Chapter 6: Shadows

A. INTRODUCTION

This chapter considers the potential for the Proposed Actions to induce new buildings that can cast new shadows on sunlight sensitive resources, which include publicly accessible parks and other open spaces, sunlight-dependent features of historic resources, and natural resources that depend on sunlight. Following the guidelines of the 2020 *City Environmental Quality Review (CEQR) Technical Manual*, a shadow study is required if a proposed project would result in structures 50 feet or more in 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," the Proposed Actions would facilitate the development of a series of mixed-use buildings, the tallest of which would be 335 feet (including rooftop bulkhead and mechanical structures). In addition, three of the Projected Development Sites would be adjacent to, or across the street from, Playground Thirty Five XXXV, a public park. Consequently, a shadow study was conducted to determine whether and to what extent new shadows would be cast on the adjacent park and any other sunlight-sensitive resources and to assess the significance of their impact.

PRINCIPAL CONCLUSIONS

A detailed shadows analysis was conducted based on the methodology set forth in the *CEQR Technical Manual* and determined that the Proposed Actions would result in a significant adverse impact related to shadows. Specifically, development resulting from the Proposed Actions would cast new shadows on Playground Thirty Five XXXV, moving throughout the day in all seasons, covering large areas of the playground at times, eliminating much or all of the remaining sunlight in the park at times—particularly in the fall, winter, and early spring—and affecting the user experience in all seasons. Trees and plantings in the park would continue to receive adequate direct sunlight through the May to August heart of the growing seasons, but those in the southern part of the park would receive up to an hour less than generally desired during the March and September "shoulders" of the growing season, potentially impacting the health of those trees or plantings. The Proposed Actions would not cause significant shadows on any other sunlight-sensitive resources.

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 that a structure resulting from a proposed project would cast on a sunlight-sensitive resource.

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

- *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 the following: 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 the following, for the purposes of CEQR:

- *City streets and sidewalks* (except Greenstreets);
- *Private open space* (e.g., front and back yards, stoops, vacant lots, community gardens and any private, non-publicly accessible open space); and
- *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 discussion of how shadows would affect the new space may be warranted.

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

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 development(s) 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. Incremental shadows are determined by establishing a baseline condition in the future without the Proposed Actions (the No Action condition) and comparing it to the future condition with the Proposed Project (the With Action condition), thus illustrating the baseline shadows cast by existing (or future No Action) buildings and distinguishing the additional (incremental) shadows cast by a proposed 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.

ANALYSIS FRAMEWORK

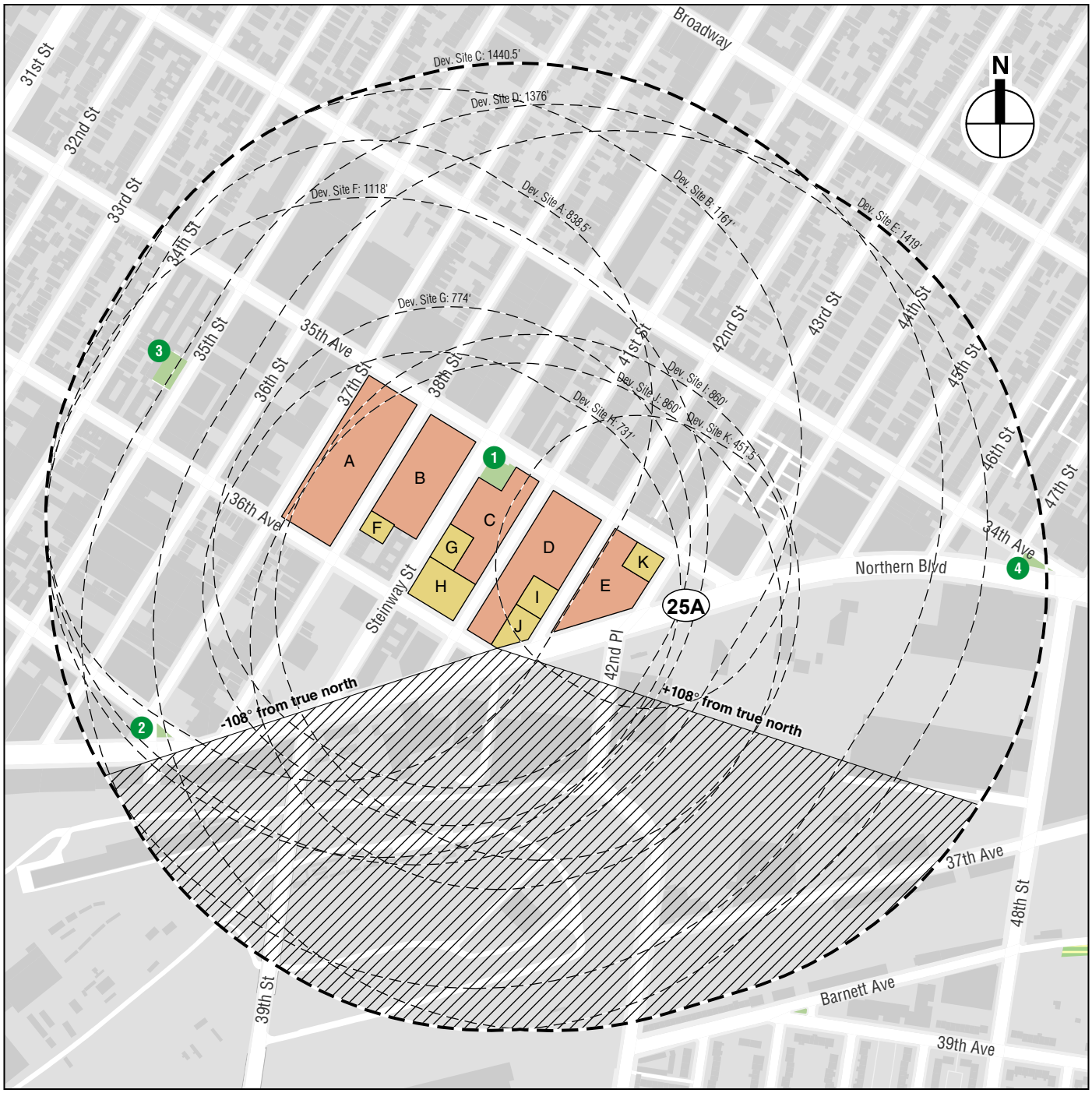
To assess the potential effects of the Proposed Actions, a Reasonable Worst Case Development Scenario (RWCDS) was developed for both the future With Action condition and the future No Action condition. As described in Chapter 1, "Project Description," the With Action RWCDS would include the Proposed Development on Projected Development Sites A, B, C, D, and E, with buildings ranging in maximum height from 155 feet to 295 feet. In order to ensure a conservative analysis, space for rooftop mechanical structures was added to the Proposed Development building massings, resulting in maximum heights of 195 feet to 335 feet. The With Action RWCDS would also include additional developments on Projected Development Sites F, G, H, I, J, and K, ranging in maximum heights from 80 feet to 220 feet, or 105 feet to 260 feet including rooftop mechanical structures. In the No Action condition, also described in detail in Chapter 1, "Project Description," the Projected Development Sites would contain 1-story buildings, small multi-family townhouses, and surface parking.

C. PRELIMINARY SCREENING ASSESSMENT

A base map was developed using Geographic Information Systems (GIS)[1] showing the location of the Projected Development Sites and the surrounding street layout (see **Figure 6-1**). Mapped databases of parks and other public open spaces, City, state, and national historic resources, and natural resources were added to the map.[2] In coordination with the open space and historic and cultural resources assessments presented in other sections of this DEIS, potential sunlight-sensitive resources were identified.

[1] Software: Esri ArcGIS Pro 2.8

[2] Data: City, State, and Federal agencies including New York City Parks Department; New York City Department of Information Technology and Telecommunications (DoITT), New York City Department of City Planning, New York City Landmarks Preservation Commission, New York City Department of Transportation, New York State Office of Parks, Recreation, and Historic Preservation, New York State Dept. of Environmental Conservation (NYSDEC), U.S. Fish and Wildlife Service, and others; supplemented by Nearmap hi-resolution imagery, and AKRF site visits.



Projected Development Sites (LSGD Area)

Projected Development Sites (Additional Affected Area)

Longest Shadow Study Area, Individual Development Sites (radius = max. height x 4.3)

Tier 1: Maximum Longest Shadow Study Area Perimeter

Tier 2: Area South of Development Sites That Could Never Be Shaded by Proposed Development

Publicly Accessible Open Space (see Table 6-2)

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Tier 1 and Tier 2 Assessments

Figure 6-1

TIER 1 SCREENING ASSESSMENT

For the Tier 1 assessment, the longest shadow that the With Action developments could cast was calculated and, using this length as the radius, a perimeter was drawn around the development sites. Anything outside this perimeter representing the longest possible shadow could never be affected by project-generated shadow, while anything inside the perimeter would need 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 the morning of December 21, the winter solstice, and is equal to 4.3 times the height of the structure.[3]

As noted above in the Analysis Framework section, to provide for a conservative analysis, the shadows assessment considered the height of each With Action development plus additional height to account for rooftop bulkheads and other mechanical structures, as shown in **Table 6-1**, below. Each With Action development's maximum height including rooftop mechanical was multiplied by 4.3 to determine the longest shadow it could cast, also shown in **Table 6-1**. For each development site, using its longest-shadow distance as the radius, a perimeter was drawn around the site. The resulting eleven perimeters were merged, resulting in the maximum longest-shadow study area for the overall With Action development, as shown in **Figure 6-1**.

Table 6-1
Tier 1: Longest Shadow

Development Site	Maximum Height	Maximum Height with Mechanical	Longest Shadow
A	155	195	838.5
B	230	270	1161
C	295	335	1440.5
D	280	320	1376
E	290	330	1419
F	220	260	1118
G	140	180	774
H	130	170	731
I	160	200	860
J	160	200	860
K	80	105	451.5

Notes:
Heights are given in feet. Longest shadow distance is calculated using a shadow factor of 4.3 x the height.

The Tier 1 assessment showed that four publicly accessible open spaces are located in the maximum longest shadow study area, and therefore the next tier of assessment was required for these resources. No historic resources with sunlight-sensitive features or natural resources are located in the maximum longest shadow study area.

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 structure or project site. In New York City this area lies between -108 and +108 degrees from true north. **Figure 6-1** illustrates this triangular area

[3] The CEQR shadows assessment considers shadows occurring between one and a half hours after sunrise and one and a half hours before sunset on any given day. For more information, see "Timeframe Window of Analysis" in "Tier 3 Assessment" below.

south of the Projected Development Sites. In many cases, the triangular area south of one given Site would be north of another development site located farther south. Only areas too far south to be shaded by any development on the Projected Development Site were included in the excluded Tier 2 area. The complementary area to the north within the maximum longest shadow study area represents the remaining area that could potentially experience new project generated shadow.

The Tier 2 assessment concluded that the same four publicly accessible open spaces identified in the Tier 1 assessment are located in the remaining Tier 2 longest shadow study area and required further assessment. The four open space resources of concern are listed in **Table 6-2** below, along with the Tier 3 assessment results.

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[4] is used in the Tier 3 assessment to calculate and display the proposed project's shadows on individual representative days of the year.

A computer model was developed containing three-dimensional representations of the elements in the base map used in the preceding assessments, the topographic information of the study area, and a reasonable worst-case three-dimensional representation of the Proposed Development and With Action developments in the Additional Affected Area.

Furthermore, for informational purposes, representations of the several public open spaces that would be developed as part of the Proposed Development were added to the three-dimensional model. As noted in the Methodology section above, project-generated public open space cannot experience a significant adverse impact from the project, because without the project the open space would not exist, but it can be included in the study and assessed for potential shadow conditions.

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 extremely long, move fast, and generally blend with other shadows. Consequently, shadows occurring outside the

[4] Bentley MicroStation

timeframe window of analysis are not considered significant under CEQR, and their assessment is not required.

TIER 3 SCREENING ASSESSMENT RESULTS

Figures 6-2 to 6-5 illustrate the range of shadows that would occur, in the absence of intervening buildings, from the With Action development on the four representative days for analysis. As they move clockwise and generally west to east 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). **Table 6-2** summarizes which analysis day or days each resource could potentially receive project-generated shadow.

Table 6-2
Tier 3 Assessment

Map Reference	Name	December 21	March 21/ September 21	May 6/ August 6	June 21
Publicly Accessible Open Space					
1	Playground Thirty Five XXXV	Potential	Potential	Potential	Potential
2	Triangle Thirty Seven XXXVII	No	No	No	Potential
3	ARROW Field House	No	No	No	No
4	Dwyer Square	No	No	No	No

Notes:
See **Figures 6-2 to 6-5** for corresponding resource locations and shadow sweeps.
In the columns representing the representative analysis dates, "No" means project-generated shadow could not reach the resource, even without accounting for intervening buildings. "Potential" means project-generated shadow could potentially reach the resource on this date and requires further assessment.

The Tier 3 assessment concluded that Playground Thirty Five XXXV, which is adjacent to Projected Development Site C, could potentially receive new project-generated shadow on all four representative analysis days. In addition, a portion of Triangle Thirty Seven XXXVII, a small park/traffic median at the intersection of 37th Street, 37th Avenue, and Northern Boulevard, could potentially receive project-generated shadow at the start of the June 21 analysis day only. These two open space resources required a detailed analysis. The other two resources included in the assessment were too far away and could not receive project-generated shadow on any representative day, and therefore do not require further assessment.

D. DETAILED SHADOW ANALYSIS

A detailed analysis is warranted when the screening analysis does not rule out the possibility that project-generated shadows would reach sunlight-sensitive resources. The detailed analysis establishes a baseline condition, the future without the Proposed Actions (the "No Action" condition), to illustrate the shadows cast by existing buildings (and other future planned buildings). This baseline is then compared to the future condition with the Proposed Actions (the "With Action" condition) to distinguish the additional (incremental) shadow cast by the Proposed Development and projected developments in the Additional Affected Area. The purpose of the detailed analysis is to determine the extent and duration of new incremental shadow that would be cast on a sunlight-sensitive resource as a result of the development facilitated by the Proposed Actions. Because existing (or future No Action) buildings may already cast shadows on a sunlight-sensitive resource, the Proposed Actions may not result in additional, or incremental, shadows on that resource.

Following the analysis framework described in Chapter 1, "Project Description," detailed analysis was performed for the analysis year of 2032, comparing the future With Action condition to the

4.1.22



Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-2)

Project-Generated Public Open Space

This figure illustrates the range of shadows that would occur from the Proposed Project on the analysis day representing the winter. The shadows are shown occurring approximately every 60 minutes from the start of the analysis day (90 minutes after sunrise) to the end of the analysis day (90 minutes before sunset). The Tier 3 assessment does not account for future No Action shadows, and the shadows shown in this figure do not represent incremental shadows. 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.

