_2O), methane, and ozone are the primary GHGs in the Earth's atmosphere.

There are also a number of entirely anthropogenic GHGs in the atmosphere, such as halocarbons and other chlorine- and bromine-containing substances, which damage the stratospheric ozone layer (and contribute to the "ozone hole"). Since these compounds are being replaced and phased out due to the 1987 Montreal Protocol, there is no need to address them in GHG assessments for most projects. Although ozone itself is also a major GHG, it does not need to be assessed as such at the project level since it is a rapidly reacting chemical and efforts are ongoing to reduce ozone concentrations as a criteria pollutant (see Sections 2.11, 3.9, 4.10, and 5.10, "Air Quality"). Similarly, water vapor is of great importance to global climate change, but is not directly of concern as an emitted pollutant since the negligible quantities emitted from anthropogenic sources are inconsequential.

CO_2 is the primary pollutant of concern from anthropogenic sources. Although not the GHG with the strongest effect per molecule, CO_2 is by far the most abundant and, therefore, the most influential GHG. CO_2 is emitted from any combustion process (both natural and anthropogenic); from some industrial processes such as the manufacture of cement, mineral production, metal production, and the use of petroleum-based products; from volcanic eruptions; and from the decay of organic matter. CO_2 is removed ("sequestered") from the lower atmosphere by natural processes such as photosynthesis and uptake by the oceans. CO_2 is included in any analysis of GHG emissions.

Methane and N_2O also play an important role since the removal processes for these compounds are limited and because they have a relatively high impact on global climate change as compared with an equal quantity of CO_2. Emissions of these compounds, therefore, are included in GHG emissions analyses when the potential for substantial emission of these gases exists.

The *CEQR Technical Manual* lists six GHGs that could potentially be included in the scope of a GHG analysis: CO_2, N_2O, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). This analysis focuses mostly on CO_2, N_2O, and methane. There are no significant direct or indirect sources of HFCs, PFCs, or SF_6 associated with the proposed project.

To present a complete inventory of all GHGs, component emissions are added together and presented as CO_2e emissions—a unit representing the quantity of each GHG weighted by its effectiveness using CO_2 as a reference. This is achieved by multiplying the quantity of each GHG emitted by a factor called global warming potential (GWP). GWPs account for the lifetime and

the radiative forcing[2] of each chemical over a period of 100 years (e.g., CO_2 has a much shorter atmospheric lifetime than SF_6, and therefore has a much lower GWP). The GWPs for the main GHGs discussed here are presented in **Table 6-1**.

Table 6-1
Global Warming Potential (GWP) for Major GHGs

Greenhouse Gas	100-year Horizon GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	140 to 11,700
Perfluorocarbons (PFCs)	6,500 to 9,200
Sulfur Hexafluoride (SF_6)	23,900

Note: The GWPs presented above are based on the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report (SAR) to maintain consistency in GHG reporting. The IPCC has since published updated GWP values that reflect new information on atmospheric lifetimes of GHGs and an improved calculation of the radiative forcing of CO_2. In some instances, if combined emission factors were used from updated modeling tools, some slightly different GWP may have been used for this study. Since the emissions of GHGs other than CO_2 represent a very minor component of the emissions, these differences are negligible.

Source: 2014 *CEQR Technical Manual.*

POLICY, REGULATIONS, STANDARDS, AND BENCHMARKS FOR REDUCING GHG EMISSIONS

Because of the growing consensus that GHG emissions resulting from human activity have the potential to profoundly impact the Earth's climate, countries around the world have undertaken efforts to reduce emissions by implementing both global and local measures addressing energy consumption and production, land use, and other sectors. Although the U.S. has not ratified the international agreements that set emissions targets for GHGs, in December 2015, the U.S. signed the international Paris Agreement[3] that pledges deep cuts in emissions, with a stated goal of reducing annual emissions to a level that would be between 26 and 28 percent lower than 2005 emissions by 2025.[4] On June 1st, 2017, The President announced that "the United States will withdraw from the Paris Climate Accord."[5]

Regardless of the Paris Agreement, the U.S. Environmental Protection Agency (USEPA) is required to regulate GHGs under the Clean Air Act and has begun preparing and implementing regulations. In coordination with the National Highway Traffic Safety Administration (NHTSA),

[2] *Radiative forcing* is a measure of the influence a gas has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the gas as a GHG.

[3] Conference of the Parties, 21st Session. *Adoption of The Paris Agreement, decision -/CP.21*. Paris, December 12, 2015.

[4] United States of America. *Intended Nationally Determined Contributions (INDCs)* as submitted. March 31, 2015.

[5] Under the Agreement, countries are allowed to withdraw four years from the date the agreement entered into force—meaning the United States can officially withdraw on November 4, 2020. However, given the voluntary nature of the agreement, any action in the U.S. may or may not occur regardless of this status.

USEPA currently regulates GHG emissions from newly manufactured on-road vehicles. In addition, USEPA regulates transportation fuels via the Renewable Fuel Standard program, which will phase in a requirement for the inclusion of renewable fuels increasing annually up to 36.0 billion gallons in 2022. In 2015, USEPA also finalized rules to address GHG emissions from both new and existing power plants that would, for the first time, set national limits on the amount of carbon pollution that power plants can emit. The Clean Power Plan sets carbon pollution emission guidelines and performance standards for existing, new, and modified and reconstructed electric utility generating units. On February 9, 2016, the Supreme Court stayed implementation of the Clean Power Plan pending judicial review. In October 2017, USEPA proposed to repeal the Clean Power Plan.

