Chapter 7: Shadows

A. INTRODUCTION

This chapter examines whether the proposed project would cast new shadows on any sunlight-sensitive publicly accessible resources or other resources of concern, and considers the potential effects of any new shadows. Sunlight-sensitive resources of concern include publicly accessible open spaces, important natural features such as water bodies, and sunlight-dependent features of historic and cultural resources.

According to the 2012 *City Environmental Quality Review (CEQR) Technical Manual*, a shadows assessment is required if the proposed project would result in structures (or additions to existing structures) of 50 feet or more, or if the project site is located adjacent to, or across the street from, a sunlight-sensitive resource. The proposed project would result in new structures more than 50 feet in height and the building sites are located adjacent to several open spaces, as well as the East River, an important natural resource. Therefore, a shadow analysis was warranted.

PRINCIPAL CONCLUSIONS

The analysis demonstrates that the proposed project would result in new shadows on several nearby open spaces, including Hallet's Cove Esplanade, Hallet's Cove Playground (the playground area between 1st Street and the East River), Whitey Ford Field, and the New York City Housing Authority (NYCHA) Astoria Houses Campus open spaces, as well as on the East River, an important natural feature. These resources are all located adjacent to, or within, the project site, and new shadows would occur in all seasons. However, vegetation in all areas affected by project shadow would continue to receive a minimum of four hours of direct sunlight throughout the growing season. For users of these open spaces, despite the new incremental shadows, alternative sunlit open spaces would be available for use nearby during the affected times, along the waterfront and in the Astoria Houses development. For the users of Whitey Ford Field, primarily youth and adult baseball and softball leagues active in the spring, summer, and fall, the new shadows would not substantially reduce the usability of the space. The analysis concludes that the proposed project would not cause any significant adverse shadow impacts to either the vegetation or the users of these open spaces, nor to the biota of the river.

B. DEFINITIONS AND METHODOLOGY

This analysis has been prepared in accordance with the guidelines of the *CEQR Technical Manual*.

DEFINITIONS

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

Sunlight-sensitive resources are those resources 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* (e.g. parks, beaches, playgrounds, plazas, schoolyards, greenways, landscaped medians with seating). Planted areas within unused portions of roadbeds that are part of the Greenstreets program are also considered sunlight-sensitive resources.
- *Features of architectural resources that depend on sunlight for their enjoyment by the public.* Only the sunlight-sensitive features need be considered, as opposed to the entire resource. Such sunlight-sensitive features might include: design elements that depend on the contrast between light and dark (e.g. recessed balconies, arcades, deep window reveals); elaborate, highly carved ornamentation; stained glass windows; historic landscapes and scenic landmarks; and features for which the effect of direct sunlight is described as playing a significant role in the structure's importance as a historic landmark.
- *Natural resources* where the introduction of shadows could alter the resource's condition or microclimate. Such resources could include surface water bodies, wetlands, or designated resources such as coastal fish and wildlife habitats.

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

- *City streets and sidewalks* (except Greenstreets);
- *Private open space* (e.g. front and back yards, stoops, vacant lots, and any private, non-publicly-accessible open space);
- *Project-generated open space* cannot experience a significant adverse shadow impact from the project, according to CEQR, because without the project the open space would not exist. However, a qualitative discussion of shadows on the project-generated open space should be included in the analysis.

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 accounts for existing shadows cast by intervening and surrounding buildings, and 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.

In order to ensure a conservative analysis, the study presented below is based on the proposed zoning envelopes for each building.

C. PRELIMINARY SCREENING ASSESSMENT

A base map was developed using Geographic Information Systems (GIS)[1] showing the location of the proposed project and the surrounding street layout (see **Figure 7-1**). In coordination with the open space, historic resources and natural resources assessments presented in other chapters of this Environmental Impact Statement (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 each of the proposed buildings could cast is calculated, and using this length as the radius, a perimeter is drawn around each site. Anything outside this perimeter, which represents 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.

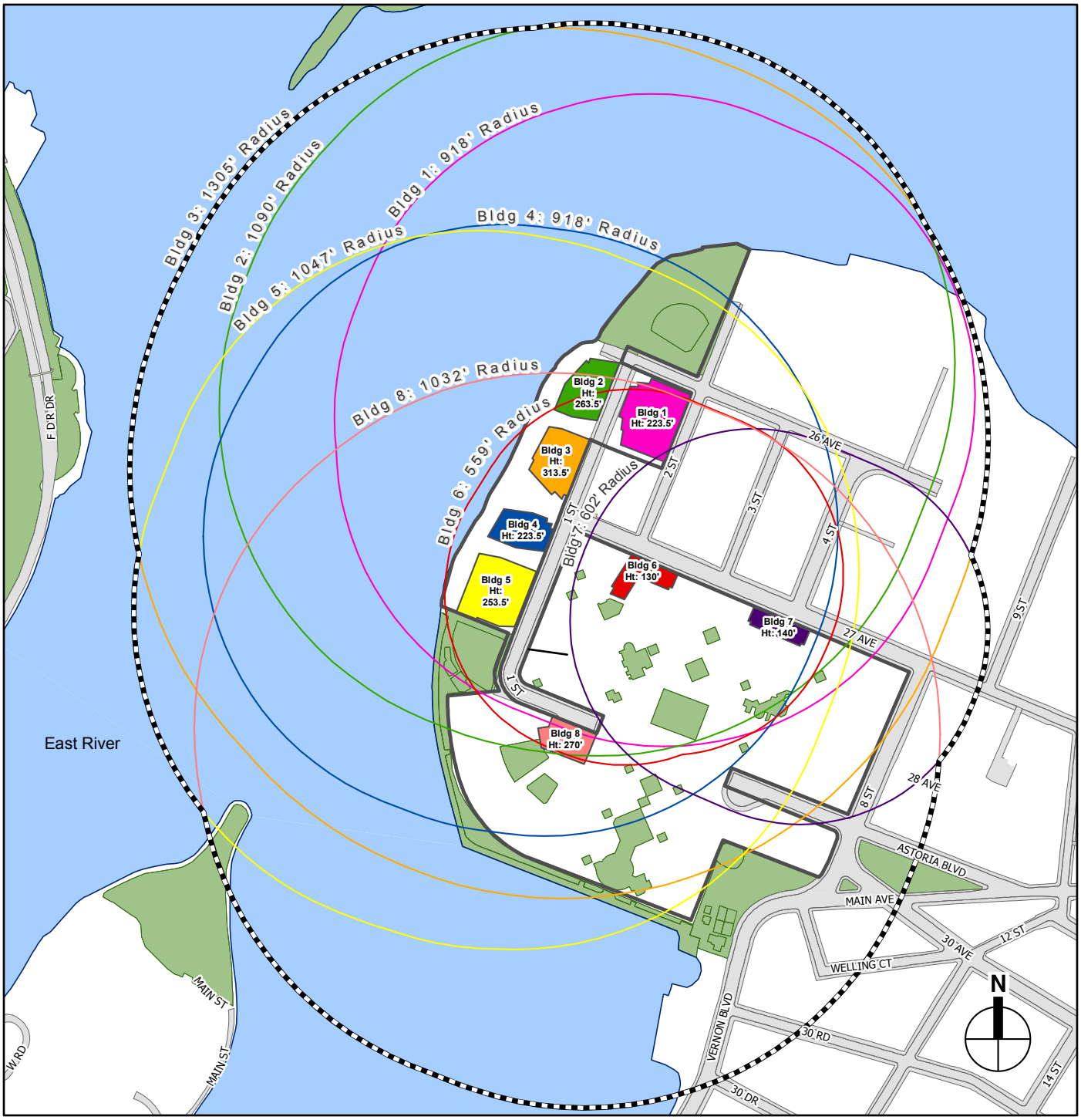
Table 7-1 summarizes the maximum height of each of the eight proposed buildings and, multiplying each height by 4.3, the longest possible shadow in feet that each building could cast.

