A. INTRODUCTION

According to the *CEQR Technical Manual*, a shadow is defined as the circumstance in which a building or other built structure blocks the sun from the land. An adverse shadow impact is considered to occur when the incremental shadow from a proposed project falls on a sunlight-sensitive resource and substantially reduces or completely eliminates direct sunlight exposure, thereby significantly altering the public's use of the resource or threatening the viability of vegetation or other resources. Sunlight-sensitive resources include publicly accessible open space, historic architectural resources if the features that make the resource significant depend on sunlight, natural resources, and greenstreets. In general, shadows on city streets and sidewalks or on other buildings are not considered significant under CEQR. In addition, shadows occurring within an hour and a half of sunrise or sunset generally are also not considered significant under CEQR.

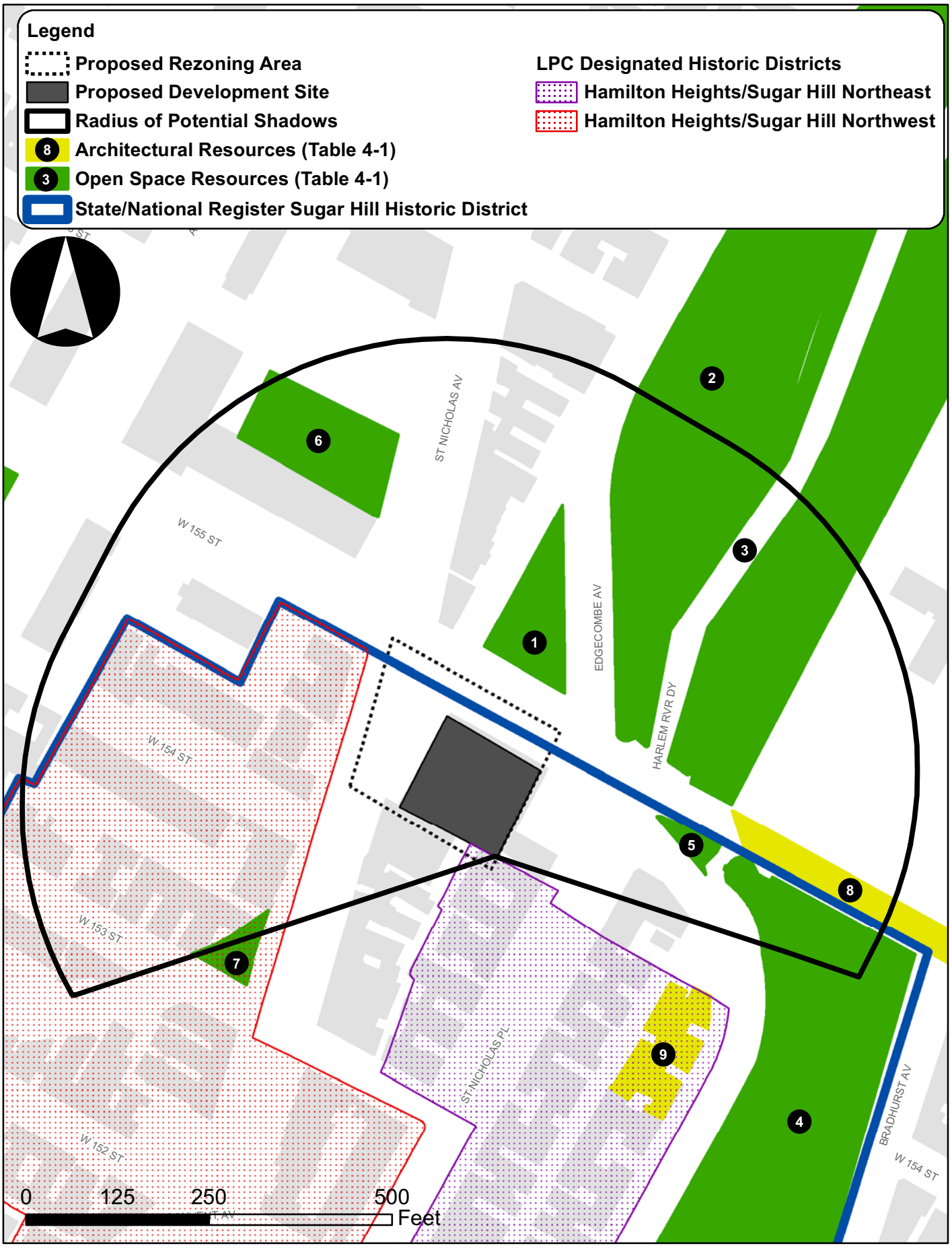
In accordance with CEQR guidelines, this chapter provides a shadows assessment to determine whether the Proposed Action would result in new shadows long enough to reach any sunlight-sensitive resources (except within an hour and a half of sunrise or sunset). As discussed below, the Proposed Action would result in minimal new shadows being cast on three open space resources and one greenstreet to the north and east of the rezoning area, which would not be significant either in terms of frequency or duration.

B. METHODOLOGY

According to the *CEQR Technical Manual*, the longest shadow a structure will cast in New York City, except for periods close to dawn or dusk, is 4.3 times its height. For actions resulting in structures less than 50 feet high, a shadow assessment is generally not necessary unless the site is adjacent to a park, historic resource, or important natural feature (if the features that make the structure significant depend on sunlight).

The Proposed Action would facilitate the construction of the Proposed Development, with a height of approximately 120 feet (refer to Chapter 1, "Project Description"). Therefore, the longest shadow that could be cast by the Proposed Development would be approximately 516 feet. These incremental shadows would be cast to the north, east, and west of the site. Because of the path that the sun travels across the sky, no shadows can be cast in the triangular area between –108 degrees from true north and 108 degrees from true north. Therefore, open space and historic resources located in the area to the south of the site (where no project shadows could fall) are excluded from further assessment. The maximum shadow radius is illustrated in Figure 4-1.

Resources of Concern Within Maximum Shadow Radius for Proposed Development Site



Resources of Concern

In coordination with Chapter 3, "Open Space," and Chapter 5, "Historic Resources," publicly accessible open spaces, greenstreets, and sunlight-sensitive architectural resources within an approximate 516-foot radius to the north, east, and west of the Proposed Development Site were identified, as shadows created by the Proposed Development could fall in the direction of these resources. According to the *CEQR Technical Manual*, historic resources that need to be considered in a shadows analysis must have sunlight-dependent features such as stained glass windows, historic landscapes, design elements that are part of a recognized architectural style that depends on contrast between light and dark design features, exterior materials and color that depend on direct sunlight for visual character, or elaborate, highly carved ornamentation. As discussed below, there are no historic resources with sunlight-dependent features in the immediate vicinity of the Proposed Development Site, but several open space resources have been identified within the applicable maximum shadow radius.

Open Space Resources

As illustrated in Figure 4-1, six open space resources fall within the maximum shadow radius for the Proposed Development Site. As shown in Figure 4-1, these include the southern portion of Highbridge Park, located to the north of West 155th Street (which has been divided into three segments for analysis purposes - east, central and west), the southern portion of the Harlem River Parkway, the northern portion of Jackie Robinson Park located one block to the east of the rezoning area, Orville and Wilbur Playground located to the northwest, the northernmost portion of the William A. Harris Garden, located to the southwest, and a small greenstreet/plaza area encompassing Maher Circle at West 155th Street.

Highbridge Park, located just north of the rezoning area, has the greatest potential to be affected by shadows from the Proposed Development Site. The segment of the park that falls within the defined maximum shadow radius is comprised mostly of vegetated areas with paths and benches. Similarly, the small portion of Jackie Robinson Park that falls within the defined shadow radius also consists mostly of vegetated areas with paths and benches, and does not include any of the park's most notable recreational facilities (pool, playground, etc.).