There are also regional and local efforts to reduce GHG emissions. In 2009, Governor Paterson issued Executive Order No. 24, establishing a goal of reducing GHG emissions in New York State by 80 percent, compared with 1990 levels, by 2050, and creating a Climate Action Council tasked with preparing a climate action plan outlining the policies required to attain the GHG reduction goal; an interim draft plan has been published.[6] The State is now seeking to achieve some of the emission reduction goals via local and regional planning and projects through its Cleaner Greener Communities and Climate Smart Communities programs. The State has also adopted California's GHG vehicle standards (which are at least as strict as the federal standards).

The New York State Energy Plan outlines the State's energy goals and provides strategies and recommendations for meeting those goals. The latest version of the plan was published in June 2015. The new plan outlines a vision for transforming the state's energy sector that would result in increased energy efficiency (both demand and supply), increased carbon-free power production and cleaner transportation, in addition to achieving other goals not related to GHG emissions. The 2015 plan also establishes new targets: (1) reducing GHG emissions in New York State by 40 percent, compared with 1990 levels, by 2030; (2) providing 50 percent of electricity generation in the state from renewable sources by 2030; and (3) increasing building energy efficiency gains by 600 trillion British thermal units (Btu) by 2030.

New York State has also developed regulations to cap and reduce CO_2 emissions from power plants to meet its commitment to the Regional Greenhouse Gas Initiative (RGGI). Under the RGGI agreement, the governors of nine northeastern and Mid-Atlantic States have committed to regulate the amount of CO_2 that power plants are allowed to emit, gradually reducing annual emissions to half the 2009 levels by 2020, and reducing an additional 30 percent from 2020 to 2030. The RGGI states and Pennsylvania have also announced plans to reduce GHG emissions from transportation, through the use of biofuel, alternative fuel, and efficient vehicles

Many local governments worldwide, including New York City, are participating in the Cities for Climate Protection™ campaign and have committed to adopting policies and implementing quantifiable measures to reduce local GHG emissions, improve air quality, and enhance urban livability and sustainability. New York City's long-term comprehensive plan for a sustainable and resilient New York City, which began as PlaNYC 2030 in 2007, and continues to evolve today as OneNYC, includes GHG emissions reduction goals, many specific initiatives that can result in emission reductions, and initiatives aimed at adapting to future climate change impacts. The goal to reduce citywide GHG emissions to 30 percent below 2005 levels by 2030 ("30 by 30") was

[6] New York State Climate Action Council. *New York State Climate Action Plan Interim Report*. November 2010.

codified by Local Law 22 of 2008, known as the New York City Climate Protection Act (the "GHG reduction goal")[7] The City has also announced a longer-term goal of reducing emissions to 80 percent below 2005 levels by 2050 ("80 by 50"), which was codified by Local Law 66 of 2014, and has published a study evaluating the potential for achieving that goal. More recently, as part of OneNYC, the City has announced a more aggressive goal for reducing emissions from building energy down to 30 percent below 2005 levels by 2025.

In December 2009, the New York City Council enacted four laws addressing energy efficiency in large new and existing buildings, in accordance with PlaNYC. The laws require owners of existing buildings larger than 50,000 square feet to conduct energy efficiency audits and retro-commissioning every 10 years, to optimize building energy efficiency, and to "benchmark" the building energy and water consumption annually, using an USEPA online tool. By 2025, commercial buildings over 50,000 square feet will also require lighting upgrades, including the installation of sensors and controls, more efficient light fixtures, and the installation of submeters, so that tenants can be provided with information on their electricity consumption. The legislation also creates a local New York City Energy Conservation Code, which along with the Energy Conservation Construction Code of New York State (as updated in 2016), requires equipment installed during a renovation to meet current efficiency standards.

To achieve the 80 by 50 goal, the City is convening Technical Working Groups to analyze the GHG reduction pathways from the building sector, power, transportation, and solid waste sectors to develop action plans for these sectors. The members of the Technical Working Groups will develop and recommend the data analysis, interim metrics and indicators, voluntary actions, and potential mandates to effectively achieve the City's emissions reduction goal. In 2016, the City published the building sector Technical Working Group report, which included commitments by the City to change to building energy code and take other measures aimed at substantially reducing GHG emissions.

For certain projects subject to CEQR (e.g., projects with 350,000 gsf or more of development or other energy intense projects), an analysis of the projects' contributions to GHG emissions is required to determine consistency with the City's reduction goal, which is currently the most appropriate standard by which to analyze a project under CEQR, and is therefore applied in this section.

A number of benchmarks for energy efficiency and green building design have also been developed (green building design considerations include factors such as material selection, which affects GHG emissions associated with materials extraction, production, delivery, and disposal.) For example, the LEED system is a benchmark for the design, construction, and operation of high-performance green buildings that includes energy efficiency components. Similarly, Envision is a voluntary system for benchmarking performance and resiliency of physical infrastructure projects. USEPA's Energy Star is a voluntary labeling program designed to identify and promote the construction of new energy efficient buildings, facilities, and homes and the purchase of energy efficient appliances, heating and cooling systems, office equipment, lighting, home electronics, and building envelopes. As mentioned above and discussed in more detail in the analysis below, City capital projects, such as the proposed project, also have green building design and energy requirements under the City's green building standards.