Using the longest shadow distance as a radius, a perimeter was drawn around each site (see **Figure 7-1**). Since a number of sun-sensitive resources lie within the combined perimeter or longest shadow study area, 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 7-2** illustrates this triangular area south of the project site. The complementing area to the north within the combined longest shadow study area represents the remaining area that could potentially experience new project-generated shadow.

[1] Software: Esri ArcGIS 10.1; Data: New York City Department of Information Technology and Telecommunications (DoITT) and other City agencies, and AKRF site visits.



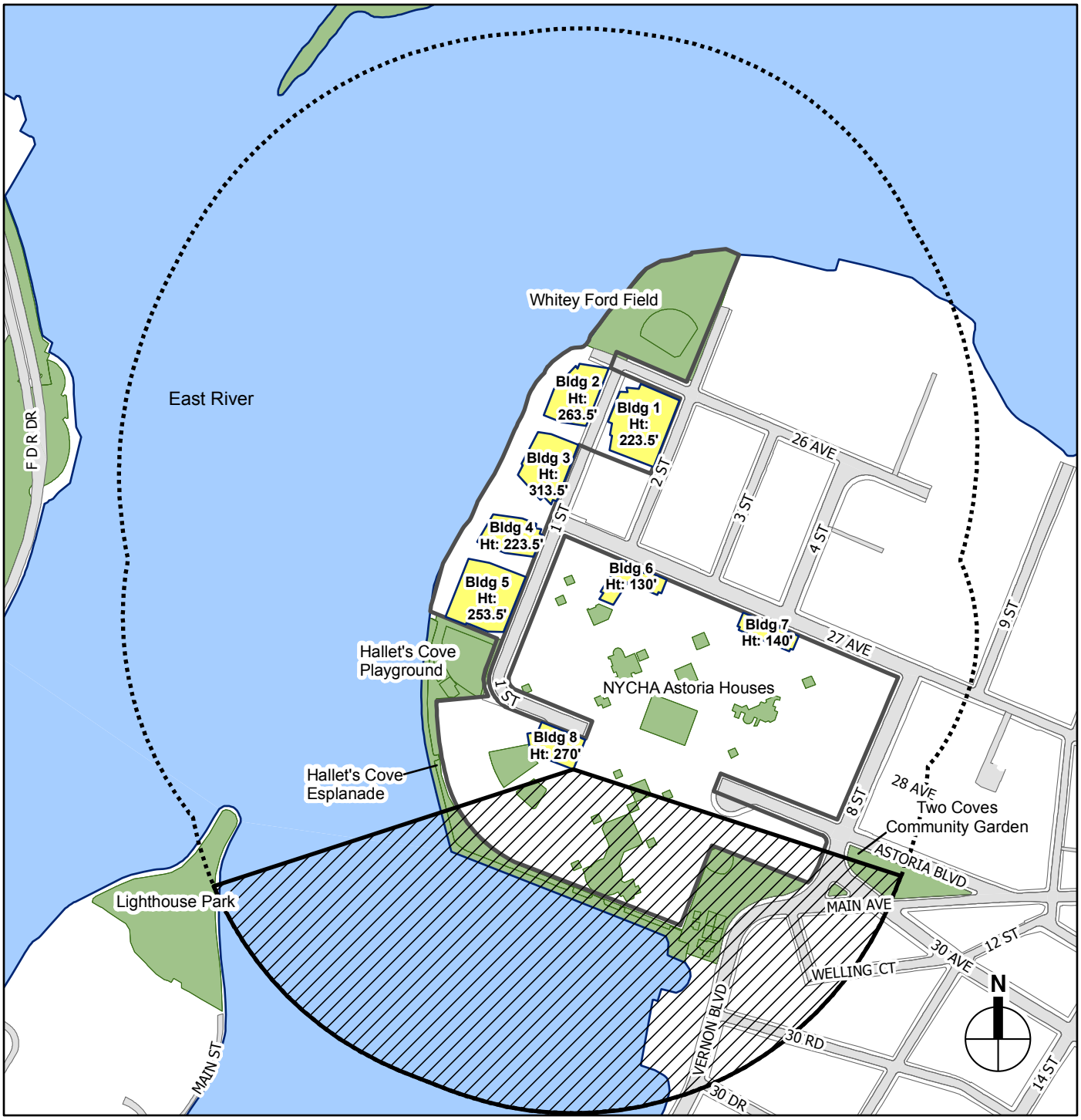
The longest shadow a structure can cast occurs on December 21 at the start of the analysis day, and its length is equal to 4.3 times the height of the structure. For the Tier 1 analysis, a radius representing this maximum shadow length was calculated and drawn for each proposed building.

In this diagram each proposed building and the corresponding maximum shadow length radius from each building are represented by a unique color.

