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Memorandum

To:	New York City Department of City Planning
From:	Henry Kearney
Date:	August 12, 2013
Re:	Columbia University Manhattanville in West Harlem Rezoning and Academic Mixed Use Development CEQR No. 06DCP032M
cc:	Phillip Pitruzello, Wilmouth Elmes (Columbia University); Richard Leland (Fried, Frank, Harris Shriver & Jacobson LLP); Shabana Tajwar (AKRF); Kenneth Mui (AKRF)

INTRODUCTION

The Final Environmental Impact Statement (FEIS) for the "Manhattanville in West Harlem Rezoning and Academic Mixed Use Development" project (the Proposed Actions) was completed in 2007. Columbia University is considering modifications to the design of heating, ventilation and air conditioning (HVAC) systems which would involve modifications to certain conditions in a Restrictive Declaration for the Academic Mixed Use Area executed by Columbia University that has been superseded by a December 14, 2011 Restrictive Declaration. This Technical Memorandum describes the proposed modifications and examines whether the Proposed Actions with the proposed modifications would result in any new or different significant adverse environmental impacts not already identified in the FEIS, and a subsequent Technical Memorandum dated November 26, 2007 describing certain modifications to the ULURP application, which was approved by the City Planning Commission.

The analysis concludes that the Proposed Actions with the proposed modifications would not result in any significant adverse environmental impacts not already identified in the FEIS or the November 26, 2007 Technical Memorandum.

DESCRIPTION OF PROPOSED MODIFICATIONS

The Central Energy Plant Boiler System has been sized based on the projected demand for the Campus. These loads are based on the building program provided by Columbia University. The sizing of the boiler plant is based on standard industry practice in conjunction with input from Columbia University's Operations staff to ensure that adequate boiler capacity would be installed. For the later phases of the project, preliminary boiler sizes were estimated based on the proposed building program and standard industry practice.

The design development process described above has resulted in proposed changes to the maximum capacity of certain boiler plants proposed for the Academic Mixed Use Area. Specifically:

- The Central Energy Plant to be constructed below Site 3 (known as the South CEP) would be equipped with four boilers, each capable of producing 45,000 pound/hour (lb/hr) steam (including one spare) instead of two 40,000-lb/hr boilers and two 80,000-lb/hr boilers (of which 80,000-lb/hr was described as spare capacity);
- The Central Energy Plant to be constructed below Site 14 (known as the North CEP) would be equipped with two boilers each capable of generating 40,000 lbs/hr steam (including one spare) instead of two 40,000-pound/hour (lb/hr) boilers and one 80,000-lb/hr boilers (of which 80,000-lb/hr was described as spare capacity);
- Site 15 would be equipped with three-300 boiler horsepower (bhp) packaged boilers (including one spare) instead of boilers rated at 800-horsepower (one of which was to be a spare); and
- Site 16 would be equipped with three-100 bhp packaged boilers (including one spare) instead of three 40-horsepower boilers (one of which was to be a spare).

In addition, Site 17 would have three-150 bhp packaged boilers (including one spare). In the FEIS, Site 17 was assumed to have three 800-horsepower boilers, one of which was to be a spare. As discussed in the Technical Memorandum dated November 26, 2007, the programming and square footage of Site 17 was changed; therefore, the proposed reduced boiler capacity is consistent with the program for Site 17, as approved. The changes to Site 17, as well as Sites 15 and 16, were made in consultation with the project designers and reflect the anticipated heating demand for these buildings.

The Proposed Actions with the proposed modifications would therefore include (not including spare boilers):

- Two 50 hp packaged boilers located at Site 1, both operating at 100 percent load;
- South CEP with exhaust stacks located at Site 2 (serving sites 2, 3, 4, 6, 6b, 7, 8, 9, and 10) with three boilers, each capable of producing 45,000 lbs/hr steam;
- North CEP with exhaust stacks located at Site 14 (serving sites 11, 12, 13, and 14) with one boiler at 40,000 lbs/hr steam, operating at 100 percent load;
- Two 300 hp packaged boilers located at Site 15, both operating at 100 percent load;
- Two 100 hp packaged boilers located at Site 16, both operating at 100 percent load; and
- Two 150 hp packaged boilers located at Site 17, both operating at 100 percent load.