As noted above, a greenstreet, a.k.a. Maher Circle, falls within the shadow radius (#7 in Figure 4-1). Maher Circle is a traffic island at the intersection of Edgecombe Avenue, St. Nicholas Place and West 155th Street. It contains the Hooper Fountain, and a small fenced planted area, with one tree. The Circle does not host any recreational activity, and is more of a visual marker. Although this area functions as a traffic island and does not host any recreational activity, nor does it contain benches, it is included in the detailed shadows assessment below because the *CEQR Technical Manual* lists greenstreets as sunlight-sensitive resources.

Historic Resources

According to the *CEQR Technical Manual*, historic resources are considered to be sunlight-sensitive if the features that make the resource significant depend on sunlight. The following architectural features are identified by the *CEQR Technical Manual* in as being sunlight sensitive:
(a) buildings containing design elements that are part of a recognized architectural style that depends on the contrast between light and dark design elements (e.g. deep recesses or voids such as open galleries, arcades, recessed balconies, deep window reveals, and prominent rustication);

(b) buildings distinguished by elaborate, highly carved ornamentation; (c) buildings with stained glass windows; (d) exterior materials and color that depend on direct sunlight for visual character; (e) historic landscapes; and (f) features in structures where the effect of direct sunlight is described as playing a significant role in the structure's significance as an historic landmark.

A shadow impact on a historic resource would occur if shadows cast by a proposed building obscures the features or details that make that resource significant.

Historic resources that could potentially be affected by shadows from the Proposed Development are those located mostly to the north, east and west of the rezoning area. As shown in Figure 4-1, these include small areas of the S/NR-listed Sugar Hill Historic District and the NYCLPC-designated Hamilton Heights/Sugar Hill Northwest Historic District, and the West 155th Street Viaduct. However, none of these resources within the defined shadow radius have significant sunlight-dependent features that contribute to their historic importance, and they were therefore excluded from further analysis. In addition, as shown in Figure 4-1, the NYCLP-designated Hamilton Heights/Sugar Hill Northeast Historic District and the landmark 409 Edgecombe Avenue are located to the south of the rezoning area and are not within the defined shadow radius.

Although Figure 4-1 shows that portions of two blocks within the NYCLPC-designated Hamilton Heights/Sugar Hill Northwest Historic District fall within the Proposed Development's maximum shadow radius, it should be noted that only resources facing the Proposed Development (i.e., facing east) could be covered by shadows created by the proposed building. Therefore, only those structures facing St. Nicholas Avenue could potentially be cast in shadows by the Proposed Development, whereas for all remaining buildings on those blocks, any shadows would fall on their roofs or secondary facades (mostly blank walls). Buildings on the west side of St. Nicholas Avenue (i.e., facing east) between West 155th and West 153rd Street consist mostly of 4-story rowhouses and mid-rise apartment buildings, including a 6-story limestone, brick, and terra-cotta neoclassical revival apartment building at the corner of West 155th Street (889 St. Nicholas Avenue), three 3-story brick and cut-brick Queen Anne style houses, a 6-story neoclassical brick apartment house, and five 4-story limestone rowhouses. A review of photographic images of those structures with east-facing facades indicates that none of them contain sunlight-dependent features, such as stained glass windows, design elements that are part of a recognized architectural style that depends on the contrast between light and dark design elements, elaborate, highly carved ornamentation that depend on sunlight for visual character, exterior materials and color that depend on direct sunlight for visual character, or features where the effect of direct sunlight is described as playing a significant role in the structure's significance as an historic landmark.

Therefore, shadows resulting from the Proposed Action would not adversely affect any of the identified historic resources in the area.

C. ASSESSMENT OF POTENTIAL SHADOW IMPACTS

An adverse shadow impact is considered to occur when the incremental shadow from a development falls on a sunlight-sensitive resource and substantially reduces or completely eliminates direct sunlight exposure, thereby significantly altering the public's use of the resource or threatening the viability of vegetation or other resources. The uses and vegetation in an open

space establish its sensitivity to shadows. This sensitivity is assessed for both (1) warm-weather-dependent features like wading pools and sand boxes, or vegetation that could be affected by a loss of sunlight during the growing season; and (2) features, such as benches, that could be affected by a loss of winter sunlight. Uses that rely on sunlight include: passive use, such as sitting or sunning; active use, such as playfields or paved courts; and such activities as gardening, or children's wading pools and sprinklers. Where lawns are actively used, the turf requires extensive sunlight. Vegetation requiring direct sunlight includes the tree canopy, flowering plants and plots in community gardens. Generally, four to six hours a day of sunlight, particularly in the growing season (defined as March to October), is often a minimum requirement.

The shadow analysis considers the times when development anticipated as a result of the Proposed Action would increase shadows falling on identified resources of concern. As the sun travels across the sky during the day, shadows fall in a curve on the ground opposite the sun. When the sun rises, shadows fall to the west. As the sun travels across the southern part of the sky throughout the day, shadows move in a clockwise direction until they stretch east, as the sun sets in the west. Midday shadows are always shorter than those at other times of the day because the sun is highest in the sky at that time. Further, because of the tilt of the earth's axis, the angle at which the sun's rays strike the earth varies throughout the year, so that during the summer, the sun is higher in the sky and shadows are shorter than during the winter. Winter shadows, although longest, move the most quickly along their paths (because of the earth's tilt) and do not affect the growing season of outdoor trees and plants.

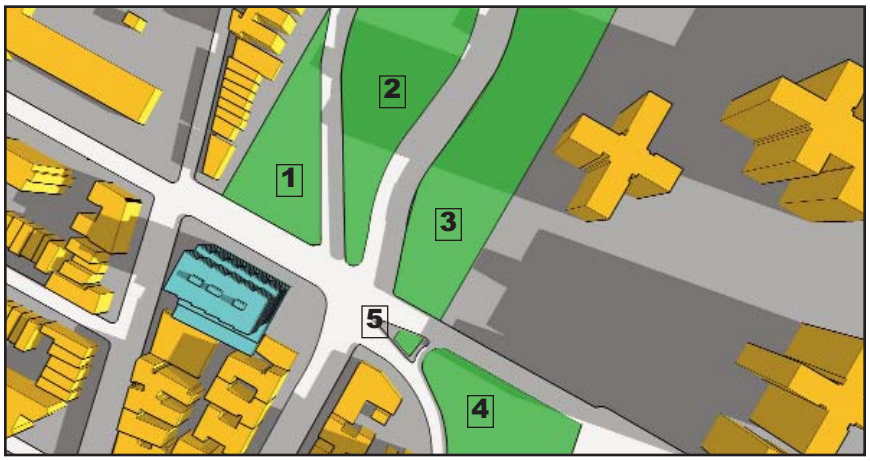
As directed by the *CEQR Technical Manual*, shadow analyses were performed for the three open space resources and one greenstreet identified in Section B above, for four representative days of the year: March 21/September 21, the equinoxes; May 6, the midpoint between the summer solstice and the equinox (and equivalent to August 6); June 21, the summer solstice and the longest day of the year; and December 21, the winter solstice and shortest day of the year. The *CEQR Technical Manual* defines the temporal limits of a shadow analysis period to fall from an hour and a half after sunrise to an hour and a half before sunset. The results of the shadow analysis on the open space resources of concern are summarized in Table 4-1 and discussed below. All times referenced in this section are eastern standard time (EST); daylight savings time is not considered.