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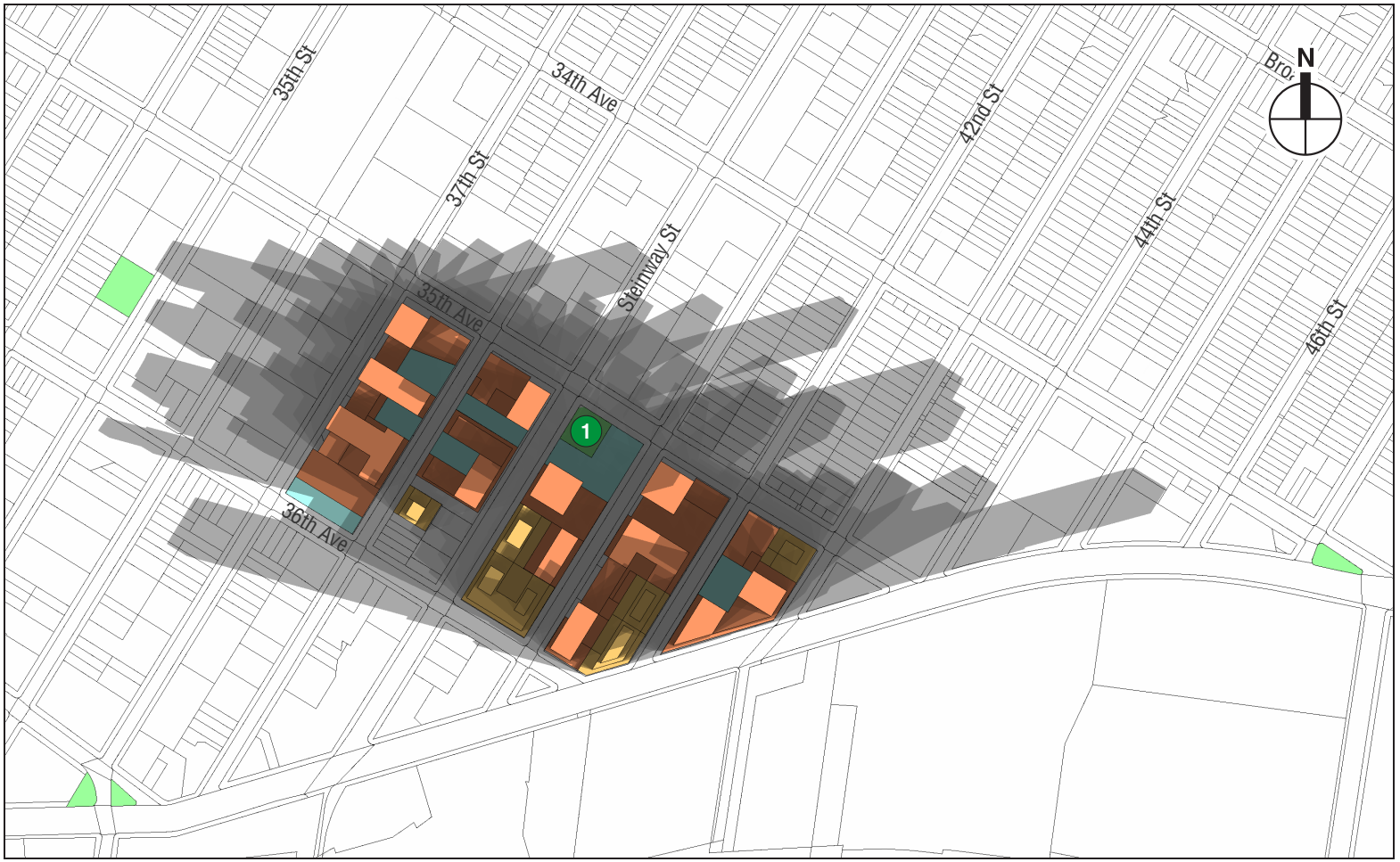
Tier 3 Assessment:
December 21
Figure 6-2



Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

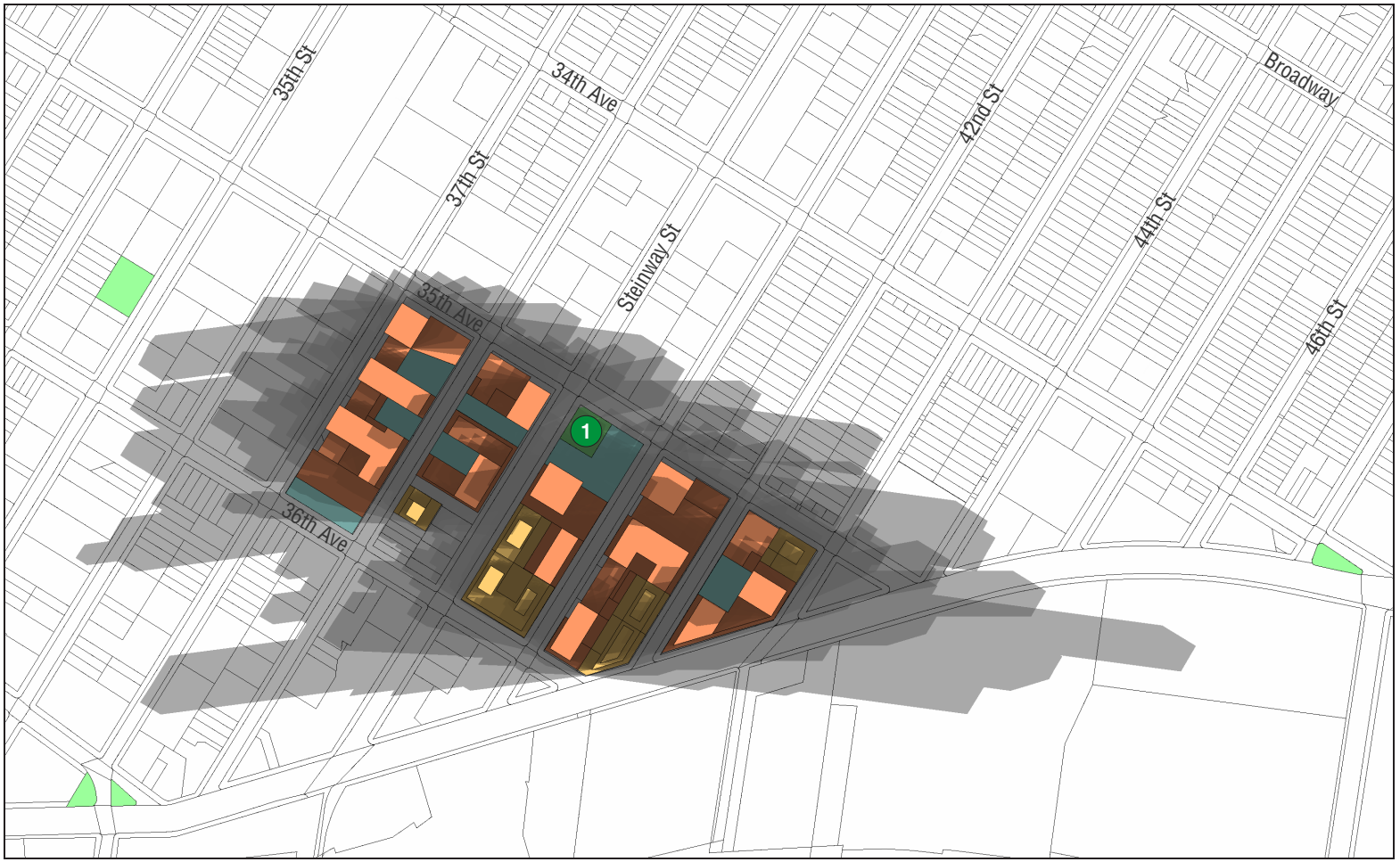
Publicly Accessible Open Space (see Table 6-2)

Project-Generated Public Open Space

This figure illustrates the range of shadows that would occur from the Proposed Project on the analysis day representing the early spring and the fall. The shadows are shown occurring approximately every 60 minutes from the start of the analysis day (90 minutes after sunrise) to the end of the analysis day (90 minutes before sunset). The Tier 3 assessment does not account for future No Action shadows, and the shadows shown in this figure do not represent incremental shadows. The Tier 3 assessment serves to illustrate the daily path or "sweep" of the proposed building's shadows across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow. Daylight Saving Time was not used, per *CEQR Technical Manual* guidelines.

Tier 3 Assessment:
March 21 / September 21

Figure 6-3



Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-2)

Project-Generated Public Open Space

This figure illustrates the range of shadows that would occur from the Proposed Project on the analysis day representing the spring and summer growing season period. The shadows are shown occurring approximately every 60 minutes from the start of the analysis day (90 minutes after sunrise) to the end of the analysis day (90 minutes before sunset). The Tier 3 assessment does not account for future No Action shadows, and the shadows shown in this figure do not represent incremental shadows. 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.

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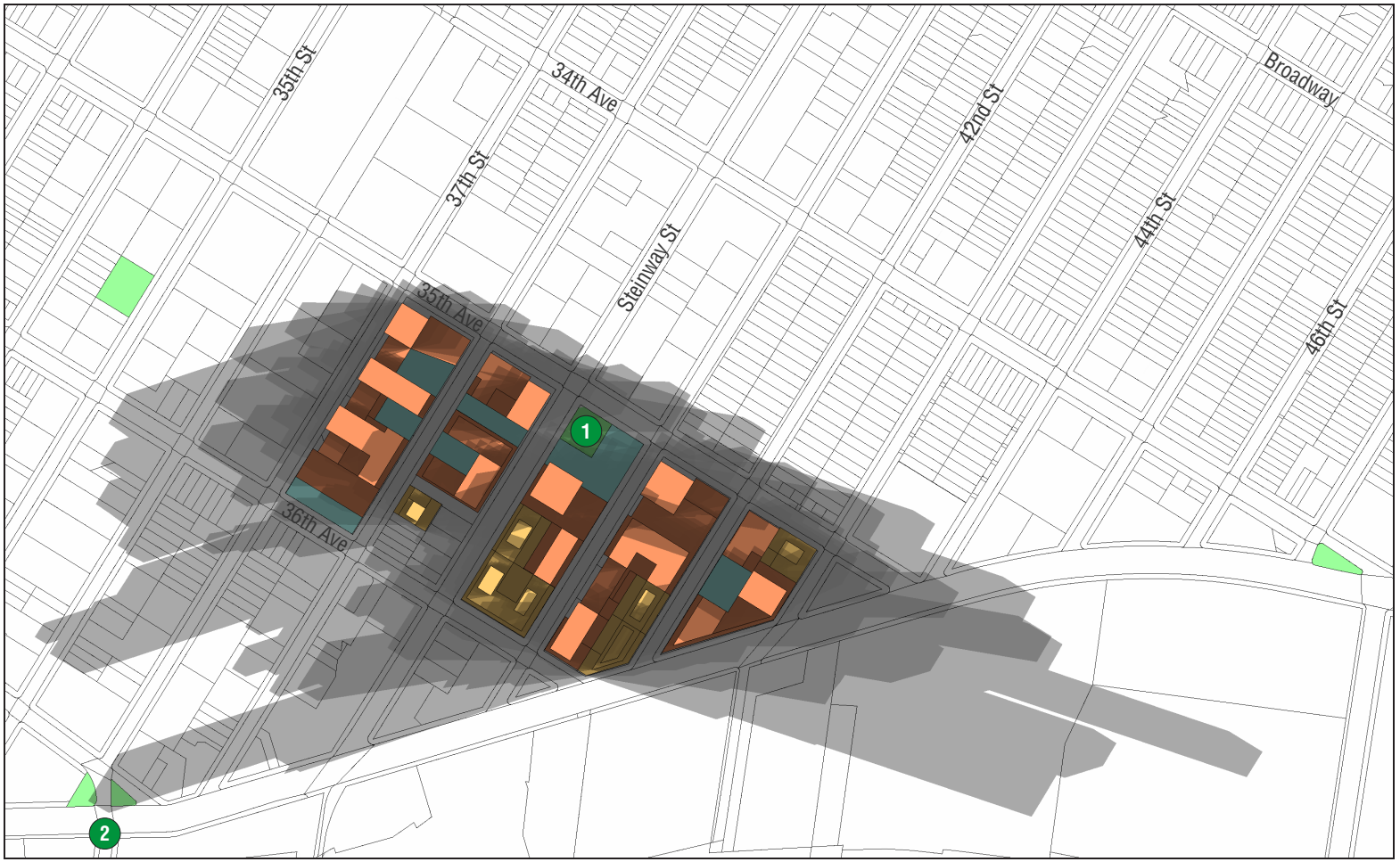
Tier 3 Assessment:
May 6 / August 6
Figure 6-4



Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-2)

Project-Generated Public Open Space

This figure illustrates the range of shadows that would occur from the Proposed Project on the summer solstice. The shadows are shown occurring approximately every 60 minutes from the start of the analysis day (90 minutes after sunrise) to the end of the analysis day (90 minutes before sunset). The Tier 3 assessment does not account for future No Action shadows, and the shadows shown in this figure do not represent incremental shadows. The Tier 3 assessment serves to illustrate the daily path or "sweep" of the proposed building's shadows across the landscape, indicating which resources could potentially be affected on that analysis day, absent intervening buildings, by project-generated shadow. Daylight Saving Time was not used, per *CEQR Technical Manual* guidelines.

Tier 3 Assessment:
June 21
Figure 6-5

future No Action condition. In the No Action condition, as described in Chapter 1, "Project Description," development would occur on portions of Projected Development Sites C and D, while the rest of the Projected Development Sites would remain unchanged from their existing condition. The No Action condition was added to the three-dimensional model as part of the baseline. Three-dimensional representations of existing buildings and future planned developments in the study area were added to the baseline three-dimensional model using best-available spatial data and information from publicly available filings with the New York City Department of Buildings and other sources.

Shadows are in constant movement. The computer simulation software utilized in the analysis produces a minute-by-minute animation showing the movement of shadows over the course of each analysis period. The analysis determines the time when incremental shadow would enter each resource, and the time it would exit. Shadow analyses were performed for each of the representative days and analysis periods indicated in the Tier 3 assessment.

DETERMINATION OF IMPACT SIGNIFICANCE

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

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

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

- **Vegetation:**
  - A substantial reduction in sunlight available to a sunlight-sensitive feature of the resource to less than the minimum time necessary for its survival (when there was sufficient sunlight in the No Action condition). In the growing season, four to six hours a day of sunlight is a minimum requirement.
  - A reduction in direct sunlight exposure where the sensitive feature of the resource is already subject to substandard sunlight (i.e., less than the minimum time necessary for its survival).
- **Historic and Cultural Resources:**
  - A substantial reduction in sunlight available for the enjoyment or appreciation of the sunlight-sensitive features of a historic or cultural resource.
- **Open Space Utilization:**
  - A substantial reduction in the usability of open space as a result of increased shadows, accounting for anticipated new users and the open space's utilization rates throughout the affected time periods.

- **For Any Sunlight-Sensitive Feature of a Resource:**
  - Complete elimination of all direct sunlight on the sunlight-sensitive feature of the resource, when the complete elimination results in substantial effects on the survival, enjoyment, or, in the case of open space or natural resources, the use of the resource.

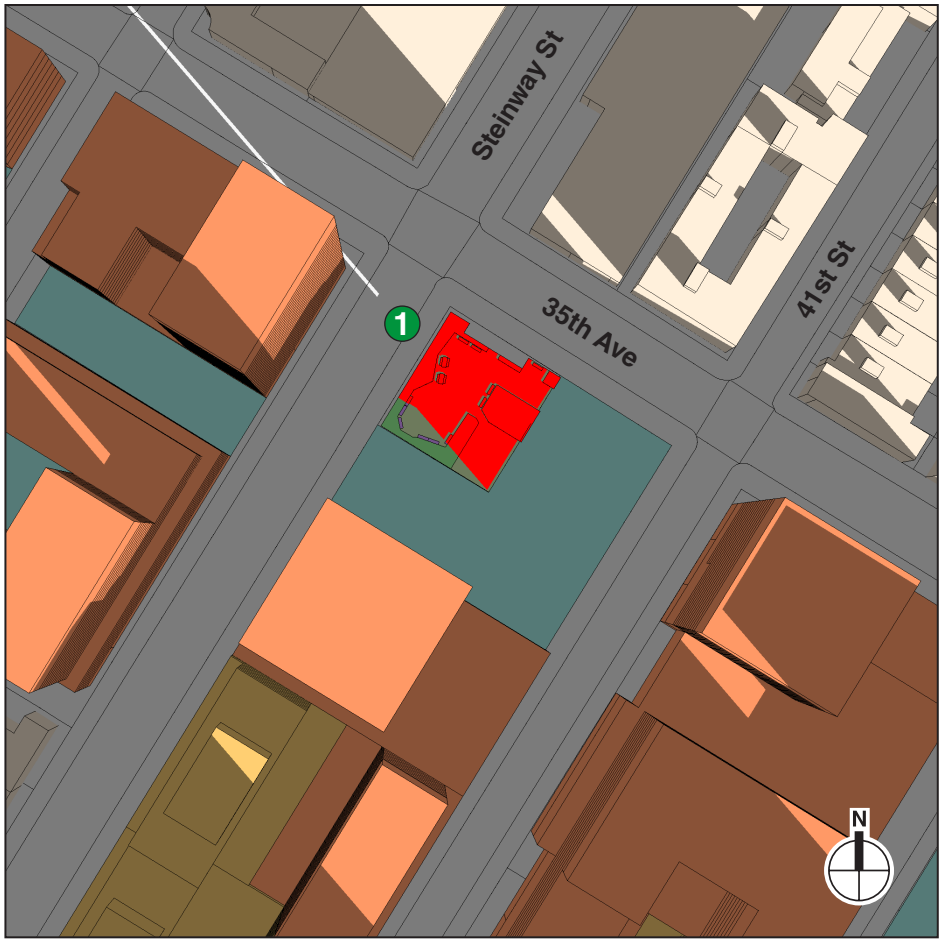
SUMMARY OF ANALYSIS RESULTS

New shadows from the With Action development would move across portions of Playground Thirty Five XXXV throughout the day in all seasons, covering much or all of the playground at times. The incremental shadow would come primarily from Projected Development Sites B, C, and D, which are adjacent to, or across the street from, the playground towards the west, south, and east, respectively. As described in more detail below, the extent of incremental shadows would be greatest in fall, winter, and early spring.