[7] Administrative Code of the City of New York, §24-803.

METHODOLOGY

Climate change is driven by the collective contributions of diverse individual sources of emissions to global atmospheric GHG concentrations. Identifying potential GHG emissions from a proposed action can help decision makers identify practicable opportunities to reduce GHG emissions and ensure consistency with policies aimed at reducing overall emissions. While the increments of criteria pollutants and toxic air emissions are assessed in the context of health-based standards and local impacts, there are no established thresholds for assessing the significance of a project's contribution to climate change. Nonetheless, prudent planning dictates that all sectors address GHG emissions by identifying GHG sources and practicable means to reduce them. Therefore, this section presents the total GHG emissions potentially associated with the proposed project overall, and identifies measures that would be implemented and measures that are still under consideration to limit emissions. (Note that this differs from most other technical areas in that it does not account for only the increment between the condition with and without the proposed project. The reason for that different approach is that to truly account for the incremental emissions only would require speculation regarding where people would live in a No Action condition if residential units are not built at this location, what energy use and efficiency might be like for those alternatives and other related considerations, and similar assumptions regarding commercial and other uses. The focus is therefore on the total emissions associated with the uses, and on the effect of measures to reduce those emissions.)

Estimates of potential GHG emissions associated with the proposed project are based on the methodology presented in the *CEQR Technical Manual*. Estimates of emissions of GHGs from the development have been quantified, including off-site emissions associated with use of electricity, on-site emissions from heat and hot water systems, and emissions from vehicle use associated with the proposed development. GHG emissions that would result from construction are discussed as well. As per the guidance, analysis of building energy is based on the average carbon intensity of electricity in 2008 and in some cases more recent data (see below), which will likely be lower in the 2027 build year and lower still in future years as the fraction of electricity generated from renewable sources continues to increase. Vehicular emission factors will also continue to decrease in future years as vehicle engine efficiency increases and emissions standards continue to decrease, resulting in lower emissions in future years. Since the methodology does not account for future years and other changes described above, it also does not explicitly address potential changes in future consumption associated with climate change, such as increased electricity for cooling, or decreased on-site fuel for heating. Overall, this analysis results in conservatively high estimates of potential GHG emissions.

CO_2 is the primary pollutant of concern from anthropogenic emission sources and is accounted for in the analysis of emissions from all development projects. GHG emissions for gases other than CO_2 are included where practicable or in cases where they comprise a substantial portion of overall emissions. The various GHG emissions are added together and presented as metric tons of carbon dioxide equivalent (CO_2e) emissions per year (see "Pollutants of Concern," above).

BUILDING OPERATIONAL EMISSIONS

Estimates of emissions from building electricity and fuel use were prepared using projections of energy consumption factors developed specifically for the proposed project by the project engineers. City capital projects, such as the proposed project, also have green building design and energy requirements under the City's green building standards. Under Local Law 31 of 2016, new

capital projects for city-owned property are required to be designed to use no more than 50 percent of the current New York City Energy Conservation Code.

The proposed project sites are anticipated to consume 36.2 and 10.4 thousand Btu per year per square foot of development (kBtu/ft^2-yr) of electricity and natural gas, respectively. Consistent with the requirements of Local Law 31, this would be 44 percent of the ASHRAE 90.1-2013—less than the required 50 percent. Since the electricity emissions represent the latest data (2015) and not the future build year (2027), future emissions are expected to be lower as efficiency and renewable energy use continue to increase with the objective of meeting state and city GHG reduction goals. Additionally, the inclusion of all-electric and cogeneration system design options are under consideration.

The ground source heating and cooling alternative (Design Option 1) would reduce the need for on-site natural gas combustion using on site boreholes to provide 200 to 400 tons of heating and cooling capacity. Furthermore, Design Option 1 would use electric boilers to provide supplemental heating to completely eliminate natural gas consumption at the proposed project sites. This would result in an increase to the projected electricity demand factors to 40.2 or 40.8 kBtu/ft^2-yr for the Bronx and Queens Sites or the Brooklyn and Manhattan Sites, respectively.

A second design option under consideration is the inclusion of a cogeneration system at each of the project sites (Design Option 2). If the cogeneration design option were implemented, the cogeneration systems would be sized to meet the buildings domestic hot water demand. Each system would produce electricity on-site while providing heat as a byproduct and would reduce the electricity demand factor to 28.2 kBtu/ft^2-yr. While cogeneration systems would reduce the peak electricity demand at each project site, the systems would increase the amount of on-site natural gas consumption. Furthermore, the heat produced by the cogeneration systems would offset some or all of the natural gas required to provide heat and hot water. The proposed project under the cogeneration alternative was projected to require 20.4 kBtu/ft^2-yr of natural gas.

In addition to the design of the proposed project, the projected GHG emissions of Design Option 1 and 2 have been analyzed.

