POLICY BRIEF

A Framework for a City Built for Sunlight

May 2021

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INTRODUCTION

This policy brief presents a framework for a city built for sunlight. It is the latest release by the Fight for Light campaign, an initiative founded by the Municipal Art Society of New York (MAS) in 2018 in partnership with New Yorkers for Parks.

Fight for Light grew out of our shared concerns about the lack of an effective park shadowing policy and the rapid growth of out-of-context development. However, it quickly evolved to focus on the role of the public realm[1] in improving the health of New York City residents and addressing the urgent demands for climate change solutions. The imperative of the campaign only grew more apparent as the events of 2020 underscored the role of public space in urban life.

This policy brief is the third publication in our exploration of the role of sunlight in urban environments. Our *Bright Ideas* report, released in October 2019, serves as a primer on the relationship between access to light and air and public health, and offers case studies on the ways that other global cities are building to protect and preserve this natural resource. In its conclusion, we laid out a series of recommendations for New York City, including the creation of a Director of the Public Realm, the development of a social vulnerability analysis, and an assessment of sunlight availability.

Last year, we followed up *Bright Ideas* with a new brief on that first recommendation. *A Public Champion for the Public Realm*, released in August 2020, outlined the responsibilities of a future Director of the Public Realm, the resources that office would need to succeed, and the most effective place to house it within New York City government.

In this latest release, we are diving into those remaining recommendations with a *Framework for a City Built for Sunlight*. Taken together, our analyses point to the need for targeted, place-based solutions alongside citywide policies that consider sunlight and public space from a broader health equity perspective. It is particularly important to home in on neighborhoods where there is a lack of sunlight, public spaces are at risk, and social vulnerability persists.

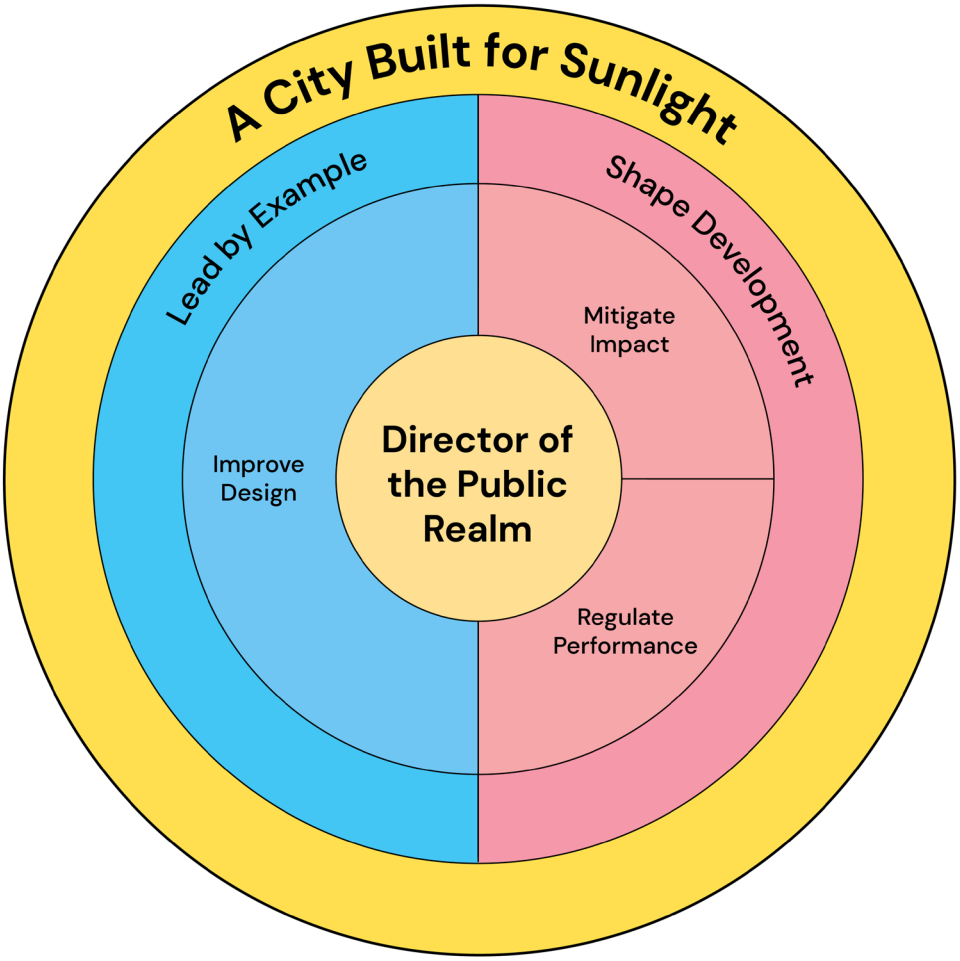
About the Framework

This Framework recommends that New York City do two things. First, it must lead by example through robust building and public realm design guidelines. Second, it must better shape development by regulating for performance and improving the environmental review process. The Framework makes recommendations for achieving these goals, placing a special focus on the importance of sunlight to human health, physical comfort, and the growth of plants and other living organisms.

The Framework's recommendations are based on our ongoing discussions with practitioners, academics, and thought leaders from around the world. They are also grounded in our emerging understanding of neighborhood sunlight access and social vulnerability, as well as our deepening knowledge about how these issues are manifested in both current and historic planning decisions.

To inform our recommendations, MAS asked the Environmental Performance and Urban

Interface teams at the global architecture firm, Kohn Pedersen Fox (KPF), to examine existing sunlight availability in case study neighborhoods across the five boroughs. MAS also conducted a citywide social vulnerability assessment to identify populations for whom protecting sunlight in the public realm is particularly crucial. The analyses and their key findings are explained briefly in the following sections, followed by our recommendations. Detailed summaries of the methodologies for both analyses may be found in the Appendix.



BACKGROUND

Modeling Sunlight Availability

MAS set out to quantify levels of sunlight in the public realm and to identify disparities in sunlight access within and across neighborhoods and types of public spaces. MAS was particularly interested in whether and where there is enough sunlight for public spaces to be considered bright, thermally comfortable, and suitable for tree growth.[2]

To do this, MAS consulted with KPF to conduct three analyses of sunlight availability. Each analysis focused on five case study areas: Downtown Brooklyn, Midtown Manhattan, Long Island City, Queens, St. George, Staten Island, and the South Bronx. The study areas were chosen to capture a range of land uses, street typologies, building types and sizes, and demographic characteristics. They are also areas of the city that are experiencing significant change because of new development.

The five study areas (Courtesy KPF)

The first analysis measured hours of daylight[3] availability in the public realm by factoring in the impacts of urban density and local sky conditions. The analysis focused on daylight availability in winter, when natural light is especially beneficial but also most limited due to the sun's angle and the fewer number of daylight hours compared to the summer. The analysis helped identify public spaces with adequate winter daylight as well as spaces where daylight access has been severely reduced.

The second analysis measured the effects of building shadows on public spaces during the times of year when direct sunlight can be the difference between physical comfort and discomfort, as measured by the Universal Thermal Climate Index (UTCI). Through the analysis, it was possible to pinpoint public spaces where existing direct sunlight is particularly critical in winter and areas that would benefit from additional shade during summer.

The final analysis measured the effects of existing and proposed buildings on direct sunlight to trees in the public realm. It identified the areas where trees do not currently have sufficient direct sunlight or are at risk of losing adequate sunlight. The analysis also identified areas where there is sufficient direct sunlight access to support the planting of additional trees.

How to Read the Maps

Level of Daylight Access During Winter

- Poor Daylight Access
- Morning Only
- Noon Only
- Evening Only

> 2 daylit hours on average

- Morning + Noon

> 4 daylit hours on average

Daylight Threshold: > 10,000 lux for > 50% hours
Evaluation Period: Winter months (Nov 7 - Feb 6)

Thermally Beneficial Sunlight
Average Daily Hours

- < 2
- 2-4
- 4-6
- > 6

Good sunlight access

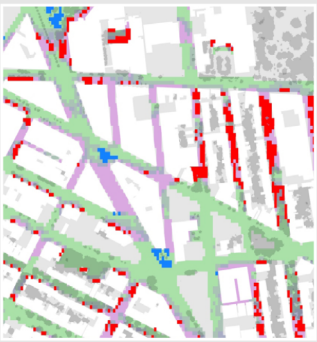
Cold Months: Perceived temperature < 57 F
Average hourly windspeeds assumed

Thermally Harmful Sunlight
Average Daily Hours

- < 2
- 2-4
- 4-6
- > 6

Shade especially critical

Warm Months: Perceived temperature > 82 F
Average hourly windspeeds assumed



Weeks in the Growing Season with 6+ Hours/Day

- 0-12 (0-49%)
- 13-18 (50-69%)
- 19-24 (70-89%)
- 25-26 (90-100%)

- Existing Tree Canopy at Risk
- Opportunity Areas for New Tree Planting
- Existing Tree Canopy

Courtesy KPF

Mapping Social Vulnerability

Social vulnerability mapping has been conducted by a range of entities including the U.S. Centers for Disease Control (CDC), academic institutions, nonprofits, consultants, and municipalities. The exercise includes identifying common measures of social vulnerability, such as age, race, and income. These social indicators are typically overlaid with one or more physical factors that are unique to the particular study. In New York

City, social vulnerability assessments have examined the disparate risks associated with excessive heat, flooding, pandemics, and climate change.

MAS's social vulnerability assessment sought to identify populations for whom protecting sunlight in the public realm is particularly critical. To do this, MAS aggregated and scored citywide census tract data for a range of socioeconomic, health, and built environment indicators based on an extensive literature and peer review process. Census indicators such as age, race, median household income, and disability status were first selected to describe underlying social vulnerability. These were then combined with wellness-related health indicators like mental health, physical activity, and sleep. Finally, built environment indicators such as population density, public space acreage, and future development potential were layered to account for the disparate physical characteristics of New York City's urban environment.

Data values were then scored for each indicator and aggregated to generate total scores for each census tract, which were mapped citywide. For the complete list of indicators, the rationale for including each, and a more detailed explanation of the scoring process, please refer to the Appendix.

DOES NEW YORK CITY HAVE A SUNLIGHT ACCESS PROBLEM?

Everyone has a sense of the sunlight they experience in their daily lives. We are aware of it when we choose to walk on the sunny side of the street in winter, watch our gardens bloom in spring, and seek shade under a tree in summer. However, understanding how much of that experiential evidence is reflected in the reality on the ground is essential to making the case for whether sunlight should be a significant factor in New York City's planning decisions. MAS set out to assess the realities in five areas of the city. We found that sunlight, human perceptions of outdoor comfort, and the survivability of plants in the public realm are inherently connected. Public spaces are *the* conveyors for sunlight in New York City. This role is especially important when public spaces are situated in neighborhoods that lack sunlight on streets and sidewalks.