Tables 1 through 4 summarize the boiler plant stack parameters emissions rates for the Proposed Actions with the proposed modifications, as well as the Technical Memorandum dated November 26, 2007 for comparison. Table 1 summarizes the boiler plant stack parameters and emissions rates used for the short-term modeling analysis of Sites 1, 15, 16 and 17, while Table 2 summarizes the boiler plant stack parameters and emissions rates used for the annual modeling analysis of these sites. Table 3 summarizes the boiler plant stack parameters and emissions rates used for the short-term modeling analysis of the South CEP and North CEP, while Table 4 summarizes the boiler plant stack parameters and emissions rates used for the annual modeling analysis of these plants.

Table 1
Projected Development Sites 1, 15, 16 and 17
Short-Term Emission Rates and Stack Parameters

Parameter		FEIS							2013 Technical Memo				
		Nat Gas	Oil	Nat Gas	Nat Gas	Oil	Nat Gas	Oil	Nat Gas	Oil	Nat Gas	Nat Gas	Nat Gas
Site		1	1	15	16	16	17	17	1	1	15	16	17
Boiler Size (hp)		50	50	800	40	40	800	800	50	50	300	100	150
Fuel sulfur content		--	0.2	--	--	0.2	--	0.2	--	0.2	--	--	--
Load		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Firing rate (cfh gas, gph oil)		2,095	15	33,480	1,675	12	33,480	239.3	2,095	15	12,007	4,185	6,003
Stack Ht (above datum, ft) [1]		181.6	181.6	344.9	195.1	195.1	396.6	396.6	181.6	181.6	346.9	195.1	226.6 [4]
Stack Ht (above bldg roof, ft)[2]		20	20	90	23	23	90	90	20	20	90	23	90
Stack exhaust temp (°F)		380	380	380	380	380	380	380	380	380	289	380	289
Stack exhaust flow (ACFM)		665	684	10,528	532	547	10,528	10,947	665	684	3,460	1,316	1,730
Stack exhaust velocity (ft/s)		31.8	32.7	35.7	25.4	26.1	35.7	37.2	31.8	32.7	18.4	27.9	20.7
Emissions Lb/MMBtu	NO_x	0.12	0.25	0.0175	0.12	0.25	0.0175	0.187	0.12	0.25	0.12	0.12	0.12
	CO	0.15	0.07	0.037	0.15	0.07	0.037	0.07	0.15	0.07	0.15	0.15	0.15
	PM_{10}[3]	0.01	0.0164	0.01	0.01	0.0164	0.01	0.0164	0.01	0.0164	0.0076	0.0076	0.0076
	$PM_{2.5}$[3]	0.01	0.0111	0.01	0.01	0.0111	0.01	0.0111	0.01	0.0111	0.0076	0.0076	0.0076
	SO_2	0.001	0.203	0.001	0.001	0.203	0.001	0.203	0.001	0.203	0.001	0.001	0.001
Emissions Lb/hr	NO_x	0.182	0.525	0.586	0.201	0.42	0.586	6.235	0.182	0.525	1.441	0.502	0.720
	CO	0.227	0.147	1.239	0.251	0.118	1.239	2.345	0.227	0.147	1.801	0.628	00.901
	PM_{10}	0.015	0.034	0.335	0.017	0.028	0.335	0.549	0.015	0.034	0.091	0.032	0.046
	$PM_{2.5}$	0.015	0.023	0.335	0.017	0.019	0.335	0.372	0.015	0.023	0.091	0.032	0.046
	SO_2	0.002	0.426	0.033	0.002	0.341	0.033	6.796	0.002	0.426	0.012	0.004	0.006

Notes:
(1) Stack heights areas referenced to Manhattan datum, which is defined as 2.75 feet above mean sea level.
(2) Stack heights referenced above roof are measured from the roof itself, i.e., do not include building mechanical space above the roof.
(3) PM_{10} and $PM_{2.5}$ emission factors based on Table 1.3-6 and 1.4-2 of AP-42 based on particle size distribution, with additional condensable fraction for fuel oil from Table 1.3-2.
(4) The lower stack height as compared to the stack height used in the FEIS was due to the programming changes discussed in the November 26, 2007 Technical Memorandum, which were approved by the City Council.