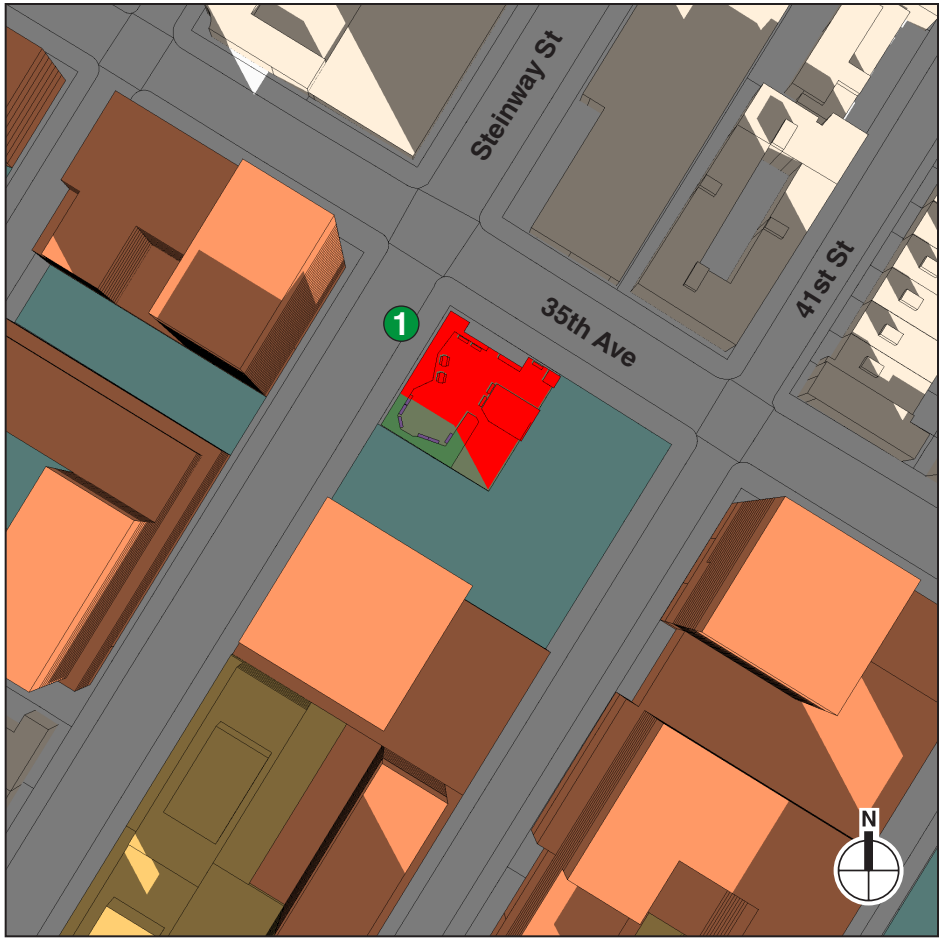
At times there would also be small areas of "reduced" shadow on the playground in the With Action condition, representing areas that would be in shadow in the No Action condition (from the one-story grocery store abutting the playground to the south, that the applicant would develop absent the Proposed Actions), but would not be in shadow from the With Action massing south of the playground, which would be 26 stories but set farther back from the playground, with new publicly accessible open space in between.

Triangle Thirty Seven XXXVII would receive five minutes of incremental shadow at approximately 6:00 a.m. on the June 21 analysis day. The *CEQR Technical Manual* states that incremental shadow is not considered significant when its duration is no more than 10 minutes and the resource otherwise continues to receive substantial sunlight, which is the case with this resource. Therefore, the Proposed Actions would not result in shadow impacts to Triangle Thirty Seven XXXVII and no further discussion of it is required.

Table 6-3 summarizes the entry and exit times and total duration of incremental shadows on each affected sun-sensitive resource. **Figures 6-6 to 6-23** 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), areas of "reduced" shadow if present (highlighted in yellow), and also show existing shadows and remaining areas of sunlight.



December 21
9:00 AM



December 21
10:00 AM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

NOTES: Only the areas of shadow highlighted in red represent incremental shadow resulting from the With Action development. All other shadow is future No Action shadow, i.e. baseline shadow from existing and future No Action buildings.

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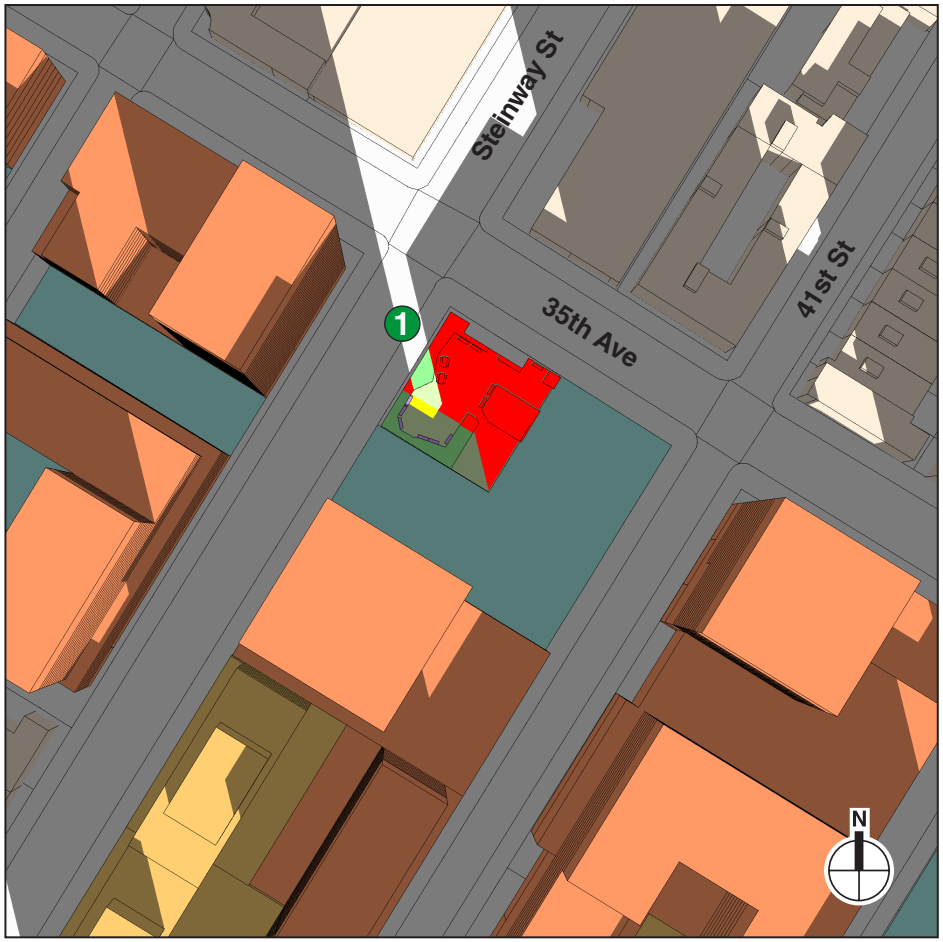
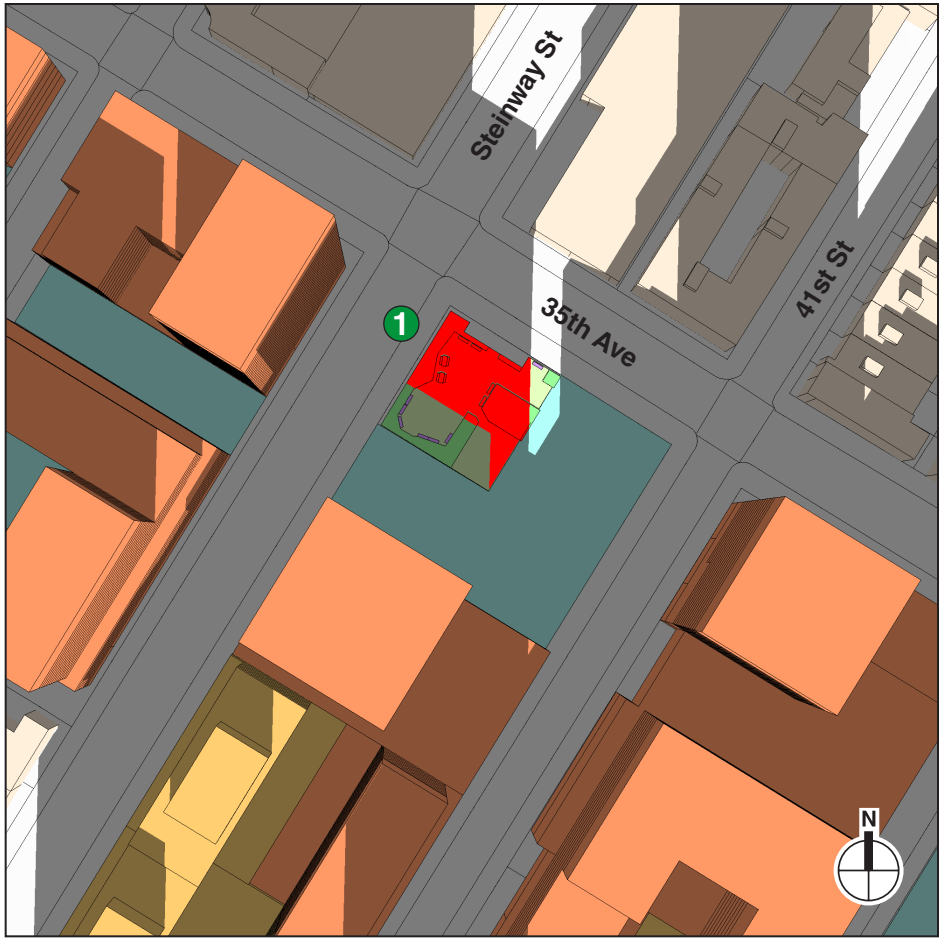
Shadows - Detailed Analysis

Figure 6-6

12.1.21



December 21
11:00 AM



December 21
12:00 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

NOTES: Only the areas of shadow highlighted in red represent incremental shadow resulting from the With Action development. All other shadow is future No Action shadow, i.e. baseline shadow from existing and future No Action buildings.

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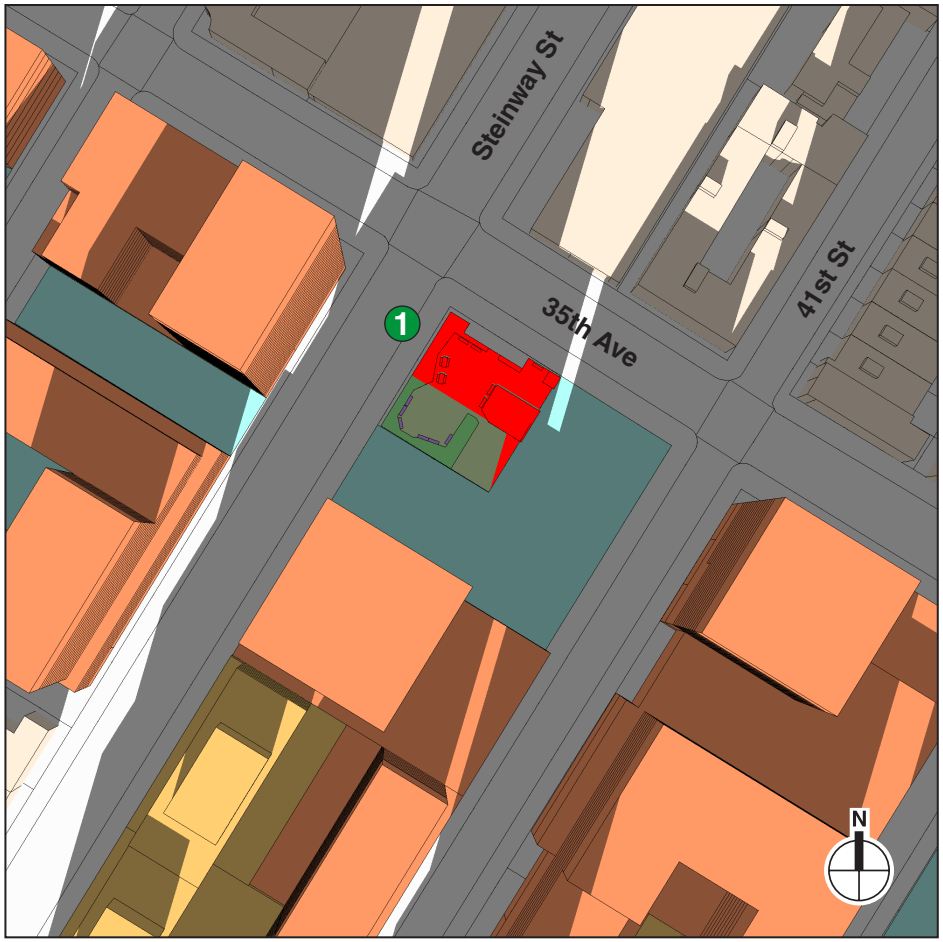
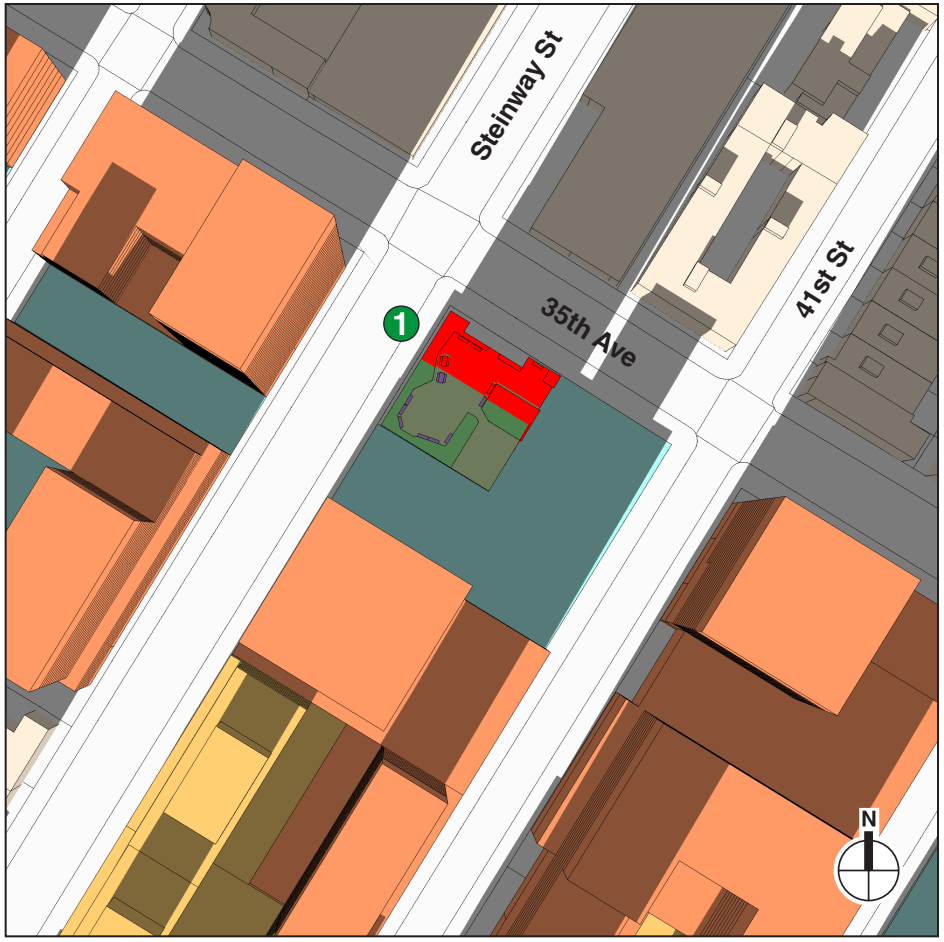
Shadows - Detailed Analysis

Figure 6-7



December 21
1:00 PM



December 21
2:00 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

NOTES: Only the areas of shadow highlighted in red represent incremental shadow resulting from the With Action development. All other shadow is future No Action shadow, i.e. baseline shadow from existing and future No Action buildings.