Tier 1: Longest Shadow Study Area Boundary

Publicly Accessible Open Space

4.3.13



Proposed Buildings

Publicly Accessible Open Space

Area that Cannot Be Shaded by Project

Remaining Longest Shadow Study Area Boundary

Table 7-1
Heights and Maximum Shadow Lengths of the Proposed Buildings

Proposed Buildings	Maximum Height (in Feet) above Base Plane[1]	Maximum Shadow Length Factor	Longest Shadow (in Feet)
Building 1	223.5	4.3	961.05
Building 2	263.5	4.3	1133.05
Building 3	313.5	4.3	1348.05
Building 4	223.5	4.3	961.05
Building 5	253.5	4.3	1090.05
Building 6	130	4.3	559
Building 7	140	4.3	602
Building 8	270	4.3	1032

Notes: 1. Base plane, in feet above Queens datum, is +8.35' for Buildings 1 through 5, +15.19' for Buildings 6 and 7, and +9.46' for Building 8.

A number of public open spaces, and the East River, a sun-sensitive natural feature, are located within the remaining shadow study area, as shown in **Figure 7-2**. Therefore, the next tier of assessment was required.

TIER 3 SCREENING ASSESSMENT

The direction and length of shadows vary throughout the course of the day and also differ depending on the season. In order to determine when project-generated shadow could fall on a sunlight-sensitive resource, three-dimensional computer mapping software is used in the Tier 3 assessment to calculate and display the proposed project's shadows on individual representative days of the year.

REPRESENTATIVE DAYS FOR ANALYSIS

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.

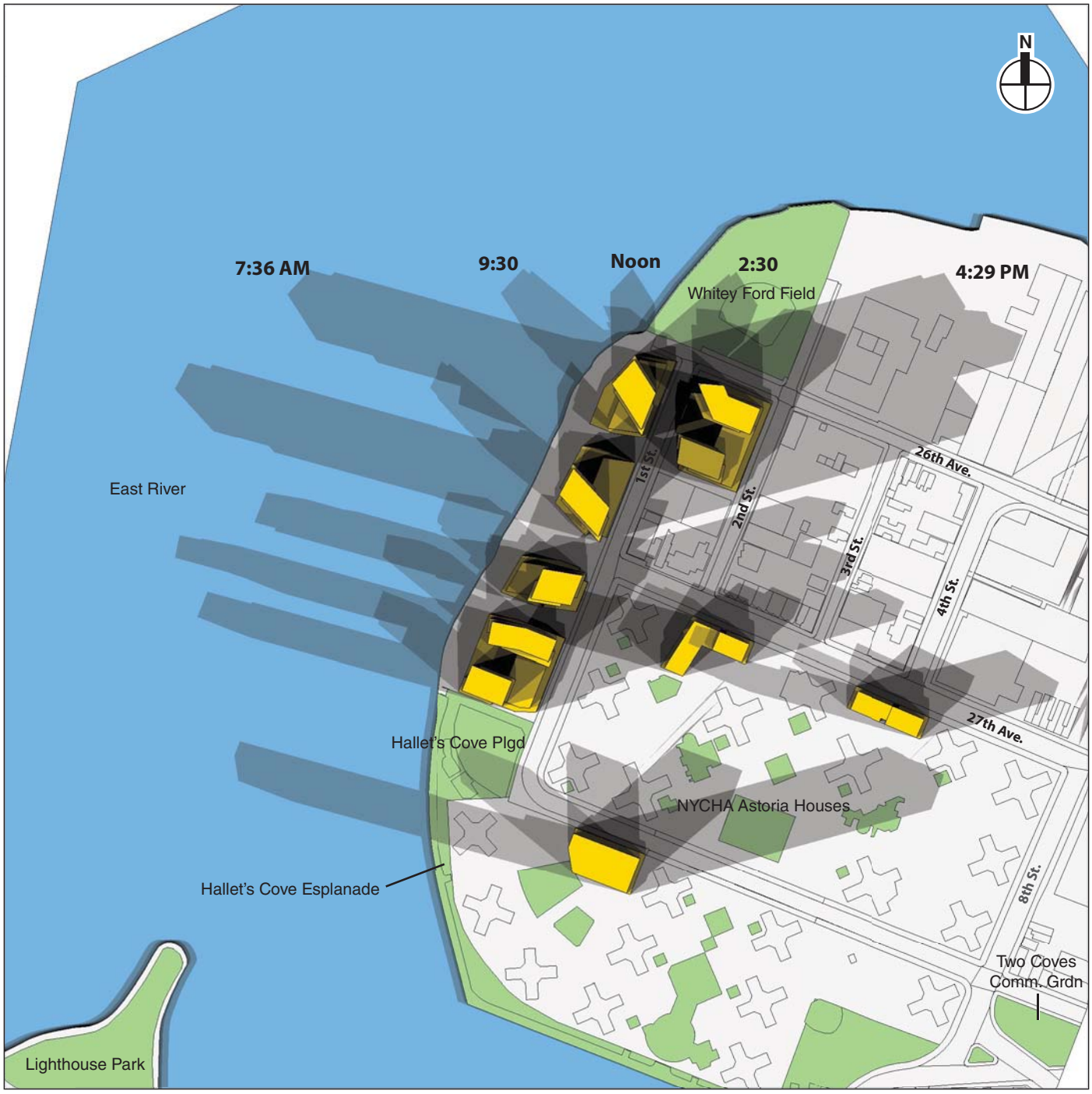
TIMEFRAME WINDOW OF ANALYSIS

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 tangential angles, diminishing the amount of solar energy and producing shadows that are 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 7-3 to 7-6 illustrate the range of shadows that would occur, in the absence of intervening buildings, from the proposed project on the four representative days for analysis. As they move east and clockwise over the landscape, the shadows from the proposed buildings are

3.8.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Shadow

This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed buildings on this representative day. The shadows are shown occurring approximately every two to three hours 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 shadow across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow.

HALLETTS POINT

Tier 3 Assessment - March 21/Sept. 21

Figure 7-3

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Shadow

This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed buildings on this representative day. The shadows are shown occurring approximately every two to three hours 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 shadow across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow.