Table 2
Projected Development Sites 1, 15, 16 and 17
Boiler Annual Average Emissions and Stack Parameters

Fuel		FEIS							2013 Technical Memo				
		Nat Gas	Oil	Nat Gas	Nat Gas	Oil	Nat Gas	Oil	Nat Gas	Oil	Nat Gas	Nat Gas	Nat Gas
Site		1	1	15	16	16	17	17	1	1	15	16	17
Boiler Size (hp)		50	50	800	40	40	800	800	50	50	300	100	150
Fuel sulfur content			0.2	--	--	0.2	--	0.2		0.2	--	--	--
Avg operating load		45%	45%	45%	45%	45%	45%	45%	45%	45%	40%	45%	45%
Avg firing rate (cfh gas, gph oil)		2,095	15	33,480	1,675	12	33,480	239.3	2,095	15	12,007	4,185	6,003
Stack Ht (above datum, ft)		181.6	181.6	344.9	195.1	195.1	396.6	396.6	181.6	181.6	346.9	195.1	226.6
Stack Ht (above bldg roof, ft)		20	20	90	23	23	90	90	20	20	90	23	90
Stack exhaust temp. (°F)		380	380	380	380	380	380	380	380	380	289	380	289
Stack exhaust flow (ACFM)		665	684	10,528	532	547	10,528	10,947	665	684	3,460	1,316	1,730
Stack exhaust velocity (ft/s)		31.8	32.7	35.7	25.4	26.1	35.7	37.2	31.8	32.7	18.4	27.9	20.7
Lb/MMBtu, HHV	NO_x	0.12	0.25	0.0175	0.12	0.25	0.0175	0.187	0.12	0.25	0.12	0.12	0.12
	CO	0.15	0.07	0.04	0.15	0.07	0.04	0.07	0.15	0.07	0.15	0.15	0.15
	PM_{10}	0.01	0.0164	0.01	0.0076	0.0164	0.01	0.0164	0.01	0.0164	0.0076	0.0076	0.0076
	$PM_{2.5}$	0.01	0.0111	0.01	0.0076	0.0111	0.01	0.0111	0.01	0.0111	0.0076	0.0076	0.0076
	SO_2	0.001	0.203	0.001	0.001	0.203	0.001	0.203	0.001	0.203	0.001	0.001	0.001
Lb/hr	NO_x	0.115	0.236	0.27	0.092	0.189	0.27	2.819	0.115	0.236	0.588	0.231	0.331
	CO	0.144	0.066	0.57	0.115	0.053	0.57	1.055	0.144	0.066	0.735	0.288	0.413
	PM_{10}	0.010	0.015	0.154	0.0058	0.012	0.154	0.247	0.010	0.015	0.037	0.015	0.021
	$PM_{2.5}$	0.010	0.01	0.154	0.0058	0.0084	0.154	0.167	0.010	0.01	0.037	0.015	0.021
	SO_2	0.001	0.192	0.015	0.0008	0.153	0.015	3.058	0.001	0.192	0.005	0.002	0.003

Table 3
Central Energy Plant Boilers
Short-Term Emission Rates and Stack Parameters