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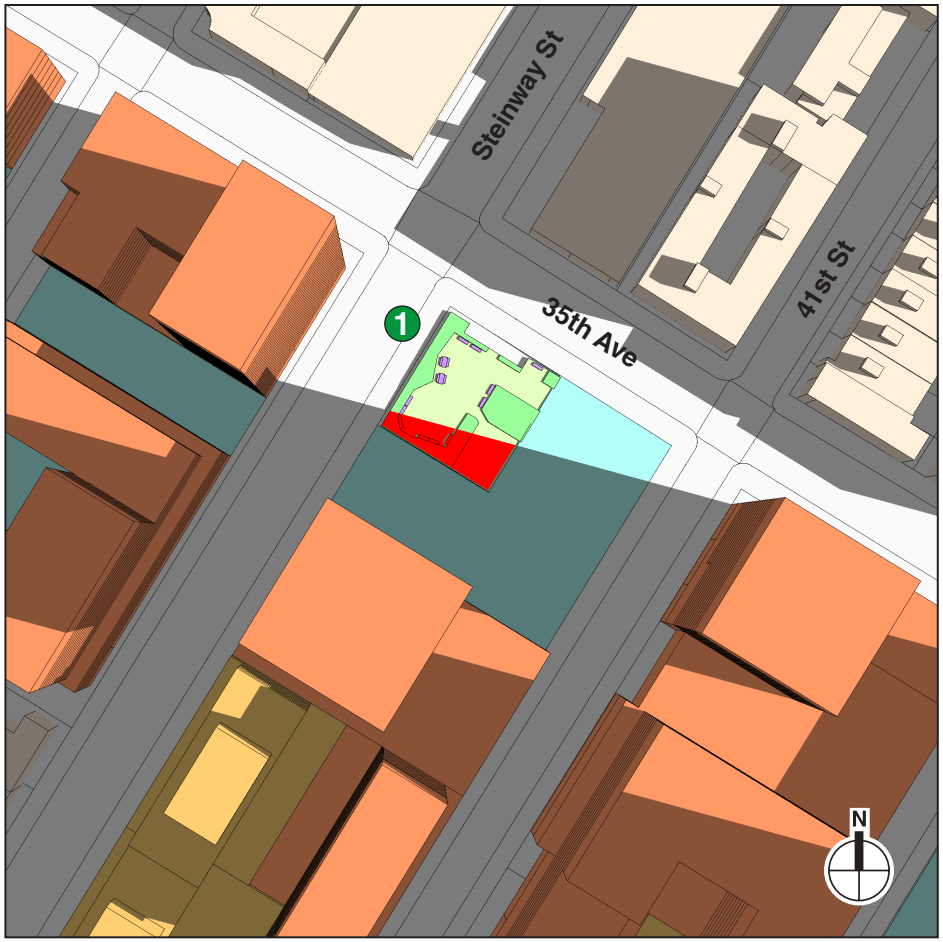
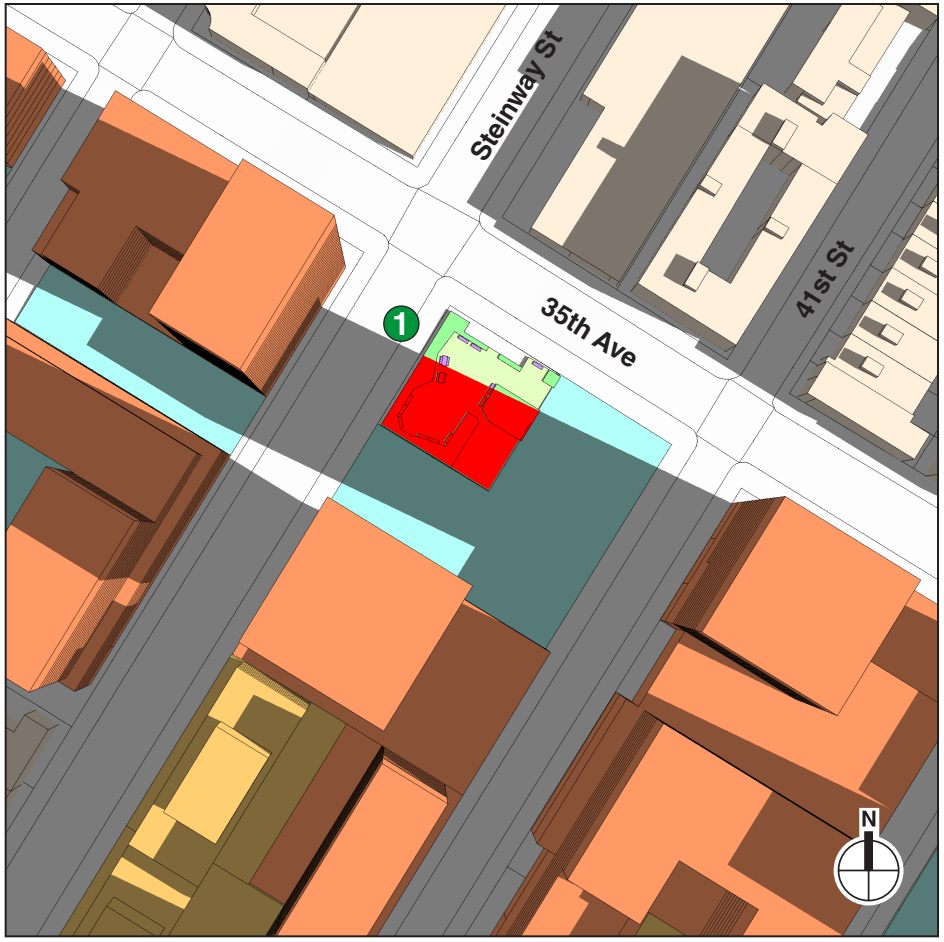
Shadows - Detailed Analysis

Figure 6-8

12.1.21



March 21 / September 21
7:36 AM



March 21 / September 21
8:30 AM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

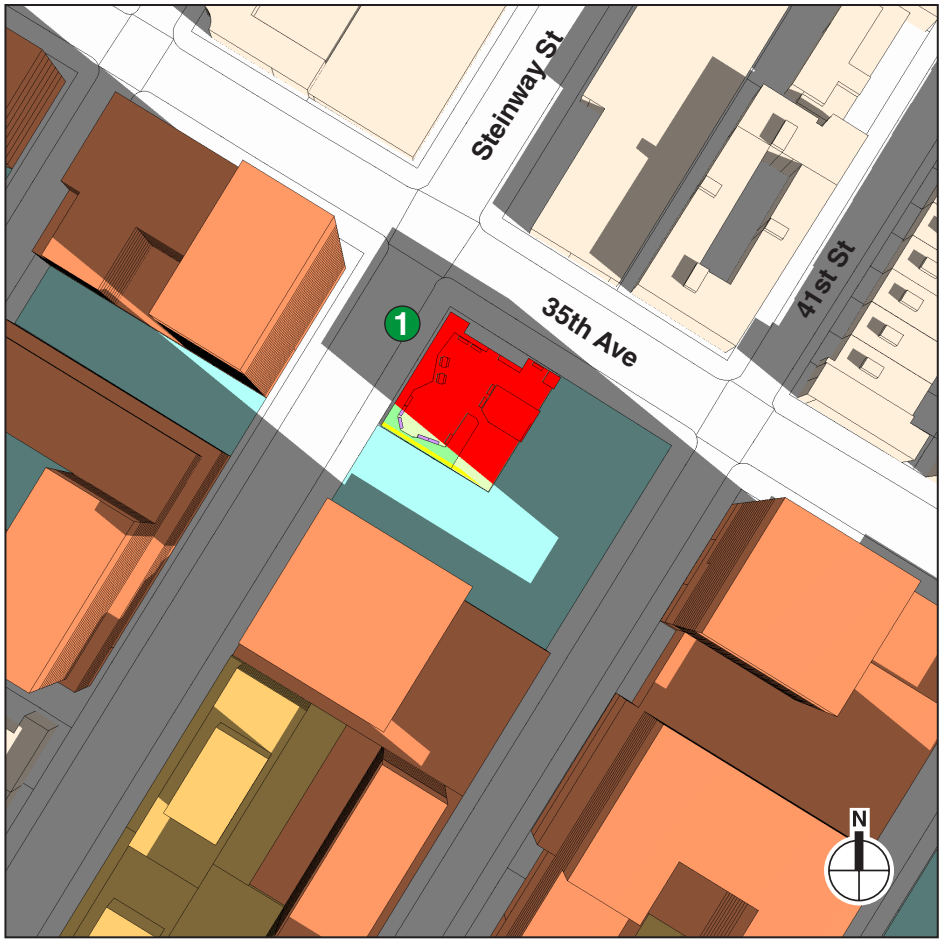
NOTES: Only the areas of shadow highlighted in red represent incremental shadow resulting from the With Action development. All other shadow is future No Action shadow, i.e. baseline shadow from existing and future No Action buildings. Daylight saving time is not used—times are Eastern Standard Time, 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.

INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

Shadows - Detailed Analysis

Figure 6-9

12.1.21



March 21 / September 21
9:30 AM



March 21 / September 21
10:30 AM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

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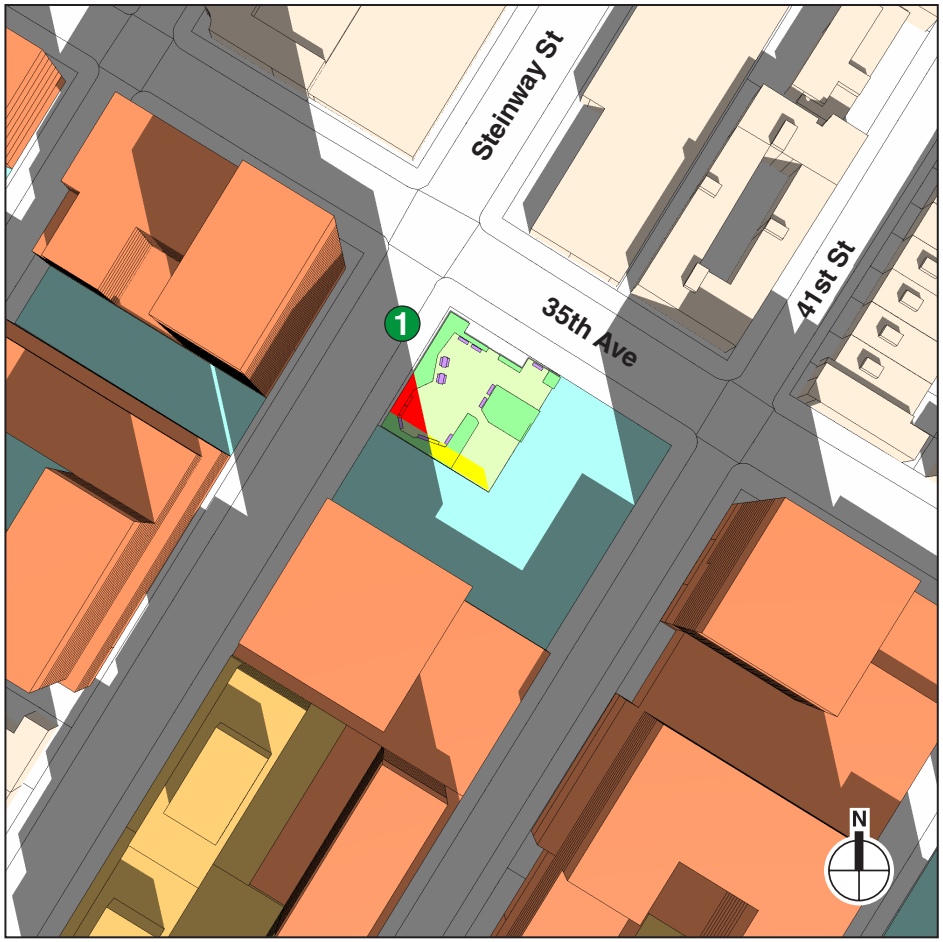
INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

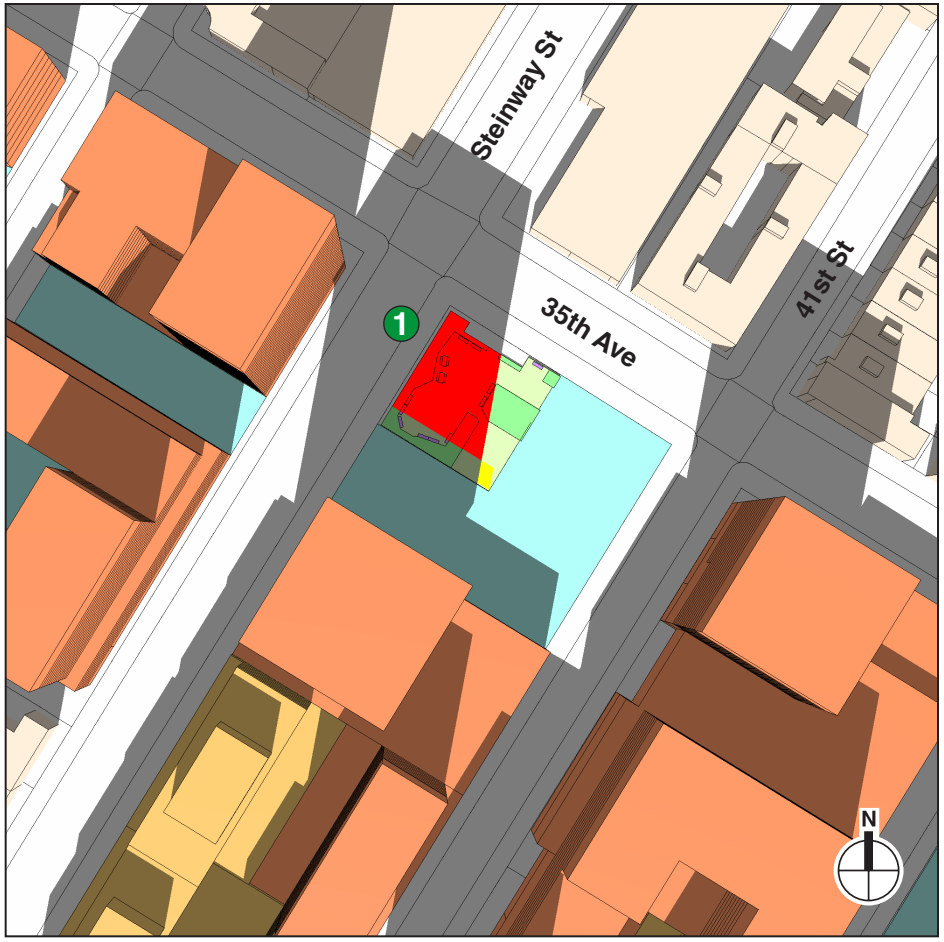
Shadows - Detailed Analysis

Figure 6-10

12.1.21



March 21 / September 21
11:30 AM



March 21 / September 21
12:30 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

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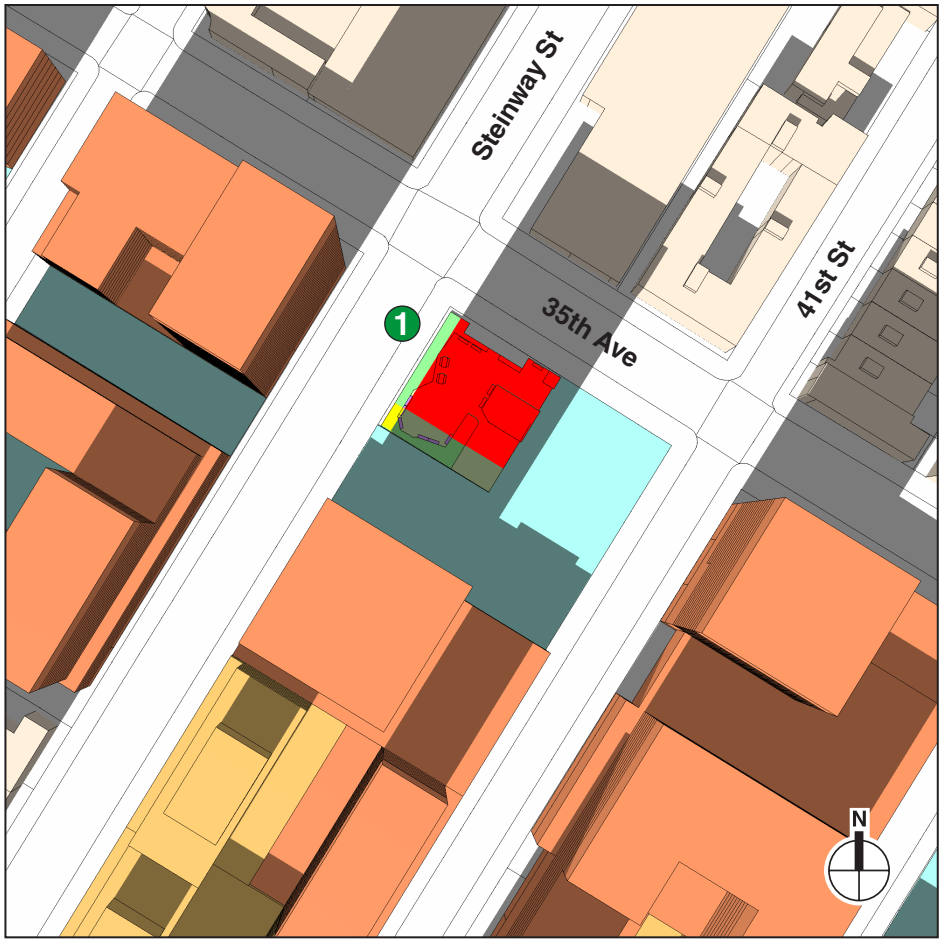
INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

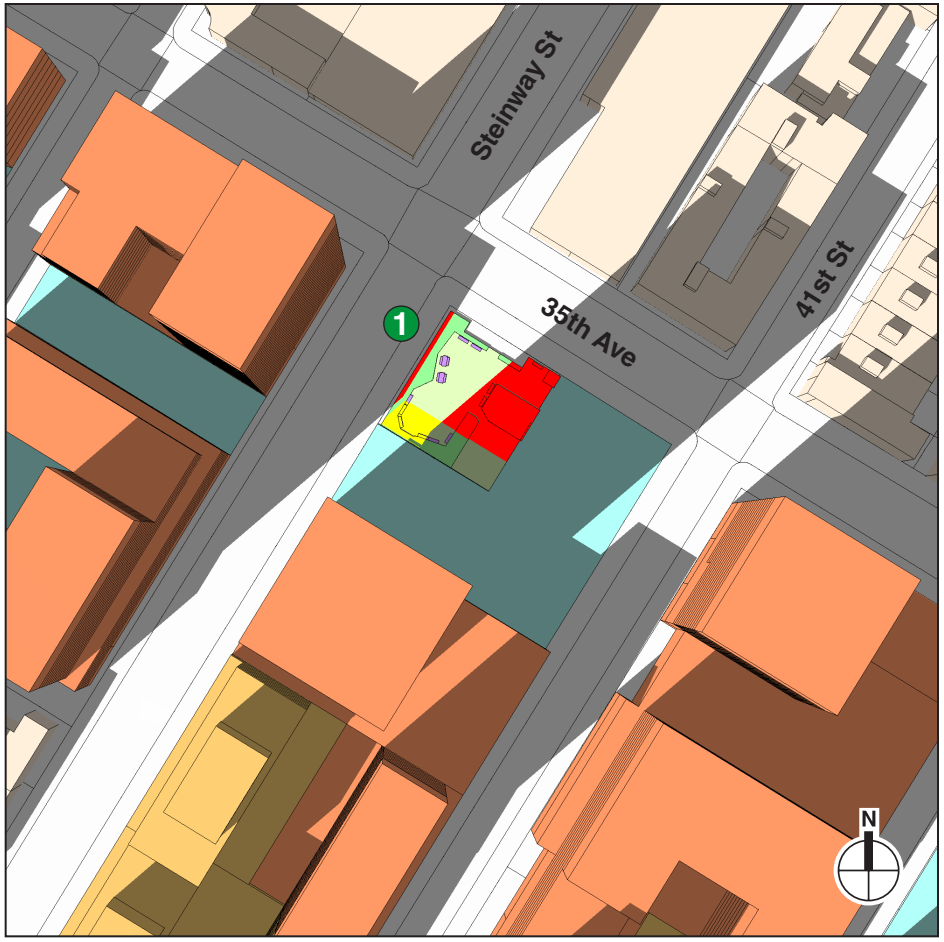
Shadows - Detailed Analysis

Figure 6-11

12.1.21



March 21 / September 21
1:30 PM



March 21 / September 21
2:30 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