MOBILE SOURCE EMISSIONS

The number of annual weekday and Saturday vehicle trips by mode (cars, taxis, and trucks) that would be generated by the proposed project was calculated using the transportation planning assumptions developed for the analysis and presented in Sections 2.10, 3.9, 4.9, and 5.9, "Transportation." The assumptions used in the calculation include average daily weekday and Saturday person trips and delivery trips by proposed use, the percentage of vehicle trips by mode, and the average vehicle occupancy. To calculate annual totals, the number of trips on Sundays was assumed to be the same as on Saturday. Travel distances shown in Table 18-6 and 18-7 and associated text of the *CEQR Technical Manual* were used in the calculations of annual vehicle miles traveled by cars, taxis, and trucks. Table 18-8 of the *CEQR Technical Manual* was used to determine the percentage of vehicle miles traveled by road type and the mobile GHG emissions calculator provided with the manual was used to estimate GHG emissions from all trips attributable to the proposed project.

Based on the latest fuel lifecycle model from Argonne National Laboratory,[8] emissions from producing and delivering fuel ("well-to-pump") are estimated to add an additional 25 percent to the GHG emissions from gasoline and 27 percent from diesel. Although upstream emissions (emissions associated with production, processing, and transportation) of all fuels can be substantial and are important to consider when comparing the emissions associated with the consumption of different fuels, fuel alternatives are not being considered for the proposed development, and as per the *CEQR Technical Manual* guidance, the well-to-pump emissions are not considered in the analysis. The assessment of tailpipe emissions only is in accordance with the *CEQR Technical Manual* guidance on assessing GHG emissions and the methodology used in developing the New York City GHG inventory, which is the basis of the GHG reduction goal.

The projected total annual vehicle miles traveled by roadway type, forming the basis for the GHG emissions calculations from mobile sources, are summarized in **Table 6-2**.

Table 6-2
Vehicle Miles Traveled per Year

Roadway Type	Passenger	Taxi	Truck
Manhattan			
Local	352,852	42,974	292,426
Arterial	769,858	93,761	638,021
Interstate/Expressway	481,162	58,600	398,763
Bronx, Brooklyn, and Queens			
Local	1,970,280	172,229	865,121
Arterial	4,039,074	353,070	1,773,499
Interstate/Expressway	3,842,046	335,847	1,686,987
Total	**11,455,272**	**1,056,480**	**5,654,816**

CONSTRUCTION EMISSIONS

A description of construction activities is provided in Sections 2.15, 3.14, 4.14, and 5.14, "Construction Impacts." Consistent with CEQR practice, emissions associated with construction have not been estimated explicitly for the proposed project, but analyses of similar projects have shown that construction emissions (both direct and emissions embedded in the production of materials, including on-site construction equipment, delivery trucks, and upstream emissions from the production of steel, rebar, aluminum, and cement used for construction) are equivalent to the total operational emissions over approximately 5 to 10 years.

EMISSIONS FROM SOLID WASTE MANAGEMENT

The proposed project would not fundamentally change the City's solid waste management system. Therefore, as per the *CEQR Technical Manual*, the GHG emissions from solid waste generation, transportation, treatment, and disposal are not quantified.

[8] Based on GREET1_2016 model from Argonne National Laboratory.

PROJECTED GHG EMISSIONS

BUILDING OPERATIONAL EMISISONS

The fuel consumption and electricity use, emission factors, and resulting GHG emissions associated with building energy uses are presented in detail in **Table 6-3**. The proposed project may include either ground source heating and cooling (Alternative 1) or a cogeneration system (Alternative 2) at each project site; therefore, emissions with the two alternatives are presented as a range in **Table 6-4**.

Table 6-3
Annual Building Operational GHG Emissions
(metric tons CO_2e)

Site	Natural Gas 53.196 Kg CO_2e/MMBtu[(1)]	Grid Electricity 76.405 Kg CO_2e/MMBtu[(2)]	Total Emissions
Bronx Site*	15,080 MMBtu	52,490 MMBtu	6,278
Brooklyn Site	14,560 MMBtu	50,680 MMBtu	4,647
Manhattan Site	14,352 MMBtu	49,956 MMBtu	4,580
Queens Site	17,732 MMBtu	61,721 MMBtu	5,659
		Total:	**21,164**

Notes:
*Natural gas and electricity energy consumption estimated for the Bronx Site do not include the proposed mixed-use building. Emissions for the mixed-use building were based on development square footage and are included in the total building emissions.
Totals may not sum due to rounding.
Per *CEQR Technical Manual* guidance, electricity emissions represent the latest data (2015) and not the build year (2027). Future emissions are expected to be lower.
Sources:
(1) *CEQR Technical Manual*
(2) The City of New York Mayor's Office of Long-Term Planning and Sustainability. *Inventory of New York City Greenhouse Gas Emissions in 2015*. September 2016. Note that this factor represents a correction of the factor presented in the 2014 *CEQR Technical Manual*.

MOBILE SOURCE EMISSIONS

The mobile-source-related GHG emissions from the proposed project are presented in detail in **Table 6-5**. In addition to the direct emissions included in the analysis, an additional approximately 25 percent would be emitted upstream, associated with fuel extraction, production, and delivery.