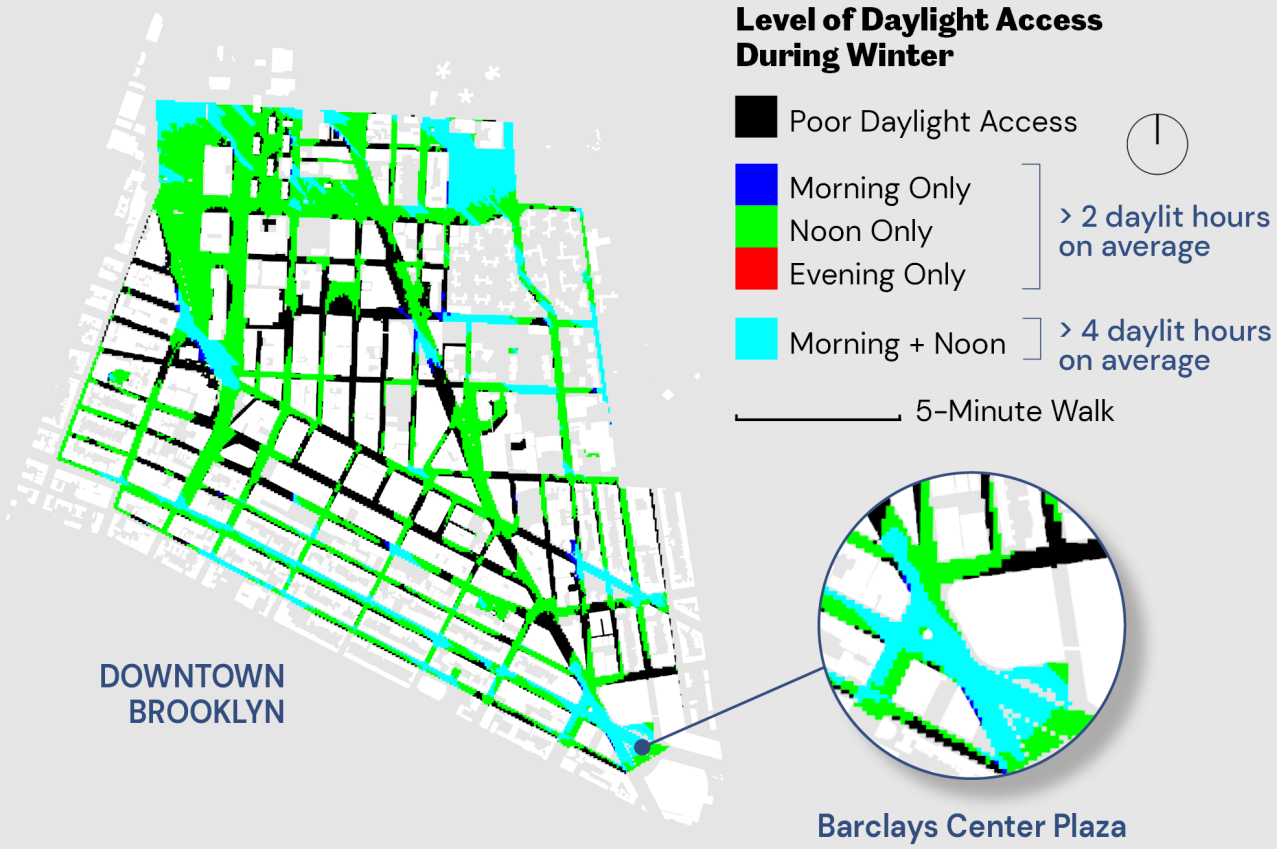
The public plaza in front of Barclays Center (Source: Flickr, The Commons, Jules Antonio)

Sunlight, Thermal Comfort, and the Health of Vegetation Go Hand-in-Hand

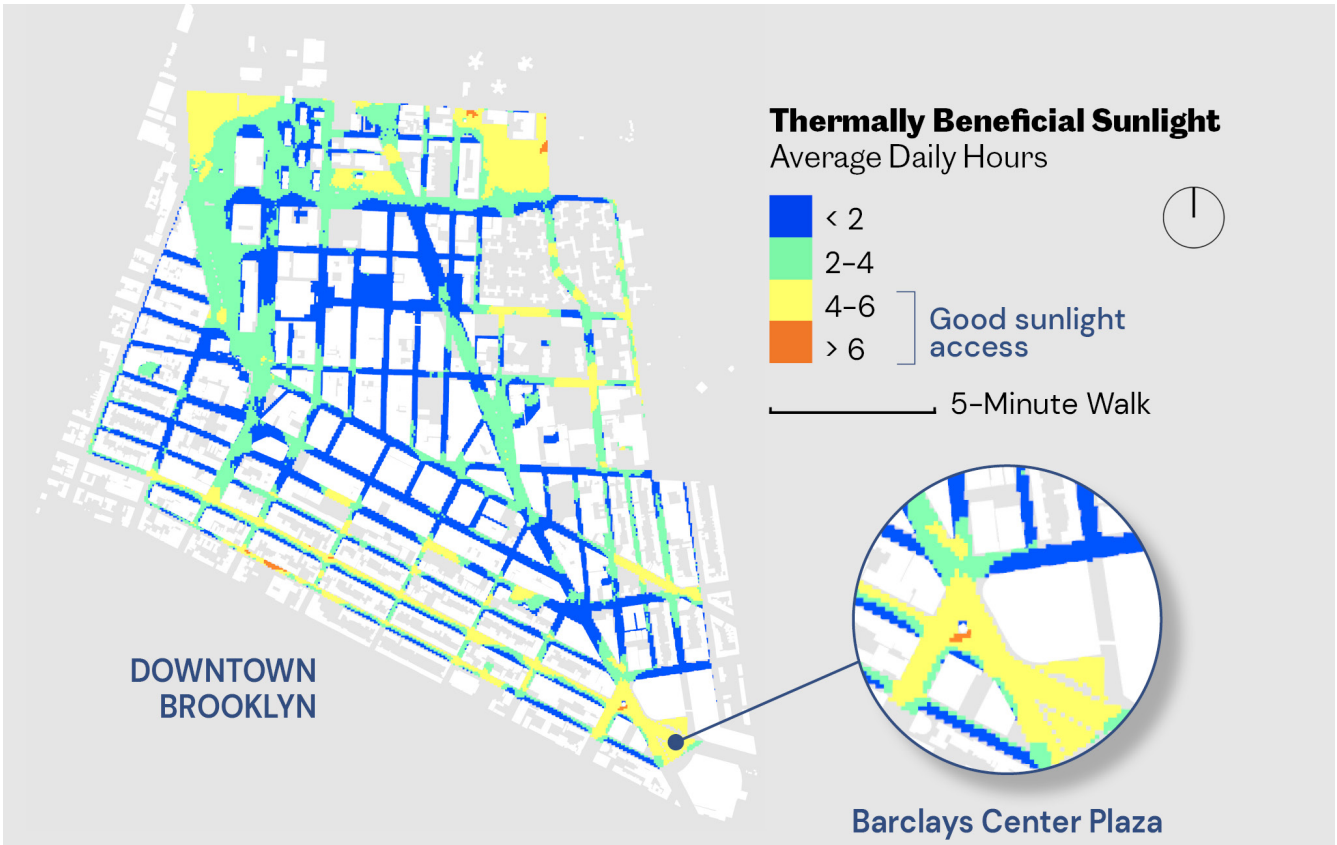
The three sunlight analyses were linked by a consistent takeaway: the physical comfort of humans and the health of the urban tree canopy go hand in hand, as both are completely dependent on the presence of sunlight. This relationship is apparent in our public spaces every season of the year.

In front of Downtown Brooklyn's Barclays Center, for example, there is a pedestrian plaza that receives ample daylight (more than four hours per day) during winter mornings and afternoons. The plaza is a small but important public space for accessing natural light in an area where it is lacking.

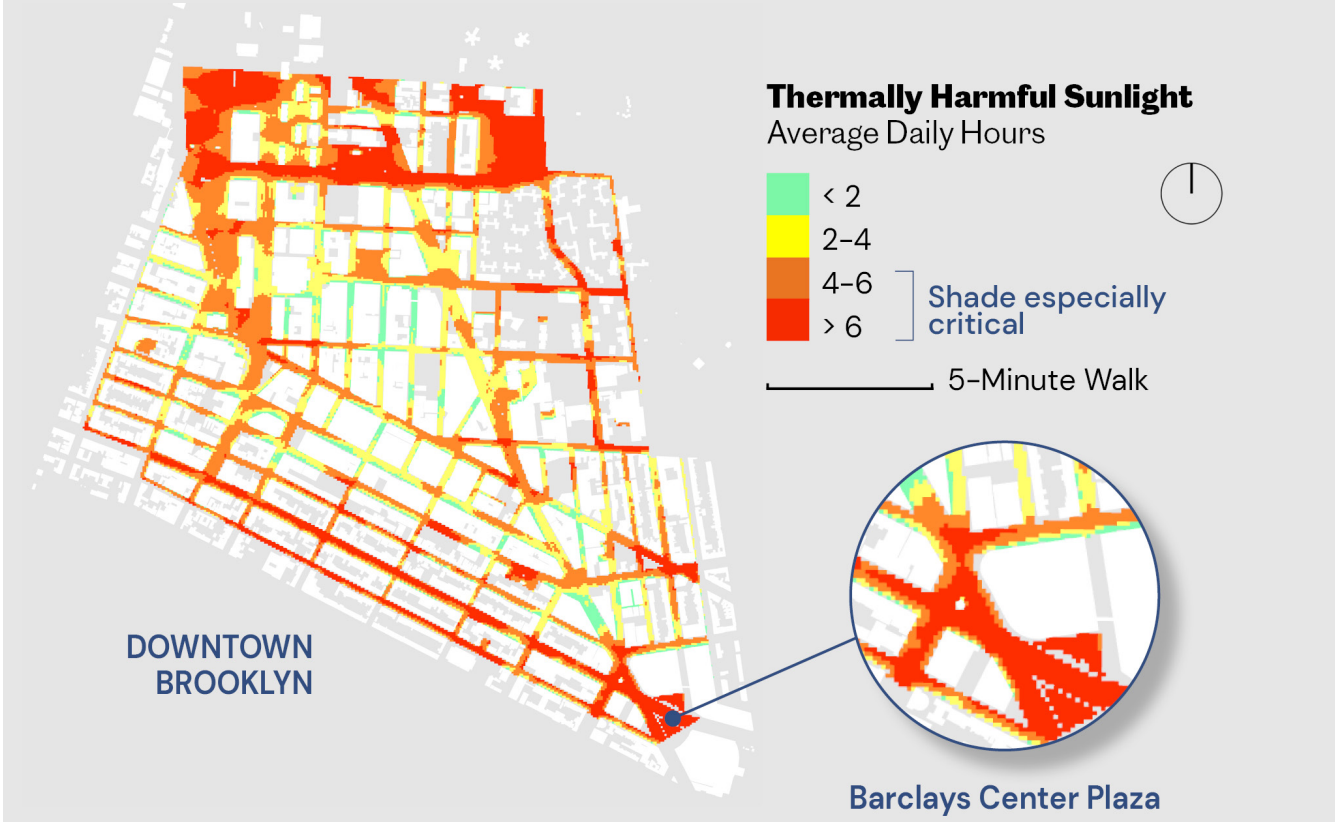
Daylight makes the plaza feel more physically comfortable, whether sitting on a bench, waiting in line for a basketball game, or participating in a rally or protest. This winter daylight is thermally beneficial between four and six hours per day, and its presence extends the usability of the space during the colder months of the year.