Parameters		FEIS – North / South [1] Natural Gas	FEIS – South CEP[1] Oil	2013 Tech Memo - North CEP [8] Natural Gas	2013 Tech Memo – South CEP[9] Natural Gas	2013 Tech Memo – South CEP[9] Oil
Liquid fuel sulfur content		--	0.2	--	--	0.2
Load		100%	100%	100%	96%	96%
Heat input rate, (MMBtu/hr, HHV)		98.05	93.77	49.03	55.0	55.0
Stack Height – Site 2 (above datum, ft) [6]		335.7	335.7	[redacted]	285.7	285.7
Stack Height – Site 2 (above building roof, ft) [7]		135	135	[redacted]	95	95
Stack Height – Site 14 (above datum, ft) [6]		382.3	[redacted]	382.3	[redacted]	[redacted]
Stack Height – Site 14 (above building roof, ft) [7]		130	[redacted]	130	[redacted]	[redacted]
Stack exhaust temp. (°F)		300	300	300	350	350
Stack exhaust flow (lbs/hr)		93,171	89,692	46,585	106,837	106,837
Stack exhaust flow (ACFM)		30,236	29,107	15,118	36,945	36,945
Stack exhaust velocity (ft/s)		40.1	38.6	40.0	49	49
Lb/MMBtu, HHV	NO_x [2]	0.011	0.096	0.011	0.011	0.096
	CO [2]	0.0068	0.028	0.0068	0.0068	0.028
	PM_{10} [3]	0.0076	0.0164	0.0076	0.0076	0.0164
	$PM_{2.5}$ [3]	0.0076	0.0111	0.0076	0.0076	0.0111
	SO_2 [4], [5]	0.0006	0.203	0.0006	0.0006	0.203
Lb/hr [1]	NO_x	1.08	9	0.54	0.58	5.07
	CO	0.67	2.63	0.33	0.36	1.48
	PM_{10}	0.75	1.54	0.37	0.40	0.87
	$PM_{2.5}$	0.75	1.04	0.37	0.40	0.59
	SO_2	0.059	19.02	0.03	0.03	10.71

Notes:
(1) Represents emissions from 1-80,000 lb/hr boiler or 2-40,000 lb/hr boilers. Operation of 1-40,000 lb/hr boiler at 100% load would be approximately equivalent to operating 1-80,000 lb/hr boiler at 50% load.
(2) NO_x and CO emissions based on vendor data.
(3) PM_{10} and $PM_{2.5}$ emission factors based on Table 1.3-6 and 1.4-2 of AP-42 based on particle size distribution, with additional condensable fraction for fuel oil from Table 1.3-2.
(4) SO_2 natural gas-based emissions are based on an emission factor of 0.6 lb/million standard cubic feet of natural gas (AP-42 Table 1.4-2).
(5) SO_2 oil-based emissions are based on an emission factor of 142 * weight % sulfur lb/MMBtu (AP-42 Table 1.3-1). Assumed 0.2% sulfur content.
(6) Manhattan datum is defined as 2.75 feet above mean sea level.
(7) Stack heights referenced above roof are measured from the roof itself, i.e., do not include any building mechanical space above the roof.
(8) Represents emissions from 1-40,000 lb/hr boiler. North CEP consists of 1-40,000 lb/hr boiler (including 1 spare).
(9) Represents emissions from 1-45,000 lb/hr boiler. South CEP consists of 4-45,000 lb/hr boilers (including 1 spare).

Table 4
Central Energy Plant Boilers
Boiler Annual Average Emissions and Stack Parameters

Parameter		FEIS – North / South CEP[1] Natural Gas	FEIS – South CEP[1] Oil	2013 Tech Memo - North CEP [4] Natural Gas	2013 Tech Memo – South CEP[5] Natural Gas	2013 Tech Memo – South CEP[5] Oil
Liquid fuel sulfur content		--	0.2	--	--	0.2
Average operating load		45%	45%	45%	45%	45%
Annual Avg. heat input rate, (MMBtu/hr, HHV)		98.05	93.77	49.03	55.0	55.0
Stack Height – Site 2 (above datum, ft) [3]		335.7	335.7		285.7	285.7
Stack Height – Site 2 (above building roof, ft)		135	135		95	95
Stack Height – Site 14 (above datum, ft) [3]		382.3		382.3		
Stack Height – Site 14 (above building roof, ft)		130		130		
Stack exhaust temp. (°F)		300	300	300	350	350
Stack exhaust flow (ACFM)		30,236	29,107	15,118	36,945	36,945
Stack exhaust velocity (ft/sec)		40.1	38.6	20.1	49.0	49.0
Lb/MMBtu, HHV	NO_x	0.011	0.096	0.011	0.011	0.096
	CO	0.0068	0.028	0.0068	0.0068	0.028
	PM_{10}	0.0076	0.0164	0.0076	0.0076	0.0164
	$PM_{2.5}$	0.0076	0.0111	0.0076	0.0076	0.0111
	SO_2	0.0006	0.203	0.0006	0.0006	0.203
Lb/hr [1]	NO_x	0.49	4.05	0.24	0.27	2.38
	CO	0.3	1.18	0.15	0.17	0.69
	PM_{10}	0.34	0.69	0.17	0.19	0.41
	$PM_{2.5}$	0.34	0.47	0.17	0.19	0.27
	SO_2	0.03	8.56	0.01	0.01	5.02

