Chapter 7: Shadows

A. INTRODUCTION

This chapter examines the potential for the proposed actions with regard to Block 675 and the Special Hudson River Park District to result in new shadows on nearby publicly accessible open spaces or other sunlight-sensitive resources. According to the 2014 *City Environmental Quality Review (CEQR) Technical Manual*, sunlight-sensitive resources of concern include public open spaces, sunlight-dependent features of historic architectural resources, and natural resources that depend on sunlight. As such, this chapter is linked to the analyses presented in Chapter 6, "Open Space" and Chapter 8, "Historic Resources."

Under *CEQR Technical Manual* guidelines, a shadows assessment is required if a proposed project would result in structures 50 feet or greater in incremental height, or of any height if the project site is located adjacent to, or across the street from, a sunlight-sensitive resource. As described in Chapter 1, "Project Description," and Chapter 2, "Analytical Framework," in the future with the proposed actions (the With Action condition), the Project Area would be redeveloped with two new mixed-use buildings on two project sites. The two project sites and Lot 38 would be rezoned and included in the Special Hudson River Park District. Overall, it is assumed that the Project Area would contain residential apartments, retail, accessory parking, and a public facility (potentially a Fire Department of the City of New York-Emergency Medical Service [FDNY-EMS] Station). As described in Chapter 2, "Analytical Framework," Applicant B has designed and intends to build a 36-story building (approximately 529 foot tall including mechanicals); however, since floor area from Lot 38 could be utilized, it is being studied as part of the project site B development for purposes of a conservative shadow analysis. Therefore, for analysis purposes, it is assumed that project site B would include an approximately 41-story building (approximately 534 feet tall plus approximately 45 feet for the building's mechanical bulkhead).

PRINCIPAL CONCLUSIONS

The analysis shows that the proposed actions would result in significant adverse shadow impacts to vegetation on portions of the High Line in the spring and fall. At these times, project-generated shadow would fall on certain portions of the High Line north of the Project Area and would receive less than the four to six hour minimum of direct sunlight in part due to the proposed buildings' shadows, potentially affecting the health of the sunlight-sensitive vegetation at that location.

Other sunlight-sensitive resources would receive project-generated shadow in one or more seasons but in those cases the limited extent and duration of the project-generated shadows would not cause significant adverse impacts.

B. DEFINITIONS AND METHODOLOGY

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

DEFINITIONS

Incremental shadow is the additional, or new, shadow resulting from a proposed project 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); and
- *Private open space* (e.g., front and back yards, stoops, vacant lots, and any private, non-publicly accessible open space).

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 projects and the surrounding street layout (see **Figure 7-1**). In coordination with the open space and historic and cultural resources assessments presented in other chapters 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 buildings 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.

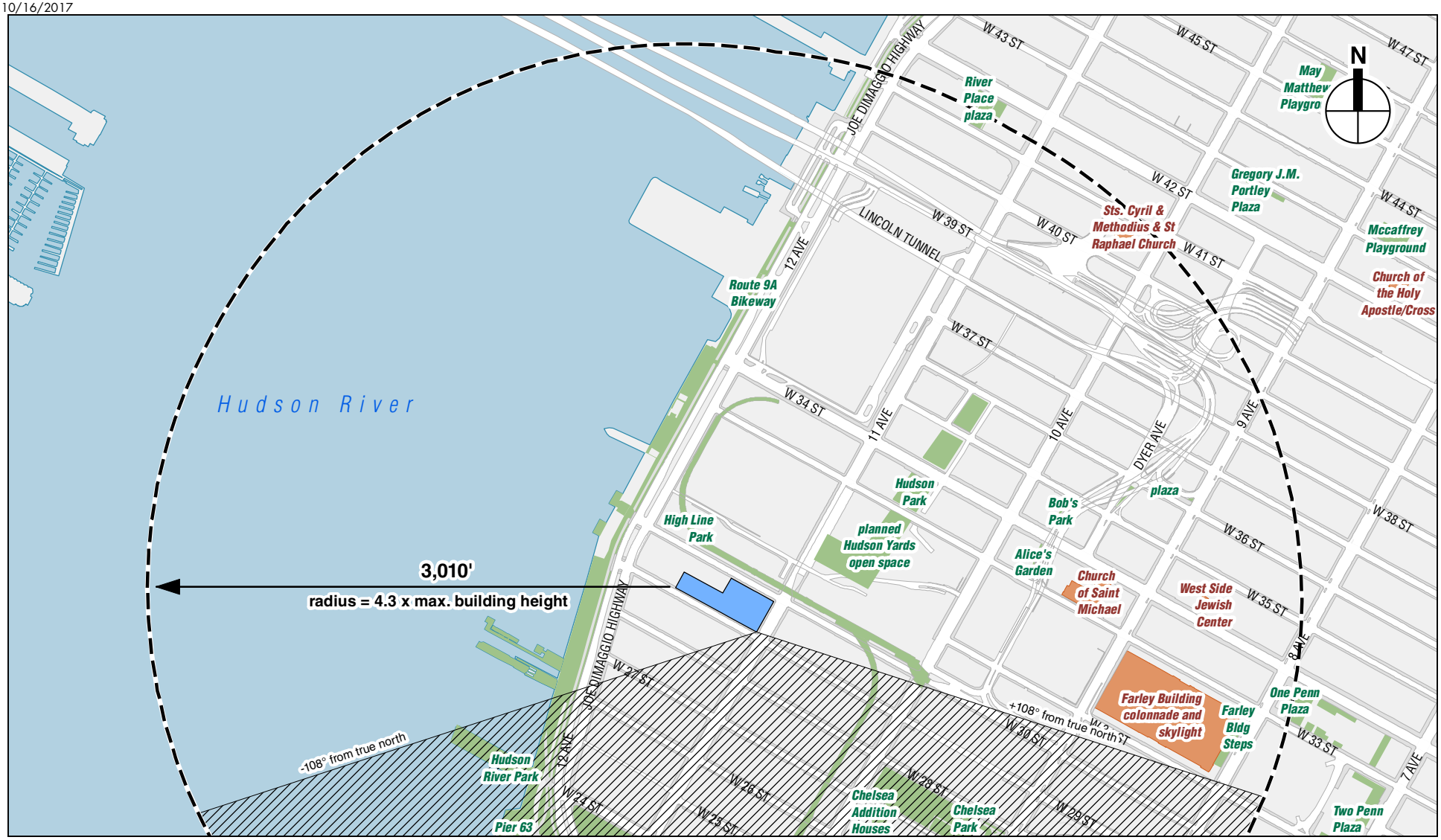
Therefore, at a maximum height of 700 feet above curb level for project site A, including rooftop mechanical structures, the proposed actions could result in a shadow up to 3,010 feet in length (700 x 4.3). Using this length as the radius, a perimeter was drawn around the Project Area (see **Figure 7-1**). A number of sun-sensitive resources are within the perimeter or longest shadow study area, and therefore the next tier of screening assessment was conducted.

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 7-1** illustrates this triangular area south of the Project Area. The complementary area to the north within the longest shadow study area represents the remaining area that could potentially experience new project generated shadow. A number of sun-sensitive resources lay within the remaining shadow study area, and therefore the assessment proceeded to the next tier.

[1] Software: Esri ArcGIS 10.3; Data: New York City Department of Information Technology and Telecommunications (DoITT) and other City agencies, and AKRF site visits.

10/16/2017



Project Area

Tier 1: Longest shadow study area boundary

Tier 2: Area south of site that could never be shaded by proposed buildings

Publicly-Accessible Open Space

Historic Resources with Sunlight-Sensitive Features

0 1,000 FEET

BLOCK 675 EAST

Tier 1 and Tier 2 Assessments

Figure 7-1

TIER 3 SCREENING ASSESSMENT

The direction and length of shadows vary throughout the course of the day and also differ depending on the season. In order to determine whether project-generated shadow could fall on a sunlight-sensitive resource, three-dimensional computer modeling software[2] is used in the Tier 3 assessment to calculate and display a 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 of the study area, and a reasonable worst-case three-dimensional representation of the proposed projects.

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

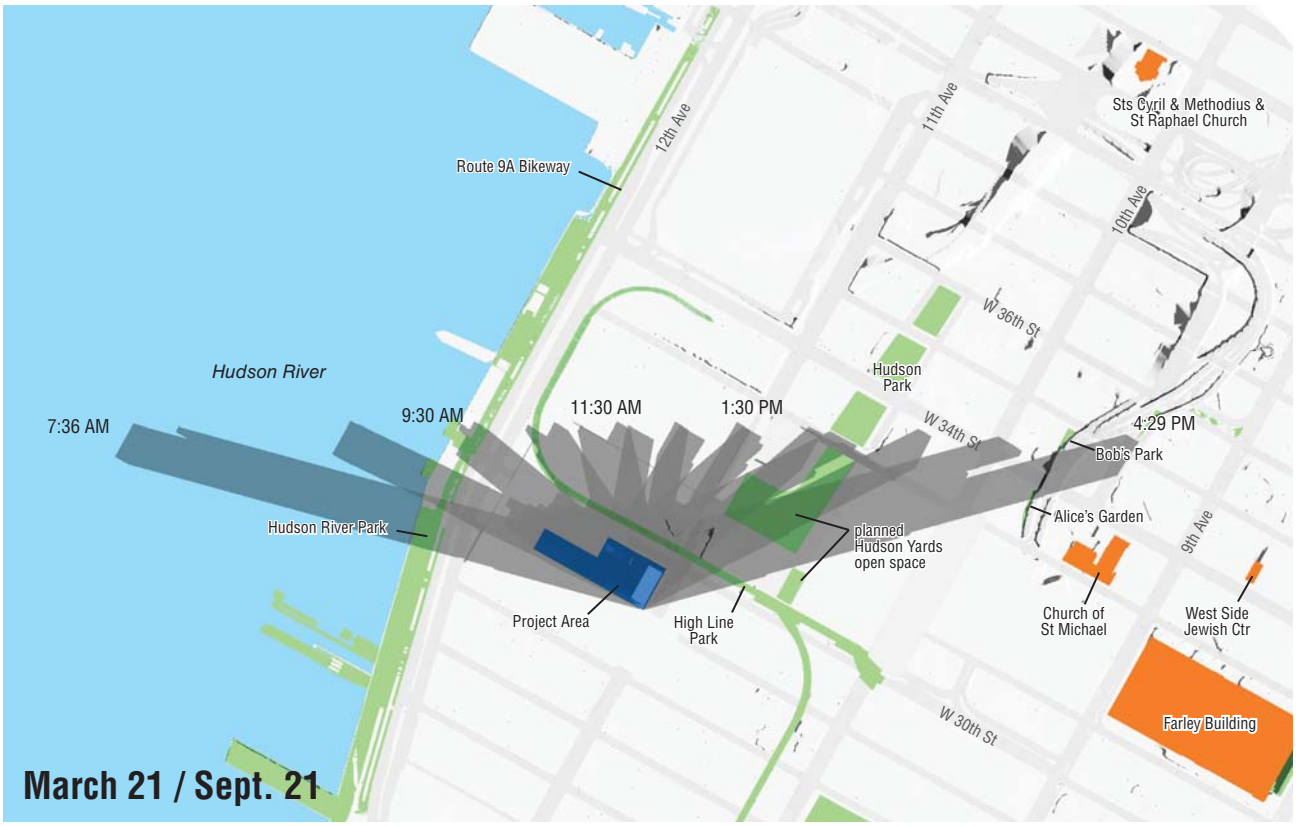
Figures 7-2 and 7-3 illustrate the range of shadows that would occur (in the absence of existing intervening buildings) from the proposed actions on the four representative days for analysis. As they move east and clockwise over the landscape, the shadows are shown occurring approximately every 60 minutes 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).

The Tier 3 assessment showed that project-generated shadow could potentially reach portions of three publicly accessible open space resources on all four representative analysis days: the High Line Park, Hudson River Park, and the planned Hudson Yards open space (on the Eastern Rail Yard site currently under construction). Further, project-generated shadow could also potentially reach portions of the Hudson River on all four analysis days.

