A. INTRODUCTION

This section assesses the potential for the proposed facility at the Brooklyn Site to cast new shadows that would adversely impact any nearby sunlight-sensitive resources. Following the guidelines of the *City Environmental Quality Review (CEQR) Technical Manual*, sunlight-sensitive open spaces include publicly accessible parks and open space, features of historic resources that depend on sunlight, and natural resources that depend on sunlight. Therefore, this section is closely linked to the data and assessments presented in Brooklyn Site Sections 3.3, "Open Space," and 3.5, "Historic and Cultural Resources."

Per CEQR guidelines, an assessment of shadows is required if the proposed project would result in structures 50 feet or greater in height, or of any height if the project site is located adjacent to, or across the street from, a sunlight-sensitive resource. As discussed in Chapter 1, "Project Description," the proposed facility that would be constructed at the Brooklyn Site would rise to a maximum envelope height of 395 feet. Therefore, an analysis was conducted to assess potential shading effects on these and any other sunlight-sensitive resources.

PRINCIPAL CONCLUSIONS

The proposed project would result in incremental shadow on two nearby plazas, one park, and two historic buildings with sunlight-sensitive features. For all but one of those resources, the incremental shadow would occur in only one of the four seasons. In no case would the incremental shadow result in significant adverse impacts to either the use or appreciation or the vegetation of any of the affected resources.

B. DEFINITIONS AND METHODOLOGY

This analysis has been prepared in accordance with New York City CEQR procedures and follows the guidelines of the 2014 *CEQR Technical Manual*.

DEFINITIONS

Incremental shadow is the additional, or new, shadow that a structure resulting from a proposed project would cast on a sunlight-sensitive resource.

Sunlight-sensitive resources are those that depend on sunlight or for which direct sunlight is necessary to maintain the resource's usability or architectural integrity. Such resources generally include:

- *Public open space* such as parks, beaches, playgrounds, plazas, schoolyards (if open to the public during non-school hours), greenways, and landscaped medians with seating. Planted areas within unused portions of roadbeds that are part of the Greenstreets program are also considered sunlight-sensitive resources.
- *Features of architectural resources that depend on sunlight for their enjoyment by the public*. Only the sunlight-sensitive features need be considered, as opposed to the entire resource.

Such sunlight-sensitive features might include: design elements that depend on the contrast between light and dark (e.g., recessed balconies, arcades, deep window reveals); elaborate, highly carved ornamentation; stained-glass windows; historic landscapes and scenic landmarks; and features for which the effect of direct sunlight is described as playing a significant role in the structure's importance as a historic landmark.

- *Natural resources* where the introduction of shadows could alter the resource's condition or microclimate. Such resources could include surface water bodies, wetlands, or designated resources such as coastal fish and wildlife habitats.

Non-sunlight-sensitive resources include, for the purposes of CEQR:

- *City streets and sidewalks* (except Greenstreets);
- *Private open space* (e.g., front and back yards, stoops, vacant lots, and any private, non-publicly accessible open space);
- *Project-generated open space* cannot experience a significant adverse shadow impact from the project, according to CEQR, because without the project the open space would not exist. However, if the condition of project-generated open space is included in the qualitative analysis presented in the Open Space chapter of the EIS, a discussion of how shadows would affect the new space may be warranted.

A significant adverse shadow impact occurs when the incremental shadow added by a proposed project falls on a sunlight-sensitive resource and substantially reduces or completely eliminates direct sunlight, thereby significantly altering the public's use of the resource or threatening the viability of vegetation or other resources. Each case must be considered on its own merits based on the extent and duration of new shadow and an analysis of the resource's sensitivity to reduced sunlight.

METHODOLOGY

Following the guidelines of the *CEQR Technical Manual*, a preliminary screening assessment must first be conducted to ascertain whether a project's shadow could reach any sunlight-sensitive resources at any time of year. The preliminary screening assessment consists of three tiers of analysis. The first tier determines a simple radius around the proposed building representing the longest shadow that could be cast. If there are sunlight-sensitive resources within this radius, the analysis proceeds to the second tier, which reduces the area that could be affected by project shadow by accounting for the fact that shadows can never be cast between a certain range of angles south of the project site due to the path of the sun through the sky at the latitude of New York City.

If the second tier of analysis does not eliminate the possibility of new shadows on sunlight-sensitive resources, a third tier of screening analysis further refines the area that could be reached by project shadow by looking at specific representative days in each season and determining the maximum extent of shadow over the course of each representative day.

If the third tier of analysis does not eliminate the possibility of new shadows on sunlight-sensitive resources, a detailed shadow analysis is required to determine the extent and duration of the incremental shadow resulting from the project. The detailed analysis provides the data needed to assess the shadow impacts. The effects of the new shadows on the sunlight-sensitive resources are described, and their degree of significance is considered. The results of the analysis and assessment are documented with graphics, a table of incremental shadow durations, and narrative text.

C. PRELIMINARY SCREENING ASSESSMENT

A base map was developed using Geographic Information Systems (GIS)[1] showing the location of the proposed project and the surrounding street layout (see **Figure 3.4-1**). In coordination with the open space, historic and cultural resources, and other assessments presented in other sections of this EIS, potential sunlight-sensitive resources were identified and shown on the map.

TIER 1 SCREENING ASSESSMENT

For the Tier 1 assessment, the longest shadow that the proposed structure(s) could cast is calculated, and, using this length as the radius, a perimeter is drawn around the project site. Anything outside this perimeter representing the longest possible shadow could never be affected by project-generated shadow, while anything inside the perimeter needs additional assessment.

According to the *CEQR Technical Manual*, the longest shadow that a structure can cast at the latitude of New York City occurs on December 21, the winter solstice, at the start of the analysis day at 8:51 AM, and is equal to 4.3 times the height of the structure.

Therefore, at a maximum envelope height of 395 feet above curb level, plus an additional 40 feet to conservatively allow for rooftop mechanical structures, the proposed facility could cast a shadow up to approximately 1,871 feet in length (435 x 4.3). Using this length as the radius, a perimeter was drawn around the project site (see **Figure 3.4-1**).

The Tier 1 assessment showed that a number of publicly accessible open spaces and historic resources with sun-sensitive features were located in the longest shadow study area. Therefore, the next tier of assessment was required.