March 21/September 21

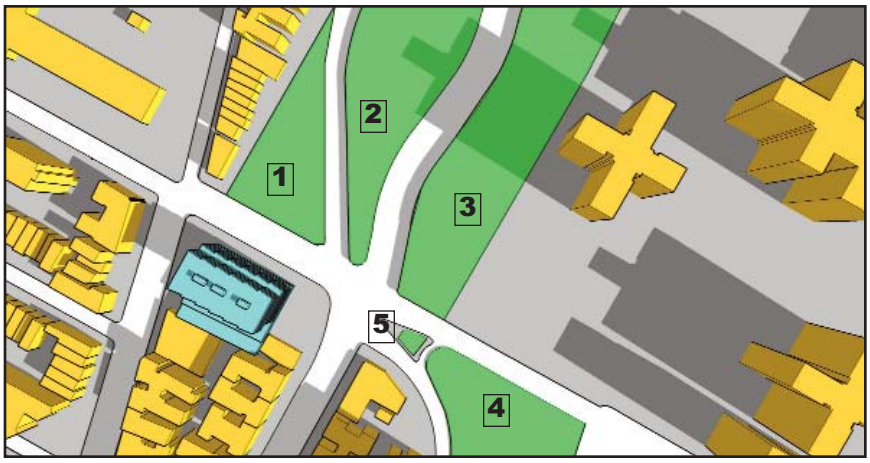
On the equinoxes, incremental shadows from the development resulting from the Proposed Action would reach Highbridge Park and the Harlem River Parkway, as shown in Table 4-1. As shown in Figure 4-2a, incremental shadows would be cast on the western segment of Highbridge Park for a duration of approximately 4 hours and 16 minutes, and would exit this segment entirely by 4:29 PM. Incremental shadows would also be cast on the central portion of Highbridge Park (1:53 PM to 4:29 PM) for a duration of approximately 2 hours and 36 minutes. In the afternoon, the incremental shadows would be cast on parts of the eastern segment of Highbridge Park and the Harlem River Parkway from 3:10 PM to 4:29 PM, for a duration of 1 hour and 19 minutes. No incremental shadows would be cast on any of the other resources in Table 4-1 on this analysis day.