Project-generated shadow would not reach any other sunlight-sensitive resources of concern on the December 21 analysis day besides the four resources mentioned above (see **Figure 7-2**). On the March 21/September 21 analysis day project-generated shadow could pass across the southern portion of the section of Hudson Park between West 33rd and 34th Streets, and could

[2] Bentley MicroStation





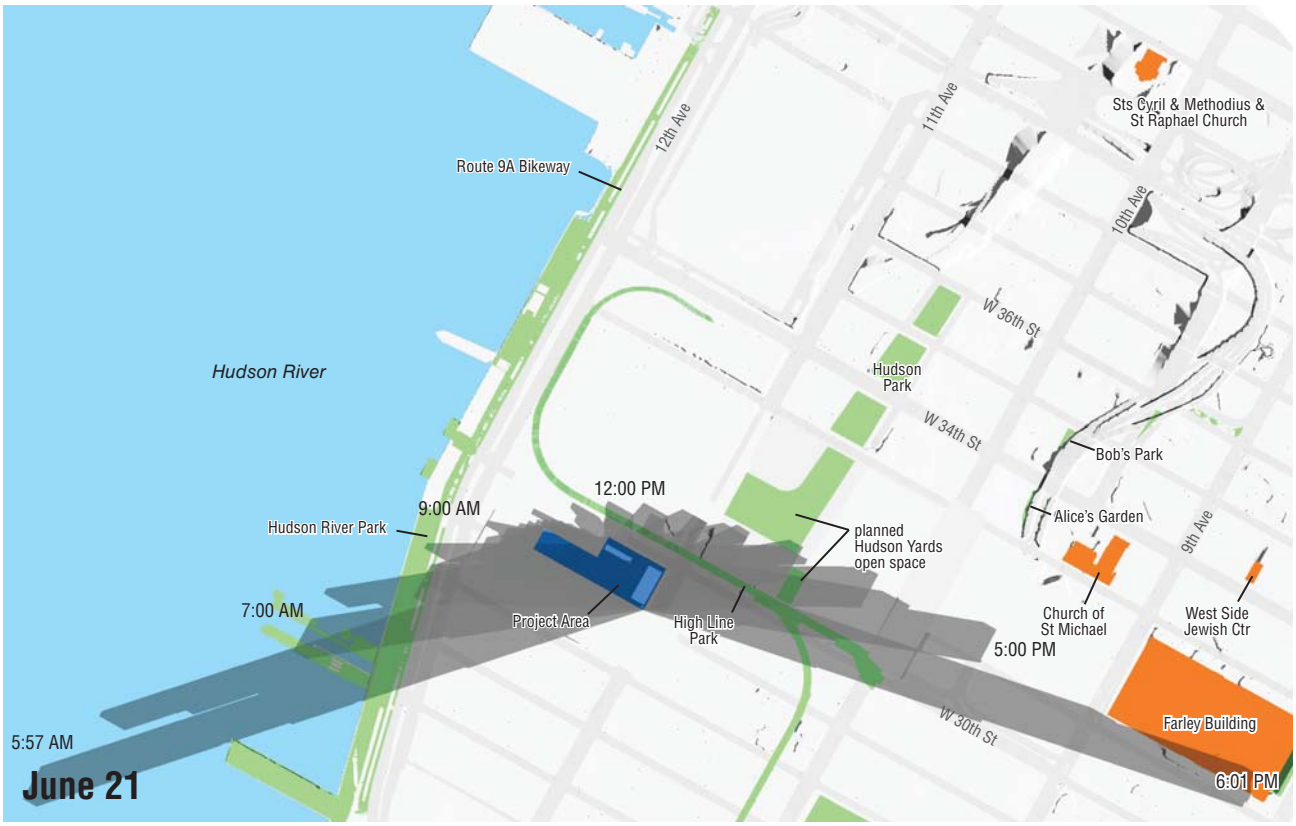
This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed buildings on the winter solstice and spring and fall equinox analysis days. The shadows are shown occurring approximately every 60 minutes from the start of the analysis day (one and a half 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.

Project Area *Shadow*
Publicly-accessible open space
Historic resources of concern

Tier 3 Assessment

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This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed buildings on the summer solstice and the May 6 / August 6 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.

Project Area *Shadow*

Publicly-accessible open space

Historic resources of concern

Tier 3 Assessment

also potentially reach Bob's Park and Alice's Garden, two small open spaces, at the end of the analysis day (see **Figure 7-2**).

As shown on **Figure 7-3** project-generated shadow would not be long enough to reach any other sunlight-sensitive resources on either the May 6/August 6 analysis day or the June 21 analysis day, beyond the four mentioned above (portions of the Hudson River, Hudson River Park and the Route 9A Bikeway, the High Line Park, and the future Hudson Yards open space). Near the end of both the May 6/August 6 and June 21 analysis days project generated shadow would be long enough to pass across a portion of the Farley Building, a historic building, but would not reach any of its sunlight-sensitive features, which include the skylight in the center of the roof, the colonnade on the 8th Avenue façade, and the steps on the 8th Avenue façade.

The Tier 3 assessment concluded that a more detailed analysis was required to determine the extent and duration of project-generated shadow on the Hudson River, Hudson River Park and the Route 9A Bikeway, the High Line Park, the planned Hudson Yards open space, Hudson Park between West 33rd and 34th Streets, Bob's Park, and Alice's Garden.

D. DETAILED 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 proposed projects, and to assess their 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 With Action condition with the proposed projects and their shadows can then be compared to the baseline condition to determine the incremental shadows that would result with the proposed projects.

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) and photos taken during visits to the project sites, and were added to the three-dimensional model used in the Tier 3 assessment. Future planned developments expected to be complete by 2022 were researched and added to the 3D model using best available data (see Chapter 2, "Analytical Framework").

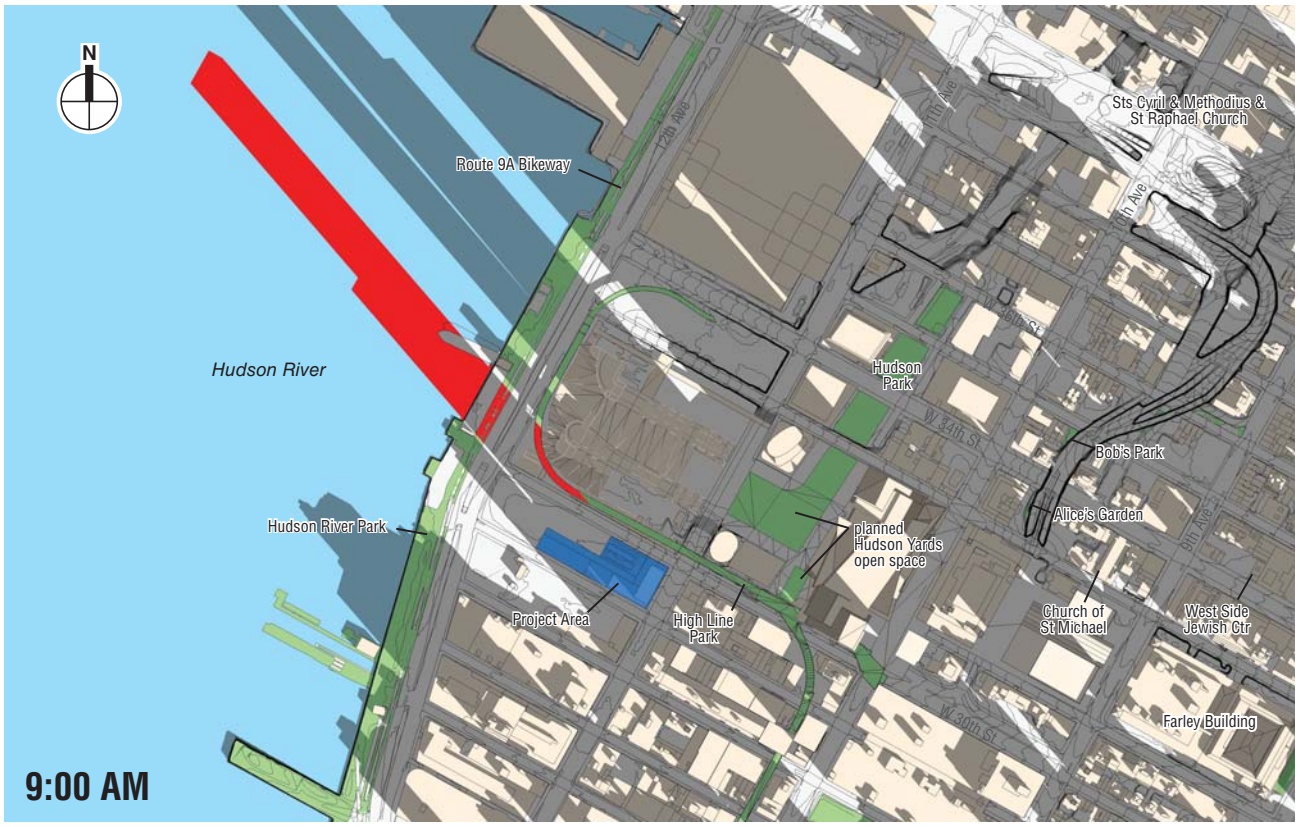
Shadows are in constant movement. The computer simulation software produces an animation showing the movement of shadows over the course of each analysis period. The analysis determines the time when incremental shadow would enter each resource, and the time it would exit.

Following the analysis framework described in Chapter 2, "Analytical Framework," the shadows assessment was performed for the analysis year of 2022, comparing the proposed developments with the future No Action condition in which the Project Area is assumed to remain as in the existing condition.

DETAILED ANALYSIS RESULTS

Table 7-1 summarizes the entry and exit times and total duration of incremental shadows on each affected sun-sensitive resource. **Figures 7-4 to 7-16** 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 also show existing shadow

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Project Area

Publicly-accessible open space

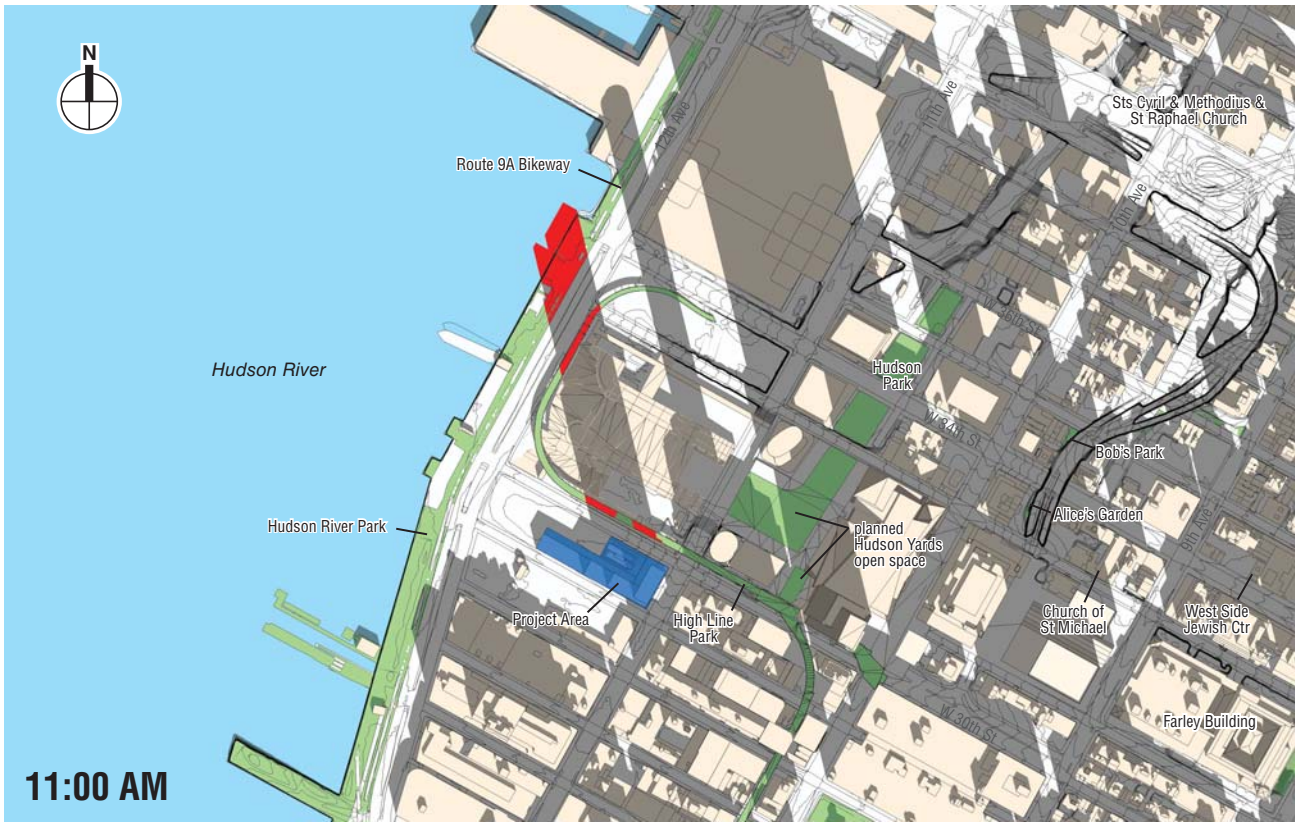
Incremental shadow on sun-sensitive resource