Courtesy KPF

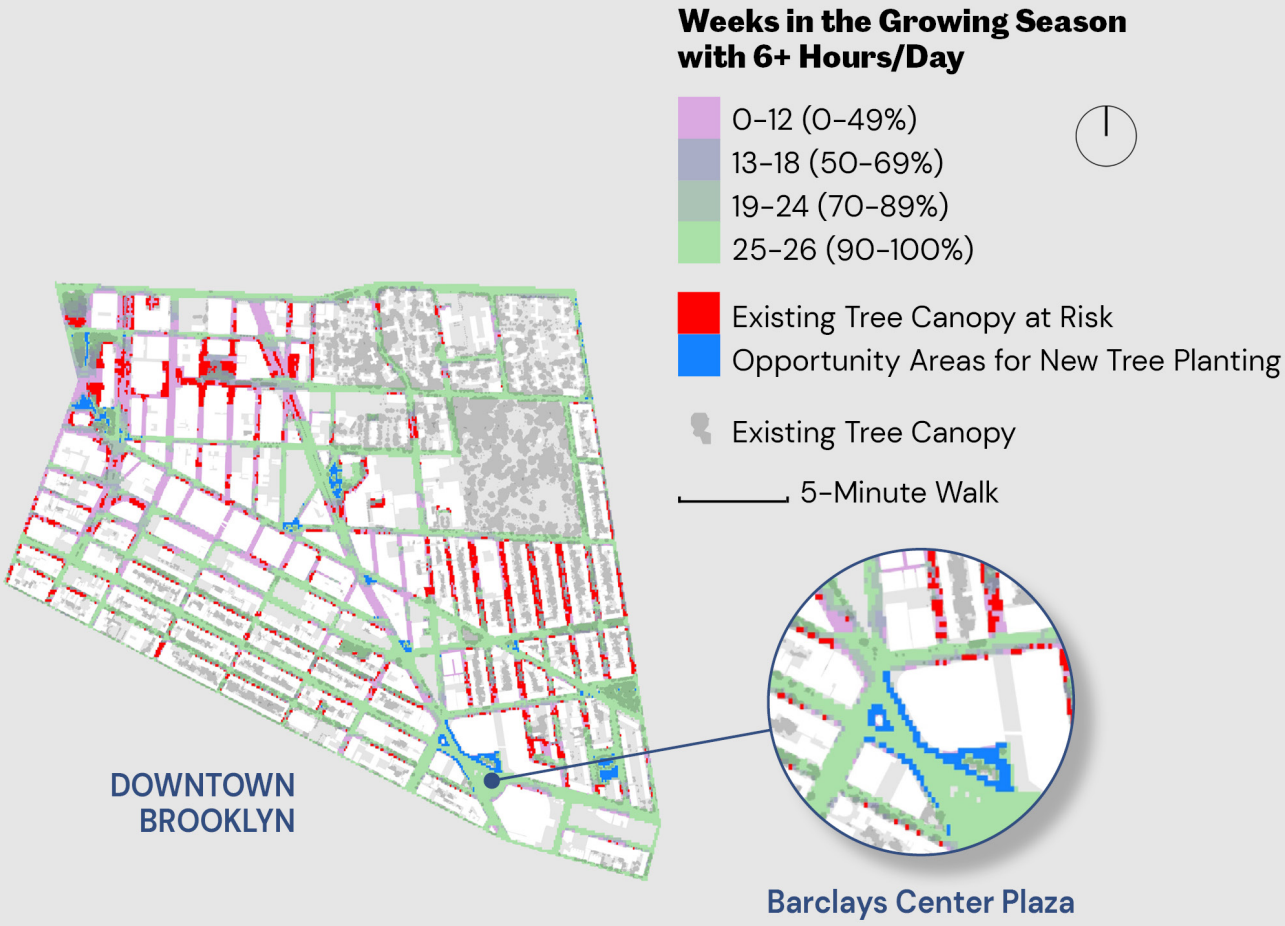


Conversely, in the height of summer, direct sunlight can make the plaza feel too hot, or thermally uncomfortable, for long periods of time (more than six hours per day). During these months, many visitors seek respite in shady areas, which are unfortunately limited in the plaza.



Courtesy KPF

However, the amount of summer sunlight in the plaza is ideal for plant growth. The existing sunlight provides an opportunity to introduce new trees that can increase the amount of beneficial summer shade and the comfort of plaza users. The trees also capture storm water runoff and planet-warming carbon, providing additional climate change and temperature cooling benefits. Tree coverage can also be supplemented with seasonal or strategically placed shade interventions like awnings or umbrellas in areas where underground subway infrastructure prevents tree planting.



When winter returns, the leaves of deciduous trees fall away, allowing sunlight to penetrate and once again warm plaza users.

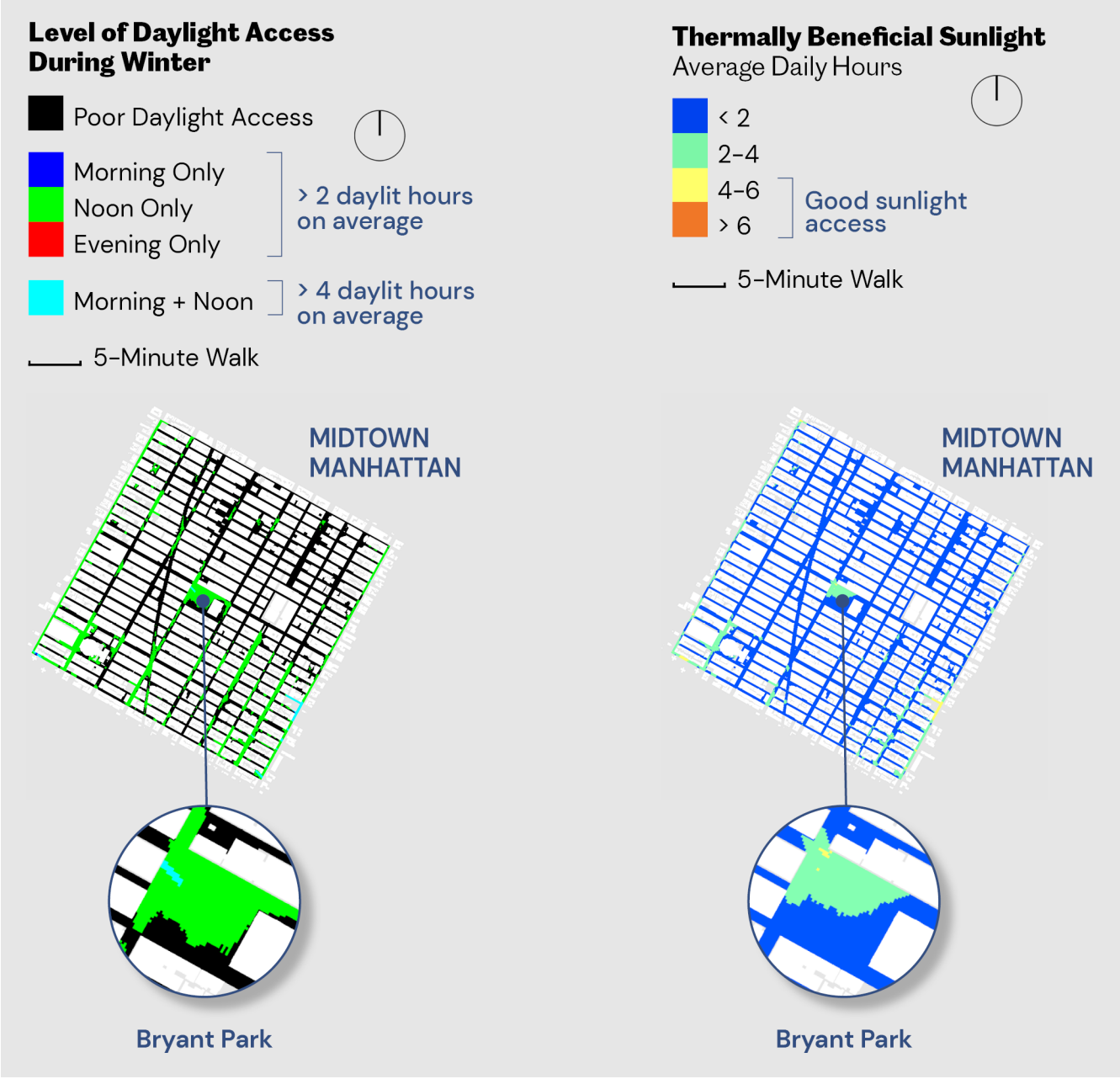
In short, sunlight provides year-round benefits and should be preserved whenever possible. This includes during the summer, when the heat from the sun is best tailored for human comfort through the planting of trees and other tactical shade strategies. Of course, thermal comfort is but one consideration for a well-designed plaza. To be truly successful, the accessibility of the plaza, its programming, and other design and usability-related factors also need to be considered.

