



DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DRAFT SECTION 4(f) EVALUATION

## APPENDIX 8

# Open Space and Recreational Resources

## 8-1: Detailed Shadows Analysis



DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DRAFT SECTION 4(f) EVALUATION

APPENDIX 8-1

# Detailed Shadows Analysis

New York City's 2014 *City Environmental Quality Review (CEQR) Technical Manual* calls for analysis of shadows for new structures higher than 50 feet that are being reviewed in the CEQR process, or of any height if adjacent to a sunlight-sensitive resource. As noted in Chapter 8, "Open Space and Recreational Resources," depending on the final configuration and massing of the Twelfth Avenue fan plant, this building may be up to approximately 150 feet tall. Therefore this shadows analysis was conducted for the Twelfth Avenue fan plant.

The CEQR methodology calls for identifying parks, natural resources, and sun-sensitive features of historic resources (such as stained glass windows) that may be affected by shadows from the new building being analyzed and provides a recommended methodology for determining the area where a proposed new building's shadows may fall and for how long they would fall. This analysis was prepared following the guidelines of the *CEQR Technical Manual*.

## **8.1 PRELIMINARY SCREENING ASSESSMENT**

A base map was developed using Geographic Information Systems (GIS)<sup>1</sup> showing the location of the proposed project and the surrounding street layout (see **Figure 8-3**). Potential sunlight-sensitive resources were identified and shown on the map.

As noted in Chapter 2, "Project Alternatives and Description of the Preferred Alternative", the shape and specific location of the fan plant building on the western portion of Block 675 will be refined during preliminary and final engineering. This NEPA analysis is based on conceptual plans (10 percent design). Based on conceptual design, the Twelfth Avenue fan plant may be developed with its tunnel fans oriented vertically, in which case the building would require a footprint of approximately 120 feet by 130 feet and a maximum height of approximately 150 feet. It is also possible for the tunnel fans to be oriented horizontally, resulting in a lower building with a larger footprint. Design of the fan plant building could be coordinated with other plans for the western end of the block and the fan plant could potentially be incorporated within a future commercial or residential building constructed at the site. Alternatively, it is also possible that the fan plant would be developed independently on the property. The shape, size, and design treatment of the fan plant will be refined during preliminary and final engineering.

This EIS considers several possible configurations for the Twelfth Avenue fan plant: a fan plant at the corner of Twelfth Avenue and West 30th Street; and a fan plant on West 29th Street east of Twelfth Avenue. To ensure a conservative analysis, the preliminary assessment accounted for both locations, as shown below.

### **8.1.1 TIER 1 SCREENING ASSESSMENT**

For the Tier 1 assessment, the longest shadow that a proposed structure 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

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<sup>1</sup> Software: Esri ArcGIS 10.3; Data: New York City Department of Information Technology and Telecommunications (DoITT) and other City agencies, and site visits by AKRF, Inc..



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<sup>2</sup>.

For the Tier 1 assessment, a Project site boundary for the Twelfth Avenue fan plant was conservatively delineated to include both potential locations of the proposed structure. At a maximum height of approximately 150 feet above curb level, the Twelfth Avenue fan plant building could cast a shadow up to approximately 645 feet in length (150' x 4.3). Using this length as the radius, a perimeter was drawn around the Project site (see **Figure 8-3**). Three existing publicly accessible open spaces are located in the longest shadow study area: a portion of Hudson River Park, a portion of the Route 9A bikeway, and a portion of the High Line. Hudson River Park includes the Hudson River to the pierhead line. A portion of the Hudson River, a sunlight-sensitive natural resource, is located in the longest shadow study area. Finally, a portion of the public open space associated with the planned Hudson Yards development that will be built by 2030 is also located in the longest shadow study area. Therefore, further assessment was required for these five sunlight-sensitive resources.

No historic resources with sunlight-dependent features were located in the longest shadow study area.

### **8.1.2 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 8-3** illustrates this triangular area south of the Project site. The complementing area to the north within the longest shadow study area represents the remaining area that could potentially experience new Project-generated shadow from the Twelfth Avenue fan plant.

Portions of all five resources identified above in the Tier 1 assessment are located in the remaining longest shadow study area. Therefore, additional assessment was required.