Table 6-4
Design Options—Total Annual Building Operational GHG Emissions (metric tons CO_2e)

Alternative	Natural Gas 53.196 Kg CO_2e/MMBtu[1]	Grid Electricity 76.405 Kg CO_2e/MMBtu[2]	Total Emissions
Proposed Project	61,724 MMBtu	214,847 MMBtu	21,164
Design Option 1—GSHP & Electric Boilers	0 MMBtu	240,255 MMBtu	19,822
Design Option 2—Cogeneration	121,074 MMBtu	167,367 MMBtu	20,694

Notes:
Totals may not sum due to rounding.
Per 2014 *CEQR Technical Manual* guidance, electricity emissions represent the latest data (2015) and not the future build year (2027). Future emissions are expected to be lower.
Sources:
[1] 2014 *CEQR Technical Manual*
[2] The City of New York Mayor's Office of Long-Term Planning and Sustainability. *Inventory of New York City Greenhouse Gas Emissions in 2015*. September 2016.Note that this factor represents a correction of the factor presented in the 2014 *CEQR Technical Manual*.

Table 6-5
Annual Mobile Source Emissions (metric tons CO_2e, 2021)

Site	Use	Passenger Vehicle	Taxi	Truck	Total
Bronx Site*	Detention Facility Staff	1,069	60	2,549	*3,677*
	Detention Facility Visitors	408	29	0	*437*
	Court	108	12	28	*148*
	Community Facility	29	93	30	*152*
	Local Retail	264	0	324	*588*
	Residential	231	17	320	*568*
	Subtotal	*2,110*	*211*	*3,251*	*5,572*
Brooklyn Site	Detention Facility Staff	944	94	2,549	*3,587*
	Detention Facility Visitors	284	18	0	*302*
	Local Retail	204	0	221	*425*
	Subtotal	*1,432*	*112*	*2,770*	*4,314*
Manhattan Site	Detention Facility Staff	641	28	2,631	*3,301*
	Detention Facility Visitors	184	29	0	*213*
	Local Retail	52	38	152	*242*
	Subtotal	877	96	2,783	*3,756*
Queens Site	Detention Facility Staff	1,111	55	2,549	*3,715*
	Detention Facility Visitors	503	18	0	*522*
	Community Facility	29	10	204	*242*
	Subtotal	*1,634*	*83*	*2,753*	*4,479*
Total		**6,062**	**502**	**11,557**	***18,121***

Note:
* Bronx Site includes the proposed mixed-use building adjacent to the proposed Bronx detention facility.
Source: AKRF, Inc., for the *NYC Borough-Based Jail System EIS*, 2018.

SUMMARY

A summary of GHG emissions by source type is presented in **Table 6-6**. The proposed project is not expected to fundamentally change the City's solid waste management system, and therefore emissions associated with solid waste are not presented.

Table 6-6
Summary of Annual GHG Emissions, 2021 (metric tons CO_2e)

Site	Building Operations	Mobile	Total
Bronx Site*	5,919 to 6,278	5,572	11,491 to 11,850
Brooklyn Site	4,364 to 4,647	4,314	8,678 to 8,961
Manhattan Site	4,302 to 4,580	3,756	8,058 to 8,336
Queens Site	5,237 to 5,659	4,479	9,716 to 10,138
Total	**19,822 to 21,164**	**18,121**	**37,943 to 39,285**

Note:
* Bronx Site includes the proposed mixed-use development adjacent to the proposed Bronx detention facility. The range of results and totals represent the range of emission associated with the various building alternatives included. See Table 6-4.
Source: AKRF, Inc., for the *NYC Borough-Based Jail System EIS*, 2018.

The operational emissions from building energy use include on-site emissions from fuel consumption as well as emissions associated with the production and delivery of the electricity to be used on-site.

ELEMENTS THAT WOULD REDUCE GHG EMISSIONS

In general, dense, mixed-use development with access to transit and existing roadways is consistent with sustainable land use planning and smart growth strategies to reduce the carbon footprint of new development. These features and other measures currently under consideration are discussed in this section, addressing the PlaNYC/OneNYC goals as outlined in the *CEQR Technical Manual*. The implementation of the various design measures and features described would result in development that is consistent with the City's emissions reduction goal, as defined in the *CEQR Technical Manual*.

BUILD EFFICIENT BUILDINGS

The proposed project is currently evaluating the specific energy efficiency measures and design elements that may be implemented, and are required at a minimum to achieve the energy efficiency requirements of the New York City Building code. In 2016, as part of the City's implementation of strategies aimed at achieving the OneNYC GHG reduction goals, the City adopted the 2016 New York City Energy Conservation Construction Code (NYCECCC), which substantially increased the stringency of the building energy efficiency requirements and adopted the ASHRAE 90.1-2013 standard as a benchmark. Furthermore, under Local Law 31 of 2016, new capital projects for city-owned property are required to be designed to use no more than 50% of the current New York City Energy Conservation Code.

In 2016, the City also published the findings of the Buildings Technical Working Group (TWG) convened by the City to identify the pathway to achieving the GHG reduction goals in the building

sector;[9] should the measures identified by the Buildings TWG or other measures not yet implemented be adopted by the City in the future, they may apply to the proposed projects similar to any new building (if prior to building approval) or existing building (after construction) and the proposed project would implement any measures required under such programs.