Notes:
(1) Emissions represent operation of 1-80,000 lb/hr boiler or 2-40,000 lb/hr boilers vented to a common exhaust stack.
(2) Stack parameters are at 100% load.
(3) Manhattan datum is defined as 2.75 feet above mean sea level.
(4) Represents emissions from 1-40,000 lb/hr boiler. North CEP consists of 1-40,000 lb/hr boiler (including 1 spare).
(5) Represents emissions from 1-45,000 lb/hr boiler. South CEP consists of 3-45,000 lb/hr boilers.

Based on the modifications to the mechanical equipment designs, the following stack modification is proposed for the South CEP:

- Minimum stack height: 285.7 feet above Manhattan datum (50 feet lower than the minimum height specified in the Restrictive Declaration).

ANALYSES

The Proposed Actions with the proposed modifications would not affect the reasonable worst-case development scenario analyzed in the FEIS in terms of the overall maximum development. The Proposed Actions with the proposed modifications would not result in any changes to the below-grade areas. In addition, no modifications to the regulations of the proposed Special Manhattanville Mixed-Use District would be required.

The analyses below address those studies where the modifications would represent a material change from the scenario analyzed in the FEIS and the Technical Memorandum dated November 26, 2007.

Urban Design, Visual Resources and Shadows

The FEIS concluded that the presence of stacks on the proposed buildings would not create significant adverse impacts on urban design or visual resources, because the proposed zoning would regulate the width and placement of the stacks to minimize views, and the stacks would not substantially add to the

overall perceived height or bulk of the proposed buildings. In addition, the FEIS found that intervening buildings and the viaducts would obscure most Project Area views of the stacks on Site 15.[1]

The proposed modifications would lower the stack height on the building located on Site 2, shown on Table 5. The height of the stacks would be reduced by 50 feet on Site 2. As shown in Table 5, the Site 2 stacks would protrude approximately 76 feet above the top of the mechanical roof. The change on Site 2 would clearly not be adverse with regard to urban design, visual resources or shadow impact. Overall, the effect on urban design, shadows and visual resources would be very similar or less as compared to the scenario analyzed in the FEIS.

Table 5
Stacks on Site 2 with Proposed Modifications

Parameter	With Proposed Modifications		FEIS	
	(meters)	(feet)	(meters)	(feet)
Stack Height	87	285.7	102	335.7
Maximum Building Height at Roofline	58	190.7	61	200.7
Maximum Building Height at Mechanical Roof	64	209.7	79	260.7
Stack Height Above Mechanical Roof	23	76	23	75
Note: Building and stack heights are referenced to Manhattan datum, which is approximately 30 feet above the average curb elevation used in the air quality analysis.				

Air Quality

As described above, the Proposed Actions with the proposed modifications would result in changes to the design of energy systems and HVAC exhaust stacks. The Proposed Actions with the proposed modifications would not affect the reasonable worst-case development scenario analyzed in the FEIS in terms of the overall maximum development. In addition, the Proposed Actions with the proposed modifications would not result in any changes to the below-grade areas which would be utilized for parking and central loading. Therefore, for the mobile source analysis presented in Chapter 19, "Air Quality," of the FEIS, the Proposed Actions with the proposed modifications would not change any of the conclusions, and no additional analysis would be necessary. In addition the Proposed Actions with the proposed modifications would not result in any new sensitive uses that would require an assessment for impacts from existing industrial sources. Therefore, no additional industrial source analysis or other studies of existing or other planned sources on the Proposed Actions are necessary. The analysis of fossil fuel-fired equipment in the Academic Mixed-Use Area is further examined below.

The analysis was conducted using the EPA AERMOD dispersion model, following the procedures described in the FEIS (see Chapter 19, "Air Quality). The receptor network was modified to account for the reduction in building massing at Site 17. In addition, receptors were placed on academic Buildings 6 and 6b at locations of potential air intakes, due to the height and proximity of these buildings relative to the proposed lower stack height for the boilers at the South CEP.