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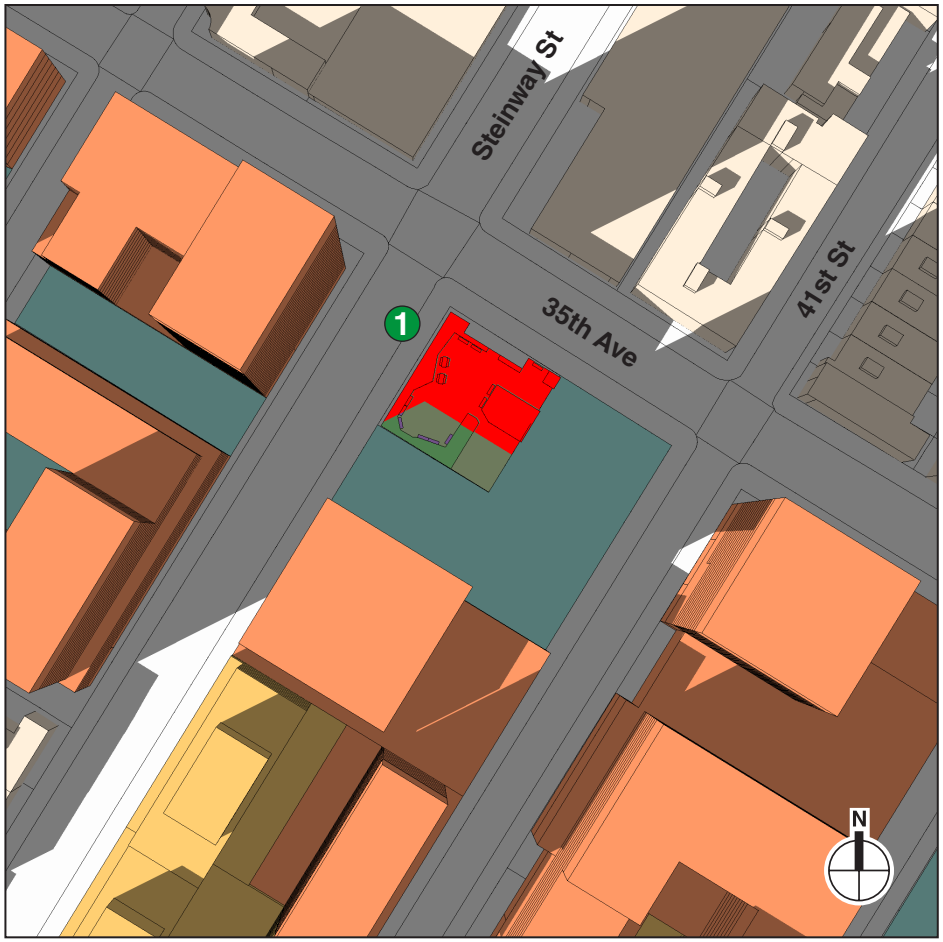
INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

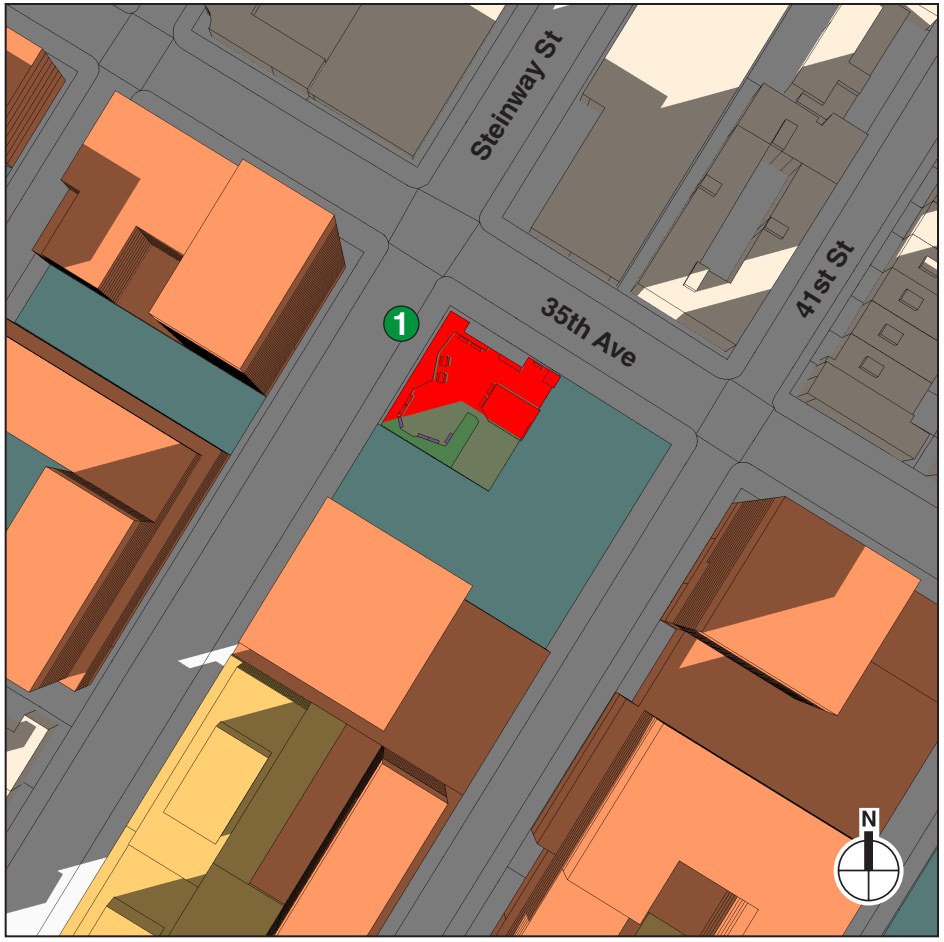
Shadows - Detailed Analysis

Figure 6-12

12.1.21



March 21 / September 21
3:30 PM



March 21 / September 21
4:29 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

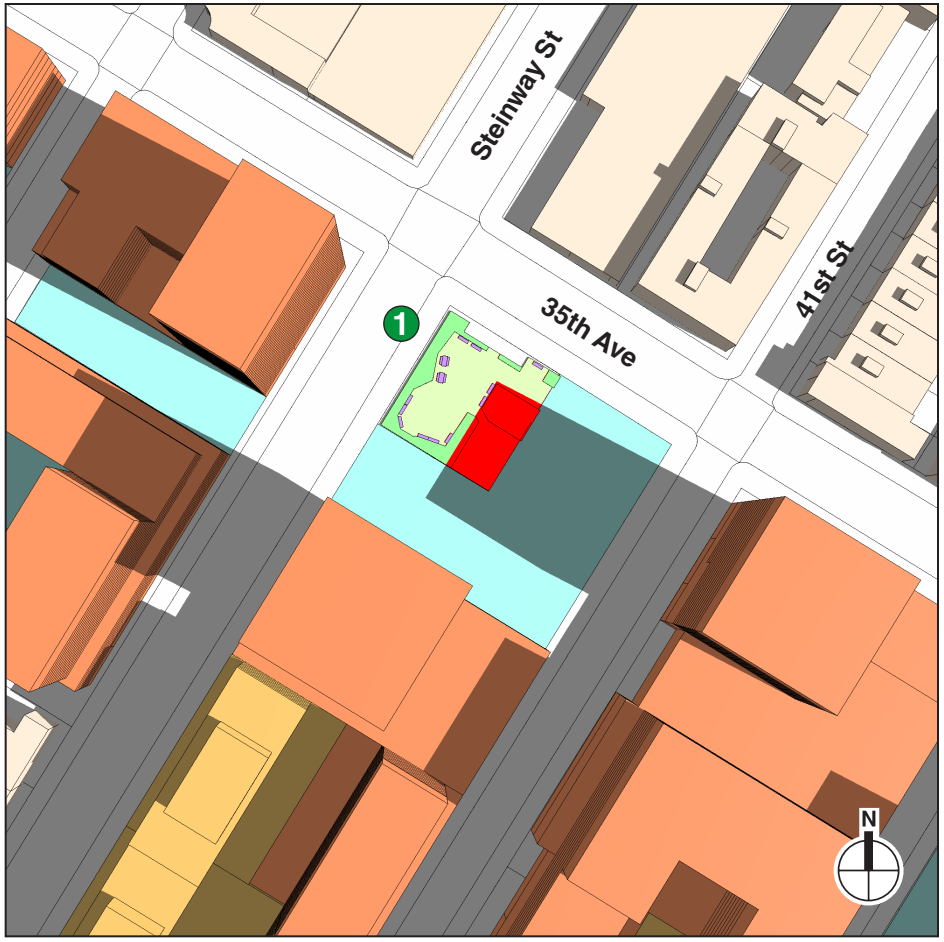
Shadows - Detailed Analysis

Figure 6-13

12.1.21



May 6 / August 6
8:30 AM



May 6 / August 6
9:30 AM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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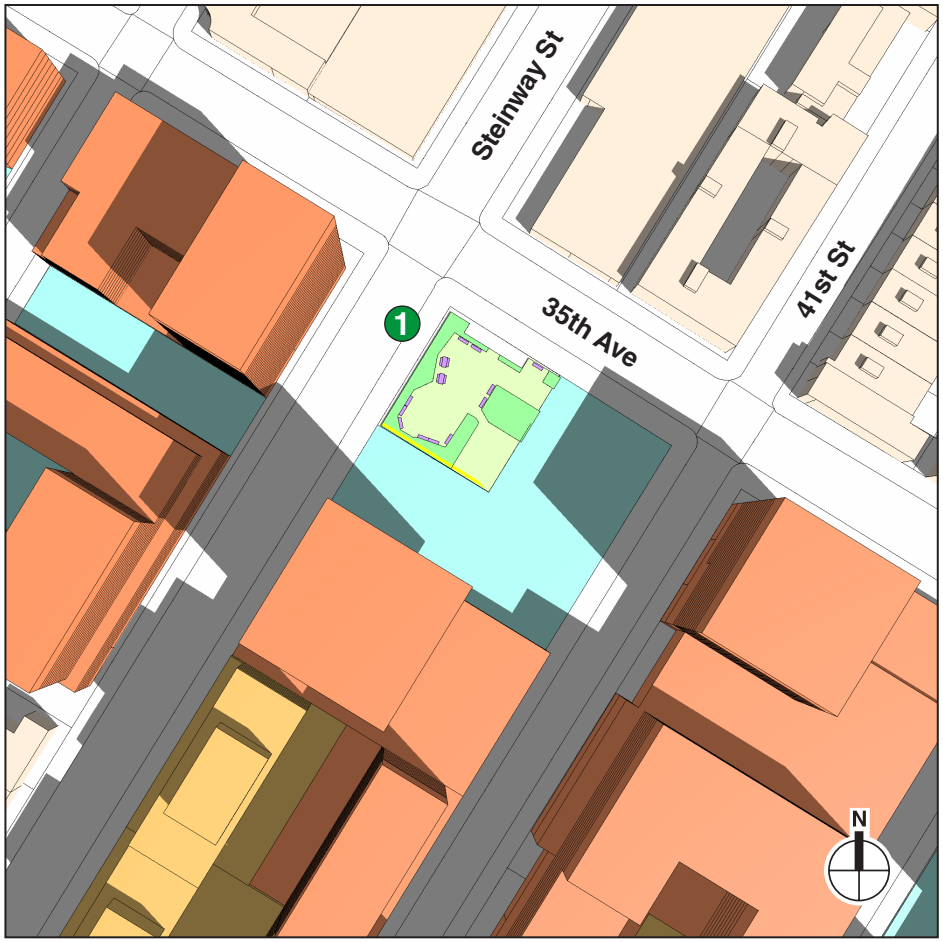
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

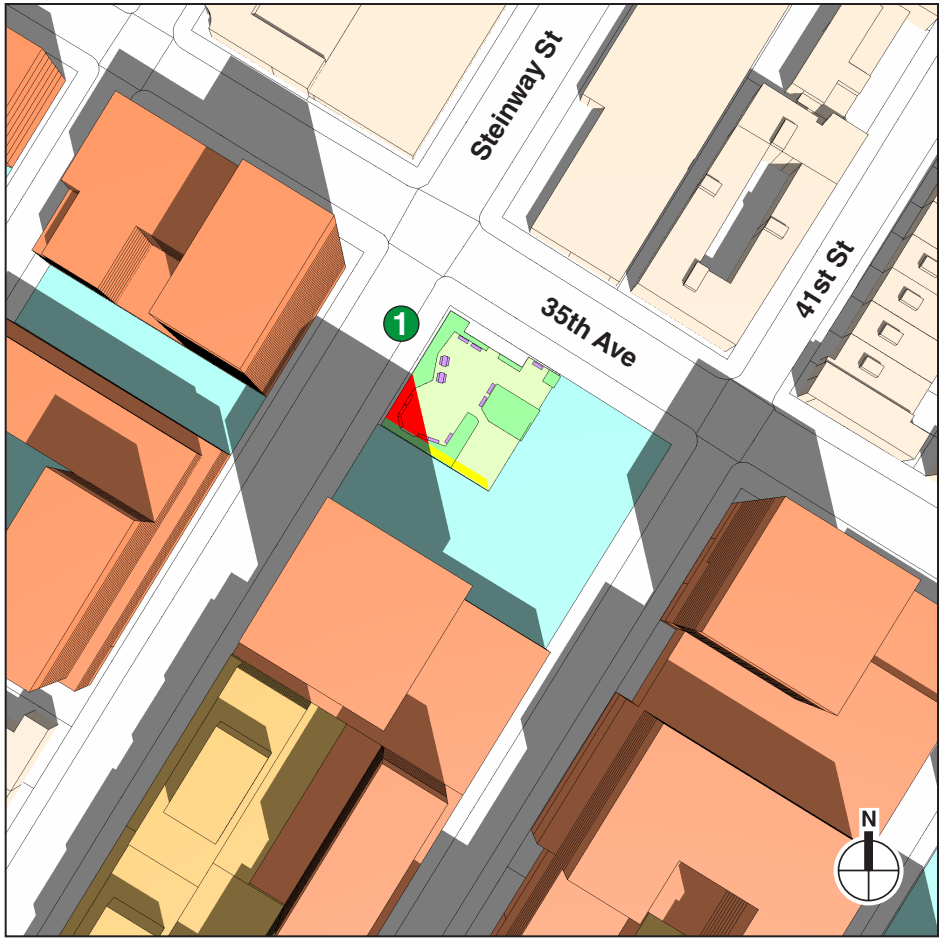
Shadows - Detailed Analysis

Figure 6-14

12.1.21



May 6 / August 6
10:30 AM



May 6 / August 6
11:30 AM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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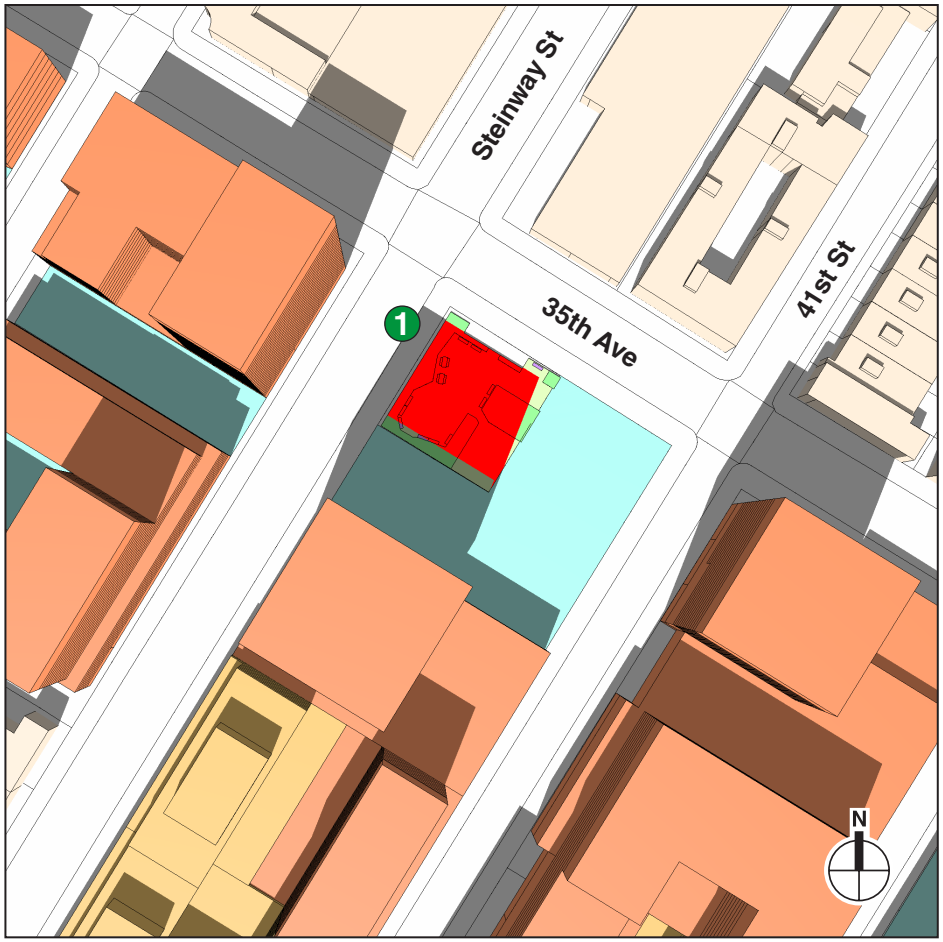
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