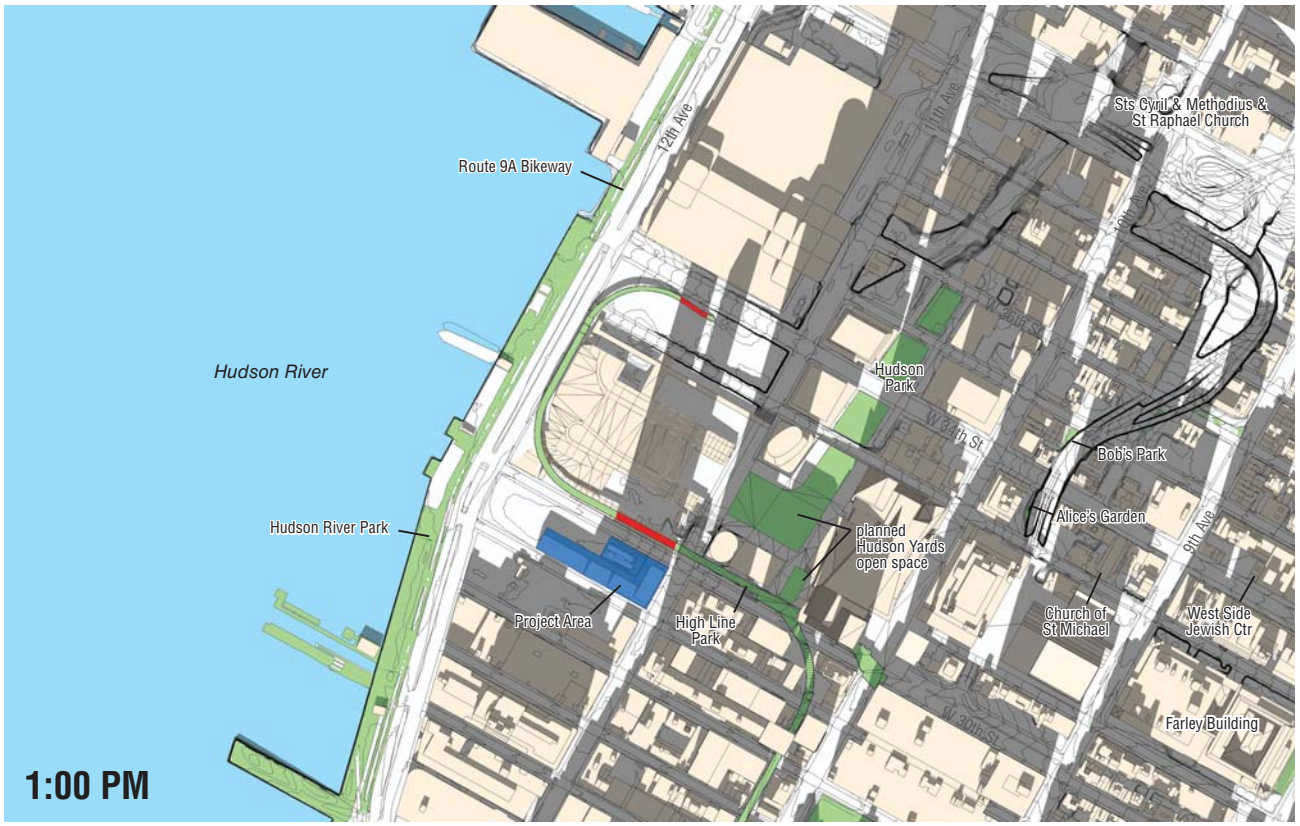
December 21

BLOCK 675 EAST

Figure 7-4

10.16.17





Project Area

Publicly-accessible open space

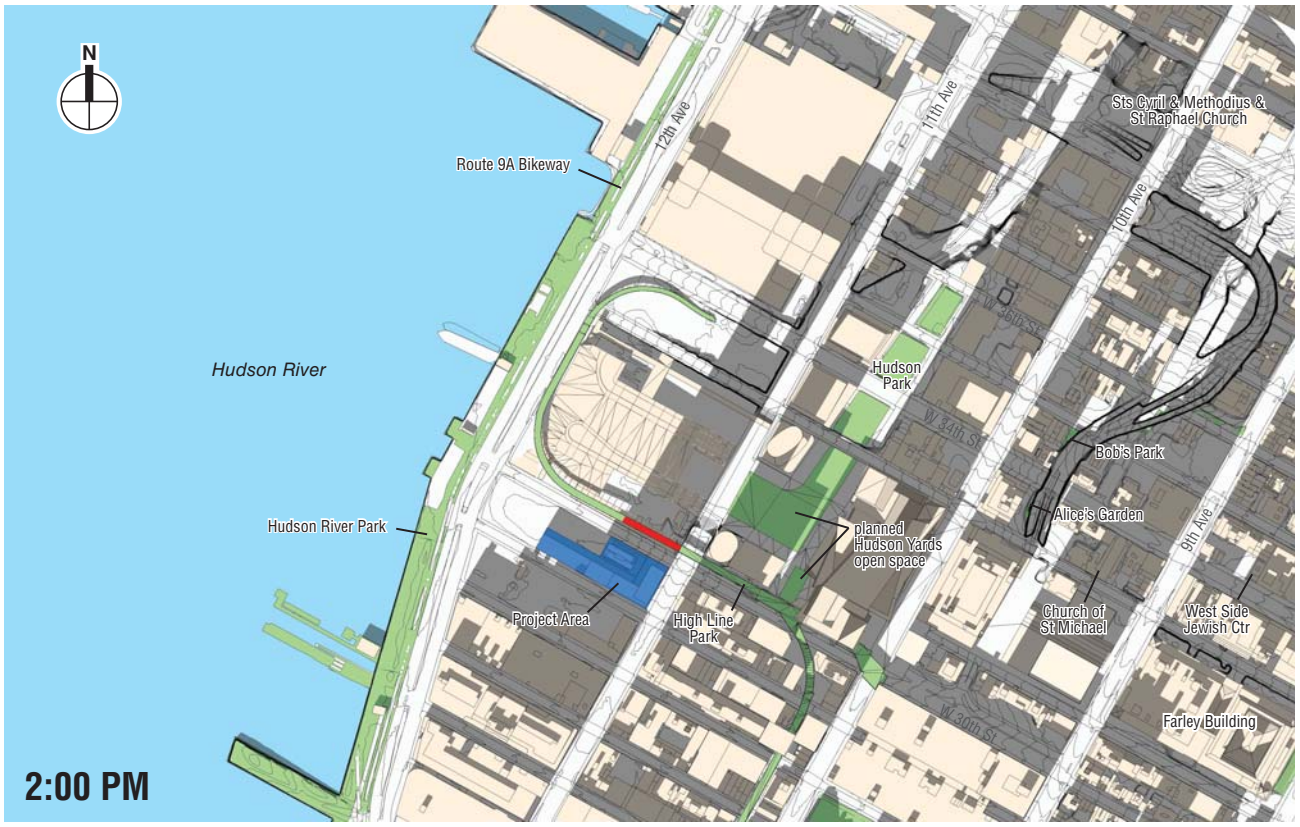
Incremental shadow on sun-sensitive resource

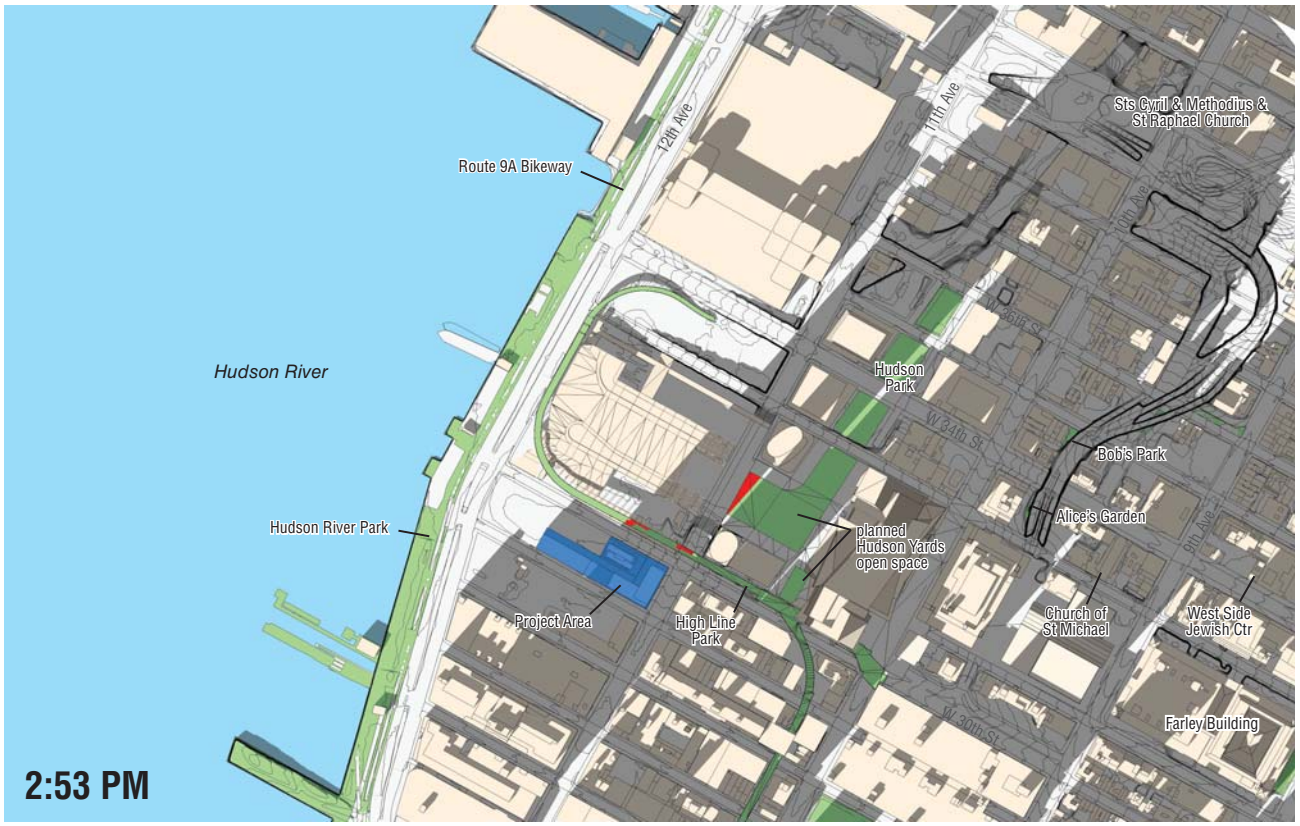
December 21

BLOCK 675 EAST

Figure 7-5

10.16.17





Project Area

Publicly-accessible open space

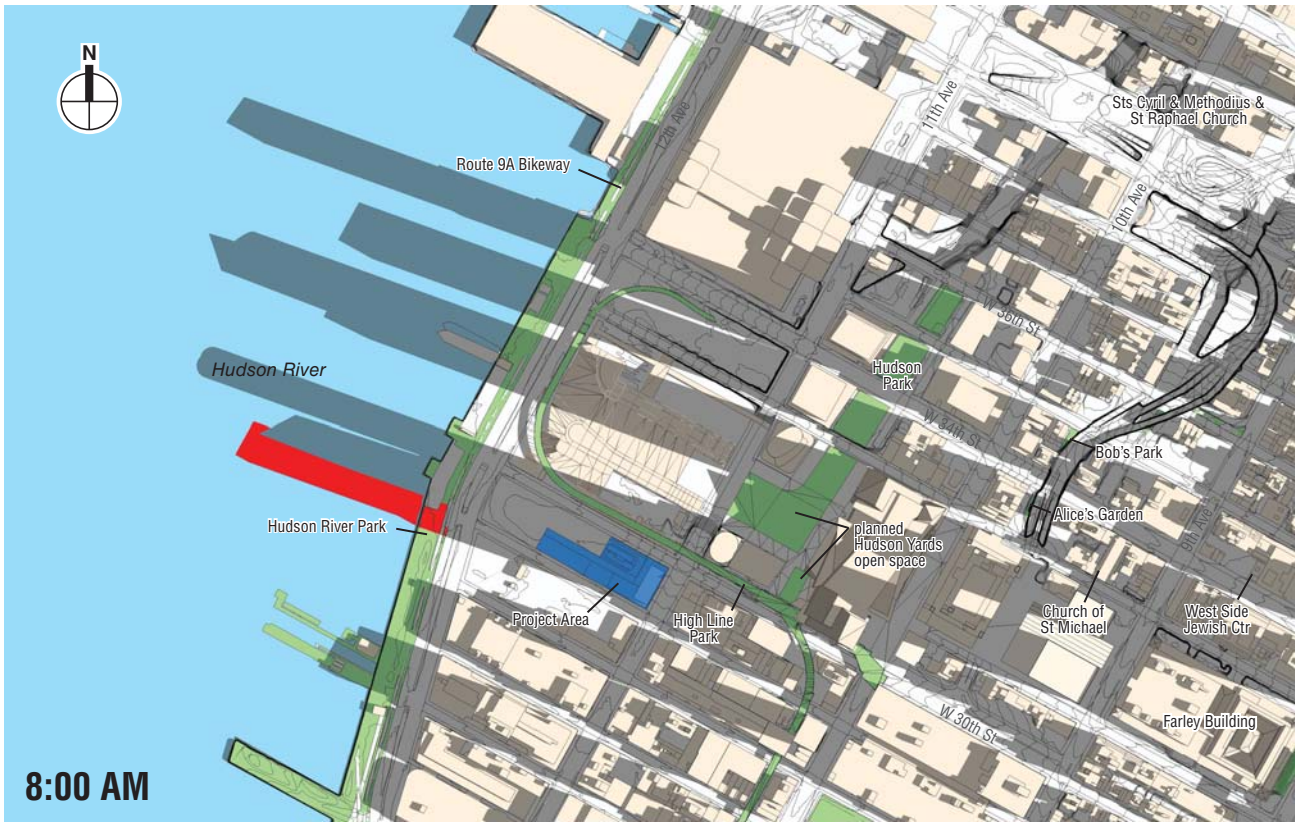
Incremental shadow on sun-sensitive resource