HALLETTS POINT

Tier 3 Assessment - May 6/August 6

Figure 7-4

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

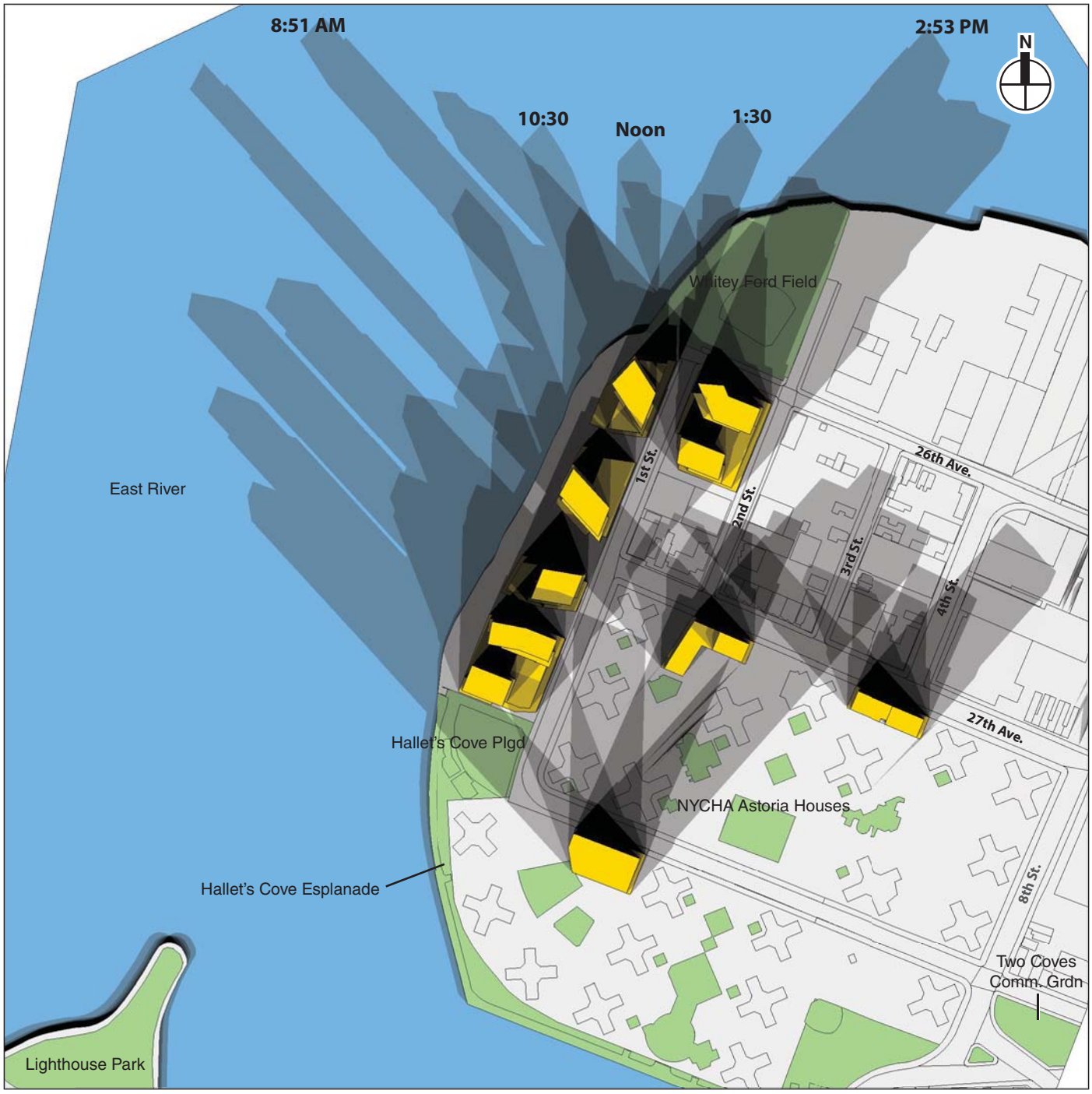
Shadow

This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed buildings on this representative day. The shadows are shown occurring approximately every two to three hours 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 shadow across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow.

HALLETTS POINT

Tier 3 Assessment - June 21

Figure 7-5



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Shadow

This figure illustrates the range of shadows that would occur, absent intervening structures, from the proposed buildings on this representative day. The shadows are shown occurring approximately every two to three hours 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 shadow across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow.

shown occurring approximately every two hours 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 several sunlight-sensitive resources are located in the sweep of project generated shadow on one or more analysis days. These resources, which include Whitey Ford Field, Hallet's Cove Playground, Hallet's Cove Esplanade, NYCHA Astoria Houses Campus, Lighthouse Park, and the East River, are described in more detail below.

Whitey Ford Field, just north of Buildings 1 and 2, could be affected by project-generated shadow on all four analysis days.

Portions of **Hallet's Cove Playground** could receive new shadows from Building 8 on the March 21/September 21 and December 21 analysis days and from Building 5 early in the mornings of the May 6/August 6 and June 21 analysis days. Portions of **Hallet's Cove Esplanade** could receive new shadows from Building 8 on all four analysis days.

In the **NYCHA Astoria Houses Campus**, there are some small seating areas adjacent to the three westernmost buildings that could potentially receive new shadows on all four analysis days. There are two playground areas south of proposed Building 6; one of them could receive new shadows on all four analysis days, and the other could receive new shadows on three of the four analysis days. A few other seating areas or play areas in the north and central area of the Astoria Houses Campus could receive project generated shadows on one or two of the analysis days.

Shadow from Building 8 would be long enough to reach a small area of the Two Coves Community Garden at the very end of the June 21 analysis day.

Project-generated shadow would fall on areas of the **East River** adjacent to the project site on each of the four analysis days.

In summary, the Tier 3 screening assessment concluded that, in the absence of intervening buildings, shadows from the proposed buildings would reach portions of four open space resources and the East River on all four analysis days, and another open space resource on one of the four analysis days. Therefore, a detailed analysis is warranted for those resources on the relevant analysis periods. No other open spaces or natural resources, nor any sunlight-sensitive features of historic or cultural resources, would be affected by project shadows.

RESOURCES OF CONCERN

OPEN SPACES

Table 7-2 lists the open space resources of concern, the owner or agency responsible for maintaining the space, the specific features of the resources, and the condition and utilization rates.

NATURAL RESOURCES

The East River is a tidal strait connecting western Long Island Sound with upper New York Harbor. It is classified by New York State Department of Environmental Conservation (NYSDEC) as Use Classification I. Recommended uses for Class I waters are secondary contact recreation and fishing, and water quality should be suitable for fish propagation and survival. The entire shoreline of the project site is bulkheaded and rip-rapped, and no vegetated tidal wetlands are present.