Shadow Diagrams - March 21

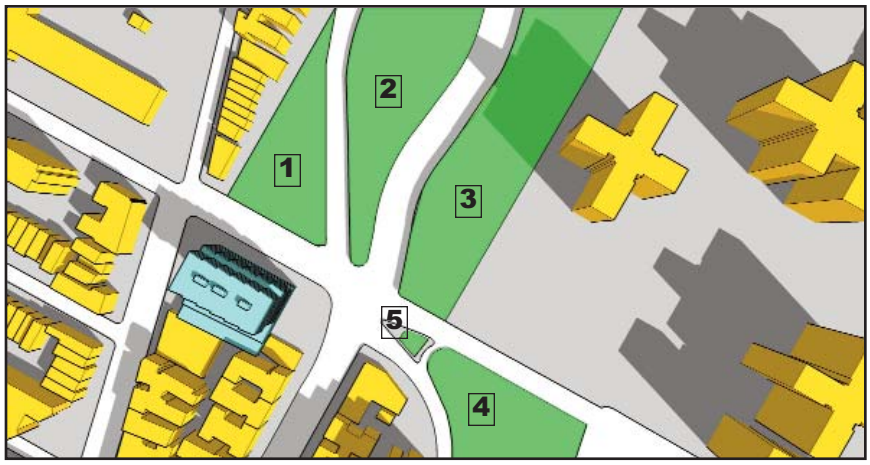
8:00 AM



9:00 AM



10:00 AM



Proposed Development

Shadow Increment from Proposed Development

1 Highbridge Park - western area

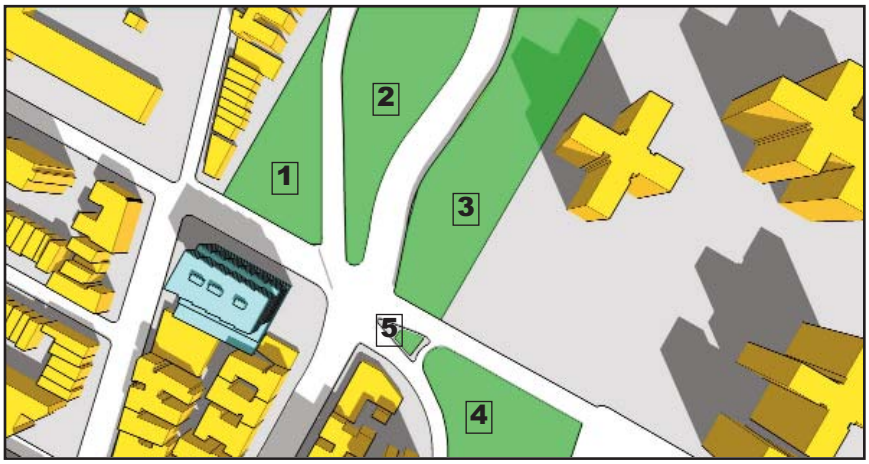
2 Highbridge Park - central area

3 Harlem River Parkway and Highbridge Park - eastern area

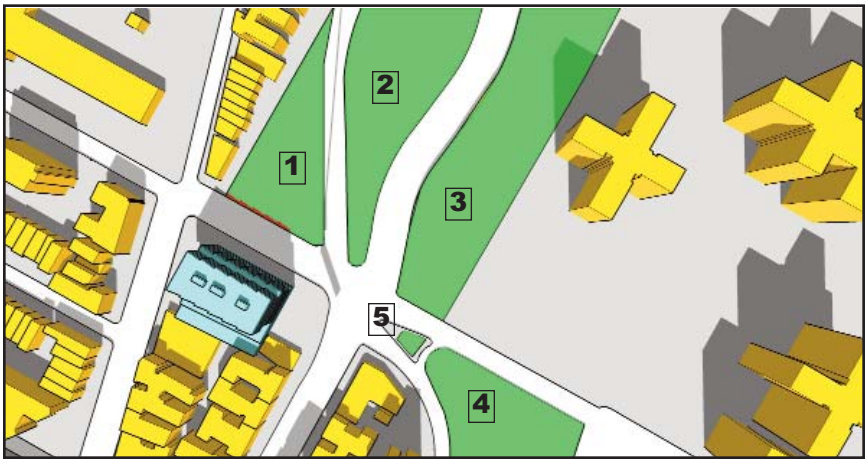
4 Jackie Robinson Park

5 Greenstreet (Maher Circle)

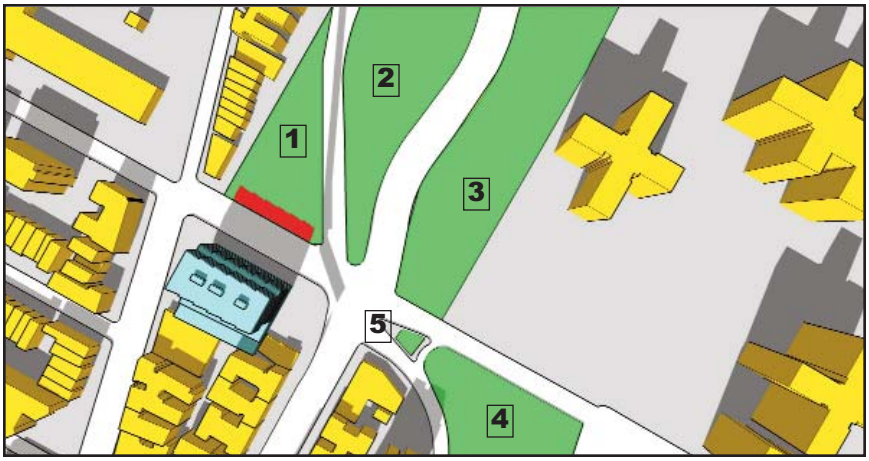
11:00 AM



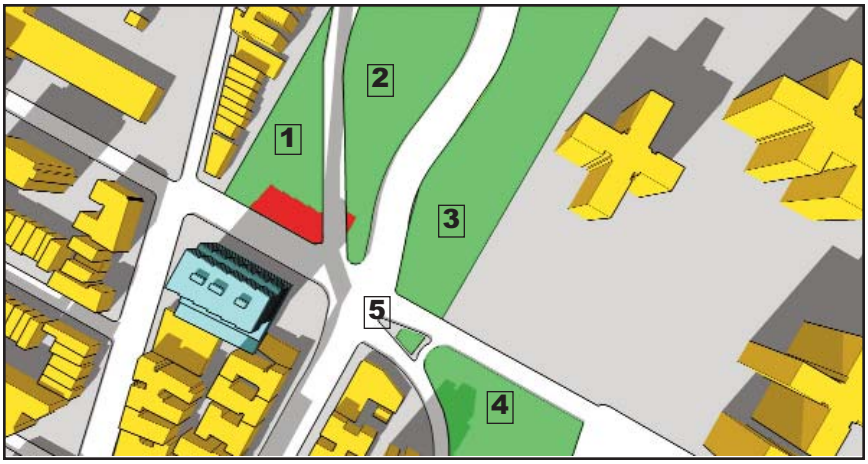
12:00 PM



1:00 PM



2:00 PM



Proposed Development

Shadow Increment from Proposed Development

1 Highbridge Park - western area

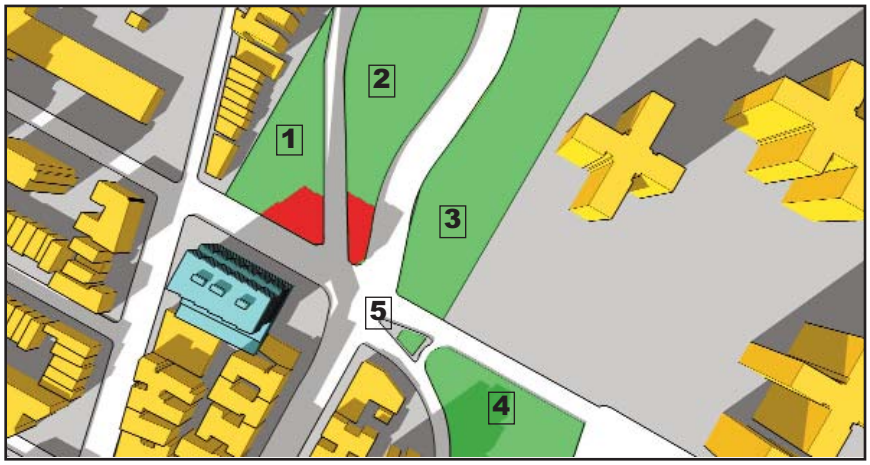
2 Highbridge Park - central area

3 Harlem River Parkway and Highbridge Park - eastern area

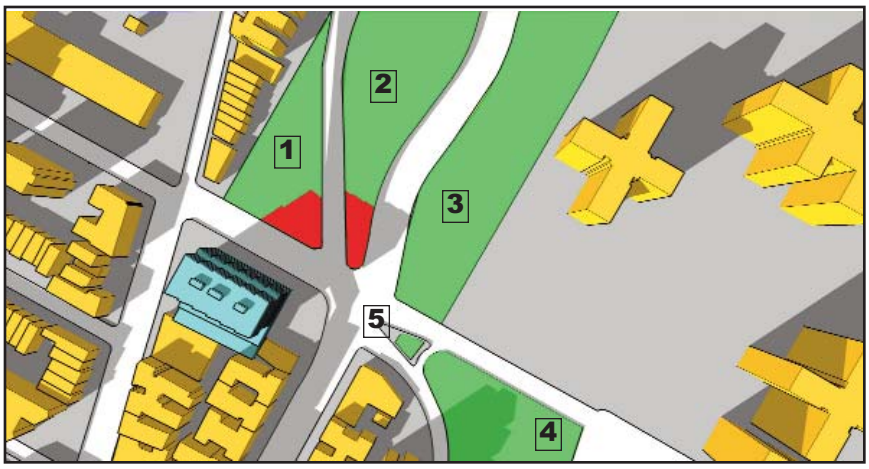
4 Jackie Robinson Park

5 Greenstreet (Maher Circle)

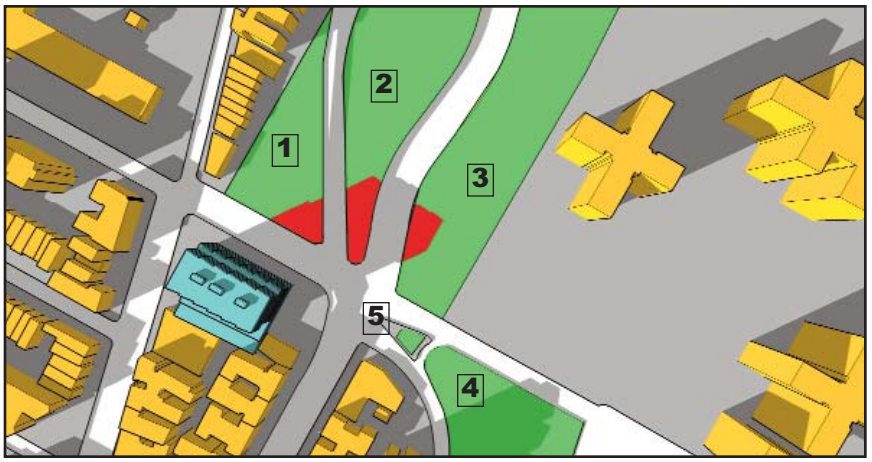
2:50 PM



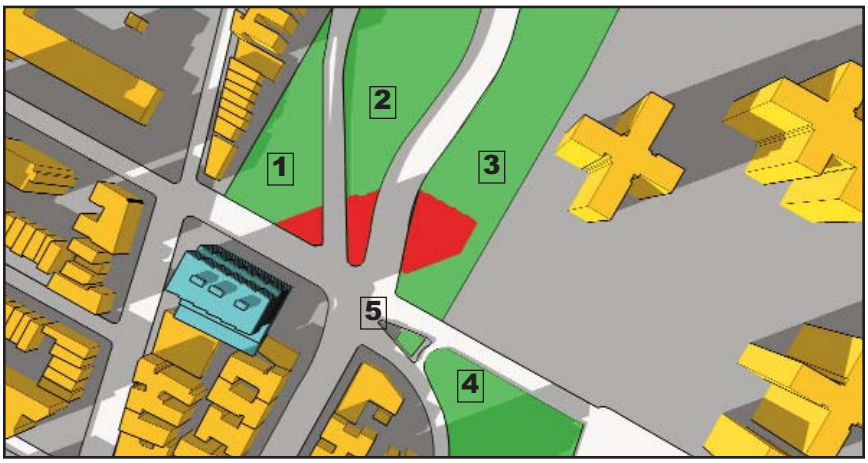
3:00 PM



3:38 PM



4:00 PM



Proposed Development

Shadow Increment from Proposed Development

1 Highbridge Park - western area

2 Highbridge Park - central area

3 Harlem River Parkway and Highbridge Park - eastern area

4 Jackie Robinson Park

5 Greenstreet (Maher Circle)

4:29 PM

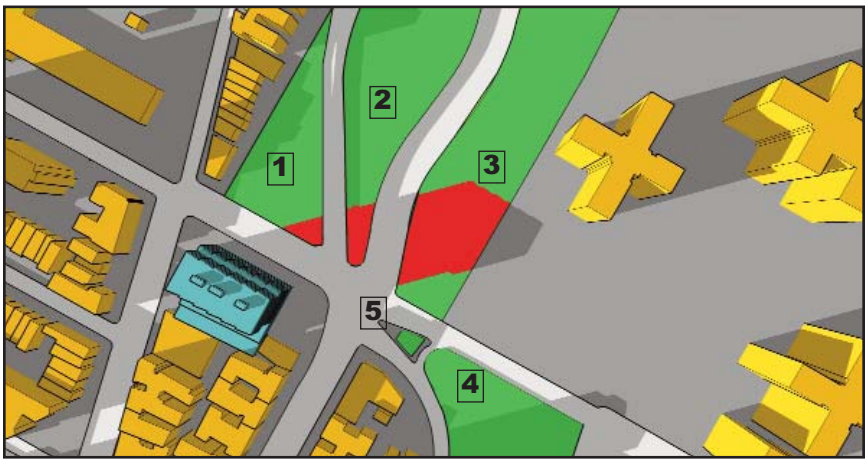


TABLE 4-1
Shadow Duration on Identified Resources Within Maximum Shadow Radius

Analysis Day	March 21/ Sept. 21	May 6/August 6	June 21	December 21
Timeframe Window	**7:36 AM – 4:29 PM**	**6:27 AM – 5:18 PM**	**5:57 AM – 6:01 PM**	**8:51 AM – 2:53 PM**
Resources Assessed For Potential Shadow Impacts				
1. ***Highbridge Park – western area***				
Shadow enter – exit time	12:13 PM – 4:29 PM	2:50 PM – 4:00 PM	N.A.	9:45 AM – 2:53 PM
Incremental shadow duration	4 hrs 16 min	1 hr 10 min	N.A.	5 hrs 8 min
2. *Highbridge Park – central area*				
Shadow enter – exit time	1:53 PM – 4:29 PM	2:13 PM – 5:09 PM	4:05 PM – 4:32 PM	1:10 PM – 2:53 PM
Incremental shadow duration	2 hrs 36 min	2 hrs 56 min	27 min	1 hr 43 min
3. *Harlem River Parkway and Highbridge Park – eastern area*				
Shadow enter – exit time	3:10 PM – 4:29 PM	4:15 PM – 5:18 PM	3:54 PM – 5:45 PM	2:43 PM- 2:53 PM
Incremental shadow duration	1 hr 19 min	1 hr 3 min	1 hr 51 min	10 min