### **8.1.3 TIER 3 SCREENING ASSESSMENT**

According to the *CEQR Technical Manual* guidelines, a Tier 3 screening assessment should be performed to determine whether a proposed structure's shadow could, absent intervening and surrounding buildings, fall on a sunlight-sensitive resource. The analysis is performed utilizing a three-dimensional (3D) model, and shadows are modeled on four representative days of the year to represent the annual variation in shadow patterns in each of the four seasons. If the Tier 3 assessment shows that project-generated shadow could reach one or more sunlight-sensitive resources, a more rigorous detailed analysis is conducted utilizing a 3D model including existing buildings in the study area.

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<sup>2</sup> Per CEQR guidelines, the assessment considers shadows occurring between one and a half hours after sunrise and one and a half hours before sunset. At times outside 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 according to CEQR impact thresholds, and their assessment is not required.

Given the fact that the Twelfth Avenue fan plant would be adjacent to Hudson River Park, the Route 9A bikeway, and the High Line with no intervening structures, Project-generated shadow could potentially fall on these resources on at least one, if not all, of the representative analysis days. As such, this intermediate step in the assessment was skipped and the assessment proceeded directly to the more rigorous detailed analysis, as detailed below.

## **8.2 DETAILED SHADOW ANALYSIS**

The direction and length of shadows vary throughout the course of the day and also differ depending on the season. In order to determine the extent and duration of project-generated shadow on the adjacent and nearby sunlight-sensitive resources, 3D computer mapping software is used 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 of the study area, and a three-dimensional representation of the proposed structure. To complete the baseline or No Action condition, existing buildings as well as future planned developments in the study area were added to the model using the best publicly available information. The future condition with the proposed project and its shadows can then be compared to the baseline condition to determine the incremental shadows that would result with the proposed project.

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 (NYC DoITT) and photos taken during project site visits.

Two alternative locations for the fan plant were assessed: the northwest corner location (a fan plant at the corner of Twelfth Avenue and West 30th Street) and the West 29th Street location (a fan plant on West 29th Street east of Twelfth Avenue).

### **8.2.1 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.

In summary, the summer and winter solstices represent the opposite extremes, and the spring and fall equinoxes the midpoint, of the yearly variation in the angles and length of shadows. Shadows on any other date will fall somewhere within the maximum extent circumscribed by the solstice and equinox shadows.

### **8.2.2 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 according to CEQR criteria, and their assessment is not required.



### 8.2.3 RESOURCES OF CONCERN

The portion of **Hudson River Park** adjacent to the Project site, extending northward from West 29th Street up to West 31st Street. This area includes a paved walkway and the West 30th Street Heliport, which is not a publicly accessible open space resource. South of West 29th Street, the park contains landscaping, walkways, and seating. In addition, the Hudson River Park includes the waters of the **Hudson River** to the pierhead line. The Hudson River is a sunlight-sensitive natural resource which is also used for recreational boating.

The **Route 9A Bikeway** extends through the longest shadow study area. Located between Hudson River Park and Twelfth Avenue, it is paved and exclusively for active uses such as cycling, walking, and jogging.

The portion of the **High Line** that extends along West 30th Street and along Twelfth Avenue is a linear park with plantings and seating areas and is primarily used for activities such as walking, jogging, and passive recreation.

The future **Hudson Yards open space** near the corner of West 30th Street and Twelfth Avenue has not yet been developed. However, it is anticipated that this open space will provide lawns, landscaped areas, walking paths, seating areas, plazas, and a dog run.

### 8.2.4 ANALYSIS RESULTS

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 a resource, and the time it would exit.

#### 8.2.4.1 NORTHWEST CORNER LOCATION

**Table A8-1** summarizes the entry and exit times and total duration of incremental shadows on each affected sun-sensitive resource that would be cast by the Twelfth Avenue fan plant at the northwest corner location. **Figures 8-4 to 8-6** 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 and remaining areas of sunlight.