TIER 2 SCREENING ASSESSMENT

Because of the path that the sun travels across the sky in the northern hemisphere, no shadow can be cast in a triangular area south of any given project site. In New York City, this area lies between -108 and +108 degrees from true north. **Figure 3.4-1** illustrates this triangular area south of the project site. The complementary area to the north within the longest shadow study area represents the remaining area that could potentially experience new project generated shadow.

The Tier 2 assessment showed that two parks, several plazas, and two historic resources with sun-sensitive features were located in the remaining longest shadow study area, and the next tier of assessment was required.

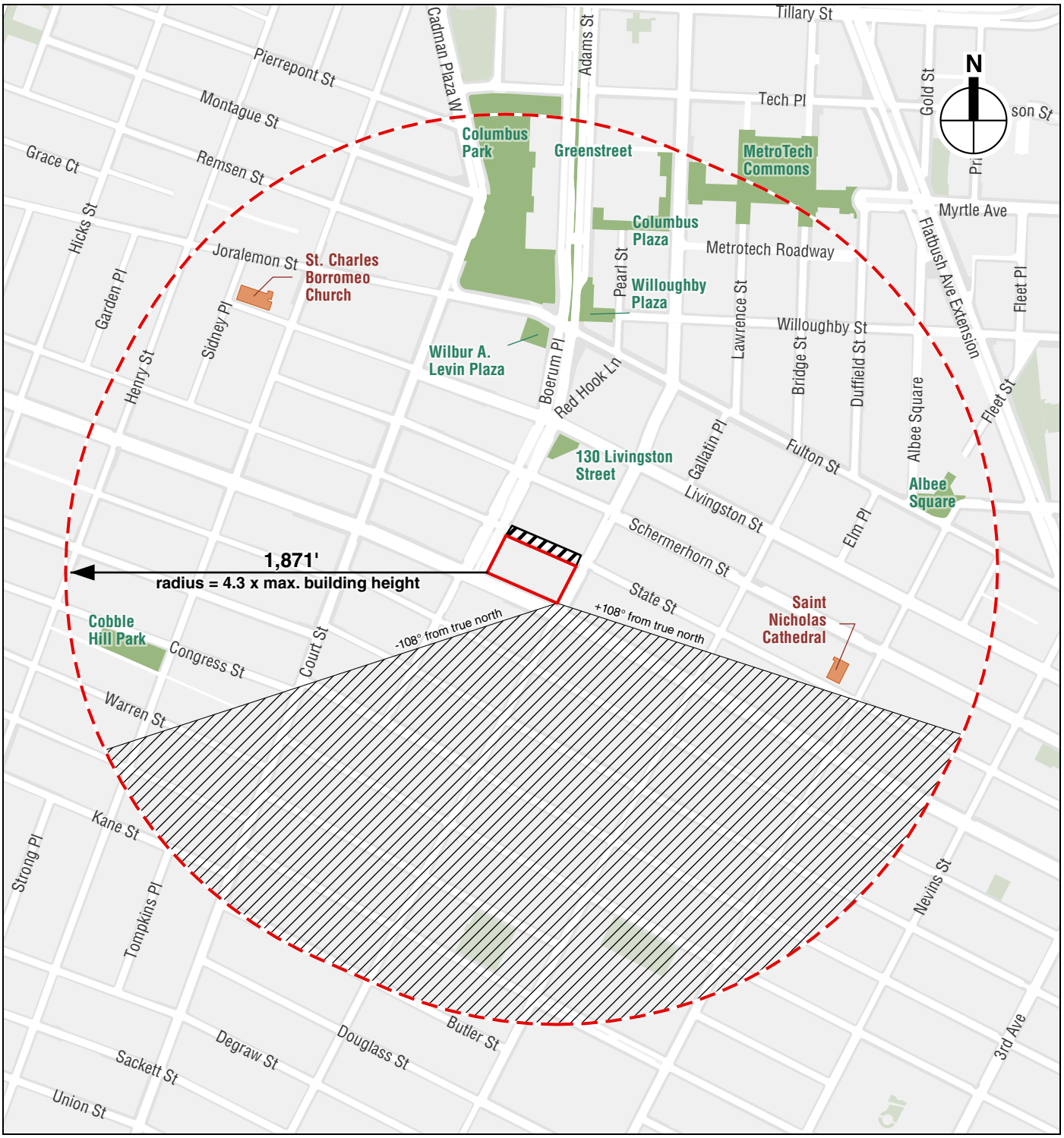
TIER 3 SCREENING ASSESSMENT

The direction and length of shadows vary throughout the course of the day and differ depending on the season. In order to determine whether project-generated shadow could fall on a sunlight-sensitive resource, three-dimensional (3D) computer modeling software[2] is used in the Tier 3 assessment to calculate and display the proposed project's shadows on individual representative days of the year. A computer model was developed containing three-dimensional representations of the elements in the base map used in the preceding assessments, the topographic information

[1] Software: Esri ArcGIS Pro; Data: New York City Department of Information Technology and Telecommunications (DoITT) and other City agencies, and AKRF site visits.

[2] Bentley MicroStation.

3/4/2019



Project Site

Proposed Demapped Area

Tier 1: Longest Shadow Study Area Perimeter

Tier 2: Area South of Site That Could Never Be Shaded by Proposed Facility

Publicly Accessible Open Space in Remaining Study Area

Historic Resources with Sun-Sensitive Features in Remaining Study Area

0 500 FEET

Tier 1 and Tier 2 Assessments
Brooklyn Site - 275 Atlantic Avenue

BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-1

of the study area, and a reasonable worst-case three-dimensional representation of the proposed project.

REPRESENTATIVE DAYS FOR ANALYSIS

Following the guidance of the *CEQR Technical Manual*, shadows on the summer solstice (June 21), winter solstice (December 21) and spring and fall equinoxes (March 21 and September 21, which are approximately the same in terms of shadow patterns) are modeled, to represent the range of shadows over the course of the year. An additional representative day during the growing season is also modeled, generally the day halfway between the summer solstice and the equinoxes, i.e., May 6 or August 6, which have approximately the same shadow patterns.

TIMEFRAME WINDOW OF ANALYSIS

The shadow assessment considers shadows occurring between one and a half hours after sunrise and one and a half hours before sunset. At times earlier or later than this timeframe window of analysis, the sun is down near the horizon and the sun's rays reach the Earth at very tangential angles, diminishing the amount of solar energy and producing shadows that are very long, move fast, and generally blend with shadows from existing structures until the sun reaches the horizon and sets. Consequently, shadows occurring outside the timeframe window of analysis are not considered significant under CEQR, and their assessment is not required.