4. *Jackie Robinson Park*				
Shadow enter – exit time	N.A.	N.A.	5:30 PM – 6:01 PM	N.A.
Incremental shadow duration	N.A.	N.A.	31 min	N.A.
5. *Greenstreet / Maher Circle*				
Shadow enter – exit time	N.A.	5:06 PM – 5:18 PM	4:19 PM – 5:56 PM	N.A.
Incremental shadow duration	N.A.	12 min	1 hr 37 min	N.A.
6. Orville and Wilbur Playground	N.A.	N.A.	N.A.	N.A.
7. William A. Harris Garden	N.A.	N.A.	N.A.	N.A.
Resources Screened Out From Further Assessment (Non-Sunlight Sensitive)				
8. West 155th Street Viaduct				
9. 409 Edgecombe Avenue				
Sugar Hill Historic District (areas of the S/NR and NYCLPC districts that fall within maximum shadow radius)				
Note: Daylight savings time not used, times shown are eastern standard time (EST)				

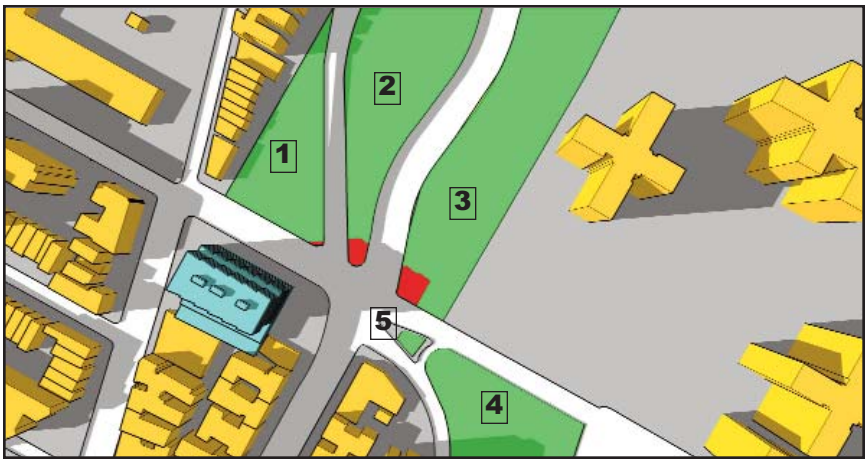
May 6/August 6

Between the equinoxes and the summer solstice, incremental shadows cast by the development resulting from the Proposed Action would reach Highbridge Park and the Harlem River Parkway, as well as the Maher Circle greenstreet, as shown in Table 4-1 and Figure 4-2b, mostly in the late afternoon hours. Incremental shadows would be cast on the western segment of Highbridge Park for a duration of approximately 1 hour and 10 minutes, from 2:50 PM to 4:00 PM. Incremental shadows would also be cast on the central portion of Highbridge Park (2:13 PM to 5:09 PM) for a duration of approximately 2 hours and 56 minutes, as well as on a small area of the eastern segment of Highbridge Park and the Harlem River Parkway (4:15 PM to 5:18 PM), for a duration of just over one hour. Incremental shadows would also be cast briefly on the Maher Circle greenstreet for a duration of approximately 12 minutes, from 5:06 PM to the end of the analysis period at 5:18 PM. No incremental shadows would be cast on any of the other resources in Table 4-1 on this analysis day.

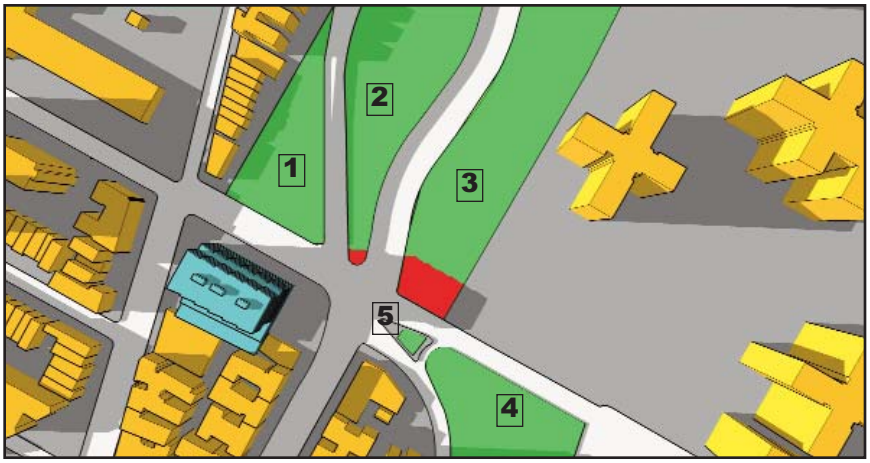
June 21

On the summer solstice, June 21, the sun is most directly overhead and shadows are shortest for most of the day. As illustrated in Figure 4-2c, incremental shadows cast by the development resulting from the Proposed Action would be cast on a very small area at the tip of the central