Table 7-2
Open Space Resources of Concern

Name	Owner/Agency	Features	Condition	Utilization
Whitey Ford Field	DPR	Grass, a few trees in the southern portion, baseball diamond, bleachers, benches, fitness equipment	Poor	Heavy
Hallet's Cove Playground	DPR	Entirely paved or hard surface: Play equipment, ball courts, benches	Fair	Moderate
Hallet's Cove Esplanade	DPR	Esplanade, benches	Poor	Moderate
NYCHA Astoria Houses Campus open spaces	NYCHA	Discrete areas within the development: basketball courts, play equipment, benches	Good	Heavy
Two Coves Community Garden	DPR	Planting beds, paths, benches, picnic tables	Good	Low
Note: The Astoria Houses open spaces comprise many small seating areas scattered throughout the development, as well as several discrete areas containing play equipment or ball courts				

HISTORIC AND CULTURAL RESOURCES

No historic resources with sunlight-sensitive features are located in the shadow study area.

D. DETAILED SHADOW ANALYSIS

The purpose of the detailed analysis is to determine the extent and duration of new incremental shadows that fall on sunlight-sensitive resources as a result of the project, and to assess their effects. A baseline or future No Build condition is established, containing existing buildings and sunlight-sensitive resources and any future developments planned in the area, to illustrate the baseline shadows from buildings and other structures in the study area defined in the preliminary assessment. The future condition with the proposed project (the Build condition) and its shadows can then be compared to the baseline condition with shadows from the No Build 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 NYC DoITT, Sanborn maps, and photos taken during project site visits, and were added to the three-dimensional model used in the Tier 3 assessment. **Figure 7-7** shows a view of the computer model used in the analysis.

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 development with the future No Build condition in which the site would remain as in the existing condition.

Shadow analyses were performed for each of the representative days and analysis periods indicated in the Tier 3 assessment.

Table 7-3 summarizes the entry and exit times and total duration of incremental shadows on each affected sun-sensitive resource. **Figures 7-8 to 7-25** document the results of the analysis by providing graphic representations from the computer animation of times when incremental shadow would fall on

4.3.13



Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

3D Computer Model - View North

Figure 7-7



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

March 21/Sept. 21 - 7:40 AM

Figure 7-8

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

March 21/Sept. 21 - 10:00 AM

Figure 7-9

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

March 21/Sept. 21 - 11:30 AM

Figure 7-10

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

March 21/Sept. 21 - 2:00 PM

Figure 7-11

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

March 21/Sept. 21 - 3:10 PM

Figure 7-12

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

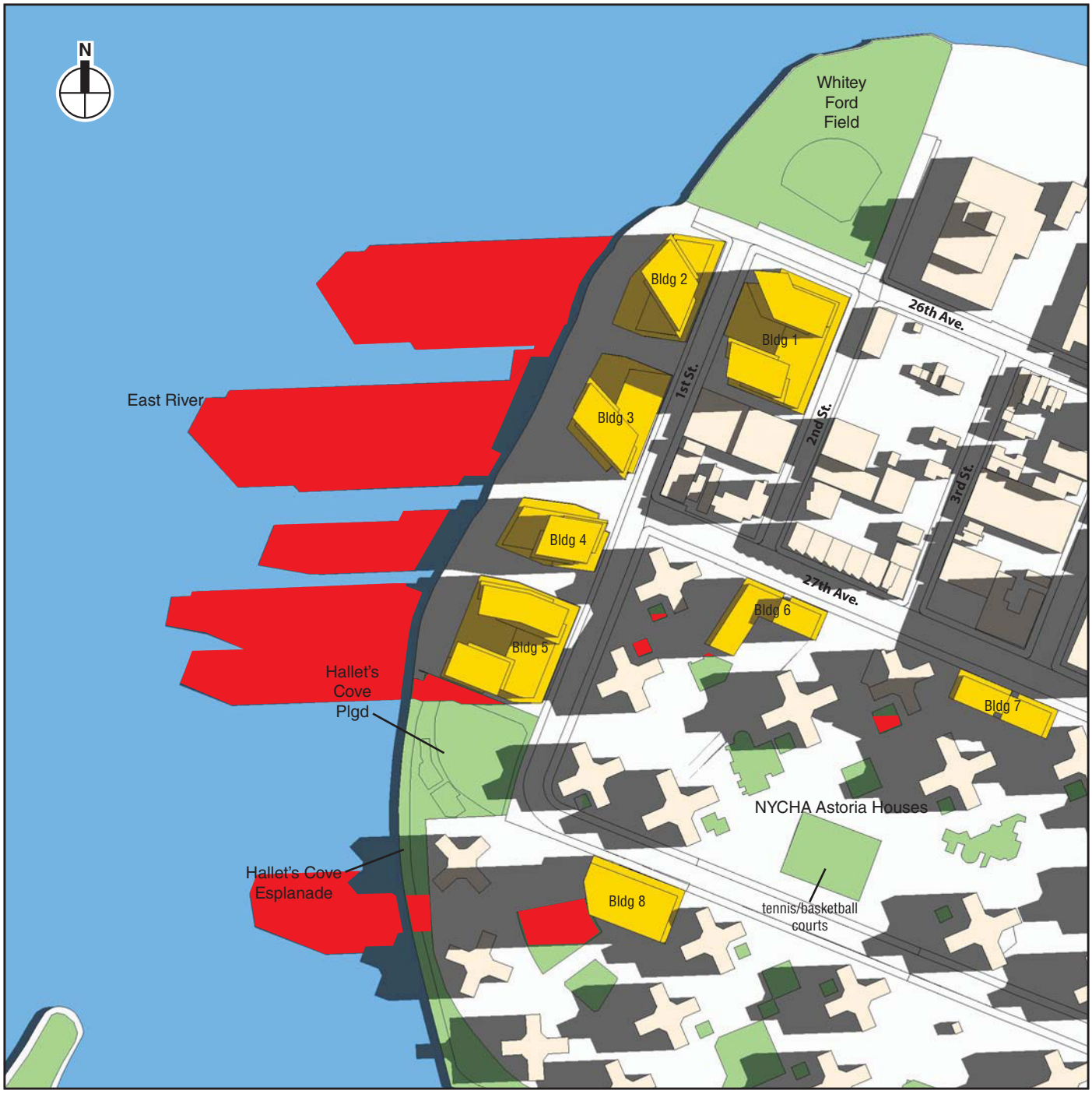
Incremental Shadow

HALLETTS POINT

March 21/Sept. 21 - 4:20 PM

Figure 7-13

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

May 6/August 6 - 7:00 AM

Figure 7-14

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

May 6/August 6 - 9:00 AM

Figure 7-15

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

May 6/August 6 - 12:00 PM

Figure 7-16

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

May 6/August 6 - 3:00 PM

Figure 7-17

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

May 6/August 6 - 5:00 PM

Figure 7-18

4.3.13



Note: Daylight Saving Time not used.