TIER 3 SCREENING ASSESSMENT RESULTS

Figures 3.4-2 and **3.4-3** illustrates the range of shadows that would occur, in the absence of intervening buildings, from the proposed building on the four representative days for analysis. As they move east and clockwise over the landscape, the shadows are shown occurring approximately every 60 minutes from the start of the analysis day (one and a half hours after sunrise) to the end of the analysis day (one and a half hours before sunset).

On the December 21 analysis day, shadow from the proposed building would be long enough to pass across the southern and eastern façades of St. Charles Borromeo Church in the morning; small portions of Wilbur A. Levin plaza and Willoughby Street plaza in the middle of the day; and 130 Livingston Street plaza in the midday to afternoon. In total, up to four resources could potentially be affected on this analysis day.

On the March 21/September 21 analysis day, shadow from the proposed building would be long enough to pass across a small portion of the 130 Livingston Street plaza in the midday and afternoon. No other resources would be affected on this analysis day.

On the May 6/August 6 analysis day, no resources would be affected by project-generated shadow.

On the June 21 analysis day, shadow from the proposed building would be long enough to pass across a small portion of Cobble Hill Park at the start of the analysis day, and the St. Nicholas Cathedral at the end of the analysis day. No other resources would be affected on this analysis day.

The Tier 3 assessment concluded that, absent intervening buildings, one resource, 130 Livingston Street plaza, could potentially be affected on the fall, winter and early spring analysis days, three other resources could be affected on the winter analysis day only, and two additional resources could be affected on the June 21 analysis day only. A detailed shadow study was therefore warranted for these resources on the relevant analysis days.

December 21

March 21 / Sept. 21

Publicly Accessible Open Space

Historic Resources with Sunlight-Sensitve Features

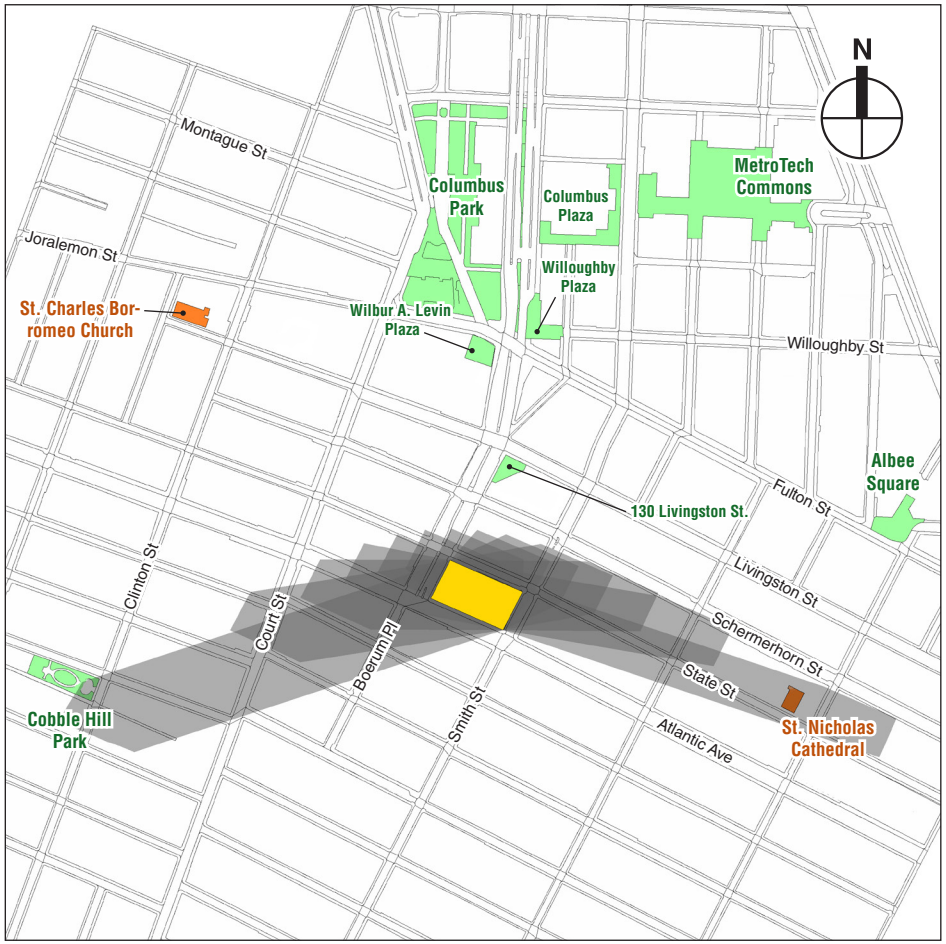
This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed building on the winter solstice and spring/fall equinox analysis days. The shadows are shown occurring approximately every 60 minutes from the start of the analysis day (one and a half hours after sunrise) to the end of the analysis day (one and a half hours before sunset). The Tier 3 assessment serves to illustrate the daily path or "sweep" of the proposed building's shadows across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow. Daylight Saving Time was not used, per CEQR Technical Manual guidelines.

Tier 3 Assessment

BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-2

May 6 / August 6



June 21

Publicly Accessible Open Space

Historic Resources with Sunlight-Sensitve Features

This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed building on the May 6/August 6 and summer solstice analysis days. The shadows are shown occurring approximately every 60 minutes from the start of the analysis day (one and a half hours after sunrise) to the end of the analysis day (one and a half hours before sunset). The Tier 3 assessment serves to illustrate the daily path or "sweep" of the proposed building's shadows across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow. Daylight Saving Time was not used, per CEQR Technical Manual guidelines.

Tier 3 Assessment

Figure 3.4-3

Columbus Park, Columbus Plaza, Albee Square, MetroTech Commons, and St. Ann and Holy Trinity Church would not be reached by project-generated shadow on any analysis day and required no further analysis.

D. DETAILED SHADOW ANALYSIS

The purpose of the detailed analysis is to determine the extent and duration of new incremental shadows that fall on sunlight-sensitive resources as a result of the project, and to assess potential effects. A baseline or future No Action condition is established, containing existing buildings and any future developments planned in the area, to illustrate the baseline shadows. The future condition with the proposed project and its shadows can then be compared with the baseline condition to determine the incremental shadows that would result with the proposed project.