Courtesy KPF

Public Open Space is a Critical Source of Neighborhood Sunlight

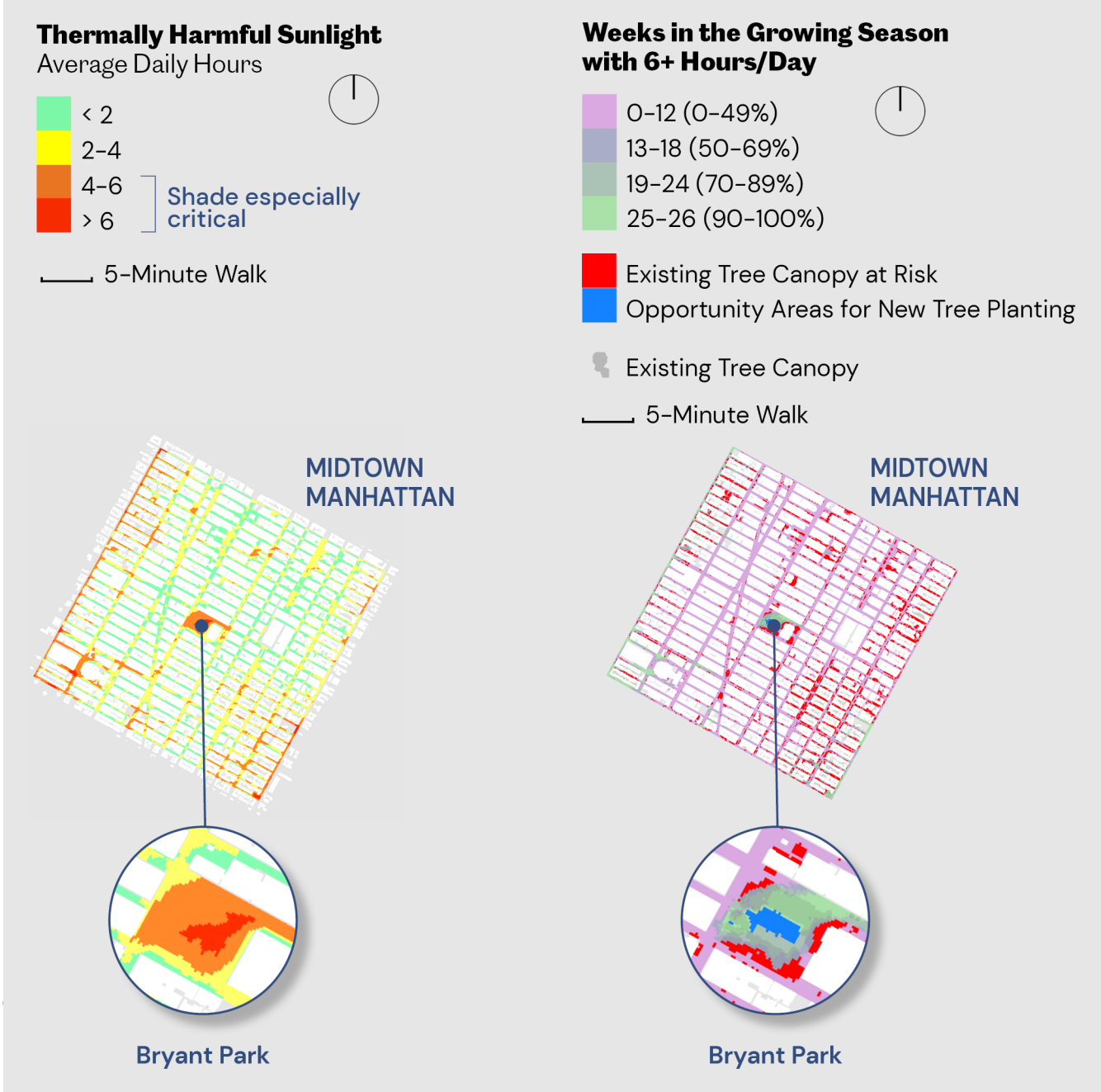
In addition to containing numerous sunlight-dependent features such as pools, gardens, lawns, trees, and seating areas, KPF's analyses found that public spaces are essential in providing sunlight access to residents and workers of surrounding areas. Nowhere was this more evident than at Bryant Park.

The park is a critical source of daylight in a Midtown area lacking other large open spaces and where a majority of the public realm receives minimal daylight. At noontime during the winter, Bryant Park is the only neighborhood open space that receives a consistent amount of daylight at 10,000 lux, a target recommended by the medical community to mitigate the effects of sleep and seasonal affective disorders. This daylight is critical to the thousands of office workers who live and work indoors, commute underground, and whose only opportunity to experience sunlight is during their lunch break.



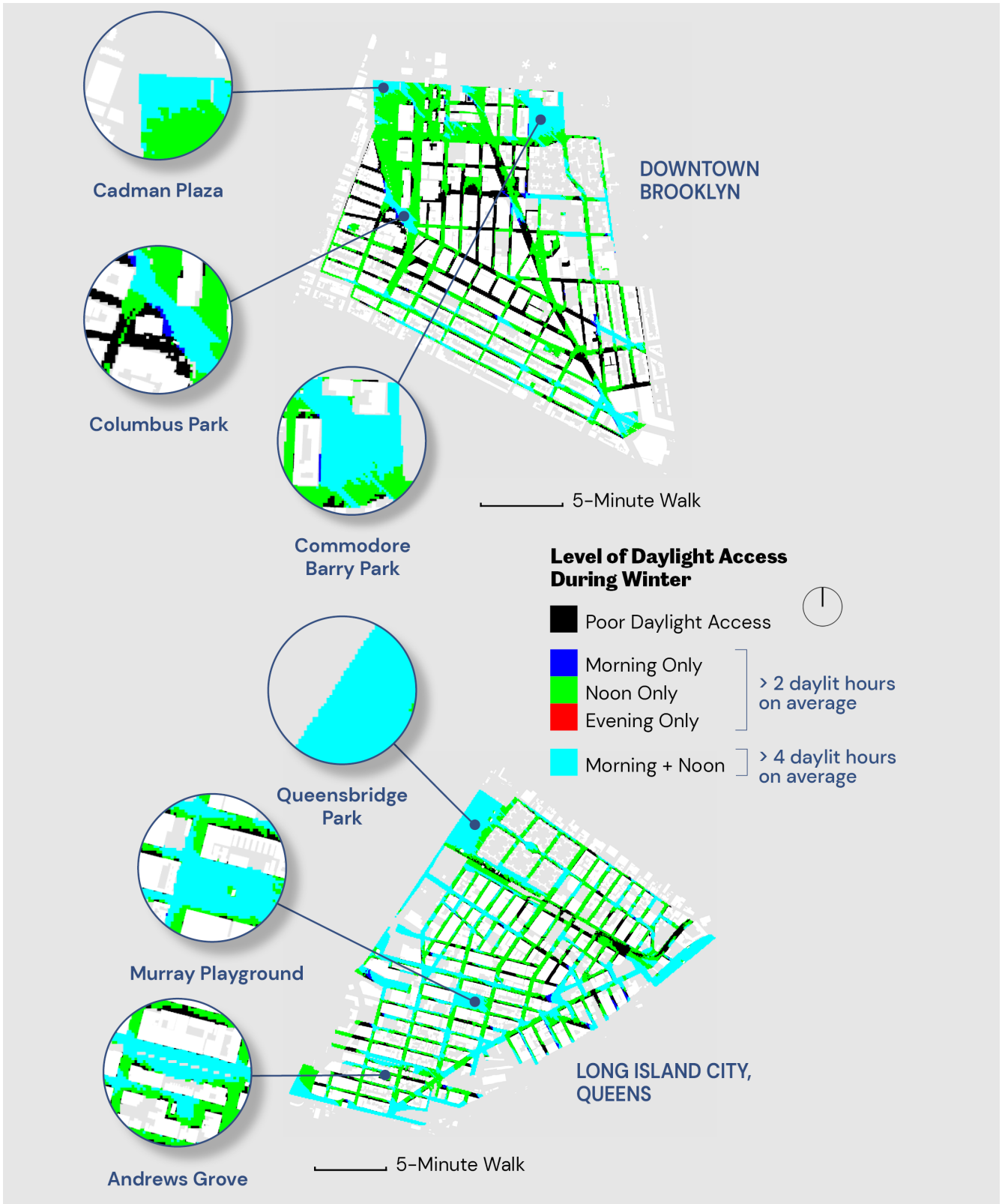
Courtesy KPF

Bryant Park also receives an ample amount of sunlight in summer when the space is most heavily used. In fact, it is the only neighborhood open space with enough direct sunlight to support an adequate growing season for trees. In summer, this vegetative greenery improves the comfort of park-goers and helps to mitigate the waste heat generated by surrounding buildings and vehicles.



Courtesy KPF

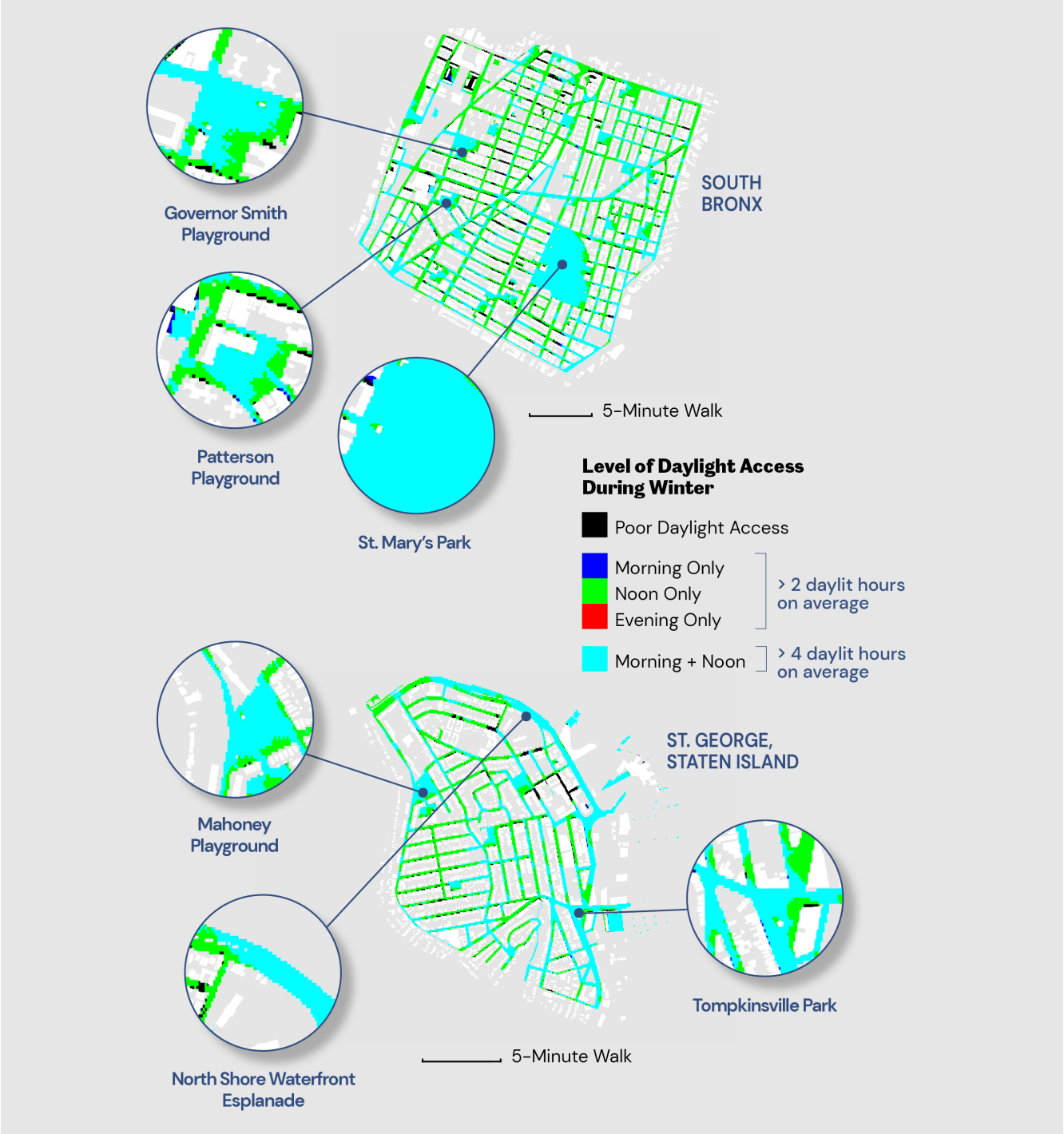
This phenomenon is apparent in each of the four other study areas that KPF examined. In densifying neighborhoods like Downtown Brooklyn and Long Island City, open spaces like Columbus Park, Commodore Barry Park, Murray Playground, and Queensbridge Park are islands of winter daylight amidst much of the public realm that no longer receives enough natural light to be considered sufficiently bright.