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

June 21 - 8:00 AM

Figure 7-19

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

June 21 - 10:30 AM

Figure 7-20

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

June 21 - 1:30 PM

Figure 7-21

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

June 21 - 5:00 PM

Figure 7-22

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

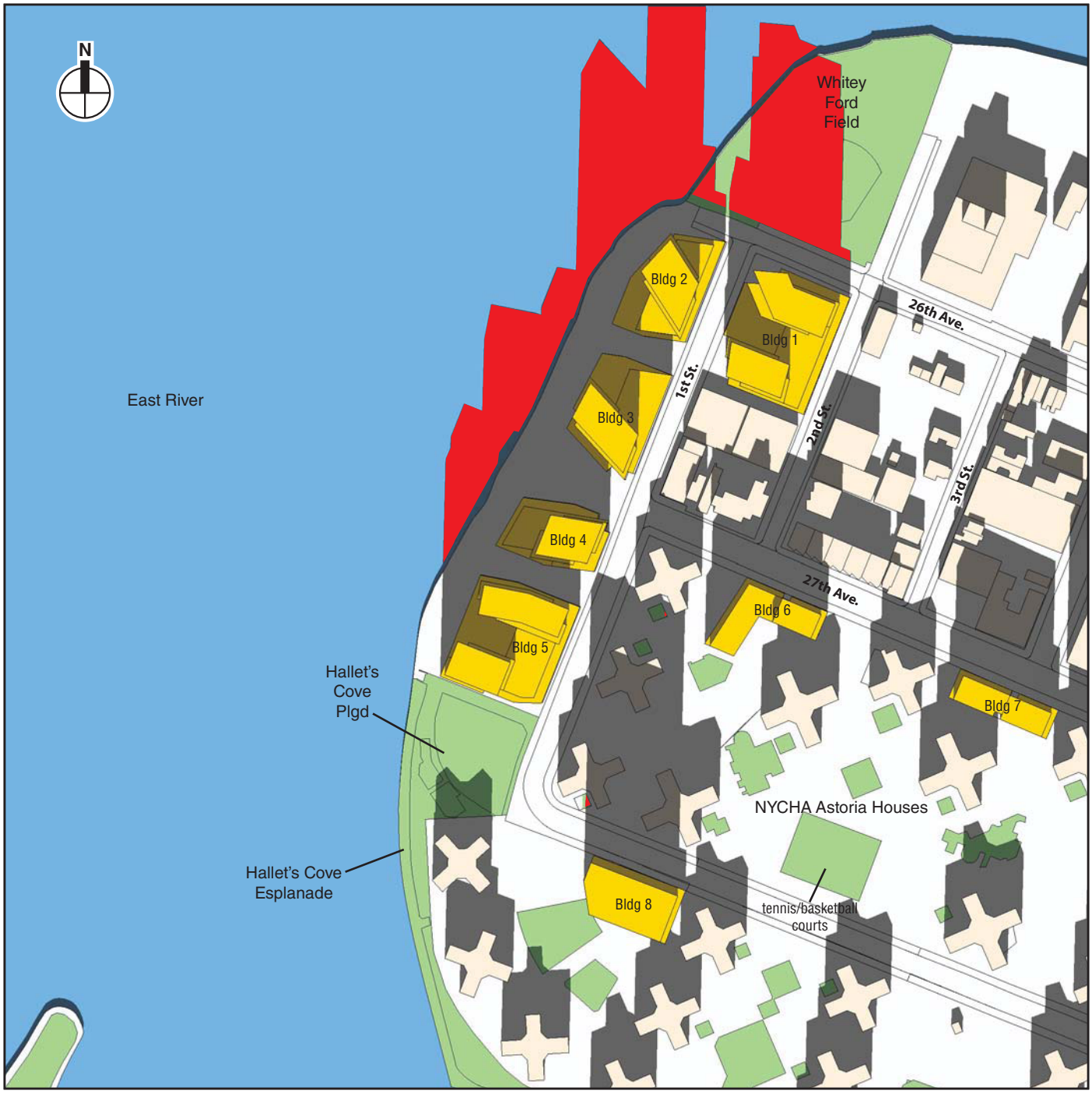
Incremental Shadow

HALLETTS POINT

December 21 - 9:30 AM

Figure 7-23

4.3.13



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

December 21 - 12:00 PM

Figure 7-24



Note: Daylight Saving Time not used.

0 200 1000 FEET

SCALE

Proposed Buildings

Publicly Accessible Open Space (does not include project-generated open space)

Incremental Shadow

HALLETTS POINT

December 21 - 2:30 PM

Figure 7-25

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 7-3
Incremental Shadow Durations

Analysis day and timeframe window	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	December 21 8:51 AM-2:53 PM
OPEN SPACES				
Hallet's Cove Esplanade	7:36 AM–9:00 AM Total: 1 hr 24 min	6:27 AM–8:10 AM Total: 1 hr 43 min	5:57 AM–8:40 AM Total: 2 hr 43 min	8:51 AM–9:20 AM Total: 29 min
Hallet's Cove Playground	7:36 AM–10:40 AM Total: 3 hr 4 min	6:27 AM–8:40 AM 9:20 AM–9:40 AM Total: 2 hr 33 min	5:57 AM–9:20 AM Total: 3 hr 23 min	8:51 AM–10:40 AM Total: 1 hr 49 min
Whitey Ford Field	9:40 AM–4:29 PM Total: 6 hr 49 min	11:30 AM–5:18 PM Total: 5 hr 48 min	12:50 PM–4:40 PM Total: 3 hr 50 min	8:51 AM-2:53 PM Total: 6 hr 2 min
NYCHA Astoria Houses Campus open spaces	7:36 AM–9:10 AM 9:50 AM–12:10 PM 1:10 PM–4:29 PM Total: 7 hr 13 min	6:27 AM–10:40 AM 11:20 AM–11:50 AM 1:20 PM–5:18 PM Total: 8 hr 41 min	5:57 AM–11:00 AM 2:40 PM–6:01 PM Total: 8 hr 24 min	8:51–9:40 AM 9:50 AM-2:53 PM Total: 5 hr 52 min
Two Coves Community Garden	—	—	5:59 AM–6:01 AM Total: 2 min	—
NATURAL FEATURES				
East River	7:36 AM–1:30 PM Total: 5 hr 54 min	6:27 AM–12:40 PM Total: 6 hr 13 min	5:57 AM–12:20 PM Total: 6 hr 23 min	8:51 AM-2:53 PM Total: 6 hr 2 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.