Following the analysis framework described in Chapter 1, "Project Description," the shadows assessment was performed for the analysis year of 2027, comparing the proposed development with the No Action condition in which the site would remain as in the existing condition.

Three-dimensional representations of the existing buildings in the study area were developed using data obtained from the New York City Department of Information Technology and Telecommunications (NYC DoITT), building plans on file with the City, and photos taken during project site visits, and were added to the three-dimensional model used in the Tier 3 assessment.

Shadows are in constant movement. The computer simulation software produces an animation showing the movement of shadows over the course of each analysis period. The analysis determines the time when incremental shadow would enter each resource, and the time it would exit.

Shadow analyses were performed for each of the representative days and analysis periods indicated in the Tier 3 assessment. The analysis showed that Willoughby Plaza would not receive any incremental shadow, due to intervening buildings that would already cast shadow on the plaza when incremental shadow would otherwise fall there. The remaining resources identified in the Tier 3 assessment would receive some duration of incremental shadow, as described below.

Table 3.4-1 summarizes the entry and exit times and total duration of incremental shadows on each affected sun-sensitive resource. **Figures 3.4-4** to **3.4-10** document the results of the analysis by providing graphic representations from the computer animation of times when incremental shadow would fall on a sun-sensitive resource. The figures illustrate the extent of additional, incremental shadow at that moment in time, highlighted in red, and show existing shadow and remaining areas of sunlight.