Courtesy KPF

Even in less built-up areas like the South Bronx and St. George, open spaces like Flynn Playground, St. Mary's Park, and Mahoney Playground are critical daylight oases, especially during the colder months. In St. George and in other waterfront communities, shoreline open spaces are particularly important sources of daylight.

For residents and workers of these areas, public open spaces are essential neighborhood sunlight hubs—the only available outdoor locations to gather on brisk spring and fall days and sit comfortably during mild winter afternoons. They are also the single most important spaces where trees and other vegetation grow and provide shade, air filtration, storm water management, and biodiversity benefits.



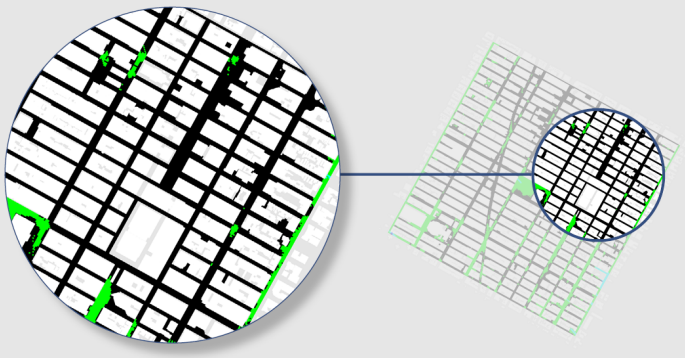
Courtesy KPF

Access to Sunlight Varies Significantly Along Streets and Sidewalks

As with open space, the presence of sunlight on streets and sidewalks can make a significant difference in terms of the pedestrian experience and the health of trees and other vegetation. Well-designed streets and sidewalks can be destinations unto themselves, encouraging pedestrians to linger and experience the city. Streets and sidewalks are also home to 233 different sunlight-dependent tree species (nearly 700,000 trees in total).[4]

Yet KPF's analyses found that some neighborhood street networks have experienced a steady or near total depletion of sunlight. In East Midtown, for example, most streets rarely experience lux levels over 10,000 in winter due to the scale of surrounding high-rises.

Similarly, in the dense MetroTech area of Downtown Brooklyn, many streets receive less than an hour of winter daylight per day with lux levels more than 10,000. The issue is intensifying as large-scale development spreads outward, with the majority of streets in the core downtown area (including wider, heavily traveled streets like Livingston Street and Flatbush Avenue) now experiencing a suboptimal amount of daylight along significant segments.



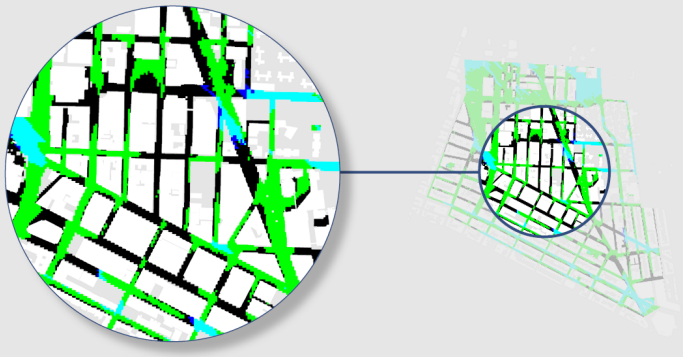
Midtown Manhattan

Level of Daylight Access During Winter

- Poor Daylight Access
- Morning Only
- Noon Only
- Evening Only
- Morning + Noon

> 2 daylit hours on average

> 4 daylit hours on average



Downtown Brooklyn

Level of Daylight Access During Winter

- Poor Daylight Access
- Morning Only
- Noon Only
- Evening Only
- Morning + Noon

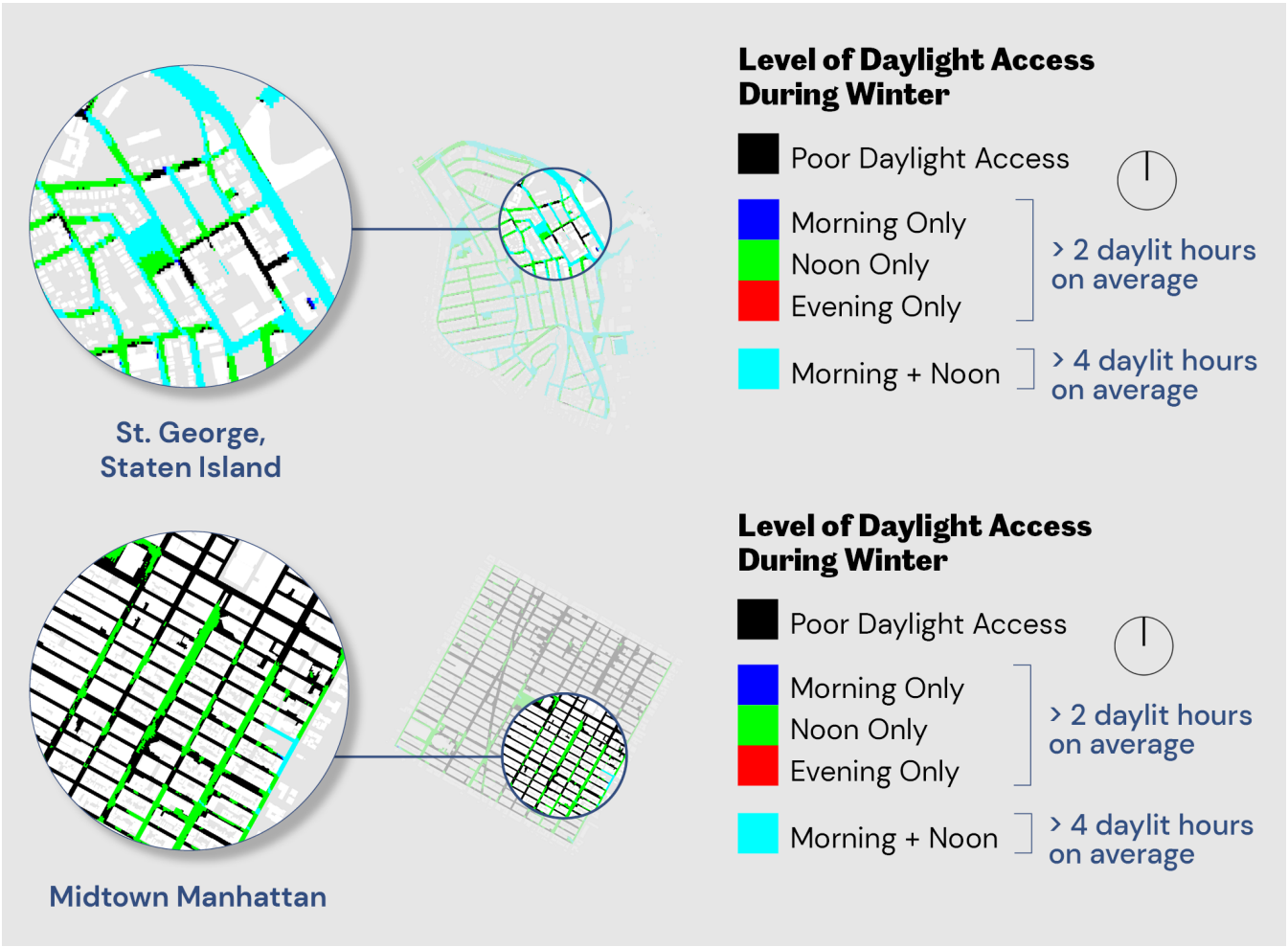
> 2 daylit hours on average

> 4 daylit hours on average

Courtesy KPF

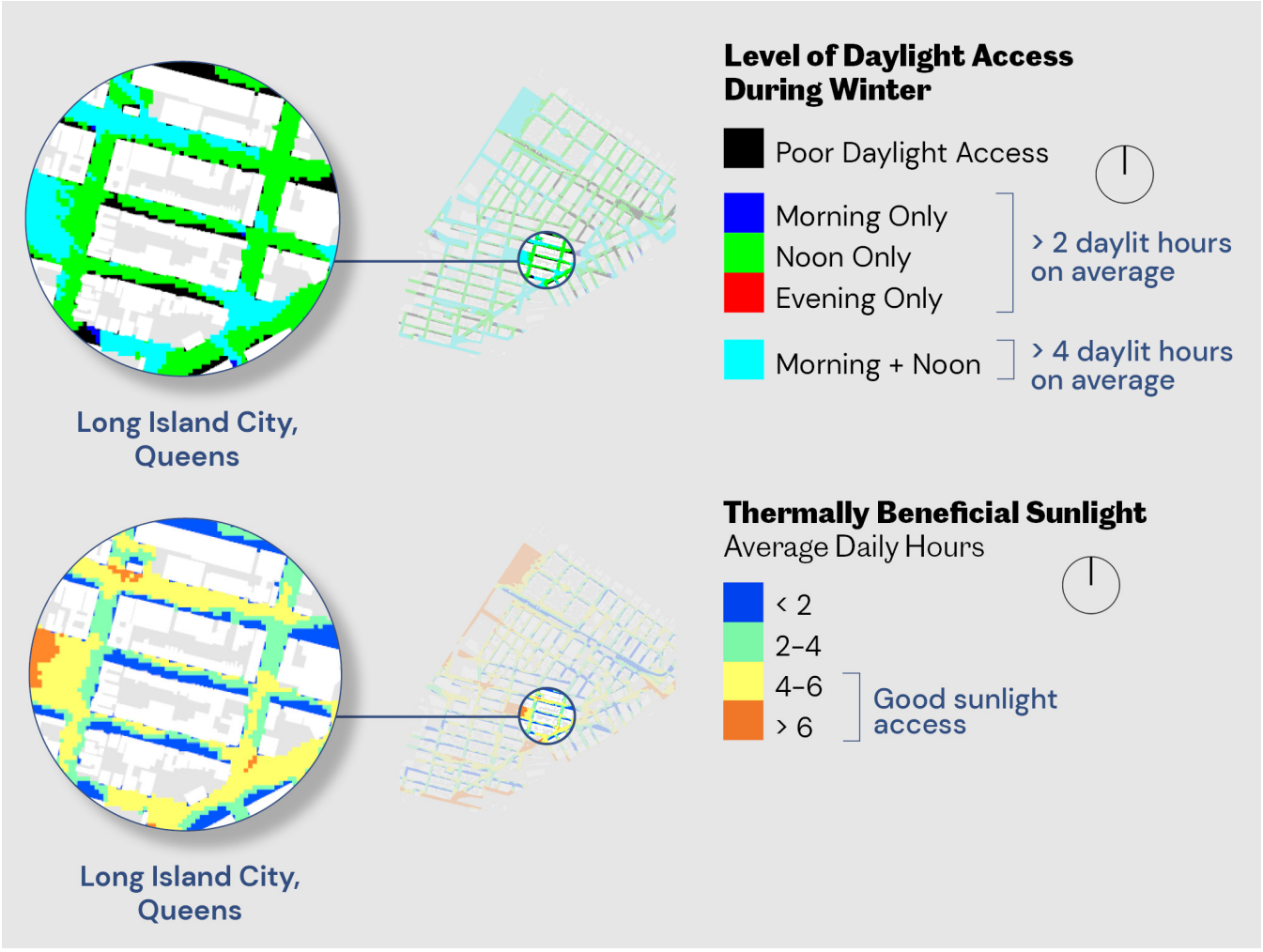
However, it is important to note that the presence or absence of daylight on streets is not just associated with the height of surrounding buildings. In St. George, even six to eight story buildings can block daylight from nearby streets for the entire day.