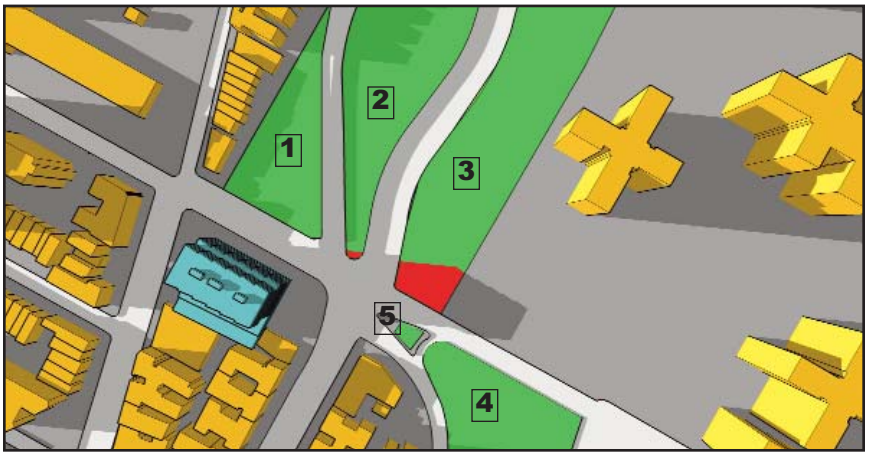
4:02 PM



4:45 PM



5:06 PM



Proposed Development

Shadow Increment from Proposed Development

1 Highbridge Park - western area

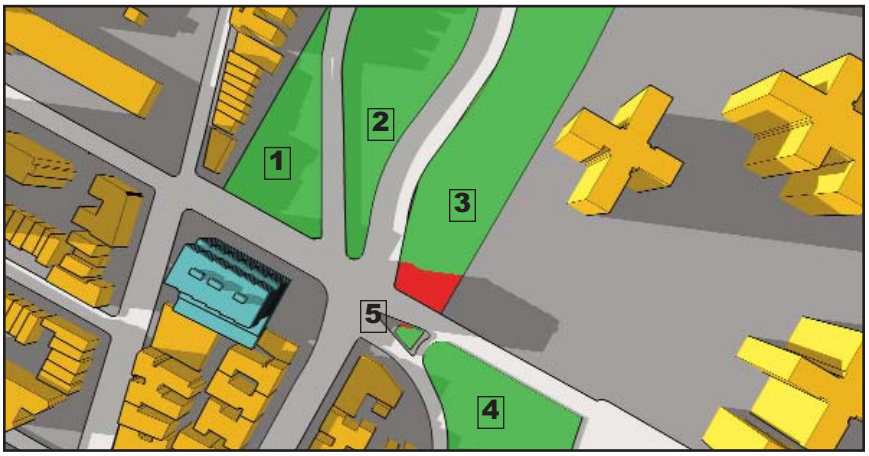
2 Highbridge Park - central area

3 Harlem River Parkway and Highbridge Park - eastern area

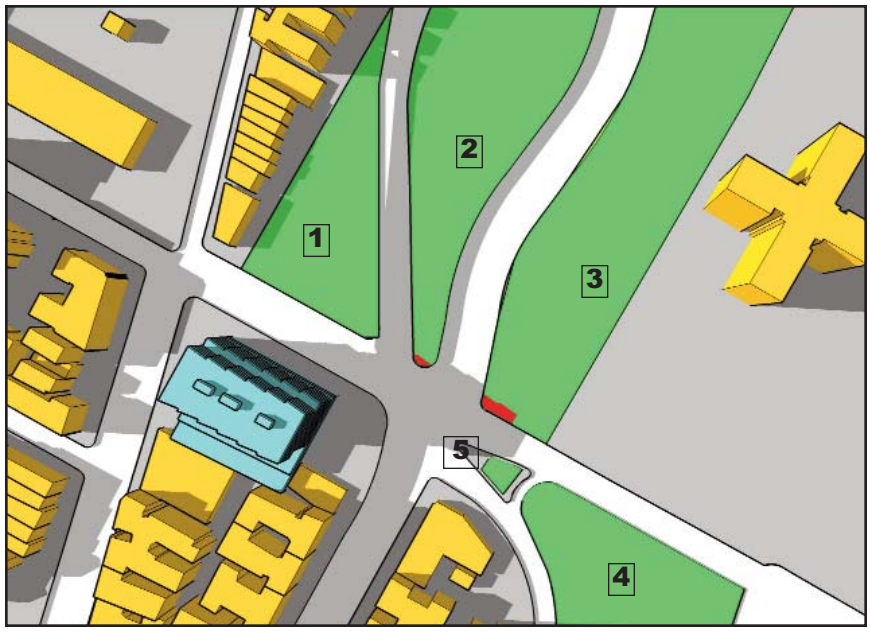
4 Jackie Robinson Park

5 Greenstreet (Maher Circle)

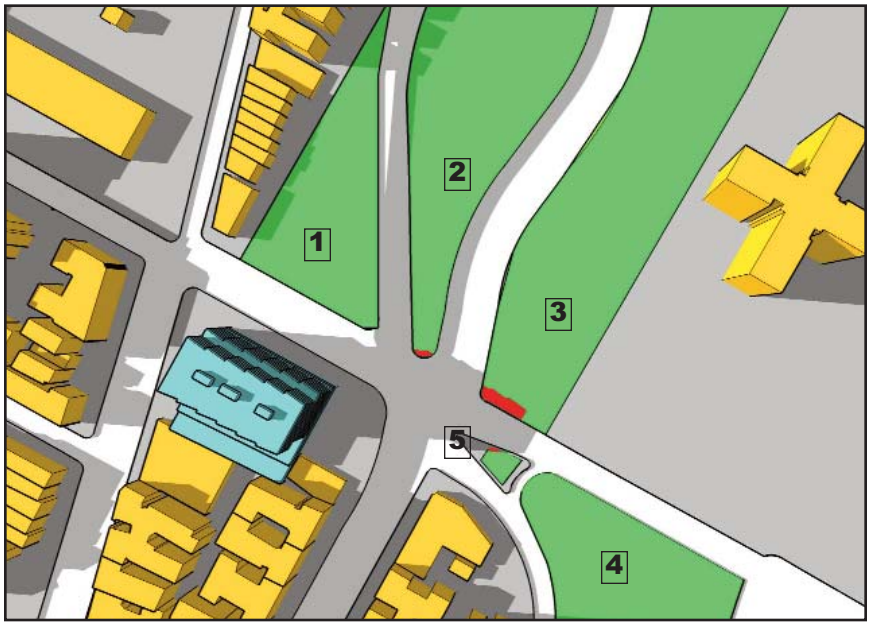
5:18 PM



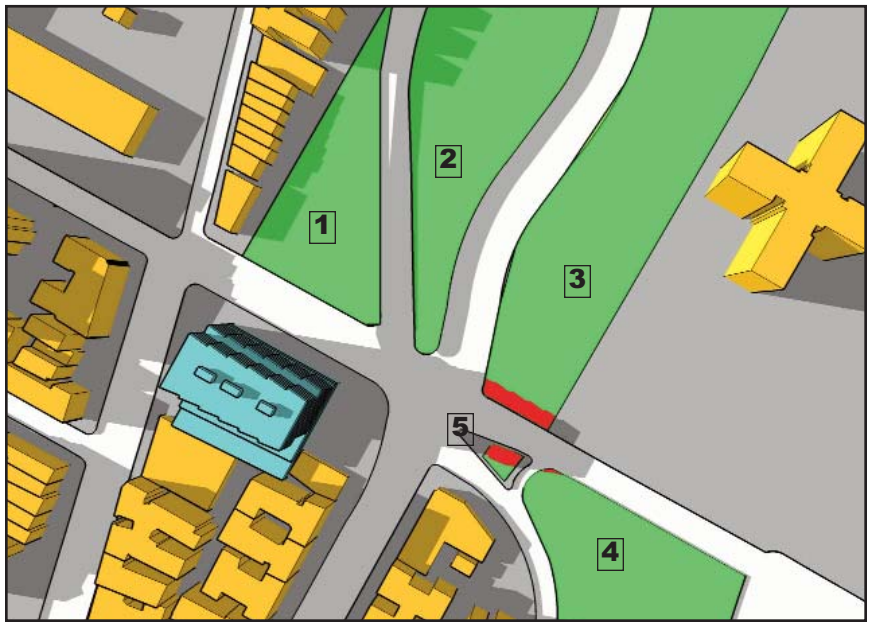
4:19 PM



4:27 PM



5:00 PM



Proposed Development

Shadow Increment from Proposed Development

1 Highbridge Park - western area

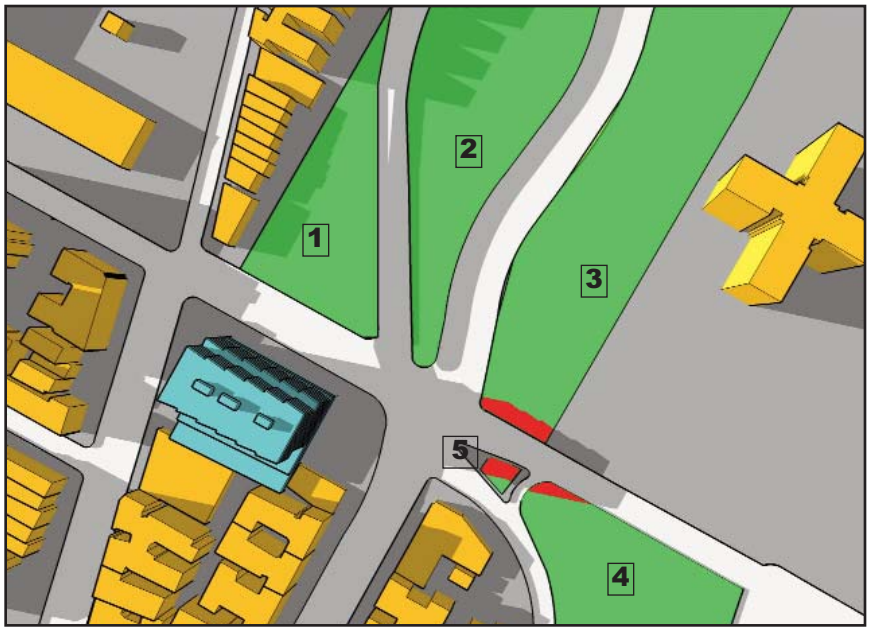
2 Highbridge Park - central area

3 Harlem River Parkway and Highbridge Park - eastern area

4 Jackie Robinson Park

5 Greenstreet (Maher Circle)

5:15 PM



5:45 PM



Proposed Development

Shadow Increment from Proposed Development

1 Highbridge Park - western area

2 Highbridge Park - central area

3 Harlem River Parkway and Highbridge Park - eastern area

4 Jackie Robinson Park

5 Greenstreet (Maher Circle)

5:56 PM



segment of Highbridge Park for a duration of approximately 27 minutes, from 4:05 PM to 4:32 PM and on a very small area along the edge of the eastern segment of Highbridge Park and the Harlem River Parkway (3:54 PM to 5:45 PM) for a duration of approximately 1 hour and 516 minutes. Incremental shadows would also be cast on part of Jackie Robinson Park (5:30 PM to 6:01 PM), for a duration of 31 minutes, as well as on the Maher Circle greenstreet for a duration of 1 hour and 37 minutes (4:19 PM to 5:56 PM). No incremental shadows would be cast on any of the other resources in Table 4-1 on this analysis day.

December 21

On the shortest day of the year (winter solstice) when the sun is low in the sky, shadows are the longest they will be all year, although they travel quickly. As shown in Table 4-1 and Figure 4-2d, incremental shadows would be cast on the western segment of Highbridge Park for a duration of approximately 5 hours and 8 minutes, from 9:45 AM to 2:53 PM. Incremental shadows would also be cast on the central portion of Highbridge Park (1:10 PM to 2:53 PM) for a duration of approximately 1 hour and 43 minutes, as well as on the eastern segment of Highbridge Park and the Harlem River Parkway (2:43 PM to 2:53 PM), for a short duration of 10 minutes. No incremental shadows would be cast on any of the other resources in Table 4-1 on this analysis day.

Assessment

According to the *CEQR Technical Manual*, trees, many plants, and many activities can require a minimum of four to six hours of sunlight, particularly between March and October (the growing season). As indicated in Table 4-1 and discussed above, the Proposed Development resulting from the Proposed Action would cast incremental shadows on several resources in one or more of the analysis periods (no incremental shadows would be cast on Orville and Wilbur Playground or the William A. Harris community garden in any of the analysis days).

Jackie Robinson Park

Given its location relative to the rezoning area, the incremental shadows resulting from the Proposed Action would reach a small area at the edge of Jackie Robinson Park only on June 21, and only for a duration of 31 minutes. As noted above, the area affected consists mostly of vegetated areas with paths and benches, and does not include any of the park's most notable recreational facilities (pool, playgrounds, etc.). As new incremental shadows cast by the Proposed Action on Jackie Robinson Park would only occur on one of the analysis days, and would last for a very short duration and cover a negligible portion of the park, there would be no noticeable reduction in the usability of this open space resource nor a reduction in the sunlight to sunlight-sensitive uses or features as a result of the Proposed Action.