The following proposed modifications to the Restrictive Declaration were analyzed, which could affect the emission and dispersion of exhaust gases exiting the stacks.

A. *Site 1:* Maximum boiler fuel consumption is 118,260 gallons per year (No. 2 oil) and 16,516,980 cubic feet per year (natural gas).

B. *South CEP:* Maximum boiler fuel consumption is 3,097,285 gallons per year (No. 2 oil) and 650,430,000 cubic feet per year (natural gas). Once any development occurs at any site beyond 1, 2, 3, 4, 6B and 7, the maximum boiler No. 2 fuel oil consumption is 1,548,643 gallons per year. Boiler stacks must have a minimum exhaust height of 285.7 feet above Manhattan Datum.

[1] Proposed Manhattanville in West Harlem Rezoning FEIS, November 16, 2007, Page 9-2.

C. *North CEP:* Boilers must utilize natural gas. Maximum boiler fuel consumption is 193,276,260 cubic feet per year.

D. *Site 15:* Boilers must utilize natural gas. Maximum boiler fuel consumption is 85,826,633 cubic feet per year. Boiler stacks must have a minimum exhaust height of 346.9 feet above Manhattan Datum.

E. *Site 16:* Boilers must utilize natural gas. Maximum boiler fuel consumption is 32,994,540 cubic feet per year.

F. *Site 17:* Boilers must utilize natural gas. Maximum boiler fuel consumption is 48,277,485 cubic feet per year. Boiler exhaust stacks must have a minimum exhaust height of 226.6 feet above Manhattan Datum.

G. Once any development occurs at any site beyond 1, 2, 3, 4, 6B and 7, the South CEP boilers must utilize natural gas exclusively from April 1 to November 30.

A comparison of the HVAC fuel usage limits in the current Restrictive Declaration and the proposed fuel usage restrictions are presented in Table 6.

Table 6
Summary of Current and Proposed Fuel Usage Restrictions

Site	Current Restrictive Declaration		Proposed Restriction	
	No. 2 Fuel Oil (Gallons/Year)	Natural Gas (Cubic Feet/Year	No. 2 Fuel Oil (Gallons/Year)	Natural Gas (Cubic Feet/Year
1 [4]	59,130	7,229,628	118,260 [5]	16,516,980
South CEP	2,640,295 [1] 4,290,480 [2]	773,026,200	3,097,285 1,548,643 [3]	650,430,000
North CEP	--	193,276,260	--	193,276,260
15	--	131,978,160	--	85,826,633
16	47,304	6,602,850	--	32,994,540
17	943,321	131,978,160	--	48,277,485

Notes:

ents the annual fuel usage for South Central Energy Plant boiler equipment constructed to service Building 1, 2, 3, 4 and 7.

(2) Represents the maximum annual fuel usage for the South CEP boiler equipment until the completion of any New Building that increases the maximum operating steam demand within the South CEP service area to greater than 130,000 pounds per hour.

(3) Maximum annual No. 2 fuel oil consumption once any development occurs at any site beyond 1, 2, 3, 4, 6B and 7.

(4) The air quality analysis assumed that Site 1 will have a boiler installation, consistent with the FEIS. In the event that the Site is served instead by the South CEP, it will not have a boiler installation; however, no further analysis is necessary since the design load assumptions for the South CEP boilers already account for the additional energy demand due to Site 1.

(5) The proposed restriction represents the fuel usage associated with the maximum number of boilers that could operate simultaneously (two boilers). The current Restrictive Declaration is based on the fuel usage associated with only one boiler.

The modeling analysis was conducted to determine $PM_{2.5}$ impacts since this pollutant was previously identified as the critical parameter for evaluating potential air quality impacts in the FEIS. Emission factors used in this analysis were consistent with those used in the FEIS.

The following general assumptions were used in the air quality analysis:

- Short-term (24-hour average) CEP boiler emission rates were calculated based on maximum steam demand, by season (winter and summer). Annual average CEP boiler emission rates were calculated

based on assumptions used in the FEIS, and supplemented by annual fuel usage estimates developed by the project design team.