No Action

Proposed Building Envelope

Publicly Accessible Open Space

Incremental Shadow on Sunlight-Sensitive Resource

Existing Building

Proposed Building

December 21 – 12:30 PM

BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-4

3.5.19

No Action

Proposed Building Envelope

Publicly Accessible Open Space

Incremental Shadow on Sunlight-Sensitive Resource

Existing Building

Proposed Building

December 21 – 1:00 PM

BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-5

3.5.19

No Action

Proposed Building Envelope

Publicly Accessible Open Space

Incremental Shadow on Sunlight-Sensitive Resource

Existing Building

Proposed Building

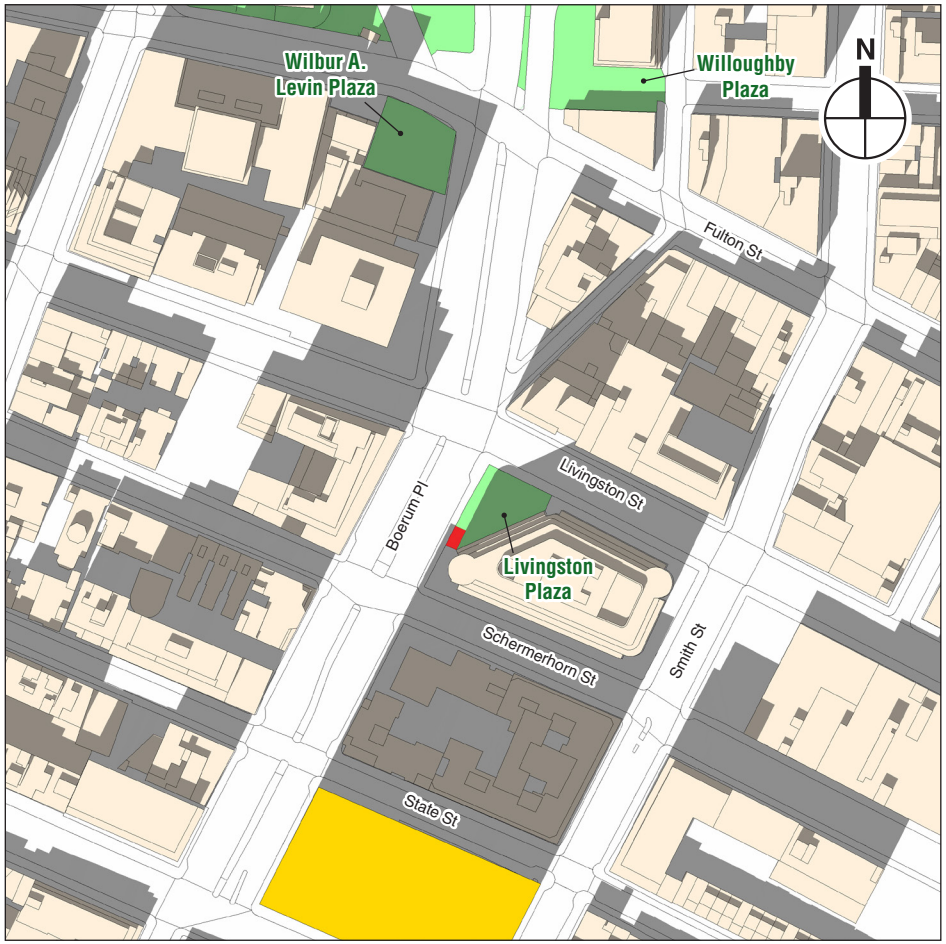
December 21 – 1:30 PM

BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-6

3.5.19

No Action



Proposed Building Envelope

Publicly Accessible Open Space

Incremental Shadow on Sunlight-Sensitive Resource

Existing Building

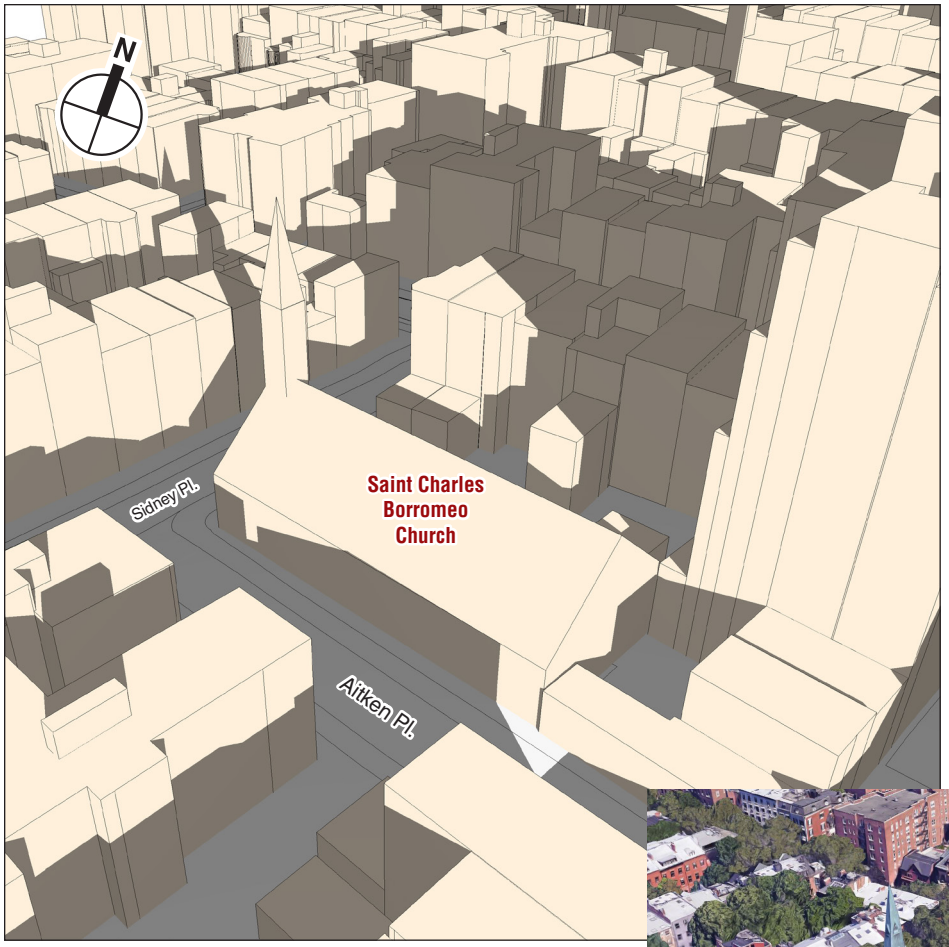
Proposed Building

March 21 / Sept. 21 – 1:15 PM

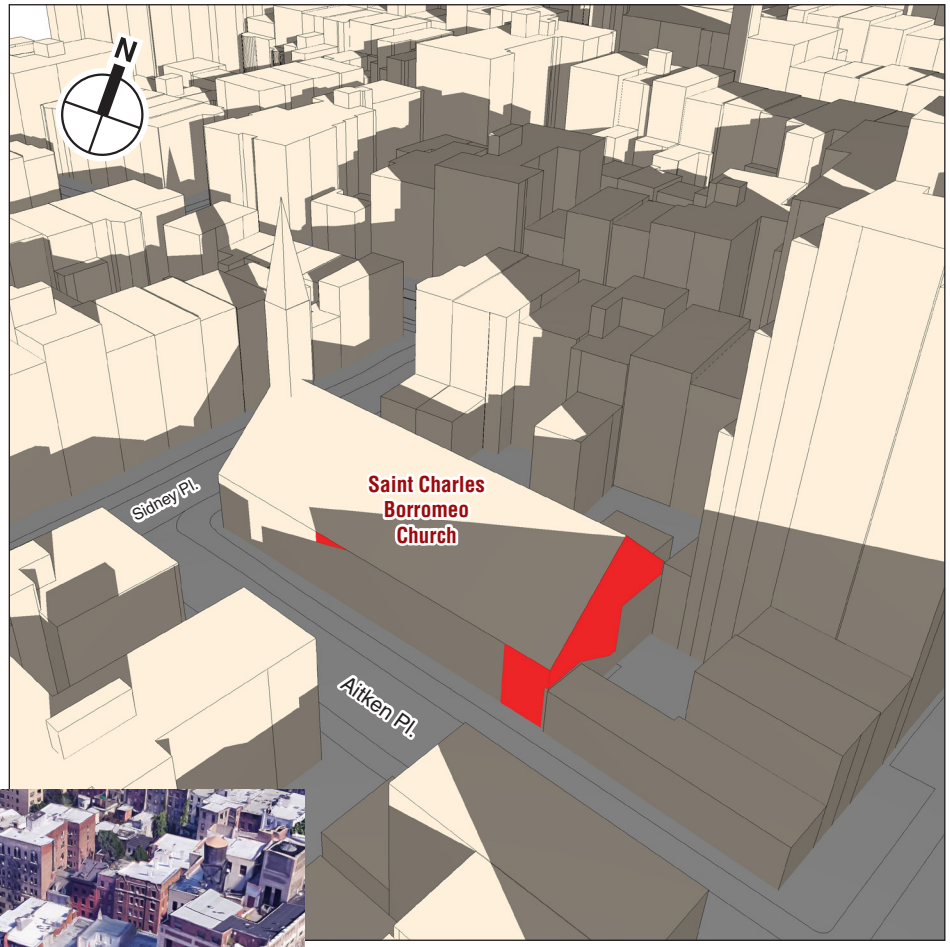
BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-7

3.5.19



No Action



Proposed Building Envelope

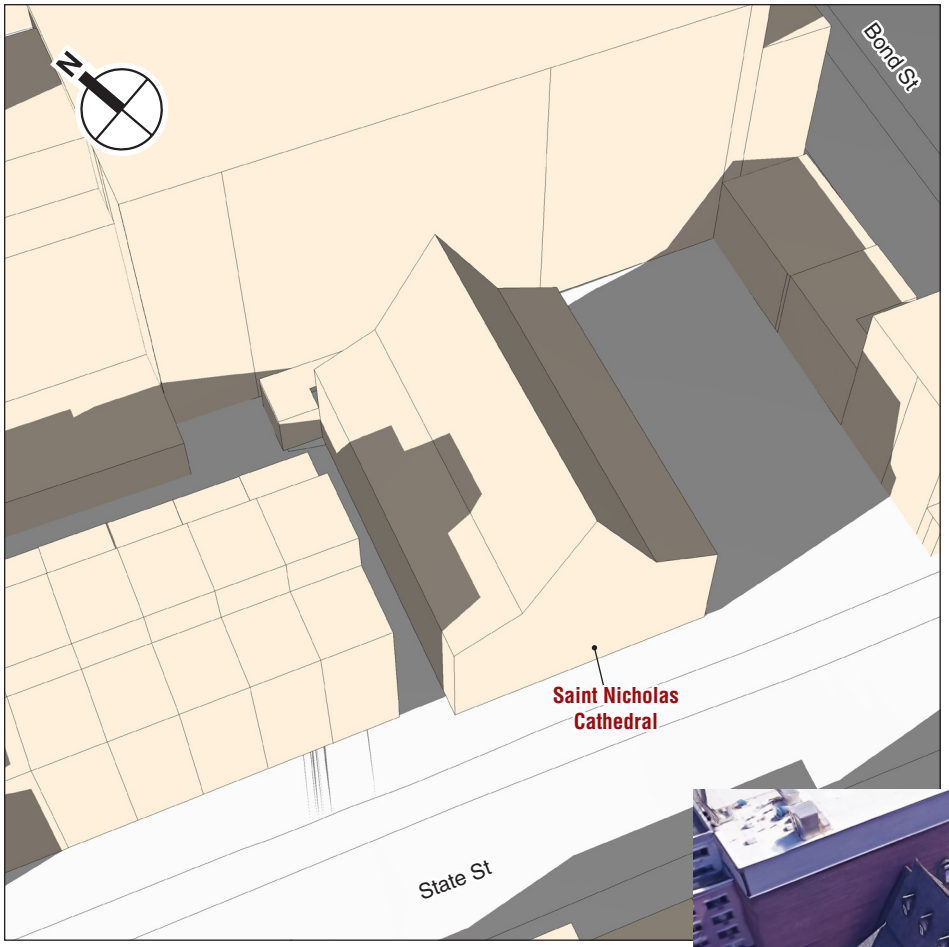
Incremental Shadow on Sunlight-Sensitive Resource