Highbridge Park and Harlem River Parkway

The three segments of Highbridge Park, and the Harlem River Parkway, given their location relative to the rezoning area, would experience some incremental shadows from the Proposed Development on most or all of the analysis days.

Shadow Diagrams - December 21

1:42 PM



2:53 PM



Proposed Development

Shadow Increment from Proposed Development

1 Highbridge Park - western area

2 Highbridge Park - central area

3 Harlem River Parkway and Highbridge Park - eastern area

4 Jackie Robinson Park

5 Greenstreet (Maher Circle)

Western Area

The western segment of the park would experience incremental shadows on March 21, May 6, and December 21. Whereas incremental shadows cast in the summer would be of the shortest duration (1 hour and 10 minutes on May 6/August 6), those cast in the spring and winter months would be of longer durations, 4 hours and 16 minutes on March 21, and 5 hours and 8 minutes on December 21. As shown in Figure 4-3, the western segment of Highbridge Park consists mostly of vegetated areas, and does not contain any playgrounds or other recreational activities that may be adversely affected by a reduction in sunlight during these periods. Although the western segment of the park would experience shadows for 4 hours and 16 minutes on March 21, which falls within the plant growing season, this segment would continue to receive more than the minimum amount of sunlight required for plant growth. As illustrated in Figure 4-2a, this segment of the park receives direct sunlight from the beginning of the analysis period in the morning until at least 12:30 or 1:00 PM, when shadows from the Proposed Development begin to be cast on a small area of this segment. As such, the majority of the western segment of Highbridge Park would receive at least 5 hours of direct sunlight on this analysis day, which is more than the minimum of 4 hours required during the plant growing season.

The specific nature of the vegetation of the shadowed areas were explored by the NYC Department of Parks and Recreation (NYCDPR) between the Draft and Final Environmental Impact Statement (EIS). The NYCDPR evaluated the existing conditions of the trees and landscaped area at the southern end of the western parcel of Highbridge Park with forestry personnel and confirmed that the incremental shadows will not have a detrimental effect on the park landscape due to the following reasons: The southern portion of the western segment of Highbridge Park is comprised of London Plane trees and the Sugar Hill Luminaries Lawn, and a planted garden area at the southeastern tip. Because the garden is already cast in shade from the tree canopy, the majority of the shadows will be cast at the beginning and end of the growing season, when trees are just emerging from and entering their dormancy stage, and in the winter when trees are dormant, and because the trees are well established, it is not believed that the trees, lawn area or plantings will be adversely impacted by the incremental shadows.