- Stand alone boiler emission factors were based on boiler horsepower (converted from steam capacities).

The air quality analyses in the FEIS determined that the Proposed Actions with the proposed modifications would not result in any exceedances of the National Ambient Air Quality Standards for PM_{10}, SO_2, NO_2 or CO impacts from the operation of boiler sources. The proposed modifications, with the restrictions stated above would result in similar levels of pollutants concentrations, and therefore, no violations of NAAQS for these pollutants would occur.

The air quality modeling analysis for the project with proposed modifications determined the highest predicted increase in 24-hour and annual average $PM_{2.5}$ concentrations from the Proposed Actions.

Phase I

An analysis of $PM_{2.5}$ impacts was conducted to assess the Proposed Actions with the proposed modifications based on the interim build condition analyzed in the FEIS (identified in the FEIS as Phase I). As discussed in the FEIS, Phase I would encompass the first of the two central energy plants to be constructed, and would be located in the below-grade space area beneath Site 3 on the block between West 129th and West 130th Streets to serve the development anticipated to be operational within this area in Phase 1.

The results of this analysis determined that maximum 24-hour incremental impacts at any discrete receptor location would be less than the applicable interim guidance criterion of 5 $\mu g/m^3$. On an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 $\mu g/m^3$ for local impacts, and the interim guidance criterion of 0.1 $\mu g/m^3$ for neighborhood scale impacts.

$PM_{2.5}$ 24-hour average incremental concentrations were also compared with the interim guideline criterion of 2 $\mu g/m^3$. The assessment examined the magnitude, duration, frequency, and extent of the increments at locations where exposure above the 2 $\mu g/m^3$ threshold averaged over a 24-hour period could occur. The receptor location with the maximum predicted continual 24-hour exposure is at 3333 Broadway, at an elevation of approximately 280 feet. At this location, the maximum predicted 24-hour $PM_{2.5}$ incremental concentration is 2.89 $\mu g/m^3$. At this receptor, 24-hour average concentrations were predicted to exceed 2 $\mu g/m^3$ at a maximum frequency of only once per year, and with an annual average frequency of less than once per year. Concentrations exceeding 2 $\mu g/m^3$ on this building were also predicted at one other discrete location at the same elevation, and at six other receptors, at elevations of 262, 301 and 307 feet. At each of these locations, 24-hour average $PM_{2.5}$ incremental concentrations from the Proposed Actions with the proposed modifications are predicted to exceed 2 $\mu g/m^3$ at a maximum frequency of only once per year, and an average frequency less than once per year. At other locations on the proposed developments and within the community, maximum 24-hour average concentrations of $PM_{2.5}$ would be less than the updated $PM_{2.5}$ interim guidance criterion of 2 $\mu g/m^3$. The magnitude, frequency, location, and size of the area of $PM_{2.5}$ concentrations above 2 $\mu g/m^3$ are very low. As compared to the FEIS, the maximum impact is slightly higher, but overall these results are very similar to those presented in the FEIS, and the maximum $PM_{2.5}$ incremental concentrations and frequency that have been approved on other similar actions subject to CEQR.

Phase II

The maximum 24-hour incremental impacts at any discrete receptor location would be less than the applicable interim guidance criterion of 5 $\mu g/m^3$. On an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 $\mu g/m^3$ for local impacts, and the interim guidance criterion of 0.1 $\mu g/m^3$ for neighborhood scale impacts.

$PM_{2.5}$ 24-hour average incremental concentrations were also compared with the interim guideline criterion of 2 $\mu g/m^3$. The assessment examined the magnitude, duration, frequency, and extent of the increments at locations where exposure above the 2 $\mu g/m^3$ threshold averaged over a 24-hour period