December 21 – 8:55 AM

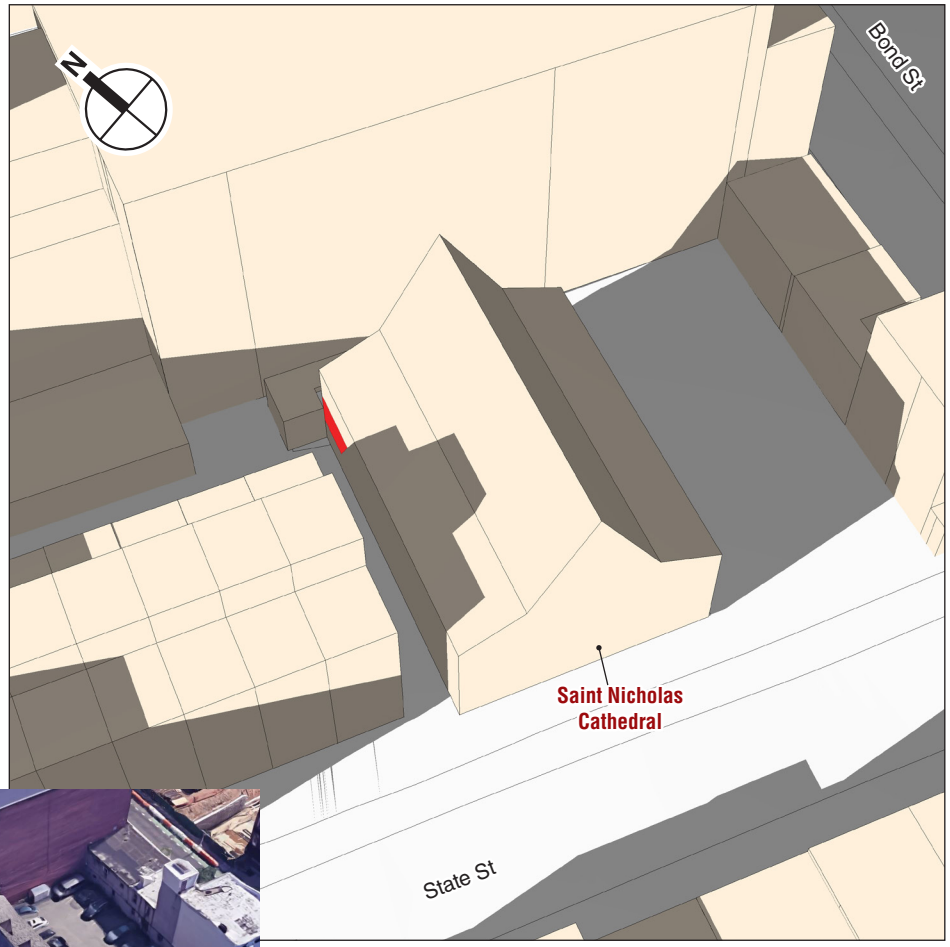
BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-8

3.5.19



No Action



Proposed Building Envelope

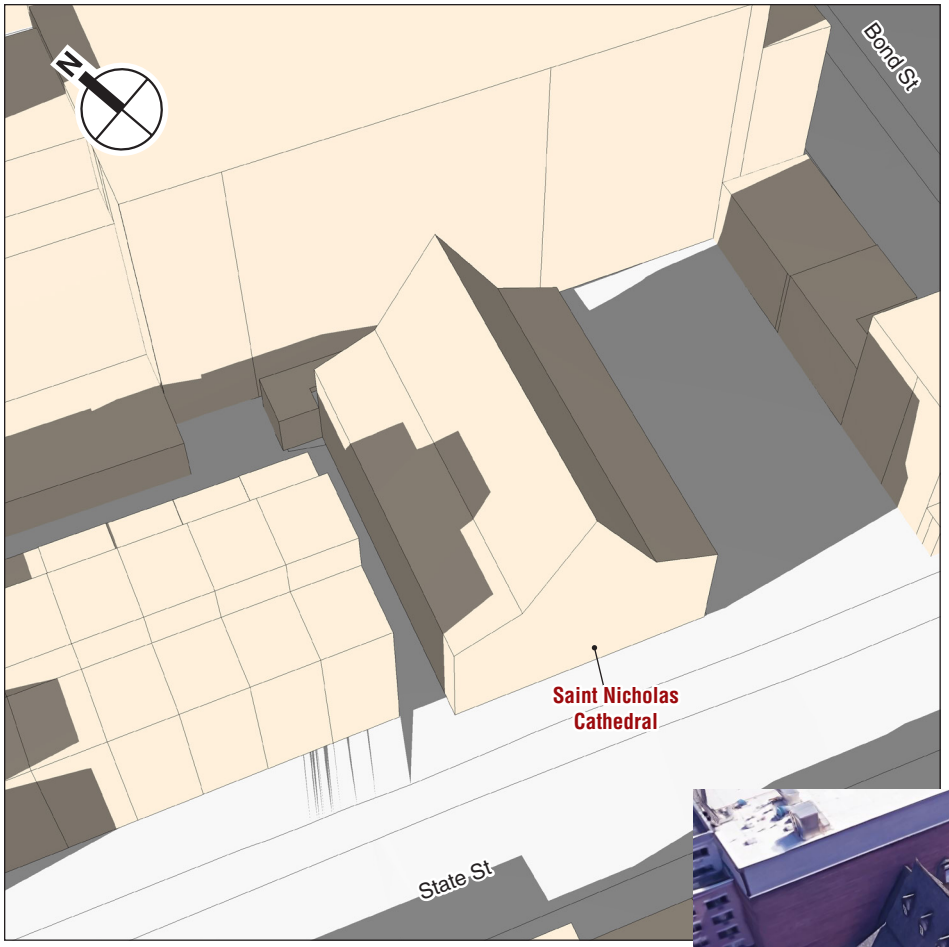
Incremental Shadow on Sunlight-Sensitive Resource