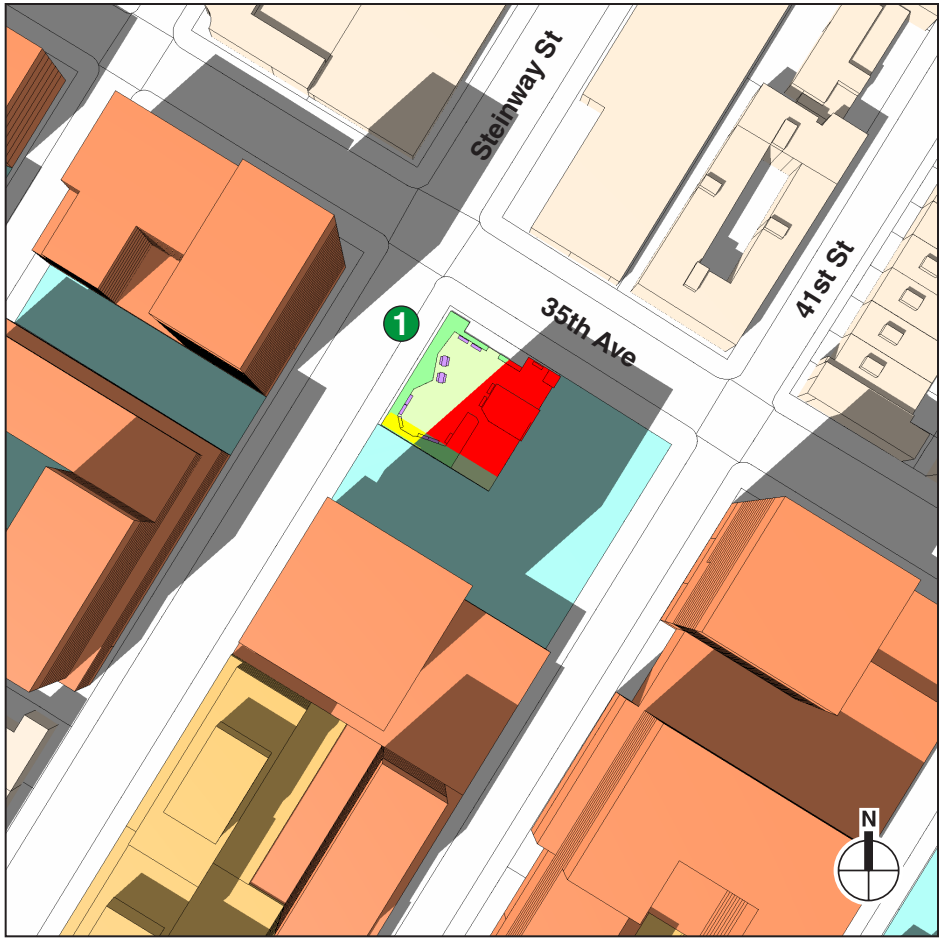
Shadows - Detailed Analysis

Figure 6-15

12.1.21



May 6 / August 6
12:30 PM



May 6 / August 6
1:30 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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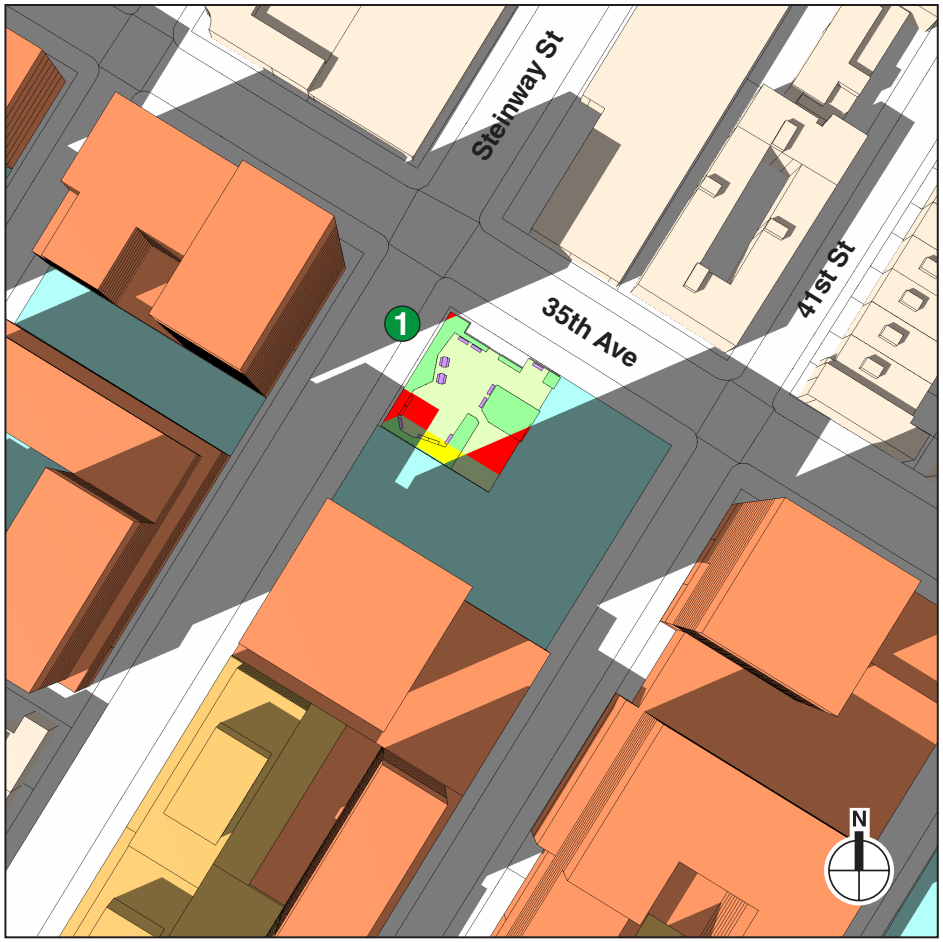
INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

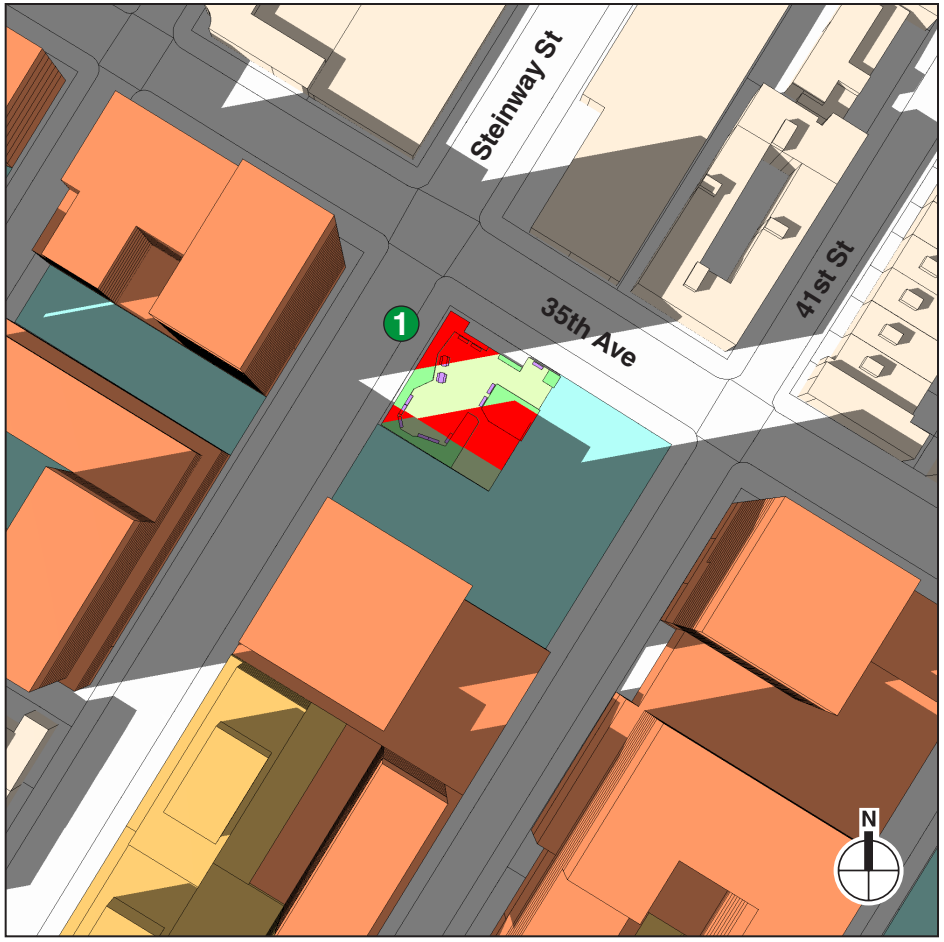
Shadows - Detailed Analysis

Figure 6-16

12.1.21



May 6 / August 6
2:30 PM



May 6 / August 6
3:30 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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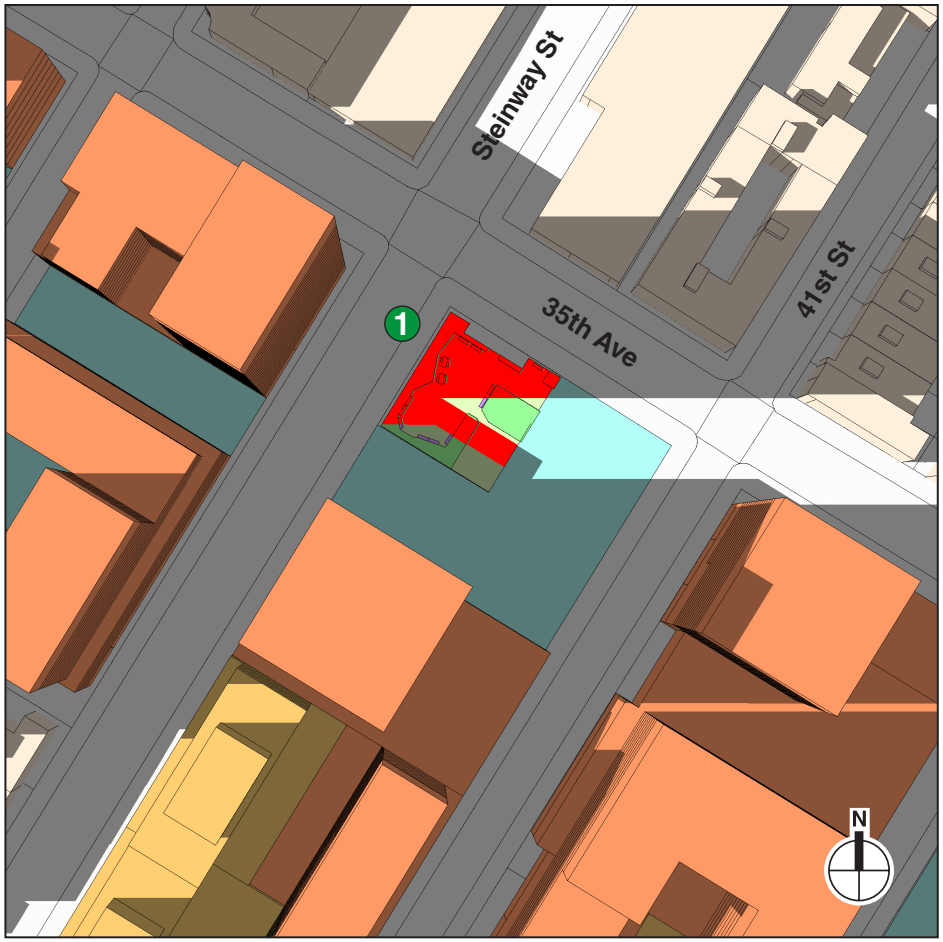
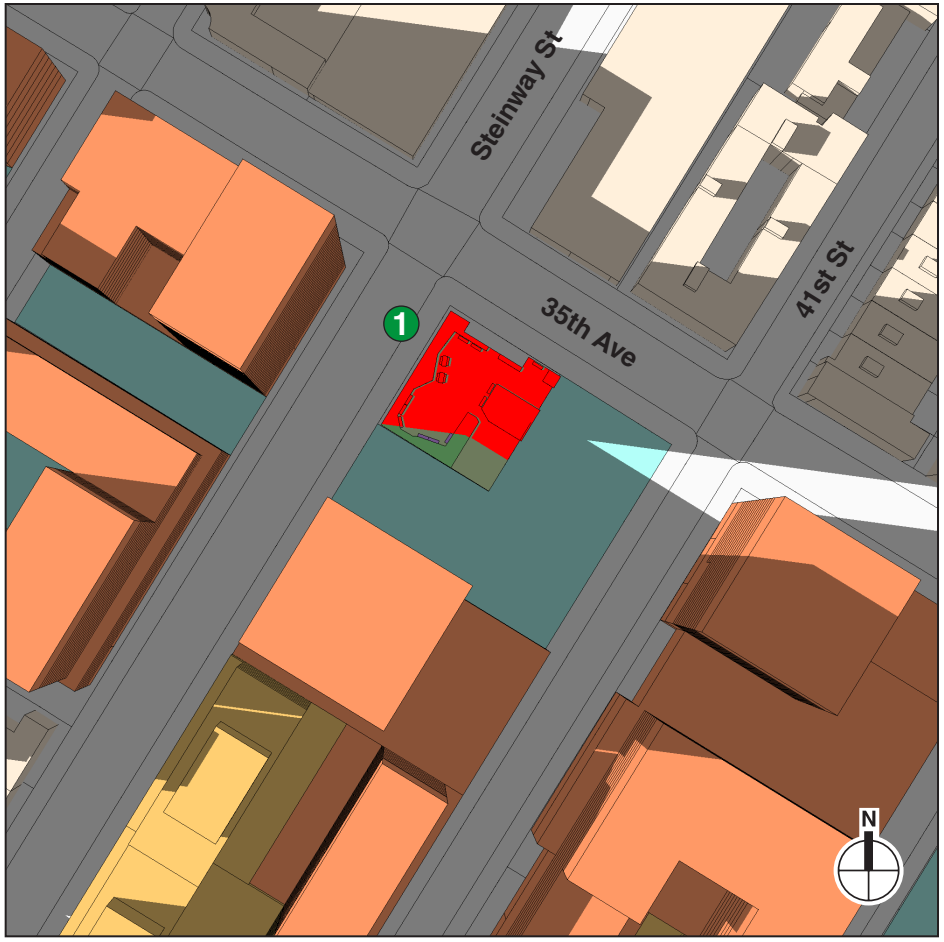
INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

Shadows - Detailed Analysis

Figure 6-17



May 6 / August 6
4:30 PM



May 6 / August 6
5:18 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

Shadows - Detailed Analysis

Figure 6-18

12.1.21



June 21
9:00 AM



June 21
10:00 AM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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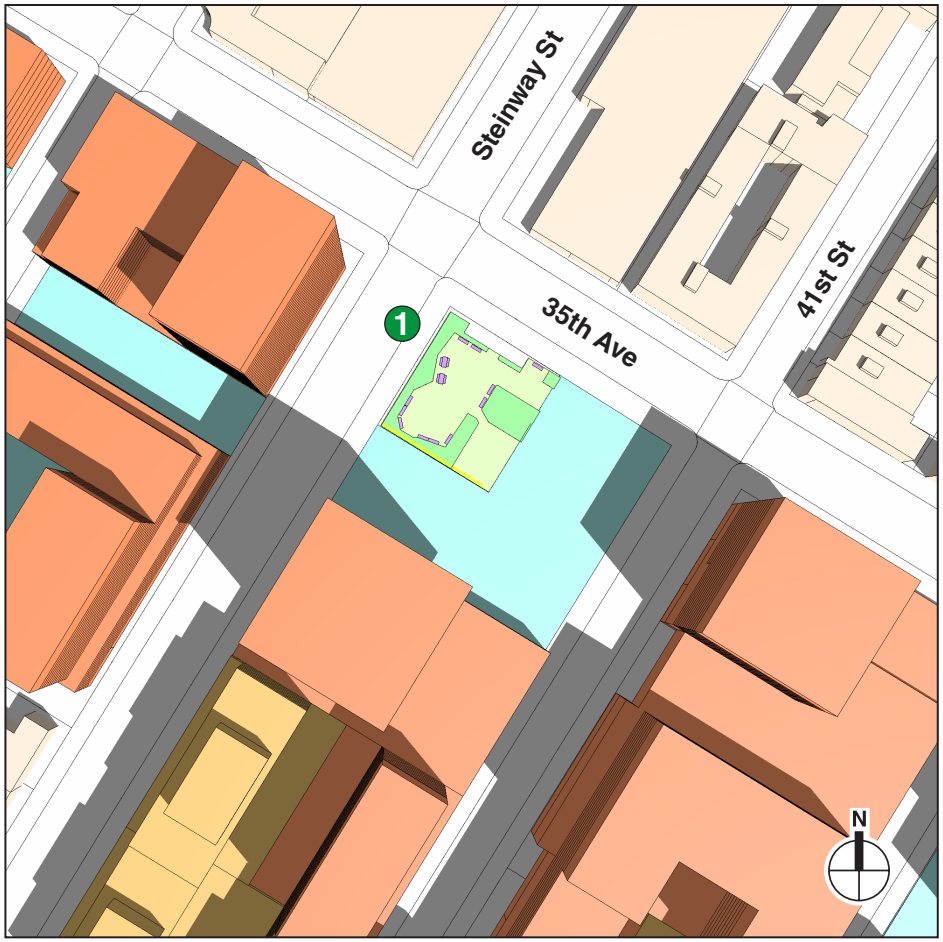
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