In fact, street width and orientation play an outsized role in determining daylight availability on streets and sidewalks. As evidenced in Midtown, streets that are wider and angled north-south tend to receive a greater amount of daylight in winter than narrower streets and those oriented east-west.



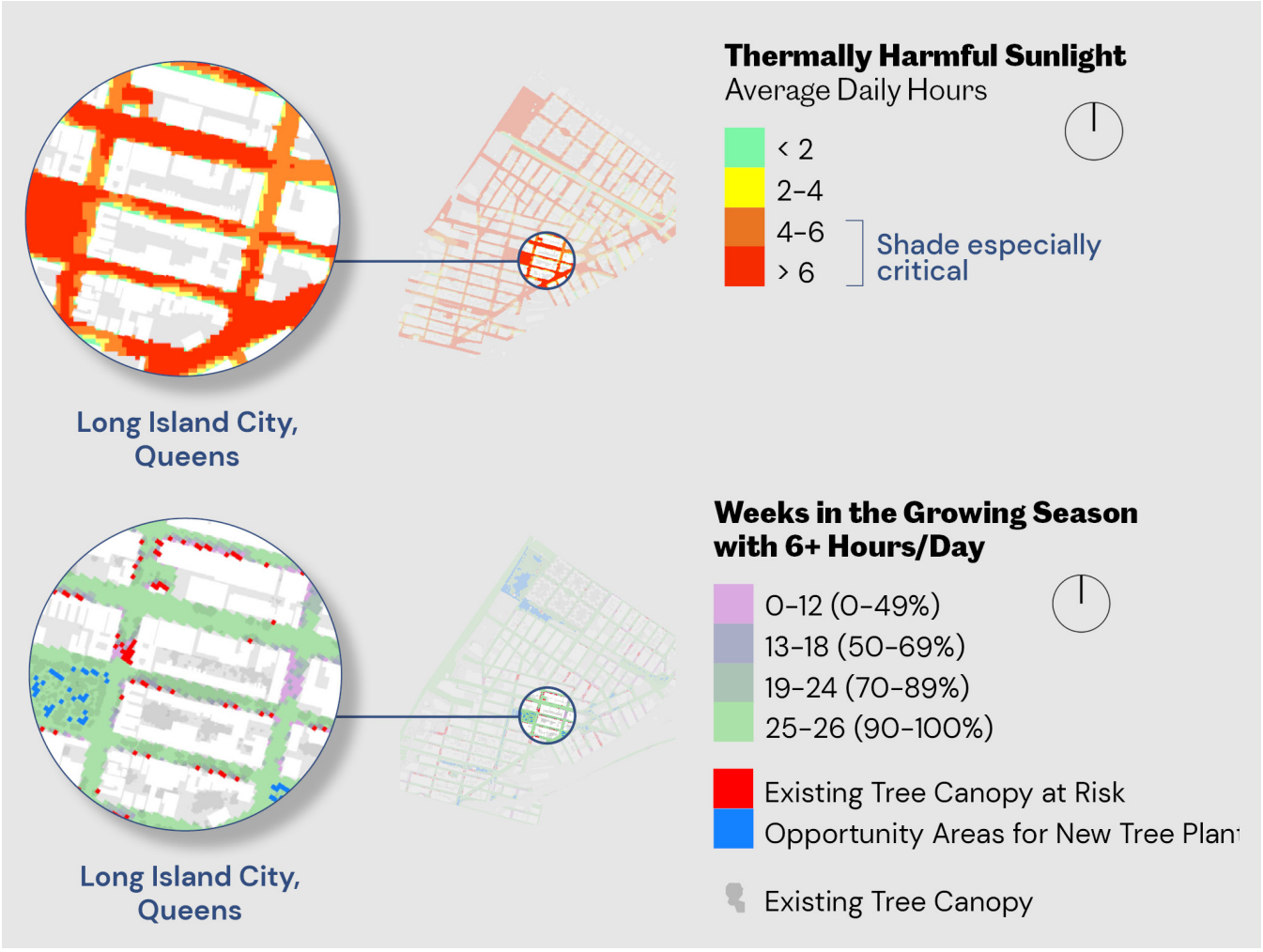
Courtesy KPF

Side of street is also an important determinant of daylight availability, particularly in winter. Because of New York's latitude, daylight is much more likely to be present on the north side of the street, where shadows from southerly buildings are less likely to reach. In Long Island City, many north sides of streets receive four to six hours of beneficial sunlight during the colder months versus less than two hours on the south sides.



Courtesy KPF

In summer, however, when the sun's angle is higher, both street sides tend to receive at least four to six hours of direct sunlight, suggesting an opportunity to plant additional shade-providing trees to mitigate hot temperatures in summer. Fortunately, this amount of summer sun is enough to support long growing seasons for trees.



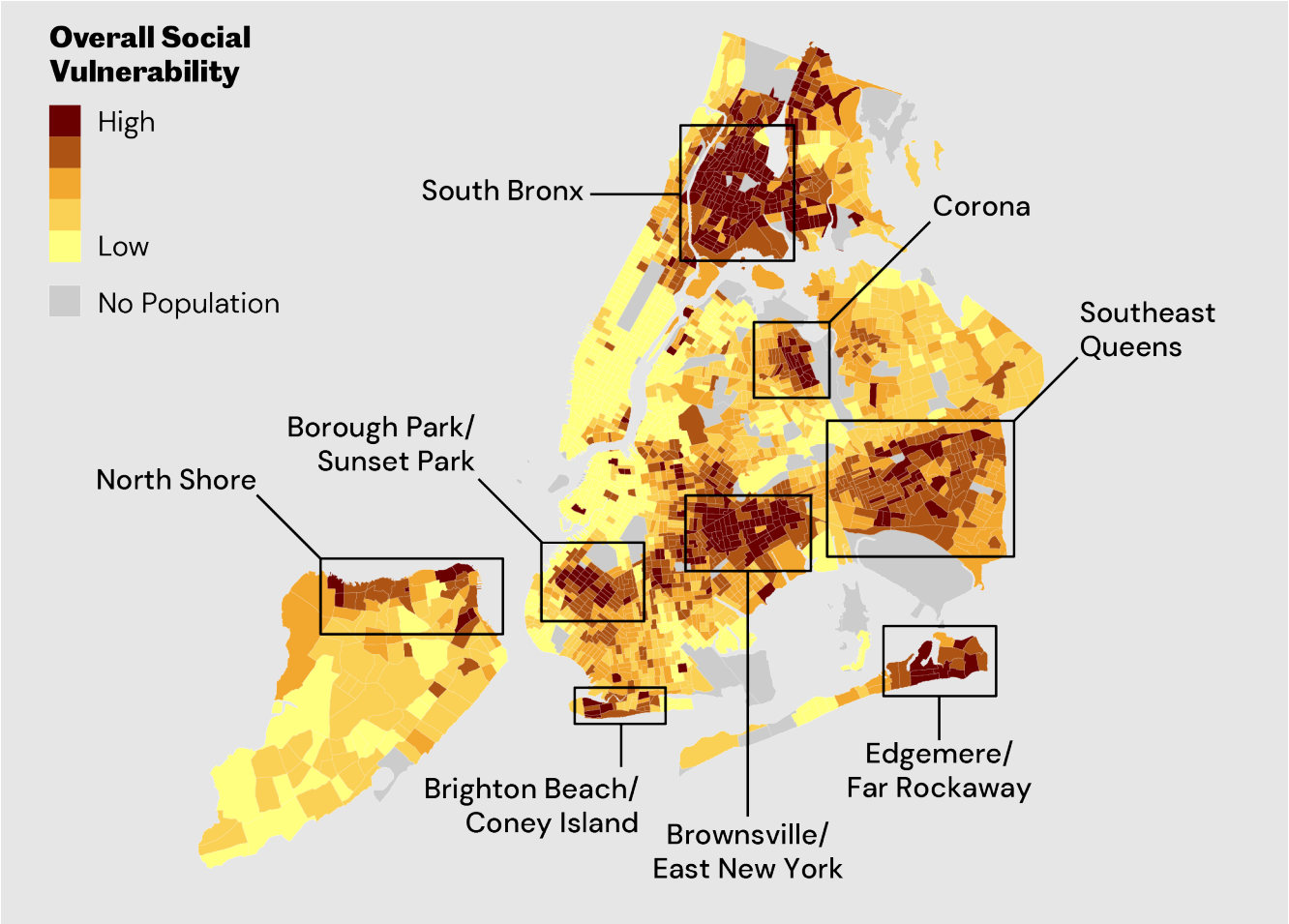
Courtesy KPF

WHERE DOES IT MATTER MOST?