could occur. The receptor location with the maximum predicted continual 24-hour exposure is at 3333 Broadway, at an elevation of 307 feet. At this location, the maximum predicted 24-hour $PM_{2.5}$ incremental concentration is 2.41 $\mu g/m^3$. At the location where the maximum 24-hour average concentration was predicted, the maximum annual frequency of concentrations greater than 2 $\mu g/m^3$ was once per year, with the average frequency of less than once per year, over five years. Concentrations exceeding 2 $\mu g/m^3$ on this building were predicted at one other discrete location at the same elevation, and at two other receptors, at elevation of 301 feet. At each of these receptors, 24-hour average concentrations were predicted to exceed 2 $\mu g/m^3$ at a maximum frequency of only once per year, and with an annual average frequency of less than once per year. Concentrations exceeding 2 $\mu g/m^3$ were also predicted at two discrete elevated locations each at the Manhattanville Houses and 646 West 125th Street, as well as at Site 4. At these locations, the maximum predicted frequency of exceedances ranged from one to four times per year and with an annual average frequency of less than three times per year. Concentrations exceeding 2 $\mu g/m^3$ were also predicted at discrete ground level locations in the open space area between projected development Sites 6B and 7, near the Manhattanville Houses, and at Site 4. At these locations, the maximum predicted frequency of concentrations greater than 2 $\mu g/m^3$ is only once per year with an annual average frequency of less than once per year. In addition, concentrations exceeding 2 $\mu g/m^3$ were also predicted at projected academic development Site 6 on the first two floors on the eastern façade of this building and at projected academic development Site 6B on the first four floors on the eastern, southern, and western façades of this building. However, at each of these receptors, 24-hour average concentrations were predicted to exceed 2 $\mu g/m^3$ at a maximum frequency of only once per year, and with an annual average frequency of less than once per year. At other locations on the proposed developments and within the community, maximum 24-hour average concentrations of $PM_{2.5}$ would be less than the updated $PM_{2.5}$ interim guidance criterion of 2 $\mu g/m^3$. The magnitude, frequency, and location, of $PM_{2.5}$ concentrations above 2 $\mu g/m^3$ are very low. As compared to the FEIS, the maximum impact is slightly higher, but overall these results are similar to those presented in the FEIS, and the maximum $PM_{2.5}$ incremental concentrations and frequency that have been approved on other similar actions subject to CEQR.

Cumulative Assessment

Since there are various source types (mobile, construction, and operational stationary sources) that may contribute to concentration increments concurrently, a cumulative assessment of all sources related to the Proposed Actions during construction was undertaken in the FEIS to determine the potential maximum effect of all sources combined. During Phase 1 of construction, this would include on-site construction and on-road mobile sources, but no operational stationary sources. Since some permanent stationary operational sources completed under Phase 1 would be operational while Phase 2 is under construction, such as the South CEP and package boilers at Site 1,, the combined effect for the Phase 2 construction period includes the effect of these additional operational sources.

The FEIS determined that cumulative concentrations of construction and operational sources near construction sites are similar to those determined for on-site construction sources alone. In addition, the predicted increments from elevated operational stationary sources at the ground level locations where maximum predicted impacts from on-site impacts were predicted were negligible under the meteorological conditions which produce the highest concentration from ground-based sources such as construction. The maximum 24-hr average $PM_{2.5}$ incremental concentration presented in the FEIS, which was 3.6 $\mu g/m^3$, was determined to be almost entirely due to construction emission sources.

With the above-described restrictions, the Proposed Actions with the proposed modifications would not result in any new significant adverse impacts on air quality from operational sources of emissions for the Phase 1 and Phase 2 Build condition, and from cumulative effects of emissions from construction activities and operational sources. With the proposed modifications, stationary sources associated with the Proposed Actions are estimated to contribute less than two percent of total pollutant concentrations at the locations identified in the FEIS as having the highest predicted concentrations from on-site construction activities.

The analysis results for the Proposed Actions with the proposed modifications would be comparable to those identified in the FEIS or the November 26, 2007 Technical Memorandum. The maximum cumulative impacts from construction and operational sources would not exceed applicable standards, including the recently revised *CEQR Technical Manual* $PM_{2.5}$ *de minimis* criteria. Therefore, there would also be no potential for significant adverse impacts from cumulative effects of emissions from construction activities and operational sources.

CONCLUSIONS

The analysis presented above concludes that the Proposed Actions with the proposed modifications would not result in any significant adverse environmental impacts not already identified in the FEIS or the November 26, 2007 Technical Memorandum. The project's Restrictive Declaration will be modified to include the revised stack and fuel restrictions discussed above.