**Table A8-1**  
**Incremental Shadow Durations – Northwest Corner Location**

<b>Analysis Day and Timeframe Window</b>	<b>December 21 8:51 AM-2:53 PM</b>	<b>March 21/Sept. 21 7:36 AM-4:29 PM</b>	<b>May 6/August 6 6:27 AM-5:18 PM</b>	<b>June 21 5:57 AM-6:01 PM</b>
Hudson River Park (portion at West 30th Street)	8:51 AM – 10:30 AM Total: 1 hr 39 min	8:00 AM – 8:15 AM Total: 15 min	—	—
Hudson River	8:51 AM – 10:00 AM Total: 1 hr 9 min	8:00 AM – 8:15 AM Total: 15 min	—	—
Route 9A bikeway (portion at West 30th Street)	8:51 AM – 11:15 AM Total: 2 hr 24 min	8:00 AM – 8:45 AM 9:15 AM – 9:30 AM Total: 1 hr	7:15 AM – 7:30 AM Total: 15 min	—
High Line (portion near corner of West 30th Street and Twelfth Avenue)	1:00 PM - 2:53 PM Total: 1 hr 53 min	2:30 PM - 4:29 PM Total: 1 hr 59 min	3:45 PM–5:18 PM Total: 1 hr 33 min	—
Proposed Hudson Yards open space (portion near corner of West 30th Street and Twelfth Avenue)	12:15 PM - 2:53 PM Total: 2 hr 53 min	1:00 PM - 4:29 PM Total: 3 hr 29 min	4:30 PM – 5:00 PM Total: 30 min	—
<b>Notes:</b> 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 <i>CEQR Technical Manual</i> 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.				

#### 8.2.4.1.1 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.

A small area of incremental shadow would fall on the area of Hudson River Park adjacent to the heliport from 8:51 AM to 10:30 AM, and on the Route 9A bikeway from 8:51 AM to 11:15 AM (see **Figure 8-4**).

Incremental shadow would fall on portions of the Hudson River between the start of the analysis day at 8:51 AM and 10:00 AM. The extent of the new shadow would be small, and would move across different areas of the river surface (see **Figure 8-4**).

Incremental shadow would move across a portion of the High Line between 1:00 PM and 2:53 PM. Only a small area of this linear park would be affected by the new shadow and plenty of adjacent sunlit areas would remain available for users (see **Figure 8-4**).

Between 12:15 PM and the end of the analysis day at 2:53 PM, incremental shadow would fall on open space in the southwest area of the planned western Hudson Yards development. The new shadow would be small in extent, and adjacent sunlit areas of the open space would remain available to users (see **Figure 8-4**).

#### 8.2.4.1.2 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.



A small incremental shadow would fall on a portion of Hudson River Park and the Hudson River from 8:00 AM to 8:15 AM (see **Figure 8-5**).

Incremental shadow would fall on the Route 9A bikeway from 8:00 AM to 8:45 AM (see **Figure 8-5**), and then again from 9:00 AM to 9:30 AM.

Incremental shadow would move across a portion of the High Line between 2:30 PM and 4:29 PM. Only a small area of this linear park would be affected by the new shadow and plenty of adjacent sunlit areas would remain available for users (see **Figure 8-5**).

Between 1:00 PM and the end of the analysis day at 4:29 PM, incremental shadow would fall on open space in the southwest area of the planned western Hudson Yards development. The new shadow would be very limited in extent, and plenty of adjacent sunlit areas of the open space would remain available to users (see **Figure 8-5**).

#### **8.2.4.1.3**     *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.

Incremental shadow would move across a portion of High Line between 3:45 PM and the end of the analysis day at 5:18 PM. Only a small area of this linear park would be affected by the new shadow and plenty of adjacent sunlit areas would remain available for users (see **Figure 8-6**).

Incremental shadow would move across a portion of the Route 9A bikeway for 15 minutes, between 7:15 AM and 7:30 AM. The new shadow would be small in size as well as brief in duration.

Incremental shadow would fall on a portion of the planned Hudson Yards open space, near West 29th Street, for 30 minutes between 4:30 PM and 5:00 PM. The new shadow would be limited in extent and duration, and there would be plenty of adjacent sunlit areas (see **Figure 8-6**).

#### **8.2.4.1.4**     *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.

No incremental shadow would fall on sunlight-sensitive resources on the June 21 analysis day.

#### **8.2.4.1.5**     *Conclusions by Resource*

##### **8.2.4.1.5.1**     *Hudson River Park*

Incremental shadow would fall on the Hudson River Park walkway in the winter for about an hour and 40 minutes and in the early spring and the fall for 15 minutes. As shown in **Figures 8-4 and 8-5**, the extent of new shadow would move and would remain small throughout the duration. This area of the park would receive many hours of direct sunlight through the midday and afternoon hours in all seasons given the lack of structures to the west. Therefore, this limited new shadow would not significantly affect the use of this area of the park or any vegetation that might potentially be located there in 2030.