December 21

BLOCK 675 EAST

Figure 7-6

10.16.17





Project Area

Publicly-accessible open space

Incremental shadow on sun-sensitive resource

March 21 / Sept. 21

BLOCK 675 EAST

Figure 7-7

10.16.17





Project Area

Publicly-accessible open space

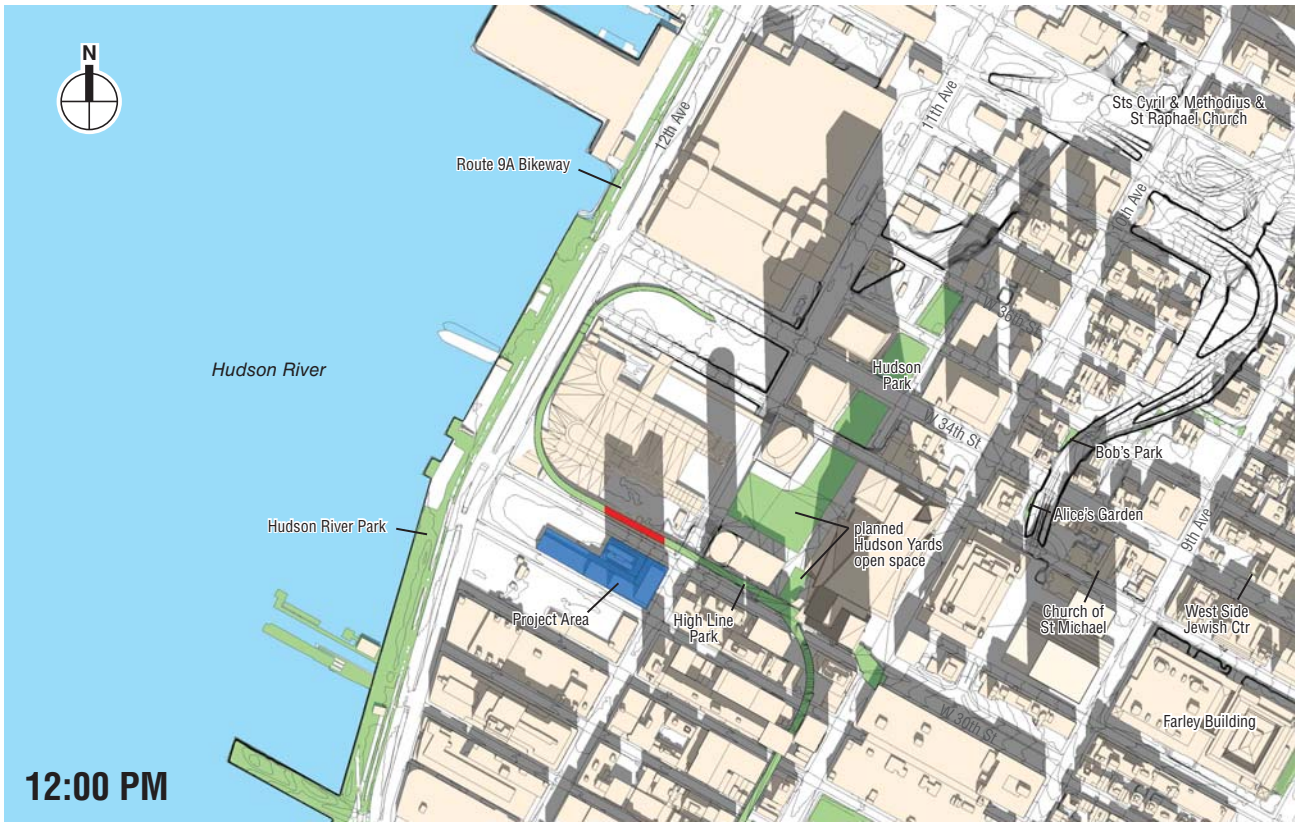
Incremental shadow on sun-sensitive resource

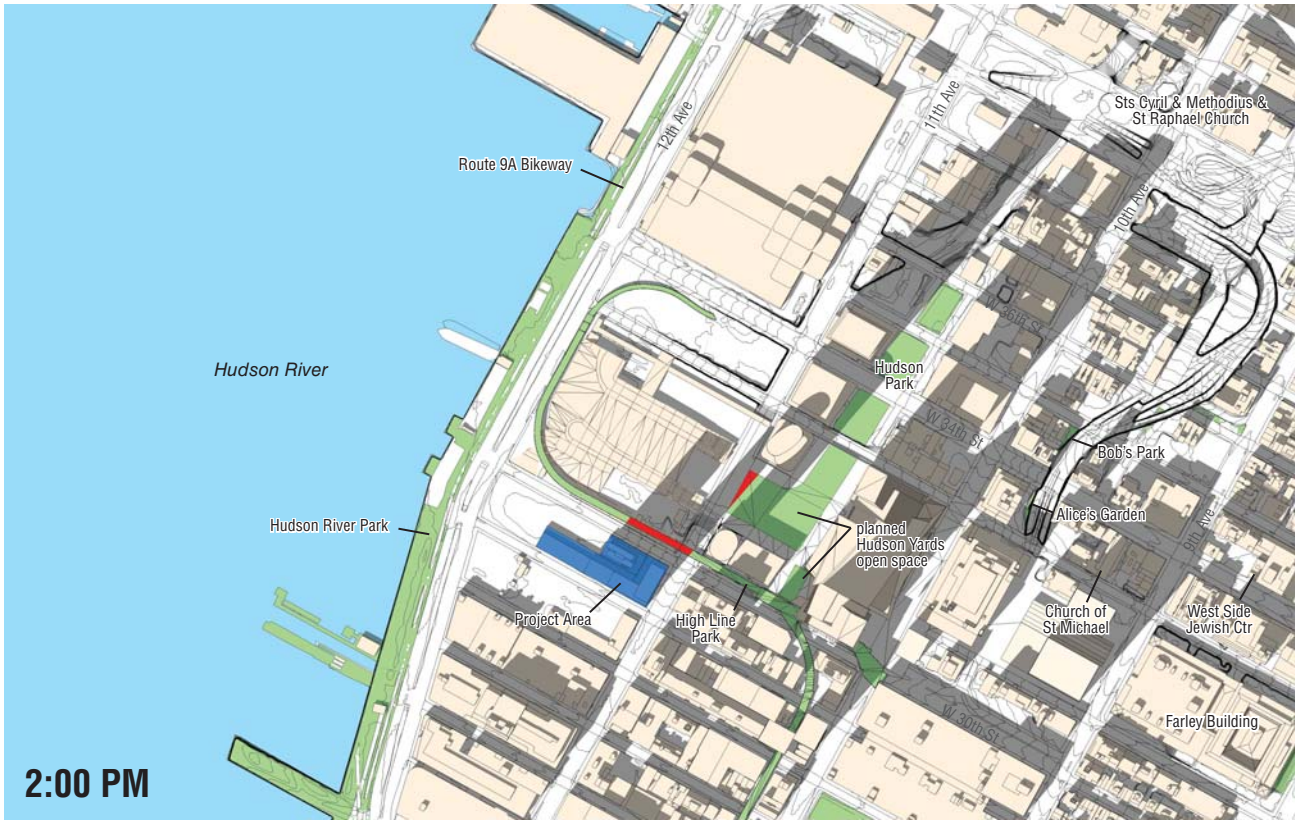
March 21 / Sept. 21

BLOCK 675 EAST

Figure 7-8

10.16.17





Project Area

Publicly-accessible open space

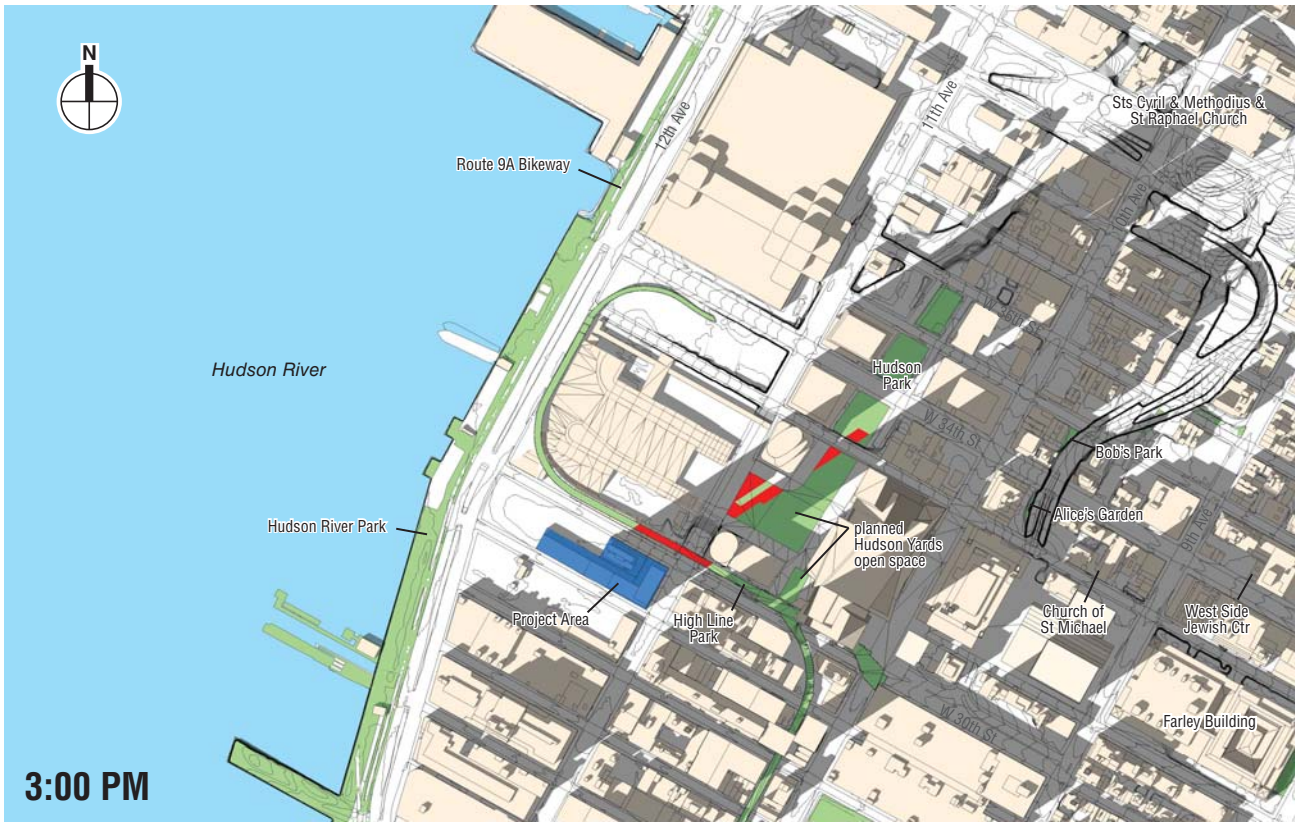
Incremental shadow on sun-sensitive resource