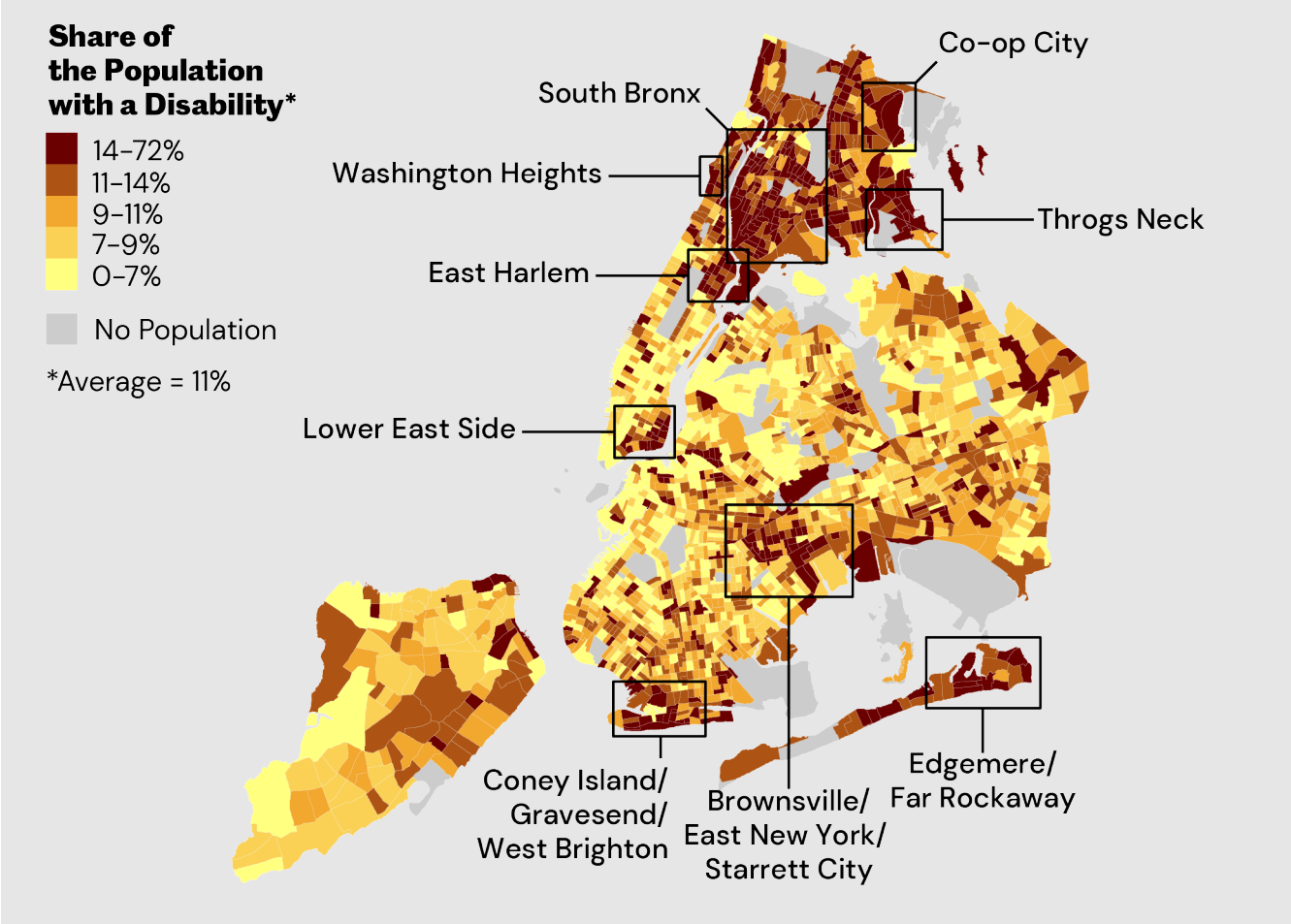
Our social vulnerability analysis sought to identify New Yorkers who have the most critical need for sunlight access protections. To do this, MAS examined a combination of factors that other studies do not normally assess together. This led us to the conclusion that each borough is burdened with great social vulnerability, and that socioeconomic, health, and built environment factors tend to correlate. It will be no surprise to students of the city that the South Bronx and southeast Brooklyn are especially vulnerable. These and other findings are explained below.

Across all Five Boroughs

Our analysis revealed that there are high levels of overall social vulnerability in each of the five boroughs. However, it is particularly concentrated in neighborhoods in the South Bronx (such as East Tremont, Fordham, and Highbridge) and southeast Brooklyn (especially Brownsville and East New York). Residents of these areas tend to be people of color with lower incomes and high rates of poverty—more than 40 percent in some cases.



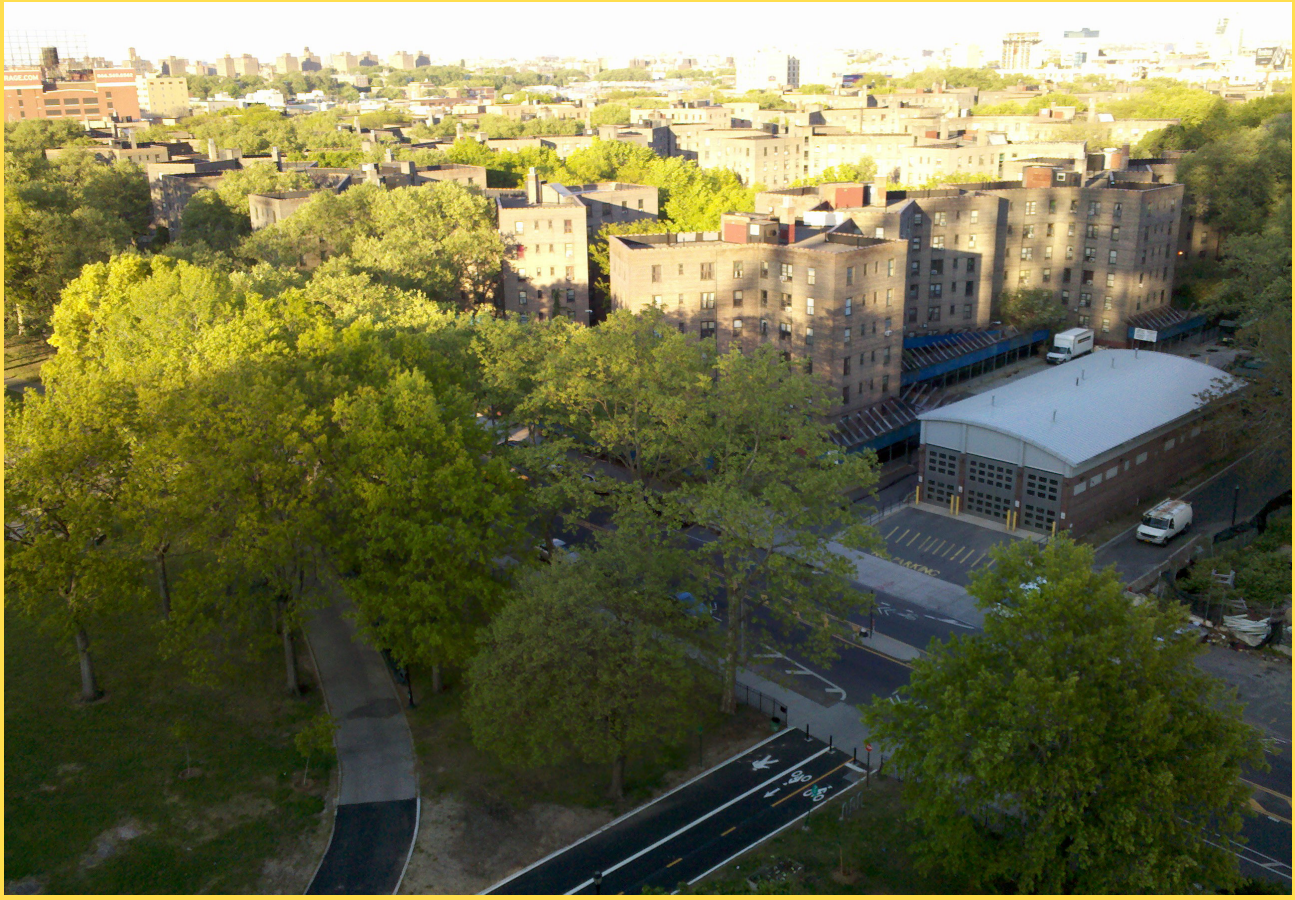
Distribution of overall social vulnerability by census tract



Disability rates by census tract

Higher levels of overall social vulnerability were also found in Borough Park and Sunset Park in Brooklyn, Corona and southeast Queens, the northeast Bronx, and Staten Island's North Shore. While these areas suffer from many vulnerabilities, certain factors were especially apparent. For example, Borough Park, Midwood, and Williamsburg have an unusually large percentage of children—almost 50 percent of the population in some cases. Because of their dependency, children are generally less mobile and more reliant on resources like open space that are closer to home. On the flip side, large housing developments such as Co-op City and Starrett City have among the highest percentage of elderly residents and high disability rates, suggesting a similar lack of mobility and an overreliance on local neighborhood resources like open space.

The lowest levels of overall social vulnerability were found in much of Manhattan below 110th Street, Bay Ridge, northwest Brooklyn, and waterfront areas in Bergen Beach, Mill Basin, and Marine Park, parts of Long Island City, Forest Hills, and Astoria in Queens, and Pelham Parkway in the Bronx.



Queensbridge Houses (Source: Flickr, The Commons, Matt Green)

Social Vulnerability and NYCHA

More than 400,000 New Yorkers reside in the New York City Housing Authority's (NYCHA) 326 public housing developments across the five boroughs.[5] Unfortunately, NYCHA is severely underfunded relative to its capital needs, which has resulted in poor living conditions for its residents, the majority of whom are low-income people of color.

Unsurprisingly, MAS found that upwards of 90 percent of NYCHA developments are located in census tracts with above average levels of social vulnerability. Eight of the top 10 most vulnerable census tracts contain NYCHA developments, such as O'Dwyer Gardens and Surfside Gardens in Coney Island, Sumner Houses in Bedford-Stuyvesant, and the Mariners Harbor Houses in Staten Island.

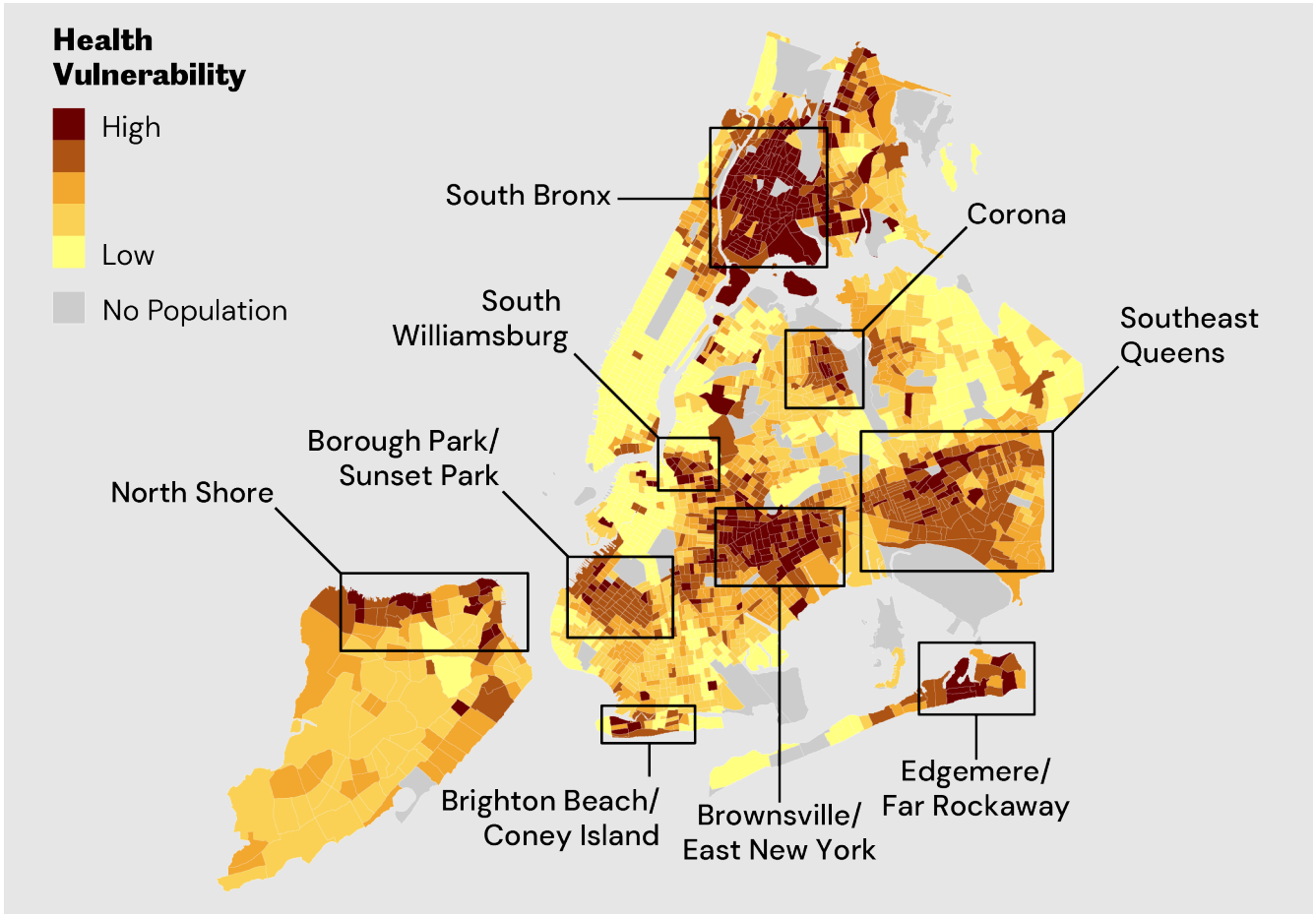
There are, however, a number of NYCHA developments located near large public spaces where sunlight is present. For example, the Ingersoll and Queensbridge Houses are adjacent to Commodore Barry and Queensbridge Parks, respectively, which both receive ample natural light. Also, NYCHA properties often contain a significant amount of open space that allows light to filter into courtyards and apartments. Unfortunately, much of it is fenced off or poorly maintained, so groups such as the Design Trust for Public Space are reimagining the design and function of NYCHA's green space. As the City considers infill development on some NYCHA property, it will be especially important to design for sunlight access given its role in improving mental and physical health.