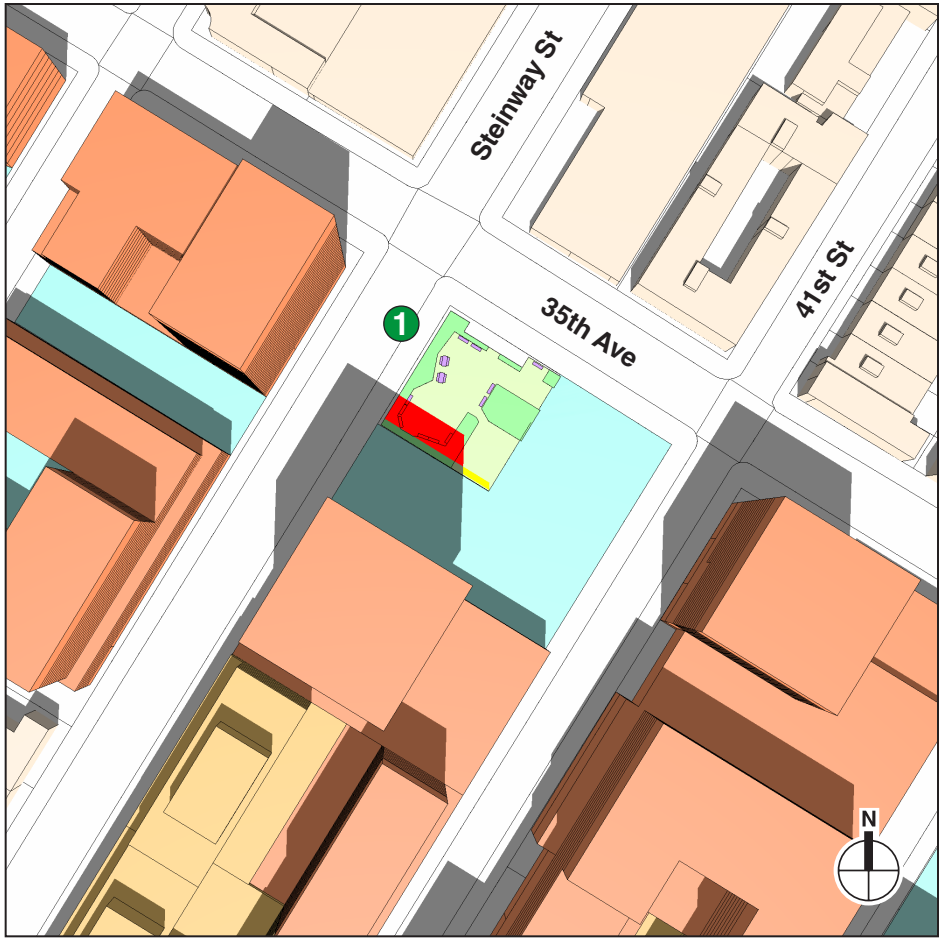
Shadows - Detailed Analysis

Figure 6-19

12.1.21



June 21
11:00 AM



June 21
12:00 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

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INNOVATION QNS
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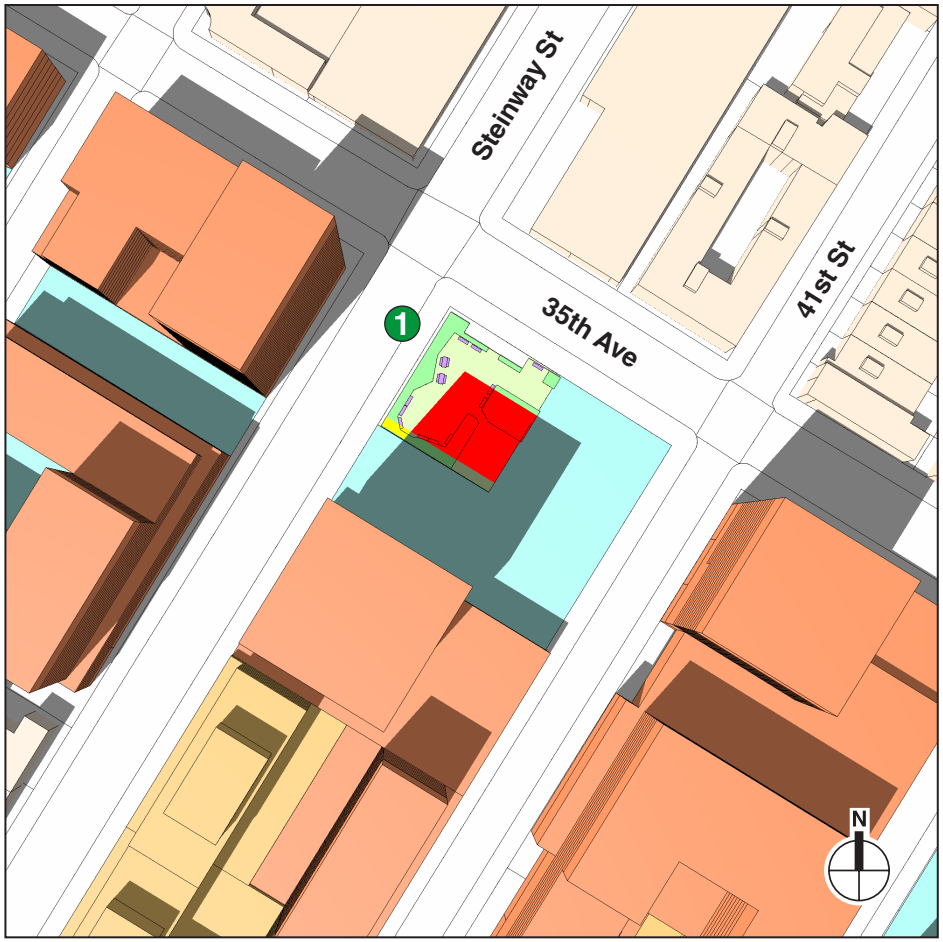
Shadows - Detailed Analysis

Figure 6-20



June 21
1:00 PM



June 21
2:00 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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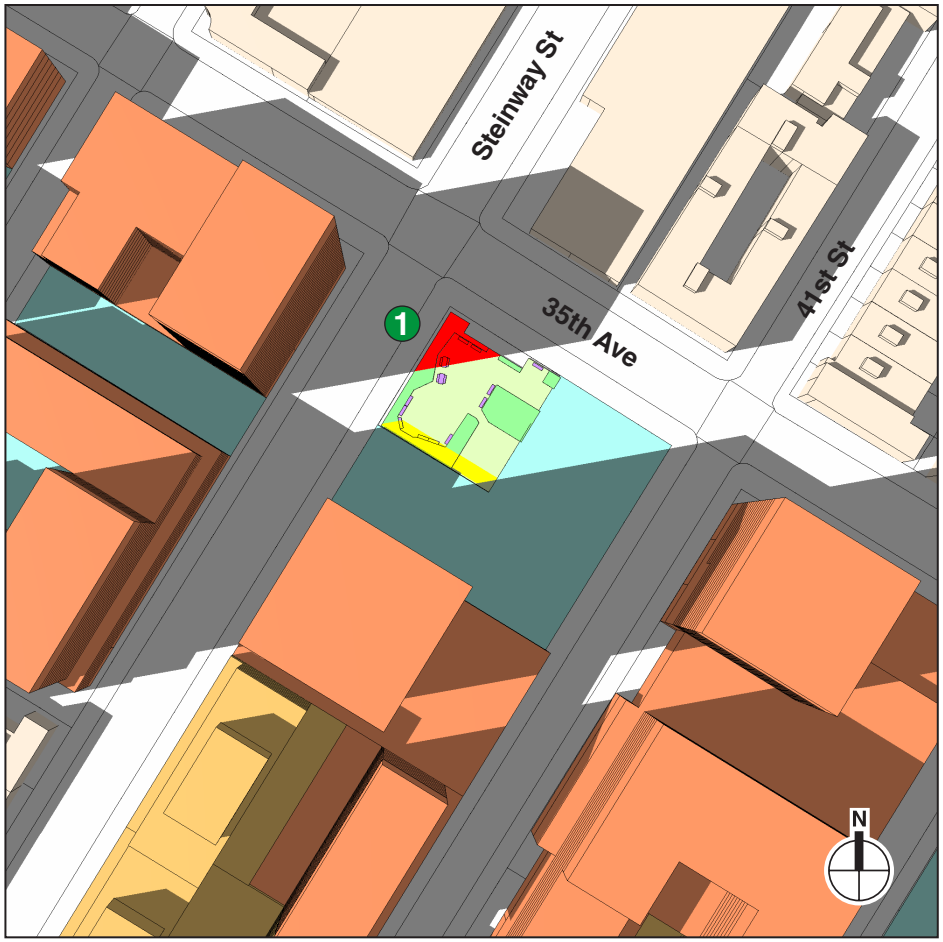
Shadows - Detailed Analysis

Figure 6-21

12.1.21



June 21
3:00 PM



June 21
4:00 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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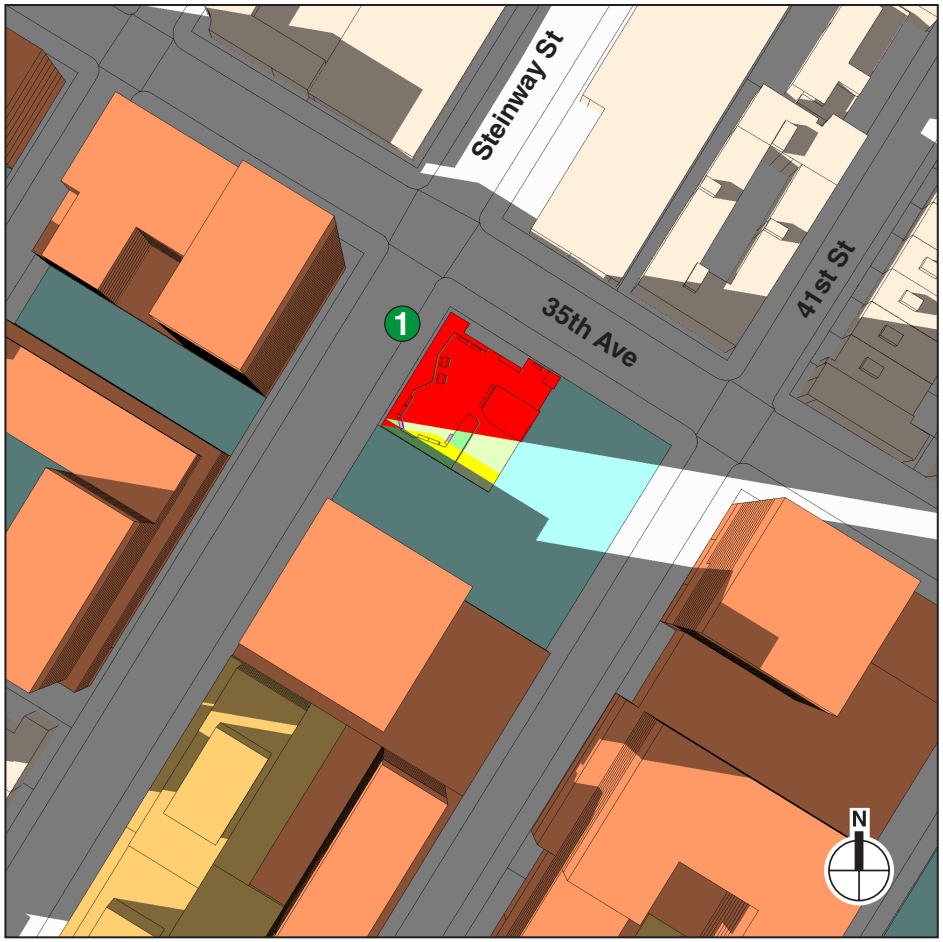
INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

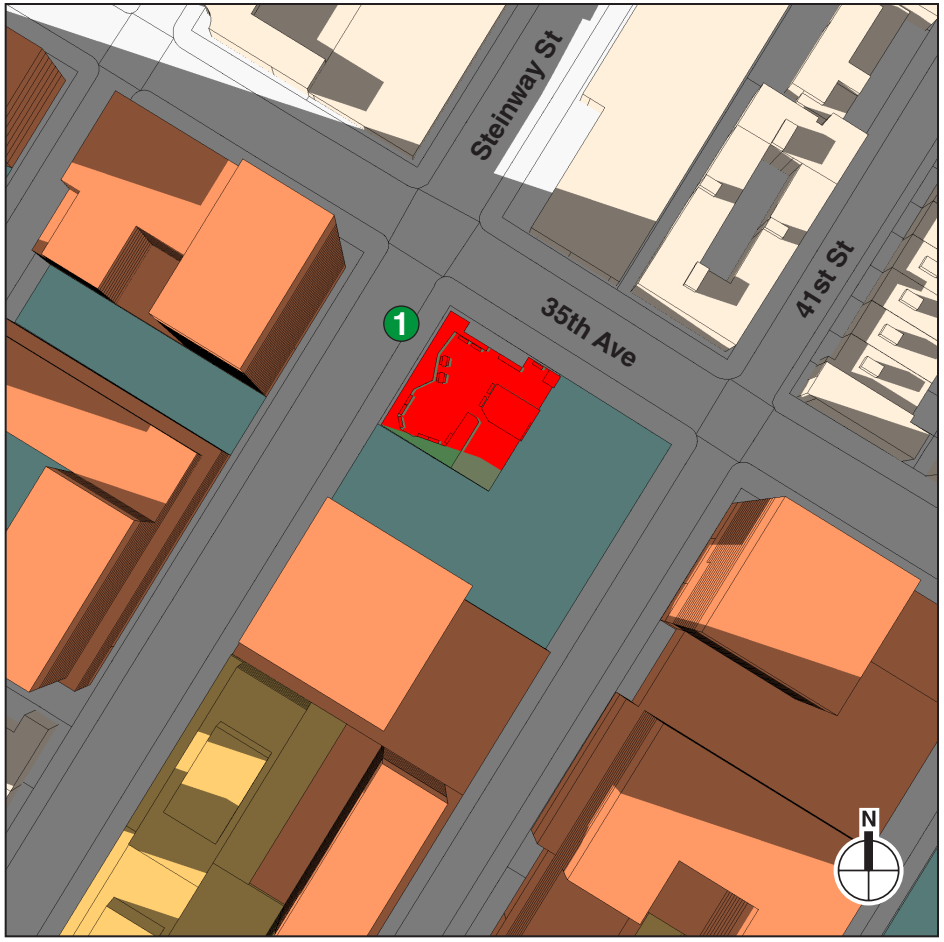
Shadows - Detailed Analysis

Figure 6-22

12.1.21



June 21
5:00 PM



June 21
6:00 PM

Proposed Development (LSGD Area)

Projected Development (Additional Affected Area)

Publicly Accessible Open Space (see Table 6-3)

Benches/Tables in Open Space

Project-Generated Open Space

Incremental Shadow on Sunlight Sensitive Resource

Reduced Shadow on Sunlight Sensitive Resource*

*"Reduced shadow," highlighted in yellow, refers to shadow that would be cast in the No Action condition, but not in the With Action condition.

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INNOVATION QNS
ASTORIA, QUEENS
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Shadows - Detailed Analysis

Figure 6-23

Table 6-3
Incremental Shadow Durations

Map Reference	Name	Dec. 21 8:51am to 2:53pm	Mar. 21 / Sept. 21 7:36am to 4:29pm	May 6 / Aug. 6 6:27am to 5:18pm	Jun. 21 5:57am to 6:01pm
1	Playground Thirty Five XXXV	Incremental: 8:51am to 2:53pm Total 6 hr 2 min *Reduced: 10:45am to 11:35am 2:15pm to 2:53pm Total 1 hr 28 min*	Incremental: 7:36am to 4:29pm Total 8 hr 53 min *Reduced: 9:15am to 12:50pm 1:25pm to 3:05pm Total 5 hr 15 min*	Incremental: 7:40am to 10:05am 11:10am to 5:18pm Total 8 hr 33 min *Reduced: 10:00am to 12:20pm 12:45pm to 3:00pm Total 4 hr 35 min*	Incremental: 8:20am to 9:35am 11:35am to 6:01pm Total 7 hr 41 min *Reduced: 10:30am to 12:20pm 12:40pm to 5:20pm Total 6 hr 30 min*
2	Triangle Thirty Seven XXXVII	—	—	—	5:57am to 6:02am Total 5 min

Notes:
Table indicates entry and exit times and total duration of incremental and reduced shadow for each sunlight-sensitive resource.
"Reduced" shadow (in *italics*) represent times when less shadow would occur on a portion of the playground in the With Action condition compared to the No Action (see "Summary of Analysis Results," above, for additional explanation). In most cases, the times of reduced shadow overlap with times of incremental shadow occurring on a different area in the resource. The size of the "reduced" shadow would generally be smaller than the size of the incremental shadow, usually substantially so.
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 actual clock time.