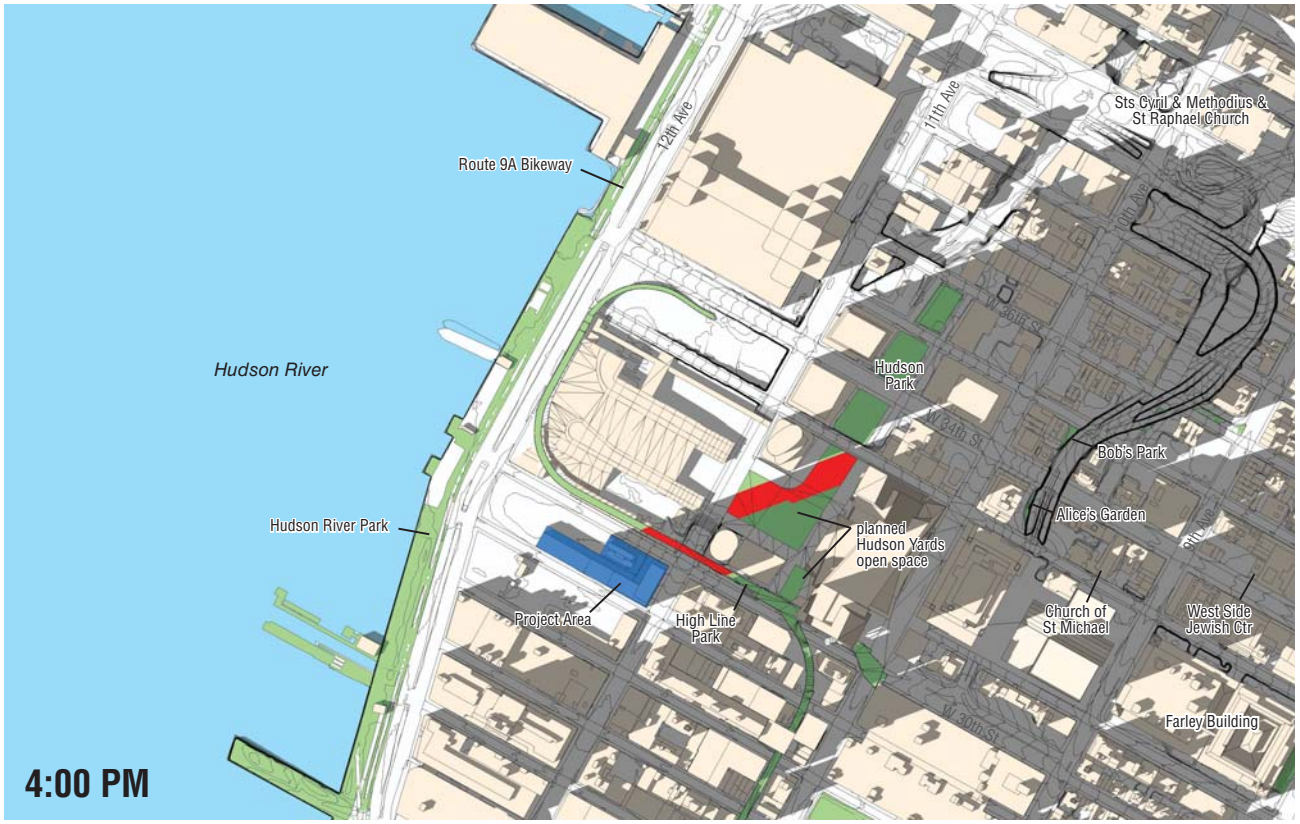
March 21 / Sept. 21

BLOCK 675 EAST

Figure 7-9

10.16.17





Project Area

Publicly-accessible open space

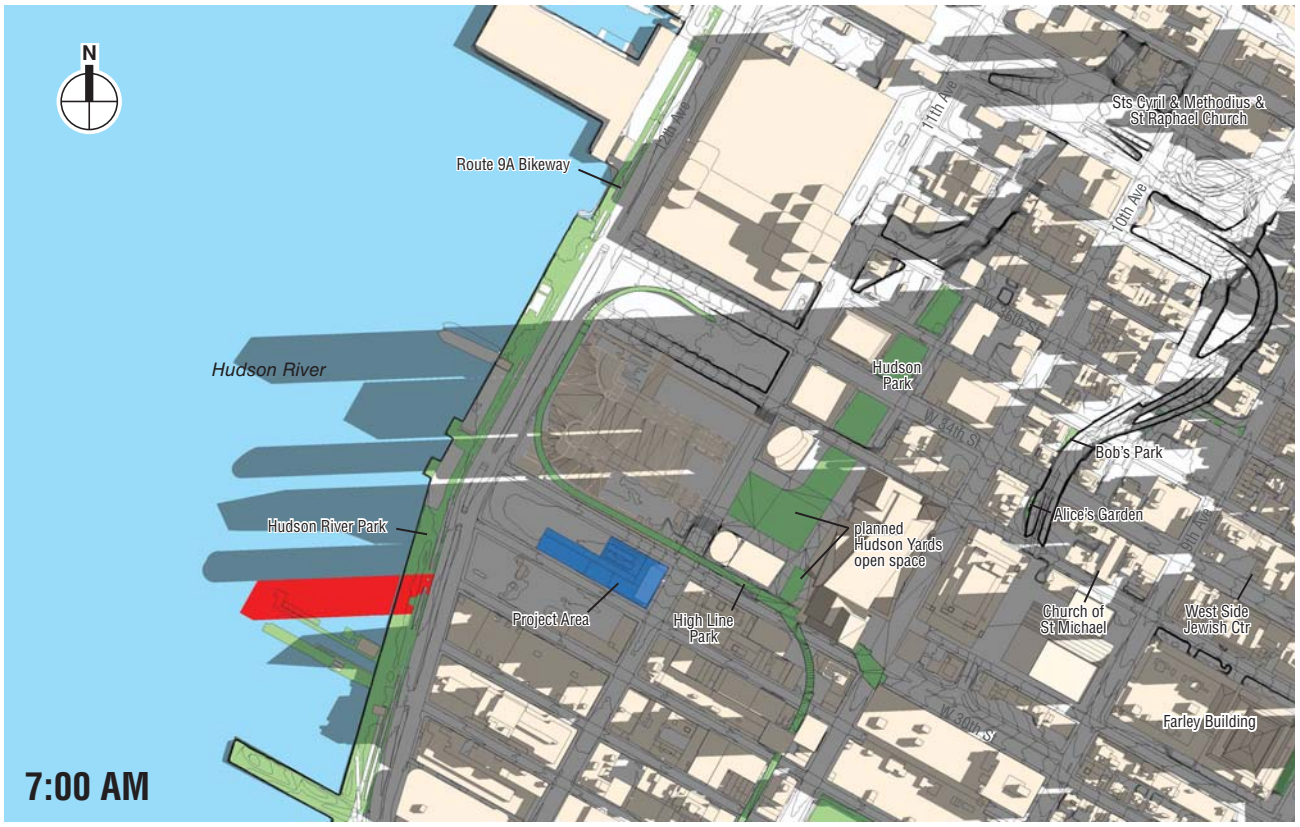
Incremental shadow on sun-sensitive resource

March 21 / Sept. 21

BLOCK 675 EAST

Figure 7-10

10.16.17





Project Area

Publicly-accessible open space

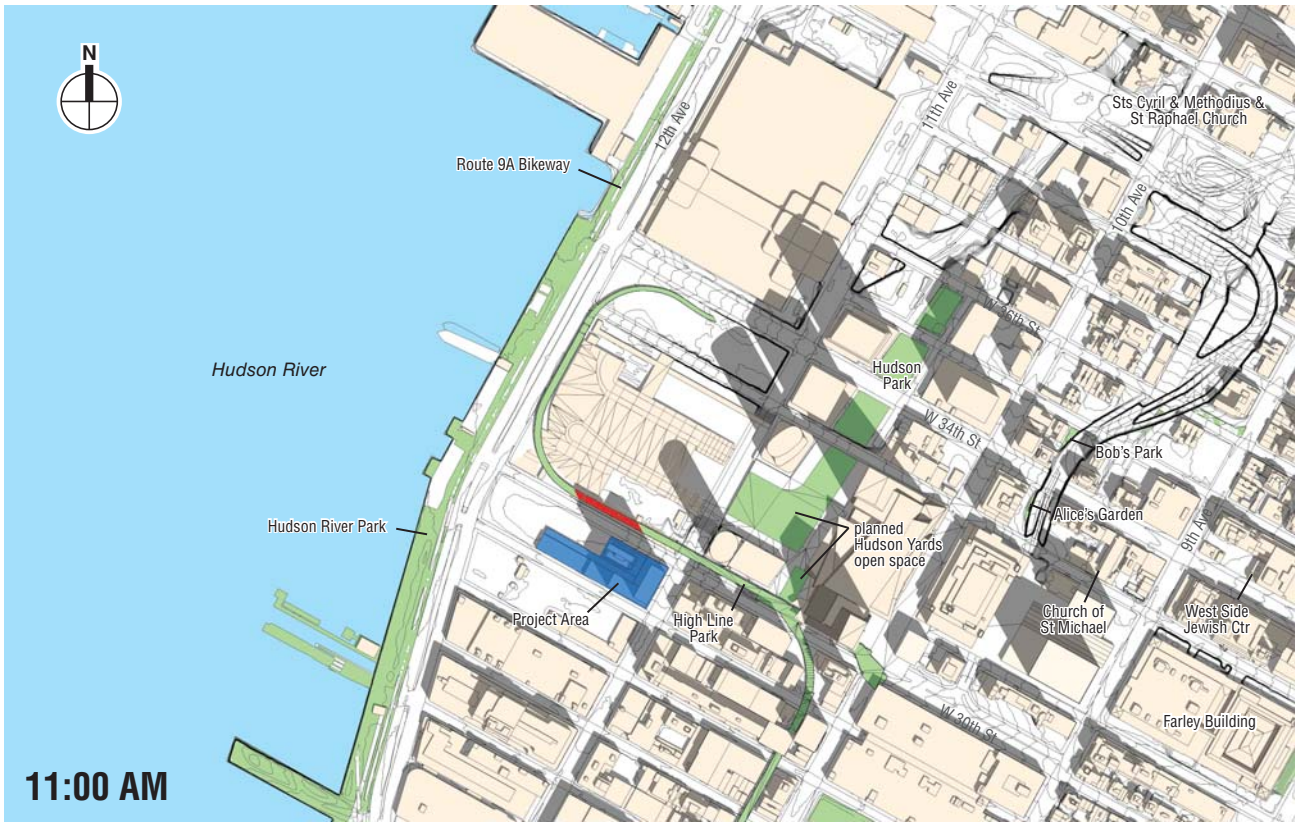
Incremental shadow on sun-sensitive resource