The proposed project would further increase energy efficiency at the proposed project sites through the implementation high performance architectural measures (including designs to exteriors, glazing, and water systems), HVAC improvements (including heat recovery, increased air handling temperature transfer efficiencies, improved insulation, and implementation of low pressure drop fan systems), and central plant improvements (including additional heat recovery, using high efficiency condensing boilers, and thermal energy storage). Therefore, the proposed project would support the goal identified in the *CEQR Technical Manual* of building efficient buildings.

USE CLEAN POWER

The proposed project would use natural gas, a lower carbon fuel, for the normal operation of the heat and hot water systems and, if implemented, for the cogeneration system. Furthermore, if implemented, the GSHP and electric boiler system would fully eliminate the demand for on-site natural gas consumption.

TRANSIT-ORIENTED DEVELOPMENT AND SUSTAINABLE TRANSPORTATION

The proposed project sites are located in areas well supported by many transit options: several subway options are located within a 10 minute-walk from the Bronx Site (the Cypress Avenue and East 143rd Street No. 6 subway stations), Brooklyn Site (Hoyt-Schermerhorn A/C/G subway station and Bergen Street F/G subway station), Manhattan Site (Canal Street R/W/N/Q6/J/Z subway station, City Hall R/W subway station, Chambers Street J/Z subway station, and Brooklyn Bridge City Hall Nos. 4/5/6 subway station), and Queens Site (Union Turnpike – Kew Gardens E/F subway station). Additionally, the sites are located within five blocks from the Bx17, Bx33, M9, M22, M55, M103, B25, B26, B38, B41, B45, B52, B57, B61, B63, B65, B103, Q10, Q20A Q37, Q44, Q46, and Q60 buses.

REDUCE CONSTRUCTION OPERATION EMISSIONS

Construction specifications would include an extensive diesel emissions reduction program, as described in detail in Sections 2.15, 3.13, 4.14, and 5.14, "Construction Impacts," including diesel particle filters for large construction engines and other measures. These measures would reduce particulate matter emissions; while particulate matter is not included in the list of standard GHGs ("Kyoto gases"), recent studies have shown that black carbon—a constituent of particulate matter—may play an important role in climate change.

USE BUILDING MATERIALS WITH LOW CARBON INTENSITY

Recycled steel would most likely be used for most structural steel since the steel available in the region is mostly recycled. Some cement replacements such as fly ash and/or slag may also be used, and concrete content would be optimized to the extent feasible.

[9] The City of New York. Technical Working Group Report: Transforming New York City Buildings for a Low-Carbon Future. 2016.

C. RESILIENCE TO CLIMATE CHANGE

The Waterfront Revitalization Program (WRP)[10] addresses climate change and sea-level rise. The WRP requires consideration of climate change and sea-level rise in planning and design of development within the defined Coastal Zone Boundary (the proposed project is within that zone). As set forth in more detail in the *CEQR Technical Manual*, the provisions of the WRP are also applied by the New York City Department of City Planning (DCP) and other city agencies when conducting environmental review.

The Bronx, Brooklyn, and Queens sites are not within projected future flood hazard areas and therefore are not evaluated for resilience to climate change. The Manhattan Site is within the Coastal Zone Boundary. The proposed project's consistency with WRP policies at the Manhattan Site is described in Section 4.1, "Land Use, Zoning, and Public Policy."

Furthermore, the Manhattan Site is within projected future flood hazard areas identified by New York City.[11] Therefore, the potential effects of global climate change on the sites are considered and measures that would be implemented as part of the project to improve resilience to climate change are identified.

DEVELOPMENT OF POLICY TO IMPROVE CLIMATE CHANGE RESILIENCE

In recognition of the important role that the federal government has to play to address adaptation to climate change, a federal executive order signed October 5, 2009 charged the Interagency Climate Change Adaptation Task Force, composed of representatives from more than 20 federal agencies, with recommending policies and practices that can reinforce a national climate change adaptation strategy. The 2011 progress report by the Task Force included recommendations to build resilience to climate change in communities by integrating adaptation considerations into national programs that affect communities, facilitating the incorporation of climate change risks into insurance mechanisms, and addressing additional cross-cutting issues, such as strengthening resilience of coastal, ocean, and Great Lakes communities.[12] In February 2013, federal agencies released Climate Change Adaptation Plans for the first time. The Federal Infrastructure Adaptation Plan and related Presidential executive orders that defined an appropriate approach to designing for future potential conditions have since been revoked, and no new guidance has been issue in their place to date.

The New York State Sea Level Rise Task Force was created to assess potential impacts on the state's coastlines from rising seas and increased storm surge. The Task Force prepared a report of its findings and recommendations including protective and adaptive measures.[13] The recommendations are to provide more protective standards for coastal development, wetlands protection, shoreline armoring, and post-storm recovery; to implement adaptive measures for habitats; integrate climate change adaptation strategies into state environmental plans; and amend

[10] City of New York Department of City Planning. *The New York City Waterfront Revitalization Program*. October 30, 2013. Approved by NY State Department of State, February 3, 2016.

[11] NYC. *NYC Flood Hazard Mapper*. Accessed 6/13/2018.