June 21 – 5:37 PM

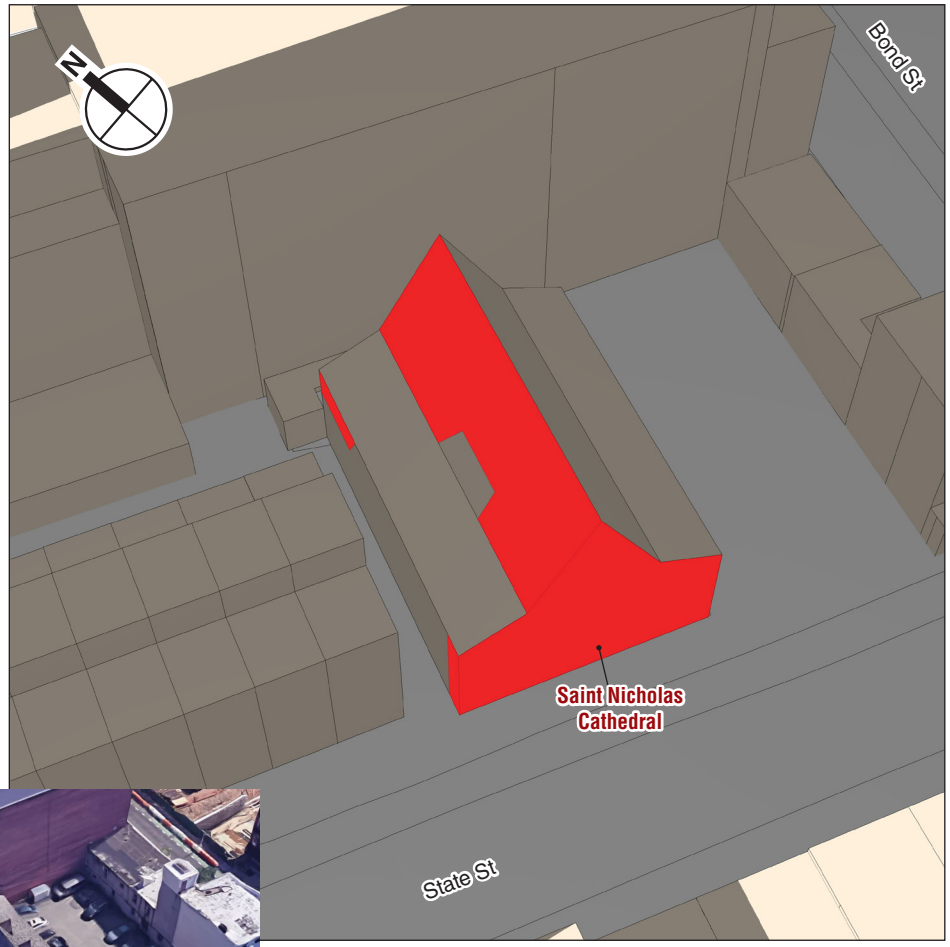
BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-9

3.5.19



No Action



Proposed Building Envelope

Incremental Shadow on Sunlight-Sensitive Resource

June 21 – 6:00 PM

BOROUGH-BASED NYC JAIL SYSTEM

Figure 3.4-10

Table 3.4-1
Incremental Shadow Durations on Sunlight-Sensitive Resources

Analysis Day and Timeframe Window	December 21 8:51 AM–2:53 PM	March 21/Sept. 21 7:36 AM–4:29 PM	May 6/August 6 6:27 AM–5:18 PM	June 21 5:57 AM–6:01 PM
OPEN SPACES				
Cobble Hill Park	—	—	—	5:57 AM–6:03 AM Duration: 6 min
Wilbur A. Levin Plaza	12:15 PM–12:45 PM Duration: 30 min	—	—	—
Livingston Plaza	12:05 PM–1:55 PM Duration: 1 hr 50 min	12:55 PM–1:20 PM Duration: 25 min	—	—
Willoughby Plaza	—	—	—	—
HISTORIC RESOURCES				
Saint Charles Borromeo Church	8:51 AM–9:05 AM Duration: 14 min	—	—	—
Saint Nicholas Cathedral	—	—	—	5:37 PM–6:01 PM Duration: 24 min

Notes:
Table indicates entry and exit times and total duration of incremental shadow for each sunlight-sensitive resource.
Daylight saving time is not used—times are Eastern Standard Time, per *CEQR Technical Manual* guidelines. However, as Eastern Daylight Time is in effect for the March/September, May/August, and June analysis periods, add 1 hour to the given times to determine the actual clock time.

DETERMINATION OF IMPACT SIGNIFICANCE

The determination of significance of shadow impacts on a sunlight-sensitive resource is based on (1) the information resulting from the detailed shadow analysis describing the extent and duration of incremental shadows, and (2) an analysis of the resource's sensitivity to reduced sunlight. The goal of the assessment is to determine whether the effects of incremental shadows on a sunlight-sensitive resource are significant under CEQR.

A shadow impact occurs when the incremental shadow from a proposed project falls on a sunlight-sensitive resource or feature and reduces its direct sunlight exposure. Determining whether this impact is significant or not depends on the extent and duration of the incremental shadow and the specific context in which the impact occurs.