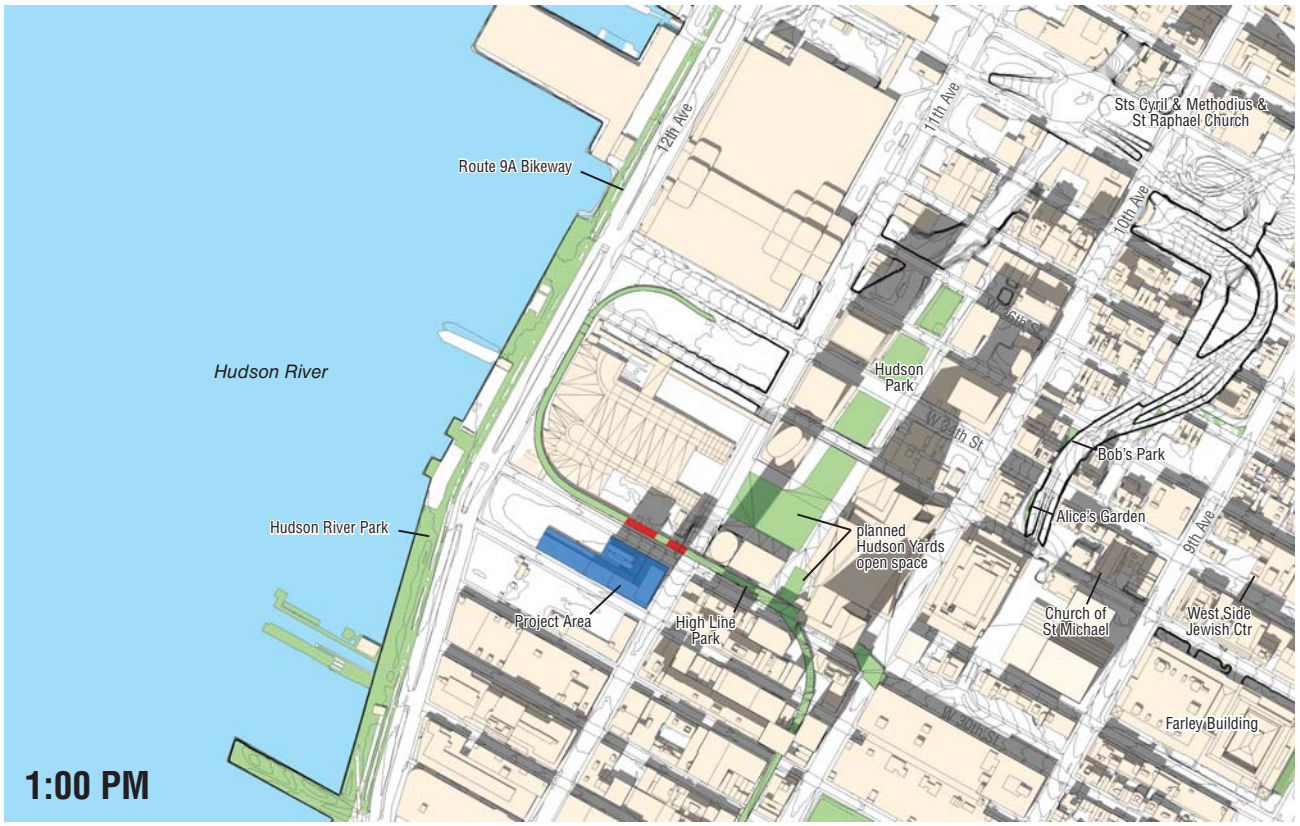
May 6 / August 6

BLOCK 675 EAST

Figure 7-11

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Project Area

Publicly-accessible open space

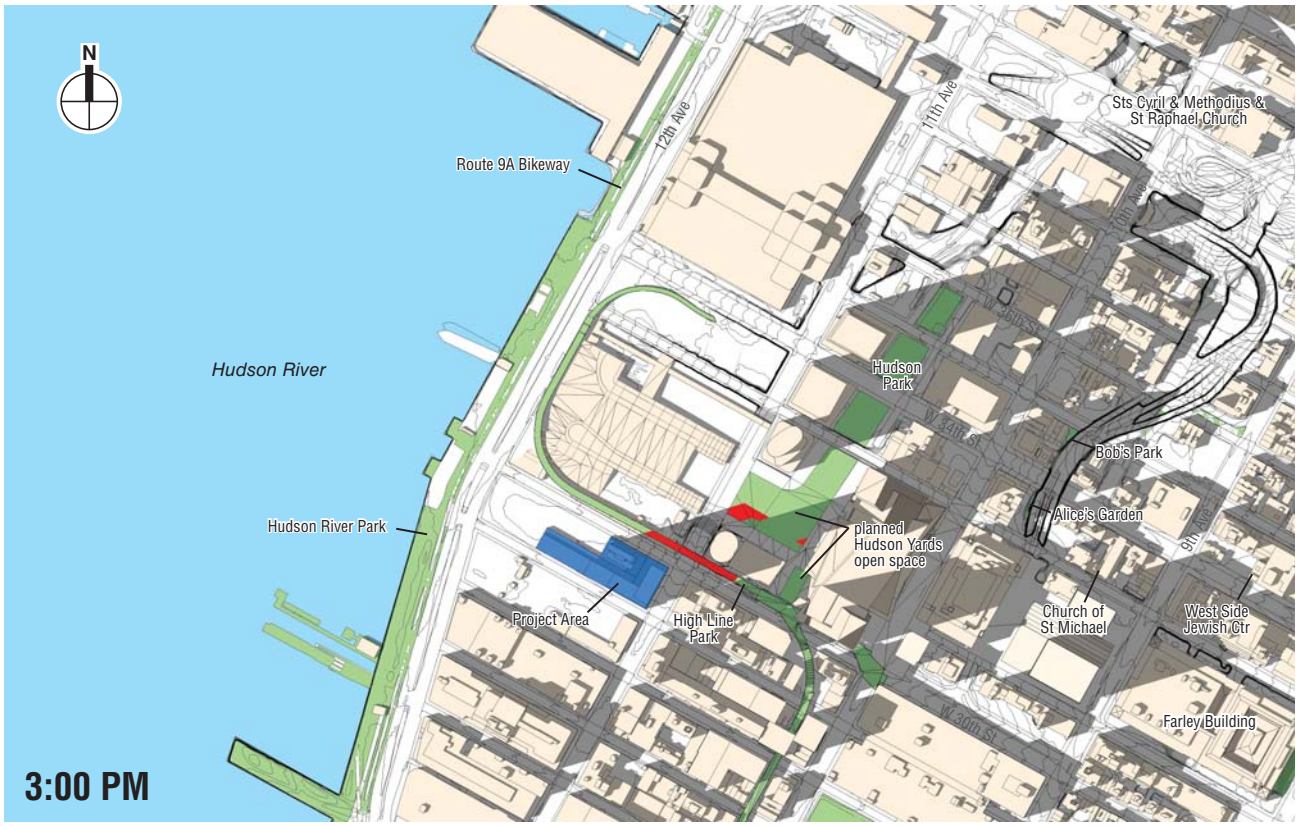
Incremental shadow on sun-sensitive resource

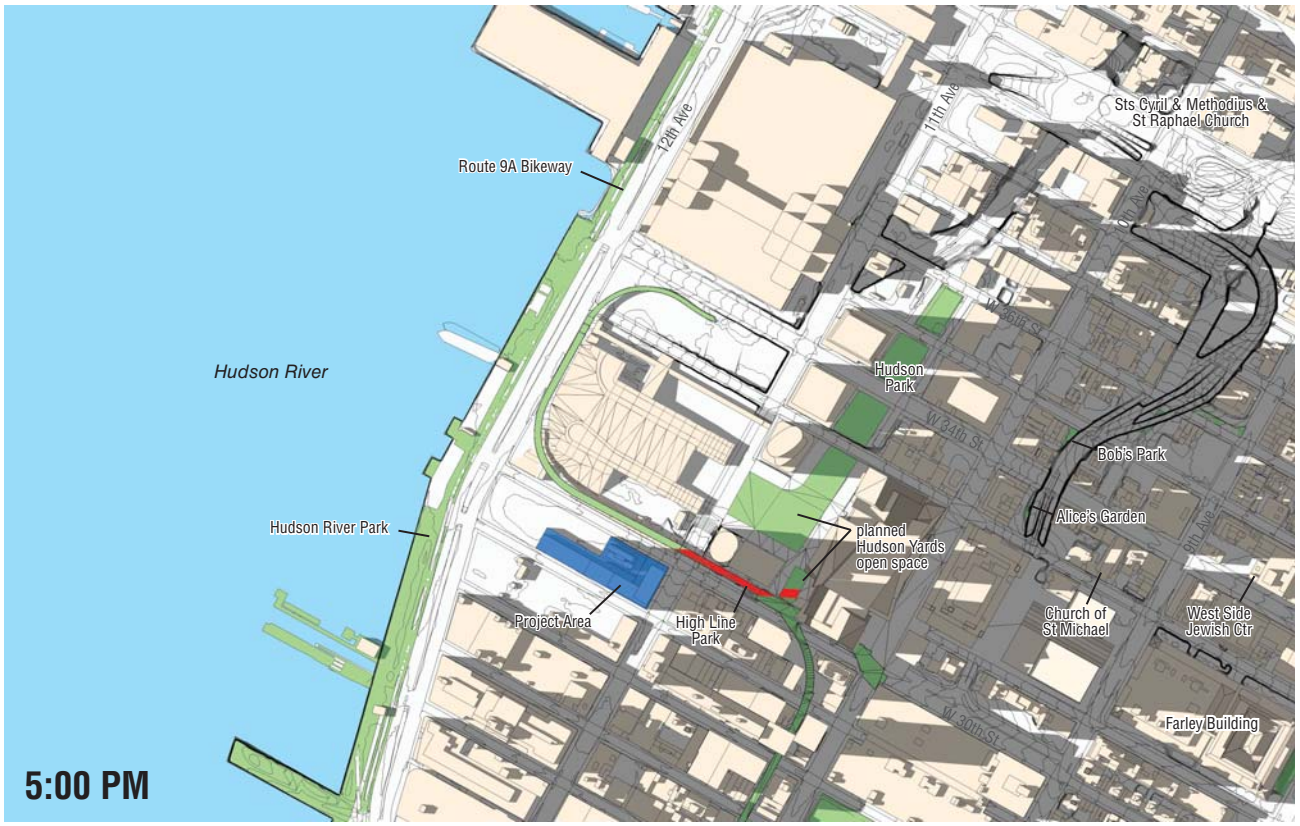
May 6 / August 6

BLOCK 675 EAST

Figure 7-12

10.16.17





Project Area

Publicly-accessible open space

Incremental shadow on sun-sensitive resource

May 6 / August 6

BLOCK 675 EAST

Figure 7-13

10.16.17





Project Area

Publicly-accessible open space

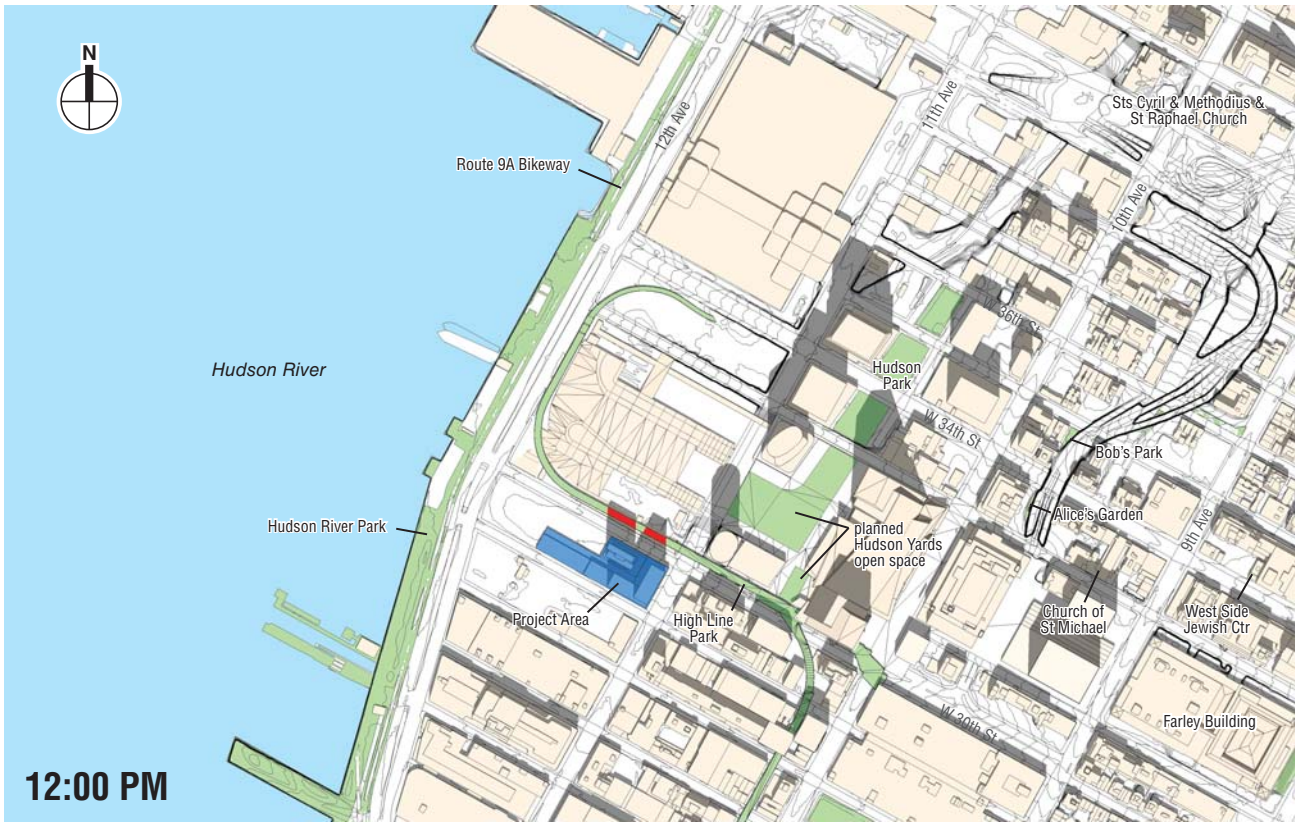
Incremental shadow on sun-sensitive resource