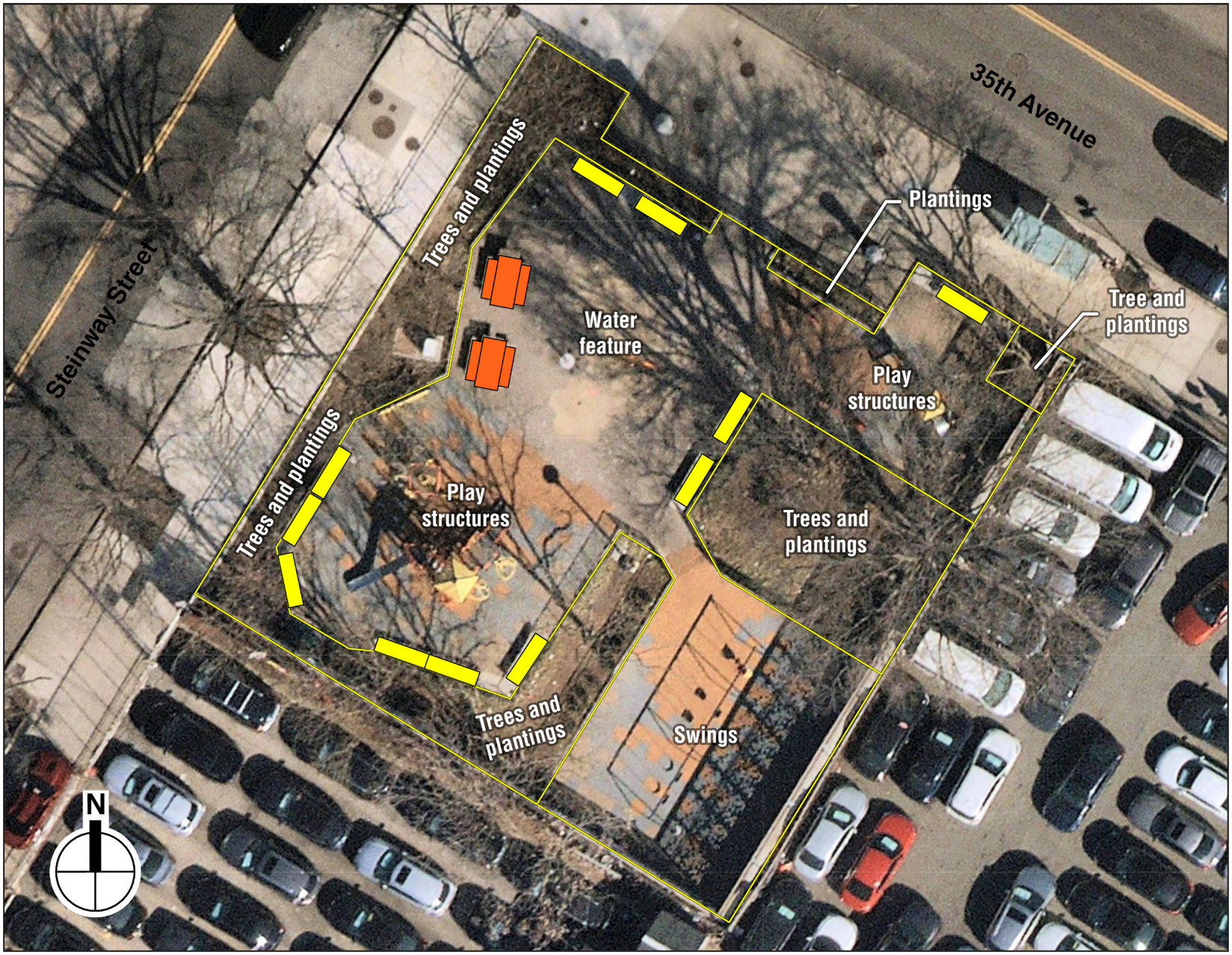
ASSESSMENT OF SHADOW IMPACTS ON PLAYGROUND THIRTY FIVE XXXV

Playground Thirty Five XXXV is located on 35th Avenue between Steinway Street and 41st Street, north-adjacent to Projected Development Site C and across the street from Projected Development Sites B (which is to the west) and D (to the east). The playground is mostly occupied by playground equipment and landscaped areas between and around the play areas, with benches located in most areas of the park, and two picnic tables on the west side (see **Figure 6-24** showing a site plan of the park). Playground Thirty Five XXXV was recently renovated and is in excellent condition. It is moderately used.[5]

The Proposed Development would include the provision of a large publicly accessible open space adjacent to, and complementing, Playground Thirty Five XXXV. Based on a conceptual design, this adjacent open space would include a dog run and a walkway area along the playground's existing fence. To ensure a conservative analysis, the existing playground was evaluated for shadow impacts as a discrete resource, unconnected to the adjacent proposed open space. However, as with any CEQR shadows assessment, sun and shade conditions on adjacent and nearby open spaces should be taken into account when assessing incremental shadow impacts. Therefore, the season-by-season assessment provided below notes sun and shade conditions on the adjacent proposed open space when relevant, including any potential for the proposed space to provide sunlit areas during times when incremental shadows would cover much or all of the existing playground space. A more comprehensive description of the anticipated design of the adjacent proposed open space, as well as its sun and shade conditions in each season, are provided in the next section, "Project-Generated Open Spaces."

[5] See the discussion of the condition and utilization of the existing playground in Chapter 5, "Open Space."

12.1.21



INNOVATION QNS
ASTORIA, QUEENS
COMMUNITY DISTRICT 1

Playground Thirty Five XXV Site Plan

Figure 6-24

On the December 21 analysis date representing winter, incremental shadow resulting from the new development would eliminate most or all sunlight on the playground throughout the day (see **Figures 6-6 to 6-8**). The incremental shadow would cover large areas of the park in the morning and mid-day hours, eliminating most or all of the sun, and later in the afternoon when No Action shadow would cover much of the park, the incremental shadow would eliminate most or all of the remaining sun. The adjacent proposed open space would also be largely in shadow throughout the day. Any incremental shadow on December 21, when temperatures would be colder and the use of the active recreational space would not be as high, would not necessarily affect the utilization or enjoyment of this open space resource. However, due to the extent and duration of the incremental shadow, a significant impact on Playground Thirty Five could occur on this analysis day.

On the March 21 and September 21 analysis date representing fall and early spring (see **Figures 6-9 to 6-13**), incremental shadow from Projected Development Site D would move across the park in the morning, covering over half the park between approximately 8:15 a.m. and 10:00 a.m. (9:15 a.m. and 11:00 a.m. Eastern Daylight Time [EDT][6]). Around 9:10 a.m., all of the park would be briefly in shadow before the sun moves across the sky and with it the shadows mostly leave the playground, exiting from the northeast after 10:30 a.m. and re-entering in the southeast around 11:30 a.m. A portion of the adjacent proposed open space would be in sun during this period. Incremental shadow from Projected Development Site C would pass across the park in the early afternoon, covering much (and briefly all) of the park between 12:15 p.m. and 2:15 p.m. (1:15 p.m. and 3:15 p.m. EDT). The eastern half of the adjacent proposed open space would be in sun during this affected period. From 2:15 p.m. to 3:15 p.m. (3:15 p.m. to 4:15 p.m. EDT) the park would continue to be in incremental shadow from Projected Development Sites C and B, and from 3:15 p.m. (4:15 p.m. EDT) until the end of the analysis day, the entire park would be in shadow, most of it incremental shadow from Projected Development Sites C and B. The proposed open space adjacent to the park would also be entirely in shadow for the final hour and a half of the day.

Given the substantial coverage and long durations of incremental shadow over the course of the day, particularly in the late afternoon when the entire park as well as the proposed open space adjacent to it would be in shadow, most of it incremental shadow, for an hour and 15 minutes, the Proposed Actions would result in significant adverse shadow impacts affecting the user experience of the park in the fall and early spring.

With respect to the park's trees and plantings, those in the northern part of the park would receive 4 to 5 hours of direct sun over the course of the day, which, per *CEQR Technical Manual* standards, is generally the minimum requirement,[7] while those in the southern part would receive 3 to 4 hours, which is generally substandard.

On the May 6/August 6 analysis date, which represents the late spring and summer and an additional date (along with the summer solstice) in the growing season, shadows are shorter then in fall, winter, and early spring, and the days are longer. As shown in **Figures 6-14 to 6-18**, incremental shadows would pass across the park throughout the day. In the morning incremental shadow from Projected Development Site D would pass across a portion of the park from 7:45

[6] Times are given in Eastern Standard Time (EST) in all seasons, as mandated by the *CEQR Technical Manual*, but Eastern Daylight Time (EDT) is in effect for all representative analysis days except for December 21, and times are also provided parenthetically in EDT when relevant, for informational purposes.

[7] *CEQR Technical Manual*, November 2020 Edition, Chapter 8, "Shadows," p. 8-23

a.m. to 10:00 a.m. (8:45 a.m. to 11:00 a.m. EDT) but would leave more than half of the park in sun even at its greatest extent at approximately 9:00 a.m. (10:00 a.m. EDT). The park would be entirely in sun for about an hour, and then incremental shadow from Projected Development Site C would pass across the park from just after 11:00 a.m. (12:00 p.m. EDT) until late in the afternoon, and would cover virtually the entire park at its maximum extent at about 12:40 p.m. (1:40 p.m. EDT). Approximately the eastern half of the adjacent proposed open space would be in sun around this time of maximum extent. From 1:00 p.m. until 5:00 p.m. (2:00 p.m. to 6:00 p.m. EDT), the park would be partially in sun and partially in shadow, primarily incremental shadow from Projected Development Sites C and B. Most of the adjacent proposed open space would be in shadow as well during this afternoon period. From just after 5:00 p.m. (6:00 p.m. EDT) until the end of the analysis day 15 minutes later the entire park would be in shadow, mostly incremental shadow.

Part or all of the park would remain in sun for portions of the day. However, incremental shadow would fall on portions of the park throughout the day for a total of 8 and a half hours and would eliminate all or most of the sun at certain times of the day. Therefore, the incremental shadow would cause a significant adverse impact affecting the user experience of this park on the May 6/August 6 analysis date. With regard to vegetation, all the trees and plantings would receive a minimum of 4 to 6 hours of direct sun over the course of this analysis day, which as noted above is generally the minimum requirement to ensure their viability.

On the June 21 analysis day, incremental shadows would follow a similar pattern to the May 6/August 6 analysis day, passing across the park at intervals throughout the day, but their coverage and duration would be less (see **Figures 6-19 to 6-23**). Incremental shadow from Projected Development Site D would remain relatively small in the morning ,and the park would be entirely in sun from approximately 9:45 a.m. to 11:30 a.m. (10:45 a.m. to 12:30 p.m. EDT). In the afternoon, shadow from Projected Development Site C would cover half or more of the space from 12:30 p.m. to 1:00 p.m. (1:30 p.m. to 2:00 p.m. EDT) but otherwise the park would be partly in incremental shadow but mostly in sun until approximately 4:00 p.m. (5:00 p.m. EDT), mostly in incremental shadow after that, until 5:30 p.m. (6:30 p.m. EDT) when it becomes fully in shadow, mostly incremental, for the final half hour of the analysis day. Substantial areas of the park would remain in sun throughout the day until the final half-hour, even during periods when incremental shadow would fall. Sunlit areas would be available to users in the park and in the adjacent new open space all day. Given these factors, the Proposed Actions would not cause a significant adverse shadow impact on this analysis day. With regard to vegetation, all the trees and plantings would receive a minimum of 4 to 6 hours of direct sun over the course of this analysis day, which as noted above is generally the minimum requirement to ensure their viability.

It should also be noted that while these incremental shadows would be an impact per the *CEQR Technical Manual,* during the hotter months, which will increasingly become hotter, the afternoon incremental shadows could be a welcome respite from the summer sun for both active and passive recreational users. Users looking for relief from the summer sun and heat in the late afternoon would find respite, like finding shade underneath a tree, in the areas temporarily affected by incremental shadows.

PROJECT-GENERATED OPEN SPACES

The Proposed Development would include the provision of new exterior publicly accessible open spaces on Projected Development Sites A, B, C, and E (the new publicly accessible open space on

Projected Development Site D would be covered). The following descriptions of the proposed open spaces are based on a conceptual design.[8]

The most northerly of the proposed open spaces on Projected Development Site A is planned as a passive community gathering space which could include public seating, planted areas, a multipurpose lawn, and a water feature. The central space on Projected Development Site A is planned as a children's playscape. The open space at the southern end of the site along 36th Avenue is planned for active public use. The more northerly proposed open space on Projected Development Site B would include a through-block pedestrian plaza with large planted areas and shade trees, a water feature, public seating, art installations, and a flexible lawn. The more southerly proposed open space on Projected Development Site B is planned as a community gathering space with seating, plantings, and lawn areas. As noted in the previous section describing shadows on the existing Playground Thirty Five XXXV, the proposed open space on Projected Development Site C is planned as a large civic oriented public open space which would surround and augment the existing playground. Astoria Commons would include a dog run and a walkway area along the playground's existing fence. The plaza would also include large planters, public seating, a through-block pedestrian promenade, a water feature, a pavilion, a multipurpose lawn, and interactive public art. The proposed open space on Projected Development Site D is planned as a through-block pedestrian promenade and plaza and would include public art installations, holiday and farmer's markets, interactive plaza furnishings, and communal tables. Additionally, the plaza space is planned to be flexible space to include temporary recreational features such as seesaws, communal games, and adult swings. The proposed open space on Projected Development Site E is planned as a community plaza and would include public seating, planters, and interactive public art installations.

On the December 21 analysis day, all the new exterior open spaces would be in shadow throughout the day, with the exception of the proposed active space on Site A along 36th Avenue, which would be mostly or entirely in sun throughout the day.

On the March 21 analysis day, the northern and central open spaces on Projected Development Site A would be mostly shady in the morning, partly shady and partly in sun in the late morning and mid-day, and in shadow through the afternoon. The proposed active space on Site A along 36th Avenue would be mostly or entirely in sun throughout the day. The open spaces on Projected Development Site B would be mostly to fully in shadow throughout the day, however the throughblock space would be sunny for about 45 minutes in midmorning. The new open space on Projected Development Site C, adjacent to Playground Thirty Five XXXV, would be partly to mostly shady in the morning and midday. It would be sunniest around 12:00 to 12:30 p.m. (1:00 to 1:30 p.m. EDT) when a little more than half of the space would be in sun, at which time much of the existing Playground Thirty Five XXXV would be in (mostly incremental) shadow. After 2:00 p.m. (3:00 p.m. EDT), it would be mostly or entirely in shadow. The open space on Projected Development Site E would be mostly or entirely in shadow throughout the day.

In the late spring and summer months represented by May 6/August 6 and June 21, the two spaces on Projected Development Site A and the throughblock space on Projected Development Site B would be mostly in shadow in the early morning and mostly sunny in the late morning. The proposed active space on Site A along 36th Avenue would be mostly or entirely in sun from midmorning until the end of the day. The southern space on Projected Development Site B would be mostly or entirely in shadow throughout the morning. The spaces on Projected Development

[8] November 2021

Site A would be in shadow throughout the afternoon, and the spaces on Projected Development Site B would be mostly in shadow in the early afternoon and entirely in shadow in the late afternoon. The new open space on Projected Development Site C, adjacent to Playground Thirty Five XXXV, would be partly in sun and partly in shade in the morning, partly to mostly sunny from 10:00 a.m. to 1:00 p.m. (11:00 a.m. to 2:00 p.m. EDT), and mostly in shadow for the rest of the afternoon. The open space on Projected Development Site E would be mostly or entirely in shadow throughout the day, except for an hour from about 1:30 p.m. to 2:30 p.m. (2:30 p.m. to 3:30 p.m. EDT) when it would be half in sun.

E. CONCLUSION

As described in detail above, the analysis concluded that development resulting from the Proposed Actions would cast new shadows on Playground Thirty Five XXXV throughout the day in all seasons, covering large areas of the playground at times, eliminating much or all of the remaining sunlight in the park at times, particularly in the fall, winter, and early spring, and causing significant adverse impacts affecting the user experience in all seasons. Trees and plantings in the park would continue to receive adequate direct sunlight through the May to August heart of the growing seasons, but those in the southern part of the park would receive up to an hour less than generally required in the March and September "shoulders" of the growing season, potentially impacting the health of those trees or plantings. The Proposed and Projected Development would not cast significant shadows on any other sunlight-sensitive resources. Potential mitigation for the shadows impact on Playground Thirty Five XXXV is discussed further in Chapter 20, "Mitigation." ✷