[12] The White House Council on Environmental Quality. *Progress Report of the Interagency Climate Change Adaptation Task Force: Federal Actions for a Climate Resilient Nation*. October 2011.

[13] New York State Sea Level Rise Task Force. *Report to the Legislature*. December 2010.

local and state regulations or statutes to respond to climate change. The Task Force also recommended the formal adoption of projections of sea-level rise.

The New York State Climate Action Plan Interim Report identified a number of policy options and actions that could increase the climate change resilience of natural systems, the built environment, and key economic sectors—focusing on agriculture, vulnerable coastal zones, ecosystems, water resources, energy infrastructure, public health, telecommunications and information infrastructure, and transportation.[14] New York State's Community Risk and Resiliency Act (CRRA)[15] requires that applicants for certain State programs demonstrate that they have taken into account future physical climate risks from storm surges, sea-level rise and flooding, and required NYSDEC to establish official State sea-level rise projections. In February 2017, NYSDEC adopted a rule (6 NYCRR Part 490) defining the existing projections for use. These projections provide the basis for State adaptation decisions and are available for use by all decision makers. CRRA applies to specific State permitting, funding and regulatory decisions, including smart growth assessments; funding for wastewater treatment plants; siting of hazardous waste facilities; design and construction of petroleum and chemical bulk storage facilities; oil and gas drilling, and State acquisition of open space. NYSDEC published draft implementation guidance on June 20, 2018, addressing sea level rise and increased precipitation.

In New York City, the Climate Change Adaptation Task Force is tasked with fostering collaboration and cooperation between public and private organizations working to build the resilience of the City's critical infrastructure against rising seas, higher temperatures, and changing precipitation patterns. The Task Force is composed of over 57 New York City and State agencies, public authorities, and companies that operate, regulate, or maintain critical infrastructure in New York City. Led by the Mayor's Office of Resilience and Recovery, the Task Force works together to assess risks, prioritize strategies, and examine how standards and regulations may need to be adjusted in response to a changing climate.

To assist the Task Force, the New York City Panel on Climate Change (NPCC) has prepared a set of climate change projections for the New York City region[16] which was subsequently updated,[17,18] and has suggested approaches to create an effective adaptation program for critical infrastructure. The NPCC includes leading climatologists, sea-level rise specialists, adaptation experts, and engineers, as well as representatives from the insurance and legal sectors. The climate change projections include a summary of baseline and projected climate conditions throughout the 21st century including heat waves and cold events, intense precipitation and droughts, sea-level rise, and coastal storm levels and frequency. NPCC projected that sea levels are likely to increase by up to 30 inches by the 2050s and up to 75 inches by the end of the century (more detailed ranges and timescales are available). In general, the probability of increased sea levels is

[14] NYSERDA. *New York State Climate Action Plan Interim Report*. November 2010.

[15] *Community Risk and Resiliency Act.* Chapter 355, NY Laws of 2014. April 9, 2013. Signed September 22, 2014.

[16] New York City Panel on Climate Change. *Climate Change Adaptation in New York City: Building a Risk Management Response*. Annals of the New York Academy of Sciences, May 2010.

[17] New York City Panel on Climate Change. *Climate Risk Information 2013: Observations, Climate Change Projections, and Maps*. June 2013.

[18] New York City Panel on Climate Change. *New York City Panel on Climate Change 2015 Report.* Ann. N.Y. Acad. Sci. 1336. 2015.

characterized as "extremely likely," but there is uncertainty regarding the probability the various levels projected and timescale. Intense hurricanes are characterized as "more likely than not" to increase in intensity and/or frequency, and the likelihood of changes in other large storms ("Nor'easters") is characterized as unknown. Therefore, the projections for future coastal storm surge levels for New York City include only sea-level rise at this time, and do not account for changes in storm frequency.

The New York City Green Code Task force has also recommended strategies for addressing climate change resilience in buildings and for improving storm water management.[19] Some of the recommendations call for further study, while others could serve as the basis for revisions to building code requirements. Notably, one recommendation was to amend the building code to expand floodplain requirements so as to include buildings in the projected future one-percent annual chance floodplain in the 2080s or later (the area that would potentially be flooded in a severe coastal storm with a probability of one percent of occurring in any given year) and to apply the standards up to future flood elevation levels.

While strategies and guidelines for addressing the effects of climate change are being developed on all levels of government, there are currently no specific requirements or accepted recommendations for development projects in New York City. However, the revisions to the WRP and accompanying guidance[20] require consideration of climate change and sea-level rise in planning and design of waterfront development. As set forth in more detail in the City's *CEQR Technical Manual*, the provisions of the WRP are applied by city agencies when conducting environmental review, and are described in detail in Section 4.1, "Land Use, Zoning, and Public Policy."

Climate change considerations and measures that would be implemented to increase climate resilience are discussed below. Additional climate change considerations may be incorporated into state and/or local laws prior to the development of the proposed project, and any development would be constructed to meet or exceed the codes in effect at the time of construction.