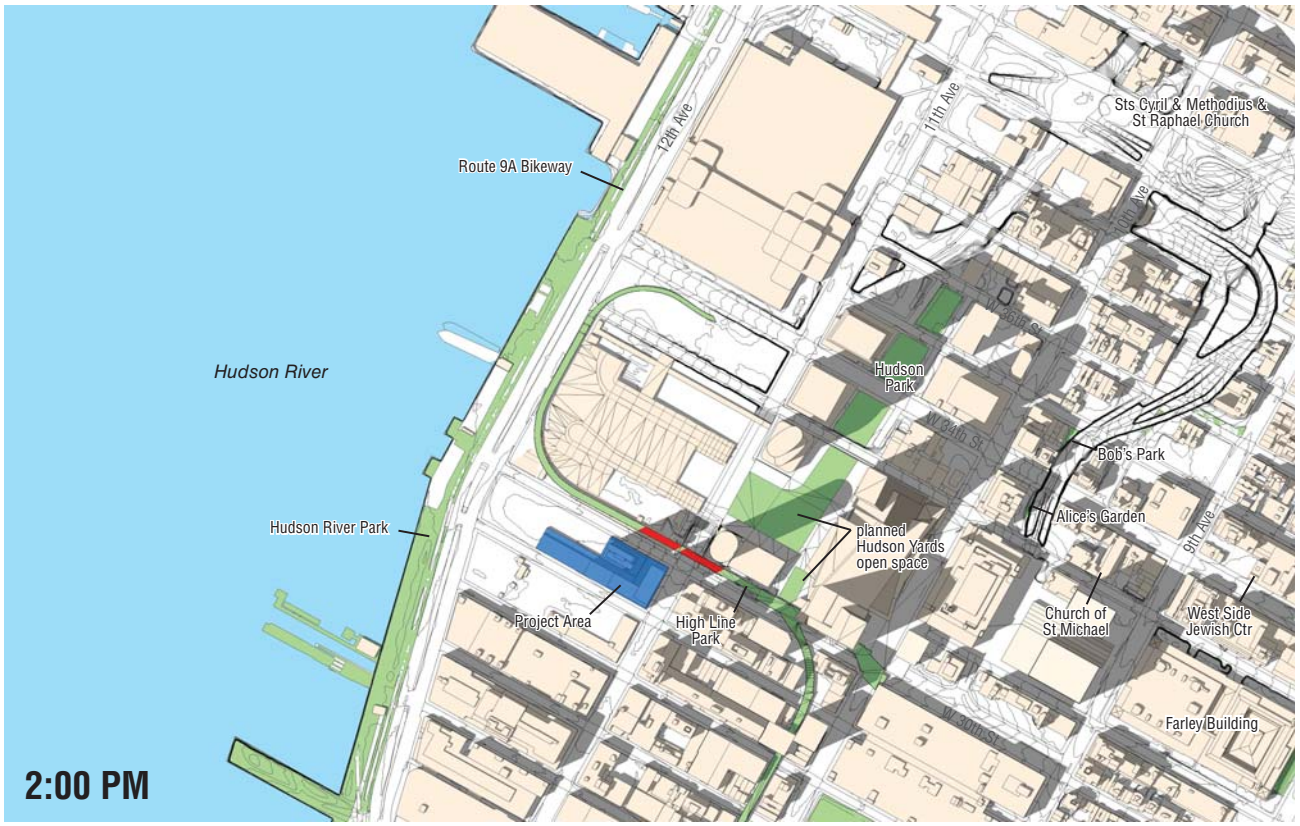
June 21

BLOCK 675 EAST

Figure 7-14

10.16.17





Project Area

Publicly-accessible open space

Incremental shadow on sun-sensitive resource

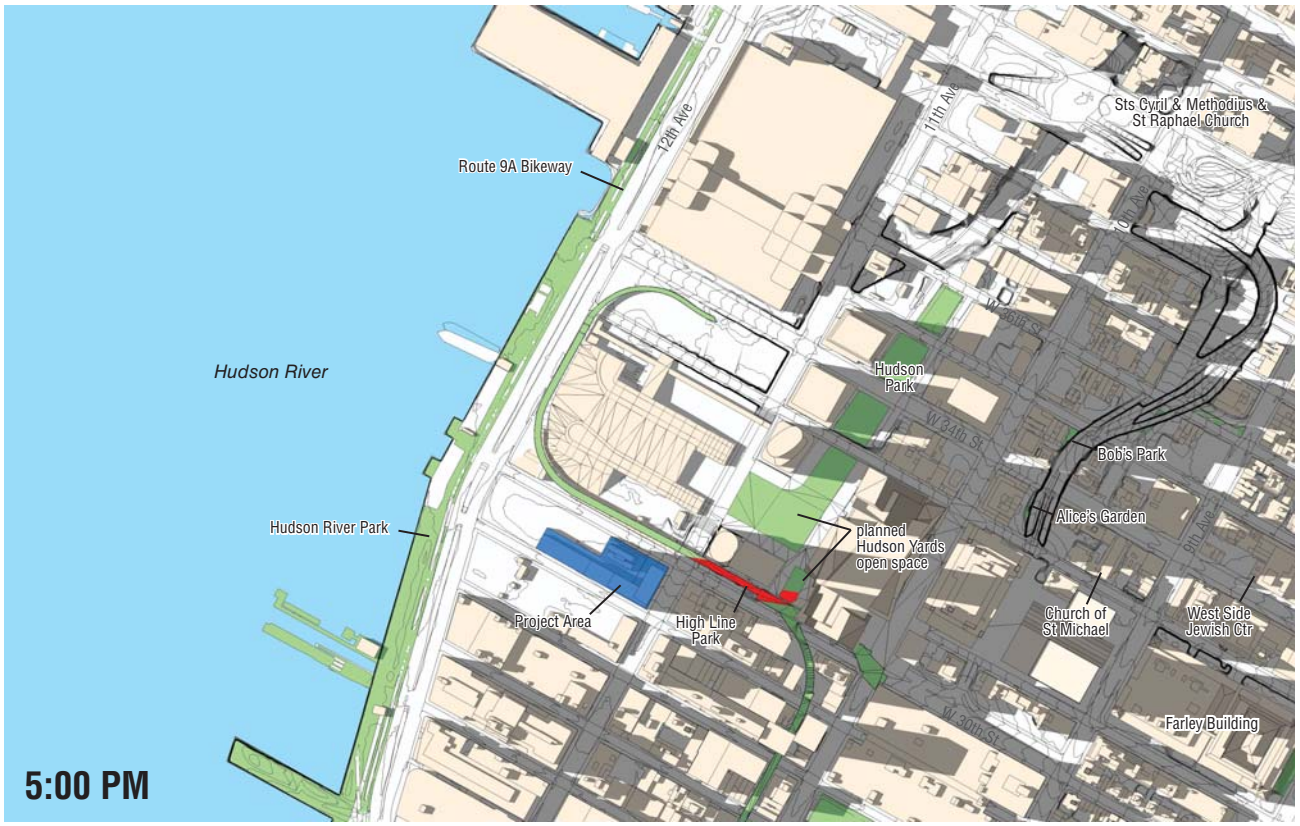
June 21

BLOCK 675 EAST

Figure 7-15

10.16.17





Project Area

Publicly-accessible open space

Incremental shadow on sun-sensitive resource

June 21

BLOCK 675 EAST

Figure 7-16

and remaining areas of sunlight. **Figure 7-17** provides a more detailed site plan of the impacted section of the High Line north and northeast of the Project Area.

Table 7-1
Incremental Shadow Durations

Analysis day and timeframe window	December 21 8:51 AM–2:53 PM	March 21/September 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				
Hudson River Park and Route 9A Bikeway	8:51 AM–11:30 AM Total: 2 hr 39 min	7:36 AM–9:45 AM Total: 2 hr 9 min	6:27 AM–8:30 AM Total: 2 hr 3 min	5:57 AM–8:10 AM Total: 2 hr 13 min
High Line Park	8:51 AM–2:53 PM Total: 6 hr 2 min	9:35 AM–4:29 PM Total: 6 hr 54 min	10:20 AM–5:18 PM Total: 6 hr 58 min	11:05 AM–6:01 PM Total: 6 hr 56 min
Hudson Yards (Eastern Rail Yard)	2:40 AM–2:53 PM Total: 13 min	2:00 PM–4:29 PM Total: 2 hr 29 min	1:30 PM–3:45 PM 4:00 PM–5:18 PM Total: 3hr 33 min	3:15 PM–5:50 PM Total: 2 hr 35 min
Hudson Park	—	2:50 PM – 3:15 PM Total: 25 min	—	—
NATURAL RESOURCES				
Hudson River	8:51 AM–11:15 AM Total: 2 hr 24 min	7:36 AM–9:15 AM Total: 1 hr 39 min	6:27 AM–8:00 AM Total: 1 hr 33 min	5:57 AM–7:45 AM Total: 1 hr 48 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 one hour to the given times to determine the actual clock time.

SHADOWS AND THE FOUR SEASONS

DECEMBER 21

December 21, representing the winter months, does not fall within New York's growing season, according to the *CEQR Technical Manual*. Shadow falling on vegetation in winter is not generally considered to cause a significant adverse impact. However, winter shadow can adversely impact users of open space who may rely on sunlight for warmth. In winter, shadows generally move more quickly but are of greater length than in other seasons.

MARCH 21/SEPTEMBER 21

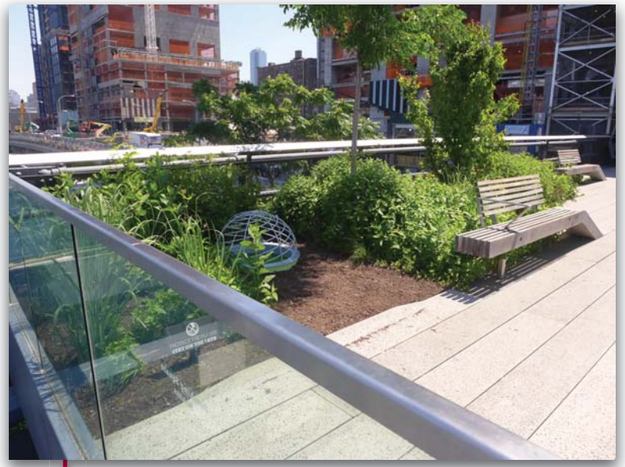
March is considered the beginning of the growing season in New York City, and September 21, which has the same shadow patterns as March 21, is also within the growing season. Shadows on March 21 and September 21 are of moderate length.

MAY 6/AUGUST 6

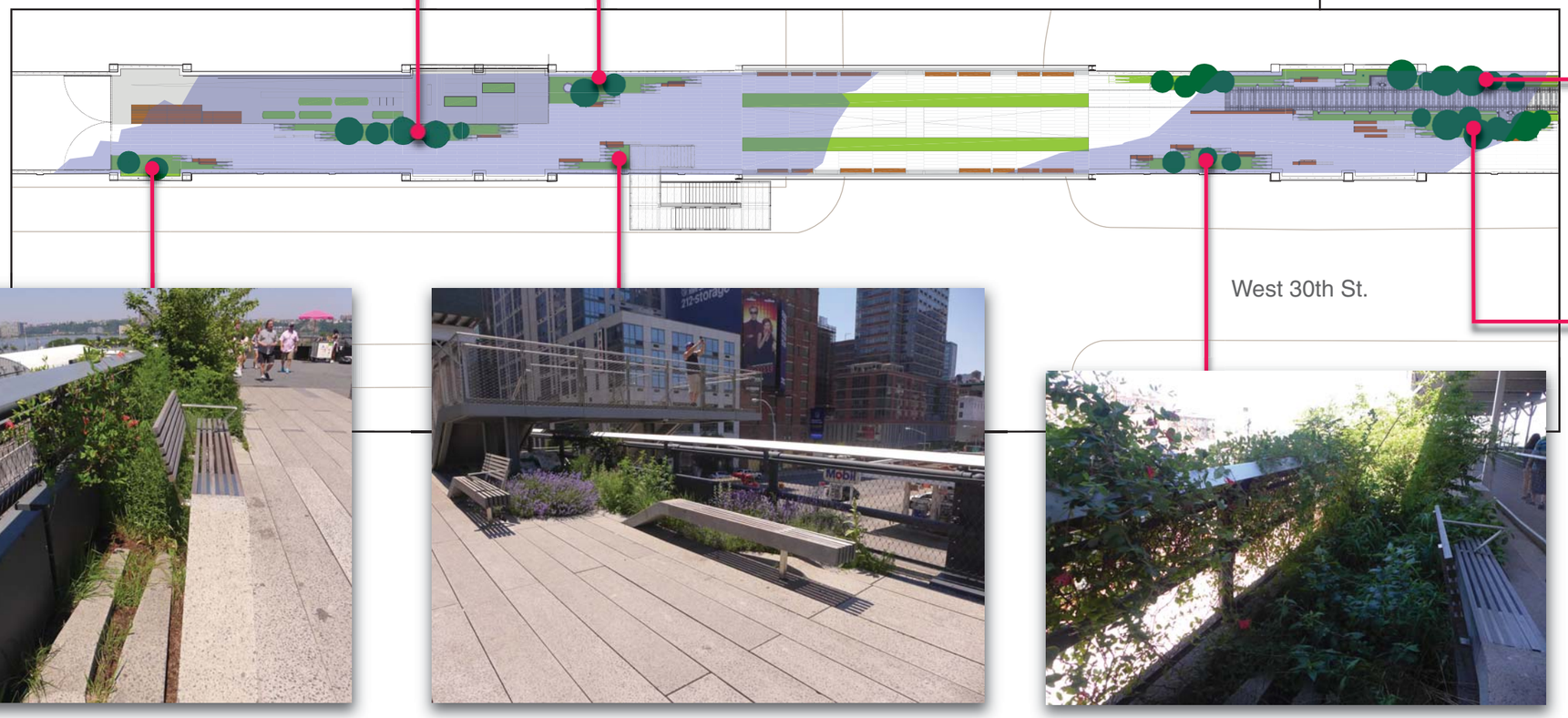
May 6 falls halfway between the March 21 equinox and the June 21 summer solstice. August 6 falls halfway between June 21 and the September 21 equinox, and has the same shadow patterns as May 6. The May 6/August 6 analysis day is representative of the growing season in the city. Shadows on this day are shorter than on the equinoxes, and the length of the day is longer.