The Astoria Houses open spaces comprise many small seating areas scattered throughout the development, as well as several discrete areas containing play equipment or ball courts.

MARCH 21/SEPTEMBER 21 (FIGURES 7-8 TO 7-13)

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.

At the start of the analysis day shadows from the proposed buildings fall to the northwest onto the East River and, in the case of Building 8, across small portions of the Esplanade and Hallet's Cove Playground (see **Figure 7-8**). Shadow from Building 6 would fall on a small Astoria Houses seating area to its west from 7:36 AM until 9:10 AM.

Shadows would shorten and move east during the morning hours. At 9:00 AM Building 8's shadow would exit Hallet's Cove Esplanade but would fall across much of the southern half of Hallet's Cove Playground. By 10:00 AM shadow from Building 8 would fall across a smaller area of the Hallet's Cove Playground in the southeast section (see **Figure 7-9**). Building 8's shadow would exit Hallet's Cove Playground at 10:40 AM. Building 8's shadow would move onto the small Astoria Houses seating area to its immediate north at 9:50 AM and shade it completely by 10:00 AM (see **Figure 7-9**). Building 8's shadow would continue to shade this entire small seating area to its north until about 11:50 AM (see **Figure 7-10** showing 11:30 AM), and would exit it completely twenty minutes later at 12:10 PM.

By 10:00 AM incremental shadow from Building 1 would have just entered the southwest corner of Whitey Ford Field (see **Figure 7-9**). Building 1's shadow would continue to move across part

of Whitey Ford Field south of the ball field during the late morning (see **Figure 7-10**). Building 2's shadow would enter the southwest corner of Whitey Ford Field just after noon. Incremental shadows from Buildings 1 and 2 would continue to move eastward across the southern half of Whitey Ford Field during the afternoon (see **Figures 7-11 through 7-13**).

From 1:10 PM to the end of the analysis day at 4:29 PM Building 8's shadow would fall into the central area of the Astoria Houses superblock, falling on portions of four other seating areas, a playground, and ball courts at different times as it moved across the superblock over the course of the afternoon (**Figures 7-11 through 7-13**). Shadow from Building 5 would shade an Astoria Houses seating area to its east for the final hour of the analysis day.

Shadow from Buildings 2 through 5 would fall northeast onto areas of the East River from the start of the analysis day until around noon, and Building 2 would continue to cast a small area of shadow northward onto the water until 1:30 PM.

MAY 6/AUGUST 6 (FIGURES 7-14 TO 7-18)

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 from Building 8, and briefly from Building 5, would fall on small areas of the Hallet's Cove Esplanade from 6:27 AM until 8:10 AM (see **Figure 7-14**). Building 5 would also cast a small shadow at the northern edge of the Hallet's Cove Playground from 6:27 AM to 8:40 AM. Building 8 would cast a very small shadow in the southeast corner of the playground for about 20 minutes, from 9:20 AM to 9:40 AM.

Incremental shadow from Buildings 6, 7 and 8 would fall on three small Astoria Houses seating areas and the playground adjacent to Building 8 beginning at 6:27 AM. The incremental shadow would exit two of the seating areas by 8:00 AM, the third at 9:00 AM, and the playground by about 10:40 AM (see **Figures 7-14 and 7-15**). Building 8's shadow would shade part of the small seating area to its immediate north in Astoria Houses briefly from 11:20 AM to 11:50 AM (**Figure 7-16**).

Shadows from Buildings 1 and 2 would move west to east across the southern part of Whitey Ford Field from 11:30 AM to the end of the analysis day at 5:18 PM (see **Figures 7-16 through 7-18**). Despite the long duration the incremental shadow would be limited to the southern area between the ball field and the fence along the southern boundary.

From 1:20 PM to 2:30 PM, Building 8 would shade a portion of a small Astoria Houses seating area to its north. Building 5 would shade one small Astoria Houses seating area to its east beginning at 2:50 PM until the end of the analysis day at 5:18 PM, and from 3:30 PM, a second seating area to its east, also to 5:18 PM (see **Figures 7-17 and 7-18**). Building 8 would shade part of the large ball courts to its east from 2:40 PM to 5:10 PM. A playground and a fourth seating area would be shaded by project-generated shadow briefly near the end of the analysis day.

Small incremental shadows would fall onto the East River from the start of the analysis day until nearly noon, and Building 2 would continue to cast a small area of shadow northward onto the water until 12:40 PM.

JUNE 21 (FIGURE 7-19 TO 7-22)

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 mid-day on June 21 are shorter than at any other time of year. June 21 is also in the growing season.

Incremental shadow from Building 8 and Building 5 would fall on small sections of the Hallet's Cove Esplanade from 5:57 AM until 8:40 AM (see **Figure 7-19**). Building 5 would cast a shadow on the adjacent Hallet's Cove Playground from 5:57 AM until about 9:20 AM (see **Figures 7-19**).

Shadows from Buildings 6 and 7 would fall on small portions of seating and play areas in Astoria Houses to their southwest for the first two and a half hours of the analysis day (see **Figure 7-19**). In addition, shadow from Building 8 would fall on the adjacent playground to its southwest from the start of the analysis day until about 11:00 AM (see **Figure 7-20**).

Very small shadows from Buildings 1 and 2 would move west to east across the southern part of Whitey Ford Field from 12:50 PM to 4:40 PM (see **Figure 7-21**).

Building 5 would shade portions of seating areas to its east from 2:40 PM to the end of the analysis day at 6:01 PM, and a portion of a playground further to its east from 4:40 PM to 6:01 PM (see **Figure 7-22**).