Per CEQR, a significant shadow impact generally occurs when an incremental shadow of 10 minutes or longer falls on a sunlight sensitive resource and results in one of the following:

VEGETATION

- A substantial reduction in sunlight available to a sunlight-sensitive feature of the resource to less than the minimum time necessary for its survival (when there was sufficient sunlight in the future without the proposed actions). In the growing season, four to six hours a day of sunlight is a minimum requirement.
- A reduction in direct sunlight exposure where the sensitive feature of the resource is already subject to substandard sunlight (i.e., less than minimum time necessary for its survival).

HISTORIC AND CULTURAL RESOURCES

- A substantial reduction in sunlight available for the enjoyment or appreciation of the sunlight-sensitive features of a historic or cultural resource.

OPEN SPACE UTILIZATION

- A substantial reduction in the usability of open space as a result of increased shadows.

FOR ANY SUNLIGHT-SENSITIVE FEATURE OF A RESOURCE

- Complete elimination of all direct sunlight on the sunlight-sensitive feature of the resource, when the complete elimination results in substantial effects on the survival, enjoyment, or, in the case of open space or natural resources, the use of the resource.

SHADOW EFFECTS BY RESOURCE – OPEN SPACES

COBBLE HILL PARK

Cobble Hill Park is a well-used neighborhood park located on the eastern half of the block bounded by Clinton, Congress and Henry Streets and Verandah Place. The park contains seating areas, plantings and landscaping, mature trees, and a playground in the western end.

The park would receive incremental shadow for six minutes early in the morning on the June 21 analysis day, from 5:57 AM to 6:03 AM. Areas of sunlight would remain on the space during this brief six-minute period. Given the early hour and very limited extent and duration, the incremental shadow would not significantly impact the use of the space or the viability of its vegetation.

WILBUR A. LEVIN PLAZA

This space is located on the grounds of the Brooklyn Law School between Joralemon Street, Boerum Place, Livingston Street, and Court Street. The plaza contains benches and planters. The plaza is in excellent condition and experiences low utilization.

Incremental shadow would fall on a small area on the eastern side of this space from 12:15 PM to 12:45 PM on the December 21 analysis day. Winter shadows are long, and the plaza would generally be shady on this analysis day, primarily due to shadows from the Brooklyn Law School building bounding the plaza on its south side, and other existing buildings to the south. The proposed building's shadow would enter the southeast corner of the space at 12:15 PM and move northward along its eastern side over the course of the following 30 minutes (see **Figure 3.4-4** showing 12:30 PM). Exiting at 12:45 PM, the incremental shadow would at no point eliminate the remaining sunlight on the plaza. After 12:45 PM, existing shadow would cover the entire space.

Utilization of the space is generally low and would be even lower in winter. Given this fact, and the limited size and duration of the incremental shadow, the use of the space would not be significantly altered by the proposed project on this analysis day. No incremental shadow would fall on the space in spring, summer, or fall.

LIVINGSTON PLAZA

This is a triangular public space located in front of the lobby of the office building at 130 Livingston Street. The space consists of a plaza area with benches and planters, and is currently in adequate condition, experiencing medium utilization. This plaza would receive incremental shadow on two of the four analysis days.

On December 21, shadows are long and the plaza would be in shadow from the adjacent 130 Livingston Street building throughout the morning and midday. From 12:05 PM to 1:55 PM, the incremental shadow from the proposed building would fall on the western edge of the space. The incremental shadow would eliminate the remaining sliver of sunlight for all but the final 10 minutes of this period; however, the size of the incremental shadow would remain small and

limited and on the western edge of the space where there are no benches (see **Figures 3.4-4 through 3.4-6**). Consequently, the incremental shadow would not significantly impact the use of the space.

On the March 21/September 21 analysis day, incremental shadow would pass across the southwest corner of the plaza for 50 minutes, from 12:55 PM to 1:20 PM (see **Figure 3.4-7** showing the incremental shadow at its greatest extent at 1:15 PM). Sunlit areas of the plaza would remain during this period, and the limited size and duration of the incremental shadow would not significantly impact the plaza on this analysis day.

SHADOW EFFECTS BY RESOURCE – HISTORIC RESOURCES

SAINT CHARLES BORROMEO CHURCH

This building is located at the corner of Sidney Place and Aitken Place in Brooklyn Heights, within the Brooklyn Heights Historic District. The southern (side) and eastern (rear) façades of the building face obliquely toward the project site. The south façade has stained-glass windows along its length, and the eastern façade has a single stained-glass window.

On the December 21 analysis day, incremental shadow would pass across both façades for a total of 14 minutes from the start of the analysis day at 8:51 AM until 9:05 AM (see **Figure 3.4-8** showing 8:55 AM). Sunlight would continue to reach a portion of one or both façades throughout this 14-minute duration, and most of the windows would remain in sun for the rest of the morning and early afternoon. Given the short duration of incremental shadow, and the fact that sunlight would never be completely eliminated from the windows, the incremental shadow would not significantly impact the usability or public appreciation of the stained-glass windows. No incremental shadow would fall on this church in the spring, summer, or fall.

SAINT NICHOLAS CATHEDRAL

This building has been deemed eligible for listing on the New York State and National Register of Historic Places. The western and southern (front) façades face obliquely toward the project site, and both of these façades have stained-glass windows.

Incremental shadow would fall on the church during the final half-hour of the June 21 analysis day, 5:37 PM to 6:01 PM (see **Figures 3.4-9 and 3.4-10**). At 5:37 PM, only a single window on the western façade would be in incremental shadow. However, shadows move quickly at the end of the analysis day and from 5:39 PM to 5:47 PM, incremental shadow would move east and fall on more windows. From 5:48 PM to 6:01 PM, the incremental shadow would eliminate all the sunlight from the church windows.

Many of the church's windows would be in sun throughout the afternoon prior to 5:48 PM. All sunlight would be eliminated for only 13 minutes on the one analysis day, and no incremental shadow would fall on the other analysis days, which represent most of the year (from early August through early May). Therefore, the brief duration of incremental shadow on June 21 would not significantly alter the use of the church or substantially affect the public's appreciation of the windows.

E. CONCLUSIONS

The proposed project would result in incremental shadow on two nearby plazas, one park, and two historic buildings with sunlight-sensitive features. For all but one of those resources, the incremental shadow would occur in only one of the four seasons. In no case would the incremental

shadow result in significant adverse impacts to either the use or appreciation or the vegetation of any of the affected resources. ✷