Area of Location













Area on the High Line receiving less than four hours of direct sunlight with the proposed actions that would receive more than four hours without the proposed actions, on the March 21 / September 21 analysis day.

The High Line - Detail
Figure 7-17

JUNE 21

June 21 has the longest amount of daylight of the year, with an analysis period of 12 hours. Shadows fall to the southwest early in the morning and to the southeast late in the afternoon, and shadows at midday on June 21 are shorter than at any other time of year. June 21 is also in the growing season.

ASSESSMENT BY RESOURCE

HUDSON RIVER PARK AND ROUTE 9A BIKEWAY

Hudson River Park is a destination park located between West 59th Street and the northern edge of Battery Park City. The detailed analysis showed that incremental shadows would only fall on portions of the park between West 26th and 34th Streets. The portion between West 26th and 29th Streets contains piers, a tree-lined bikeway, and a waterfront walkway with upland areas improved with landscaping, seating areas, and lawns. North of West 29th Street, extending up to West 34th Street, the park area currently consists almost exclusively of hardscape, with the tree-lined bikeway and adjacent heliport and parking areas.

December 21

Incremental shadow would fall on portions of the park from the start of the analysis day at 8:51 AM until 11:30 AM, moving clockwise and "uptown" from roughly West 30th Street at 8:51 AM to West 34th Street at 11:30 AM (see **Figures 7-4 and 7-5**). This area of the park currently contains heliport pads, parking areas and a vacant area.

March 21/September 21

Incremental shadow would fall on portions of the park from the start of the analysis day at 7:36 AM until 9:45 AM, moving clockwise and "uptown" from West 29th Street to between West 30th and 31st Streets (see **Figure 7-7**). At West 29th Street there is landscaping and seating, but incremental shadow would only fall on this area for the first 30 minutes of the analysis day. There would continue to be adjacent areas of sunlight at this time and this area would receive plenty of direct sunlight for the remainder of the day.

May 6/August 6

Incremental shadow would fall on portions of the park from the start of the analysis day at 6:27 AM until 8:30 AM (see **Figure 7-11**). The incremental shadow would move clockwise and "uptown" from West 27th Street at the start of the analysis day, up to West 29th Street by 8:30 AM. There would continue to be adjacent areas of sunlight at this time and the plantings in this area would receive plenty of direct sunlight for the remainder of the day.

June 21

Incremental shadow would fall on portions of the park from the start of the analysis day at 5:57 AM until 8:10 AM (see **Figure 7-14**). The incremental shadow would move clockwise and "uptown" from West 26th Street at the start of the analysis day, up to West 29th Street by 8:10 AM. There would continue to be adjacent areas of sunlight at this time and the plantings in this area would receive plenty of direct sunlight for the remainder of the day.

The analysis concluded that incremental shadow from the proposed actions would not significantly impact the use or the vegetation of Hudson River Park on any analysis day. The shadows on the boating facilities at Pier 66 and Pier 66a would occur in early morning so they would not affect these uses.

THE HIGH LINE

The portion of the High Line in the study area runs approximately from between Tenth and Eleventh Avenues along West 30th Street to Twelfth Avenue where it curves north to West 34th Street. Currently, certain sections of the High Line within the study area are covered by construction bridges for the Hudson Yards project. These construction bridges shade much of the elevated open space near Eleventh Avenue.

December 21

The proposed buildings would cast incremental shadows on a small portion of the High Line throughout the analysis day. The extent of incremental shadow would be largest at 10:00 AM, but would be more limited in size later in the day (see **Figures 7-4 to 7-6**). From 9:00 AM to 10:00 AM the incremental shadow would eliminate much, though not all, of the sunlight on the area of the High Line that extends along West 30th Street west of Eleventh Avenue. Portions of the High Line in this area towards West 34th Street would remain in sun at 10:00 AM and by 11:00 AM most of the proposed projects' incremental shadow would move to a concentrated area near Eleventh Avenue. After 10:00 AM the extent of incremental shadow would be more limited, and concentrated in one area near Eleventh Avenue.

As noted above, according to the *CEQR Technical Manual*, shadow falling on vegetation in winter is not generally considered to cause a significant adverse impact. Despite the long duration and, at times, large extent of incremental shadow, there would continue to be portions of the High Line in the study area that would remain in direct sunlight throughout the day. In the afternoon, the entire High Line extending west from where it is adjacent to the Project Area and then north, wrapping around the western rail yards, would be in sun. Given the fact that sunlit areas would remain at all times of day, and given the typically light usage on winter mornings, the incremental shadow would not cause significant impacts to the use of the High Line on this representative day.

March 21/September 21

The proposed buildings would cast incremental shadows on the High Line from 9:35 AM to 4:29 PM (see **Figures 7-8 to 7-10**). Some locations on the High Line, for example directly north and northeast of the Project Area, would receive approximately three and a half to four hours of incremental shadow. With the proposed actions, this portion of the High Line would be in direct sunlight for approximately two to three hours during this analysis day, whereas without the proposed actions, it would be in direct sunlight for approximately five to six hours. According to the *CEQR Technical Manual*, a significant adverse shadow impact generally occurs when a project results in a substantial reduction of direct sunlight to vegetation to less than the minimum time necessary for its survival, or a reduction in sunlight (substantial or not) where the vegetation was already, without the project, receiving substandard sunlight (less than the amount necessary for its survival). **Figure 7-17** shows the areas that would receive less than four hours of sunlight with the proposed actions. Species in the affected area generally require a minimum of four hours of direct sunlight each day (see **Appendix D** for a list of the plants in the affected area). Therefore, the proposed actions may result in a significant adverse impact to the vegetation in this area of the High Line. However, with the exception of the half-hour period between approximately 10:00 AM to 10:30 AM, large areas of the High Line adjacent to the affected area would remain in sun, and therefore the incremental shadow would not significantly impact the character of the park.

May 6/August 6

The proposed buildings would cast incremental shadows on the High Line from 10:20 AM to 5:18 PM (see **Figures 7-12 and 7-13**). Despite the long duration, the new shadows would be limited in extent at any given time and would not cause a significant adverse impact to either the use of the park, due to adjacent sunlit areas, or to the vegetation, because all the affected areas would continue to receive more than the minimum four to six hours of direct sunlight.

June 21

The proposed buildings would cast incremental shadows on the High Line from 11:05 AM to 6:01 PM (see **Figures 7-15 and 7-16**). Despite the long duration, the new shadows would be limited in extent at any given time and would not cause a significant adverse impact to either the use of the park, due to adjacent sunlit areas, or to the vegetation, because all the affected areas would continue to receive more than the minimum four to six hours of direct sunlight.

HUDSON YARDS (EASTERN RAIL YARD OPEN SPACE)

December 21

Incremental shadow would fall briefly on the edge of this space from 2:40 PM to 2:53 PM and would not eliminate the remaining sunlight during this time (see **Figure 7-6**).

March 21/September 21

Incremental shadow would fall on this space from 2:00 PM to 4:29 PM (see **Figures 7-9 and 7-10**). The extent of new shadow would be large for a time, in particular from 3:45 PM to 4:00 PM, but would not remove all the sunlight on this large open space. Portions of this space as well as in the adjacent Hudson Park to the north and High Line to the south would remain in sunlight at all times.

May 6/August 6

Incremental shadow would fall on this space from 1:30 PM to 3:45 PM (see **Figure 7-13**). It would be limited in coverage to an area in the southern portion of the space. Sunlit areas would remain in adjacent parts of the space during this time. Incremental shadow would fall later in the afternoon on another part of this Hudson Yards space, a section on the south side adjacent to the High Line, from 4:00 PM to 5:18 PM (see **Figure 7-13**). This incremental shadow would be small in extent, and sunlit areas would remain in the large central space.

June 21

Incremental shadow would fall on this space from 3:15 PM to 5:50 PM on the southern section of this open space, adjacent to the High Line (see **Figure 7-16**). This incremental shadow would be small in extent, and sunlit areas would remain in the large central space.

HUDSON PARK

March 21/September 21

From 2:50 PM to 3:15 PM a small incremental shadow would pass across a small area in the southern part of the park block located between West 33rd and 34th Streets (see **Figure 7-10**). Sunlit areas of this park block would remain during this affected period.

BOB'S PARK

The analysis showed that project-generated shadow would not fall on this small park. The park would already be entirely in existing shadow when project-generated shadow would otherwise pass across it late on the March 21/September 21 analysis day.

ALICE'S GARDEN

The analysis showed that project-generated shadow would not fall on this small garden. The garden would already be entirely in existing shadow when project-generated shadow would otherwise pass across it late on the March 21/September 21 analysis day.

HUDSON RIVER

Incremental shadow would fall on portions of the Hudson River in all seasons. The new shadow would be limited to the morning hours, falling on areas of the river surface beginning at the start of each analysis day and lasting between approximately one and a half and two and a half hours as it move clockwise and east across the water surface (see **Table 7-1** for specific entry and exit times).

E. CONCLUSIONS

The analysis shows that the proposed actions would result in significant adverse shadow impacts to vegetation on portions of the High Line in the spring and fall. At these times, project-generated shadow would fall on certain portions of the High Line north of the Project Area and would receive less than the four to six hour minimum of direct sunlight in part due to the proposed buildings' shadows, potentially affecting the health of the vegetation at that location.

Figure 7-17 shows a site plan of the relevant portion of the High Line, with the areas that would receive less than four hours of direct sunlight on March 21 (and September 21) highlighted in blue. The figure also provides representative photos of the vegetation and the corresponding location of the photo on the plan. Certain species located in these areas are not shade tolerant and require a minimum of four to six hours of sunlight.

While project generated shadows would fall on portions of the High Line in the spring and fall, users of the High Line would continue to find sunlit areas available in adjacent and nearby portions of this linear park at all times of the day.

In winter, the proposed buildings would cast shadows on portions of the High Line throughout the day, covering large areas in the morning, and more limited areas in the afternoon. In the morning, small portions of the High Line in the study area would remain in sun, and in the afternoon large areas in the study area would remain in sun. Given the areas of remaining sunlight, and the typical lower usage on winter mornings, the project-generated shadow would not cause significant adverse impacts to users of this resource in this season. In addition, since this is not the growing season, there would not be an adverse impact to vegetation. The Hudson Yards open space would receive 13 minutes of new shadow in winter and between two and a half and three and a half hours of new shadow during the spring, summer, and fall. The new shadow in the spring, summer and fall would not likely affect the health of vegetation in the open space areas, and sunlit areas would remain in this space and in the adjacent open spaces throughout the time when incremental shadow would occur. Therefore, the proposed actions would not cause significant adverse shadow impacts to this space.

Incremental shadow would move across areas of Hudson River Park and the Route 9A Bikeway each morning throughout the year, early in the morning. Users of the park and bikeway would continue to find sunlit areas available in adjacent and nearby portions of this linear park during the periods when project generated shadow would fall. Plantings and trees in the park would continue to receive ample sun throughout the mid-day and afternoon periods. Therefore the proposed actions would not cause significant adverse shadow impacts to this space.

A small portion of Hudson Park would receive project-generated shadow for 35 minutes on one of the analysis days. Given the limited extent and duration of new shadow, and the availability of adjacent sunlit areas, this park would not be significantly impacted by shadows from the proposed actions.

Project-generated shadow would fall on the Hudson River for up to approximately two and a half hours in the mornings throughout the year. The current flows swiftly in the Hudson River and would move phytoplankton and other natural elements quickly through the shaded areas. Therefore, project-generated shadows would not be expected to affect primary productivity. The areas that receive new shadow would continue to receive many hours of direct sunlight throughout the day, because there are no intervening structures to the west. Incremental shadows would therefore not be likely to significantly affect aquatic resources (plankton or fish) in these areas of the Hudson River. Consequently, project-generated shadows would not cause significant adverse impacts on the Hudson River. ✷