##### **8.2.4.1.5.2**     *Hudson River*

Incremental shadow would fall on a small area of the river surface adjacent to the bulkhead in the winter morning for just over an hour and in the early spring and the fall for 15 minutes. The

extent and duration would be limited as shown in **Figures 8-4 and 8-5**. 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. Further, the area that receives new shadow would continue to receive direct sunlight throughout the mid-day and afternoon, 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.

#### *8.2.4.1.5.3 Route 9A Bikeway*

Incremental shadow would fall on a portion of the Route 9A bikeway for two and a half hours in winter, an hour in early spring and fall, and for 15 minutes on the May 6 / August 6 analysis day. The bikeway is used by cyclists, joggers, walkers, and other similar uses in which the users are traveling through the shaded area. There is no seating or other passive amenities. Therefore, the new shadow would not significantly change the use or overall character of this linear resource. Any plantings in the affected area would continue to receive ample sun through the mid-day and afternoon hours in all seasons given the lack of structures to the west. Therefore the new shadow would not cause significant adverse shadow impacts to the Route 9A bikeway.

#### *8.2.4.1.5.4 High Line*

Incremental shadow would move across portions of the High Line for nearly two hours in the fall, winter and early spring, and an hour and a half on the May 6 / August 6 analysis day. As shown in **Figures 8-4, 8-5 and 8-6**, the extent of new shadow would be small and it would move over the course of the duration, affecting different plantings and amenities at different times. All the affected areas would receive four hours or more of direct sunlight over the course of the day throughout the growing season, so the health of the plantings would not be significantly affected. Large adjacent areas of the High Line would be in sun at the times when incremental shadow would occur, for users seeking sunlight. Therefore, the new shadow would not cause significant adverse shadow impacts to this resource.

#### *8.2.4.1.5.5 Future Hudson Yards Open Space*

The extent of incremental shadow would be small in all seasons and would move across the space, affecting different areas at different times. In the winter, the total duration of new shadow would be nearly three hours. However, only a small area at the corner of Twelfth Avenue and West 30th Street would be in incremental shadow. Large areas of the future open space north-adjacent and east adjacent would continue to be in sun for winter users seeking sunlight. A total duration of three and a half hours of new shadow would fall on the space in early spring and fall but as shown in **Figure 8-5** the new shadow would be quite small and limited to the southwest corner of the open space for most of that duration. Near the end of the analysis day when the extent of incremental shadow would grow larger, it would continue to be limited to a small proportion of the open space while much of the remaining open space would be in sun. All affected areas would continue to receive a minimum of four hours of direct sunlight over the course of the day throughout the growing season. Therefore, the new shadow would not significantly impact the plantings or the use of the future Hudson Yards open space.

### **8.2.4.2 WEST 29TH STREET LOCATION**

**Table A8-2** summarizes the entry and exit times and total duration of incremental shadows on each affected sun-sensitive resource that would be cast by the Twelfth Avenue fan plant at the West 29th Street location. **Figures 8-7 and 8-8** 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 and remaining areas of sunlight.



**Table A8-2**

**Incremental Shadow Durations – West 29th Street Location**

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
Hudson River Park (portion at West 30th Street)	8:51 AM – 10:00 AM Total: 1 hr 9 min	—	—	—
Hudson River	8:51 AM – 9:15 AM Total: 24 min	—	—	—
Route 9A bikeway (portion at West 30th Street)	8:51 AM – 10:15 AM Total: 1 hr 34 min	—	—	—
High Line (portion near corner of West 30th Street and Twelfth Avenue)	12:30 PM - 2:53 PM Total: 2 hr 23 min	3:45 PM - 4:29 PM Total: 44 min	—	—
Proposed Hudson Yards open space (portion near corner of West 30th Street and Twelfth Avenue)	11:30 AM - 2:53 PM Total: 3 hr 23 min	—	—	—
<p><b>Notes:</b> 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 <i>CEQR Technical Manual</i> 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.</p>				

**8.2.4.2.1 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.

A small incremental shadow would fall on the Hudson River Park walkway adjacent to the heliport from 8:51 AM to 10:00 AM, and on the Route 9A bikeway from 8:51 AM to 10:15 AM (see **Figure 8-7**). Incremental shadow would fall on portions of the Hudson River between the start of the analysis day at 8:51 AM and 9:15 AM (see **Figure 8-7**).