RESILIENCE OF THE PROPOSED PROJECT TO CLIMATE CHANGE

According to current flood hazard projections,[21] the Manhattan Site is not located within the current 1 percent chance ("100-year") flood area. The 1 percent flood elevation in the vicinity of the Manhattan Site is 10 feet NAVD88. Therefore, the official design flood elevation per the New York City building code within the flood area is one foot above this elevation—11 feet NAVD88. However, under the CEQR process, resilience considerations are accounted for throughout the lifetime of the use being evaluated. While buildings themselves may have a very long lifespan (80 years or more), major infrastructure components such as mechanical systems, emergency power systems, fuel storage, fire safety pumps, and electrical and communications connections are generally rated at up to 50 years prior to requiring major renovation or replacement. Therefore, while the furthest available projections (end of century) are considered here in general for the buildings, 2080s projections are used for systems resilience considerations.

---

[19] New York City Green Codes Task Force. *Recommendations to New York City Building Code*. February 2010.

[20] NYC Planning. *The New York City Waterfront Revitalization Program: Climate Change Adaptation Guidance*. March 2017.

[21] FEMA. *Preliminary Flood Insurance Rate Map*. Panel 3604970184G and 3604970182G. 12/05/2013.

According to the above-cited NPCC data, by the 2050s, the 1 percent annual chance flood levels could reach 30 inches higher due to sea-level rise (per NPCC "High" scenario), to a flood elevation of approximately 12.5 feet NAVD88 at the Manhattan Site. By the 2080s sea level may rise by up to 58 inches, resulting in a 1 percent flood elevation of approximately 15 feet NAVD88. By the end of the century, the 1 percent flood levels could reach 75 inches higher (per NPCC "High" scenario), to approximately 16 feet NAVD88. Any design intended to accommodate these flood levels should generally account for an additional 1 foot of freeboard. Freeboard is generally applied to account for uncertainty in the flood projections and rounding to appropriate precision.

These flood areas and elevations are likely conservatively high, and may be revised in the near future. On October 17, 2016, the Federal Emergency Management Agency (FEMA) and New York City Mayor De Blasio announced plans to revise the FEMA flood maps based on a 2015 New York City appeal of FEMA's flood risk calculations for New York City and the region. While revised flood maps have not yet been produced, the appeal generally identified potential reductions of 2.0 to 2.5 feet in the area of the Manhattan Site. Therefore, it is possible that the revised FEMA current flood elevations would be lower, and the resulting future flood elevations, including sea-level rise, may be lower than those presented here.

The Manhattan Site is located in Lower Manhattan, where New York City has conceptual plans for providing storm flood resilience through coastal protections. New York City is currently in the process of planning and approving the Lower Manhattan Coastal Resiliency (LMCR) Project, a flood-proofing and park-building measure that extends from Montgomery Street, around Lower Manhattan to the north of Battery Park City. The City received funding through the U.S. Department of Housing and Urban Development's (HUD) National Disaster Resilience Competition (NDRC) to initiate LMCR and has begun working on the design and environmental review. The City is also currently designing the East Side Coastal Resiliency (ESCR) project, a similar effort starting at Montgomery Street northward to East 25th Street, and is currently in the preliminary design phase and undergoing environmental review. The City and the HUD have committed $760 million to ESCR. Through these projects, the City is proposing to install a flood protection system within city parkland and streets. The flood protection system would include a combination of berms, floodwalls, and possibly deployable systems with other infrastructure improvements to reduce flooding, and is being designed to accommodate the 1 percent annual chance flood elevation with 30 inches of sea-level rise—equivalent to the NPCC 2050s "High" scenario.[22] The third component of protecting Lower Manhattan would be the West Side, starting at West 57th Street to the north and connecting to LMCR's norther end at Battery Park City. This is the coastal area that would feed flood waters in potential future conditions to the Manhattan Site. There is currently no explicit implementation schedule or budget for this third segment of coastal protection for Lower Manhattan.

Overall, the proposed project at the Manhattan Site would be resilient to the potential conditions projected through 2100, and the design could be adaptive such that enhancements could be implemented in the future to further protect uses up to the potential flooding conditions projected for the end of the century if necessary, based on future adjustments to end-of-century potential flood elevations estimates. Based on conceptual plans, it is expected that the ground-floor elevation of the proposed project on the Manhattan Site would be approximately 18 feet NAVD88, which would be higher than NPCC's "high" future 2100 BFE of 16.25 feet. In addition, to the

[22] The City of New York. *ESCR: Project Area One - Conceptual Design Update.* Presentation, December 1 and 7, 2016.

extent feasible, future design development for the building on the Manhattan Site would account for future flood levels and locate critical mechanical features such as heating, cooling, electrical, and telecommunication on building floors above NPCC's "high" future 2080s BFE of 14.8 feet or 2100 BFE of 16.25 feet. Those critical features that require an elevation below the BFE (such as water/sewer service and potentially other features conveyed below ground to a building's cellar level) could be dry-floodproofed either from the outset of the building's construction or at such time as the BFE reaches the proposed site, projected to be the 2080s or later. Similarly, vulnerable features (habitable space above the building's lowest floor, such as detention housing) would be located above the future BFEs by the 2080s or 2100. In addition, the proposed detention facilities would be equipped with emergency electrical generators and fuel storage to provide power for several days of power outages, as well as food supplies for seven days of operation. In the event of a power loss, the proposed facilities are intended to remain fully operational in order to provide heating and cooling to staff and people in detention during inclement weather events.

✷