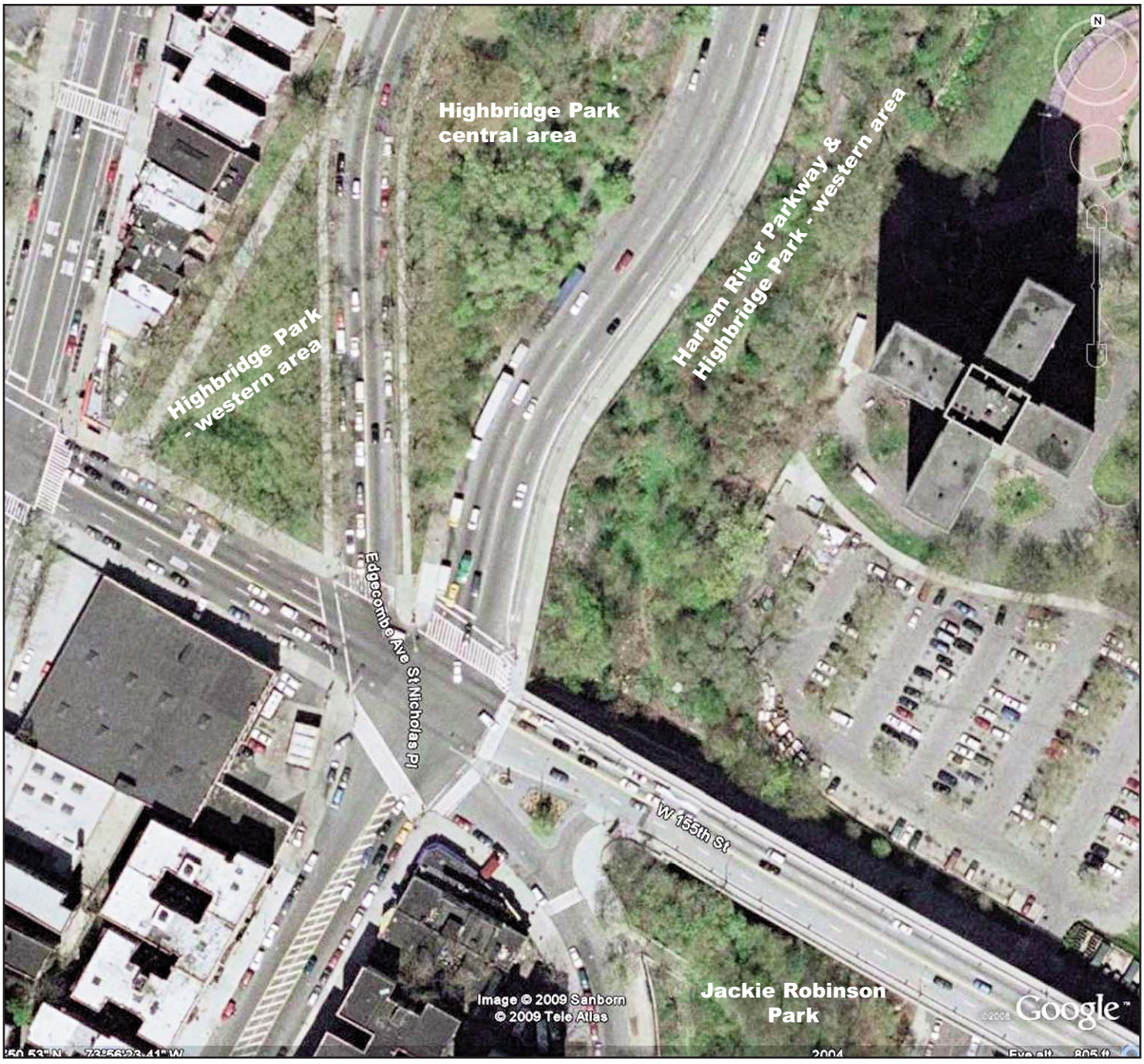
As December falls outside of the growing period between March and October, new incremental shadows cast by the Proposed Action in winter would not create significant adverse impacts on the trees and vegetation that are located in this segment of the park. Moreover, this segment of the park does not contain any benches, playgrounds or other active recreation areas that require winter sunlight. Therefore, the new incremental shadows cast by the Proposed Action on this analysis day would not adversely affect the utilization or enjoyment of this western segment, as it does not contain features that could be affected by the loss of winter sunlight.

Central Area

The central segment of Highbridge Park would experience incremental shadows on all four of the analysis days, with the longest durations experienced on March 21 and May 6 (2 hours and 36 minutes, and 2 hours and 56 minutes, respectively). Although both March 21 and May 6 fall within the plant growing season, the incremental shadows cast on those days would only be cast beginning at approximately 2:00 in the afternoon, allowing this park segment to receive more than 8 hours of sunlight before the incremental shadows enter this segment. Moreover, this central segment of Highbridge Park consists mostly of vegetated areas (refer to Figure 4-3), and does not contain any playgrounds or other recreational activities that may be adversely affected by a

Figure 4-3

Aerial Photo of Open Space Areas Affected by Incremental Shadows



reduction in sunlight during these periods. Therefore, new incremental shadows cast by the Proposed Action are not expected to create significant adverse impacts on the trees and vegetation that are located in this segment of the park, nor would they adversely affect this segment's utilization.

Eastern Area

The eastern segment of Highbridge Park and the Harlem River Parkway would also experience incremental shadows on each of the four analysis days, with durations ranging from 10 minutes on December 21 to 1 hour and 51 minutes on June 21. Although March 21, May 6 and June 21 fall within the plant growing season, the incremental shadows cast on those days would only be cast beginning in the late afternoon (at 3:10 PM on March 21, 4:15 PM on May 6, and 3:54 on June 21), allowing this park segment to receive approximately 8 to 10 hours of sunlight on each day before the incremental shadows enter this park segment. Moreover, as shown in Figure 4-3, the eastern segment of Highbridge Park consists mostly of vegetated areas, and does not contain any playgrounds or other recreational activities that may be adversely affected by a reduction in sunlight during these periods, whereas the Harlem River Parkway is essentially a bikeway that likewise not be adversely affected by a reduction in sunlight during these periods. Therefore, new incremental shadows cast by the Proposed Action are not expected to create significant adverse impacts on the trees and vegetation that are located in the eastern segment of Highbridge Park or the Harlem River Parkway, nor would they adversely affect their utilization.

Greenstreet – Maher Circle

Given its location relative to the rezoning area, the incremental shadows resulting from the Proposed Action would reach a portion of the Maher Circle greenstreet only on May 6 (12 minutes) and June 21 (1 hour and 37 minutes). As noted above, Maher Circle is a traffic island containing the Hooper Fountain, and is mostly paved except for a small fenced planted area, with one tree. The Circle does not include any benches nor does it host any recreational activity. The incremental shadows cast on May 6 and June 21 would only be cast beginning in the late afternoon, at the end of the analysis period, and therefore the planted area is expected to receive more than the minimum of 4 to 6 hours of sunlight required for plant growth. Therefore, new incremental shadows cast by the Proposed Action would not create significant adverse impacts on the Maher Circle greenstreet.

D. CONCLUSION

As detailed above, in many instances, the incremental shadows cast by Proposed Development resulting from the Proposed Action would not create a significant adverse shadow impact on the sunlight-sensitive resources in the study area. All of the affected open space resources assessed above are expected to receive more than the minimum of four to six hours of sunlight required during the growing season. The incremental shadows cast would not result in a substantial reduction in sunlight at any of the identified open space resources, would not result in a reduction in sunlight such that it would adversely impact the usability of any of these open spaces over the course of a day, nor would it adversely impact vegetation. The NYCDPR evaluated the existing conditions of the trees and landscaped area at the southern end of the western parcel of Highbridge

Park with forestry personnel and confirmed that the incremental shadows will not have a detrimental effect on the park landscape, as the majority of the shadows will be cast at the beginning and end of the growing season, when trees are just emerging from and entering their dormancy stage, and in the winter when trees are dormant, and because the trees are well established.