Incremental shadow would move across a portion of the High Line between 12:30 PM and 2:53 PM. Only a small area of this linear park would be affected by the new shadow and plenty of adjacent sunlit areas would remain available for users (see **Figure 8-7**).

Between 11:30 AM and the end of the analysis day at 2:53 PM, incremental shadow would fall on open space in the southwest area of the planned western Hudson Yards development. The new shadow would be small in extent, and adjacent sunlit areas of the open space would remain available to users (see **Figure 8-7**).

**8.2.4.2.2 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.

Incremental shadow would move across a portion of High Line between 3:45 PM and the end of the analysis day at 4:29 PM. Only a small area of this linear park would be affected by the new shadow and plenty of adjacent sunlit areas would remain available for users (see **Figure 8-8**).

#### *8.2.4.2.3 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.

No incremental shadow would fall on sunlight-sensitive resources on the June 21 analysis day.

#### *8.2.4.2.4 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.

No incremental shadow would fall on sunlight-sensitive resources on the June 21 analysis day.

#### *8.2.4.2.5 Conclusions by Resource*

##### *8.2.4.2.5.1 Hudson River Park*

Incremental shadow would fall on a small area of the Hudson River Park walkway in the winter morning for about an hour and 10 minutes. Currently this portion of the park is paved and used as a parking lot. As shown in **Figure 8-7** the extent of new shadow would move and would remain small throughout the duration. This area of the park would receive many hours of direct sunlight through the midday and afternoon hours given the lack of structures to the west. Therefore, this limited new shadow would not significantly affect the use of this area of the park or any vegetation that might potentially be located there in 2030.

##### *8.2.4.2.5.2 Hudson River*

New shadow would fall on a small area of the river surface adjacent to the bulkhead in the winter morning for 24 minutes. The extent and duration would be limited as shown in **Figure 8-7**. 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. Further, the area that receives new shadow would continue to receive direct sunlight throughout the mid-day and afternoon, 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.

##### *8.2.4.2.5.3 Route 9A Bikeway*

Incremental shadow would fall on a portion of the bikeway for approximately an hour and a half in winter. The bikeway is used by cyclists, joggers, walkers, and other similar uses in which the users are traveling through the shaded area. There is no seating or other passive amenities. Therefore the new shadow would not significantly change the use or overall character of this linear resource. Therefore the new shadow would not cause significant adverse shadow impacts to this resource.

#### 8.2.4.2.5.4 *High Line*

Incremental shadow would move across portions of the High Line for nearly two and a half hours on the winter analysis day, and for about 45 minutes in the early spring and fall. As shown in **Figure 8-7**, the extent of new shadow would be limited to a portion of this long and linear space, and sunlit areas would continue to extent in both directions from the affected area. Therefore, the new shadow would not significantly impact the use of the High Line in this season. On the March 21 / September 21 analysis day the incremental shadow would be small in extent and limited to less than an hour and sunlit areas would extend in either direct from the affected area, as shown in **Figure 8-8**. Therefore, the new shadow would not cause significant adverse shadow impacts to this resource.

#### 8.2.4.2.5.5 *Future Hudson Yards Open Space*

Incremental shadow would move across portions of the future Hudson Yards open space for nearly three and a half hours on the winter analysis day. As shown in **Figures 8-7 and 8-8**, the new shadow would be limited to the southwest corner of the open space for most of this period, extending further into the interior in the final hour of the analysis period. Throughout the affected period there would be adjacent sunlit areas available for users in this season. Therefore, the new shadow would not significantly impact the use of the future Hudson Yards open space.

### **8.3 CONCLUSION**

Incremental new shadows from the Twelfth Avenue fan plant would fall on of Hudson River Park, the Hudson River, the Route 9A bikeway, and the High Line in the immediate vicinity of the Project site, but would not change the overall character or recreational quality of these recreational resources.

The analysis of historic resources provided in Chapter 9, "Historic and Archaeological Resources," did not identify any sun-sensitive resources that may be affected by shadows from the Twelfth Avenue fan plant. \*