Building 8 would cast a very small shadow at the southern edge of the central Astoria Houses ball courts from 2:50 PM to 4:20 PM. Building 8's shadow would also fall on a very small area of Two Coves Community Garden for the final two minutes of the analysis day.

Large but quick-moving incremental shadows would fall onto the East River from the start of the analysis day until mid-morning; the shadows would then become smaller, and the last incremental shadow would exit at 12:20 PM.

DECEMBER 21 (FIGURES 7-23 TO 7-25)

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.

Building 8 would cast incremental shadow on a section at the northern end of Hallet's Cove Esplanade from the start of the analysis day at 8:51 AM until 9:20 AM, and on Hallet's Cove Playground from 8:51 AM to 10:40 AM, and on a very small section of the Astoria Houses playground to the southwest from 8:51 to 9:40 AM (see **Figure 7-23**). Building 8's shadow would fall across the Astoria Houses seating area to its northeast from 8:51 AM to noon (see **Figures 7-23 and 7-24**), and also onto portions of two small seating areas and a playground further north in Astoria Houses from 1:40 PM to 2:53 PM (see **Figure 7-25**).

Large incremental shadows would move across Whitey Ford Field over the course of the entire six-hour analysis period (see **Figures 7-23 through 7-25**).

Shadows would move across the East River northwest and north of the development site throughout the analysis day.

E. CONCLUSIONS

This section summarizes the potential shadow effects for each resource of concern, and assesses whether the proposed project would result in any significant adverse shadow impacts on these resources.

HALLET'S COVE ESPLANADE

Project-generated shadows would come primarily from Building 8. Small areas of the esplanade would be affected, relative to its overall size, and there would always be sunlit areas of the esplanade to the south for users during times when incremental shadow would occur. In addition, the proposed project's esplanade would connect to this esplanade, and would also provide areas of sunlit areas at times when the Hallet's Cove Esplanade is in shade. Vegetation in areas affected by project shadow would continue to receive a minimum of four hours of direct sunlight in the mid-days and afternoons throughout the growing season. Therefore, no significant adverse impacts to vegetation or users of the esplanade would occur.

HALLET'S COVE PLAYGROUND

This space is entirely hard-surface, containing a baseball field and play equipment, and some benches. Project-generated shadow would come almost entirely from Building 8. The paved ball field is an active recreational facility that is not particularly sensitive to shadows, and the usage of the overall space is moderate according to site visits in 2012. Incremental shadow durations would range from 30 minutes in the winter to two hours 43 minutes on the summer solstice. Some sunlit areas would remain during affected time periods, and the space would be fully in sun throughout the afternoons year-round. Therefore, no significant adverse shadows impacts would occur.

WHITEY FORD FIELD

This entire open space is devoted to active uses: a baseball field takes up most of the space, and some fitness equipment and bleachers are in the southern portion. The field is natural grass with a dirt infield. There are a few trees in the southwest and south east corners of the space, near the perimeter fence, and two more trees in the northern portion of the space beyond the outfield.

On the May 6/August 6 and June 21 analysis days, project-generated shadows would be small, limited to the area south of the baseball field. All the trees would continue to receive more than six hours of direct sun on these analysis days. On March 21/September 21, the overall duration of new shadows would be six hours and 49 minutes. However, there would be no new shadows on the space until 9:40 AM, and the new shadows would remain small from 9:40 AM until after noon, falling on areas near the southern perimeter of the space. From approximately 1:00 PM to the end of the analysis day at 4:29 PM, new shadows would fall on between roughly a third and a half of the entire park. During this time portions of the infield and most of the outfield areas of the baseball field (the primary recreation feature for users of this space), would remain in direct sun. The exercise equipment area would be mostly in incremental shadow from approximately 1:20 PM to 4:10 PM but at other times would remain in direct sun. All of the trees would continue to receive a minimum of four hours of direct sun. In winter, incremental shadows would very large but fast moving for much of the day. However, according to site visits in 2012, usage, as would be expected, would be particularly low in winter.

The field is situated on the waterfront and is bounded on the north and west by the East River and by low structures across 2nd Street to the east. Consequently, in addition to the direct sunlight that would remain on large portions of the field throughout the day in the spring, summer, and fall, a great deal of ambient skylight from the west, north, and east would illuminate this field even during times when incremental shadow would fall on some areas in the southern part of the open space. The new shadows in the southern portion of the open space would be limited in extent, particularly in the late spring and summer, and the ability of the park to serve its users, primarily youth and adult baseball and softball leagues active in the spring, summer and fall, would not be substantially reduced. Throughout the growing season, all areas of the field would receive at least four hours of direct sun. One of the primary sunlight sensitive resources at Whitey Ford Field is the turf of the playing field. The shadows analysis demonstrates that, despite the incremental increase in shadows, the reduction in exposure is not decreased below the sunlight requirements of the turf. No significant shadow impacts would be expected to occur to either the vegetation or the users of the space.

NYCHA ASTORIA HOUSES CAMPUS OPEN SPACES

Various seating areas, play areas and the central ball courts would experience durations of incremental shadow, from Buildings 5, 6, 7 and 8. The incremental shadows from these buildings would pass across sections of the large NYCHA Astoria Houses Campus at different times of the day, lasting overall from five hours in some seasons to more than eight and half hours on May 6/August 6. However, no one seating area, play area or ball court would receive the total duration of incremental shadow on any analysis day. The seating areas contain benches, and when certain benches would receive new shadows, there would always be other seating areas in direct sun nearby. Similarly, when project shadow would fall on areas containing play equipment, there would always be other areas nearby in sun, even late in the afternoons. Therefore, the new shadows would not cause significant adverse impacts due to shadows on the Astoria Houses open spaces.

EAST RIVER

The proposed project would cast new shadows on portions of the East River in the mornings in all seasons, primarily affecting areas adjacent to the shoreline. While the total duration of new shadow would generally be six to six and a half hours throughout the year, most affected areas would receive shorter durations as the shadows move west to east and clockwise over the course of the day. The areas that would receive the longest durations of new shadows would continue to receive several hours of sunlight over the course of each analysis day, because there are no other nearby structures casting shadows besides the ones on the proposed development site.

The current flows swiftly in the East River and would move phytoplankton and other natural elements quickly through the shaded areas. Therefore, given their limited duration and extent over the course of each analysis day, incremental shadows generated by the proposed project would not result in significant adverse impacts on the East River. ✷