Where Residents Have Mental and Physical Health Issues

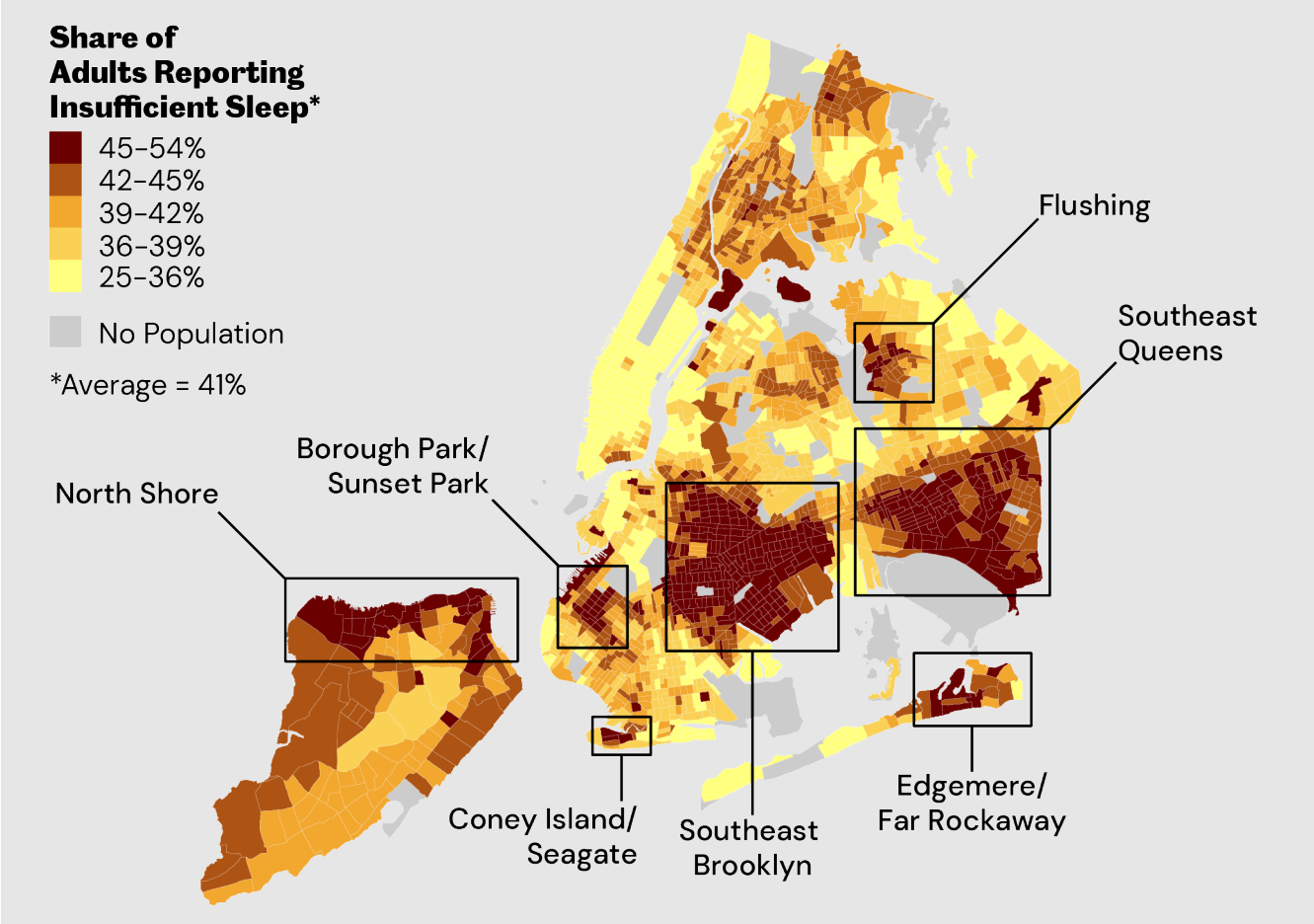
Similar to our overall findings, our analysis revealed that the highest rates of self-reported adverse health outcomes are in southeast Brooklyn neighborhoods including Brownsville, East New York, and Ocean Hill, and South Bronx neighborhoods like Claremont, Highbridge, and Melrose. Residents of these areas report suffering from myriad mental and physical health issues such as obesity, a lack of sleep, and insufficient physical activity. In Brownsville, almost 20 percent of residents report having poor mental health, more than double the reported number in wealthier areas like the Upper East Side.

Certain health issues are also apparent in areas outside of these concentrations. For example, mental health is a significant issue in Borough Park and South Williamsburg. In Starrett City, poor physical health is common. And in Flushing, southeast Brooklyn and Queens, and Staten Island's North Shore, a lack of sleep is a frequent complaint.

The areas with the lowest levels of reported health issues include much of Manhattan below 110th Street, northwest Brooklyn, and individual neighborhoods like Forest Hills, Long Island City, and Bay Ridge. They also include Hudson Heights in Upper Manhattan, Fieldston and Riverdale in the Bronx, the western Rockaway peninsula, and northeast Queens neighborhoods such as Bayside, Douglaston, and Little Neck.



Distribution of reported health issues by census tract



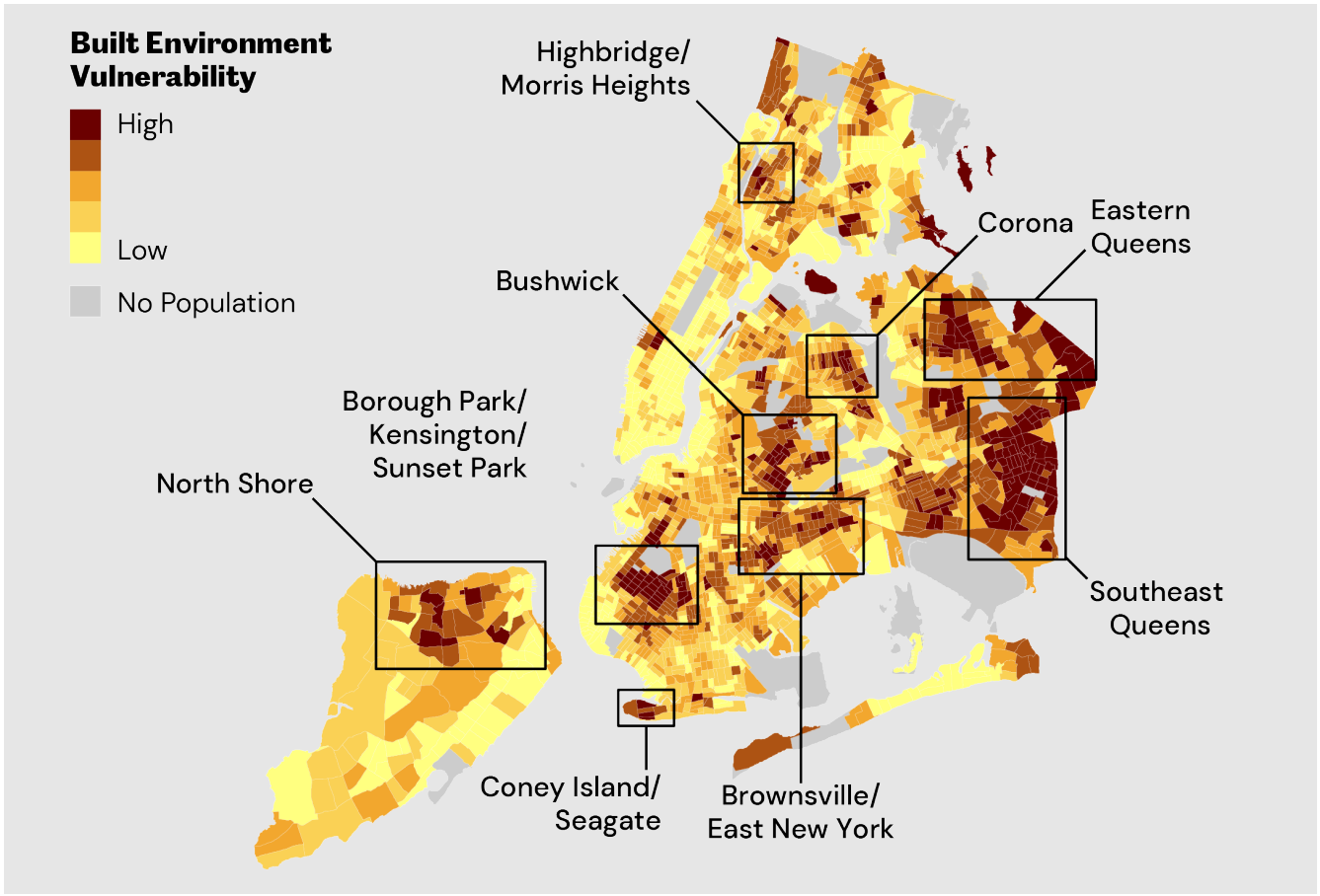
Reported rates of insufficient sleep by census tract

Areas with the Greatest Potential for Future Development and Insufficient Open Space and Public Transit

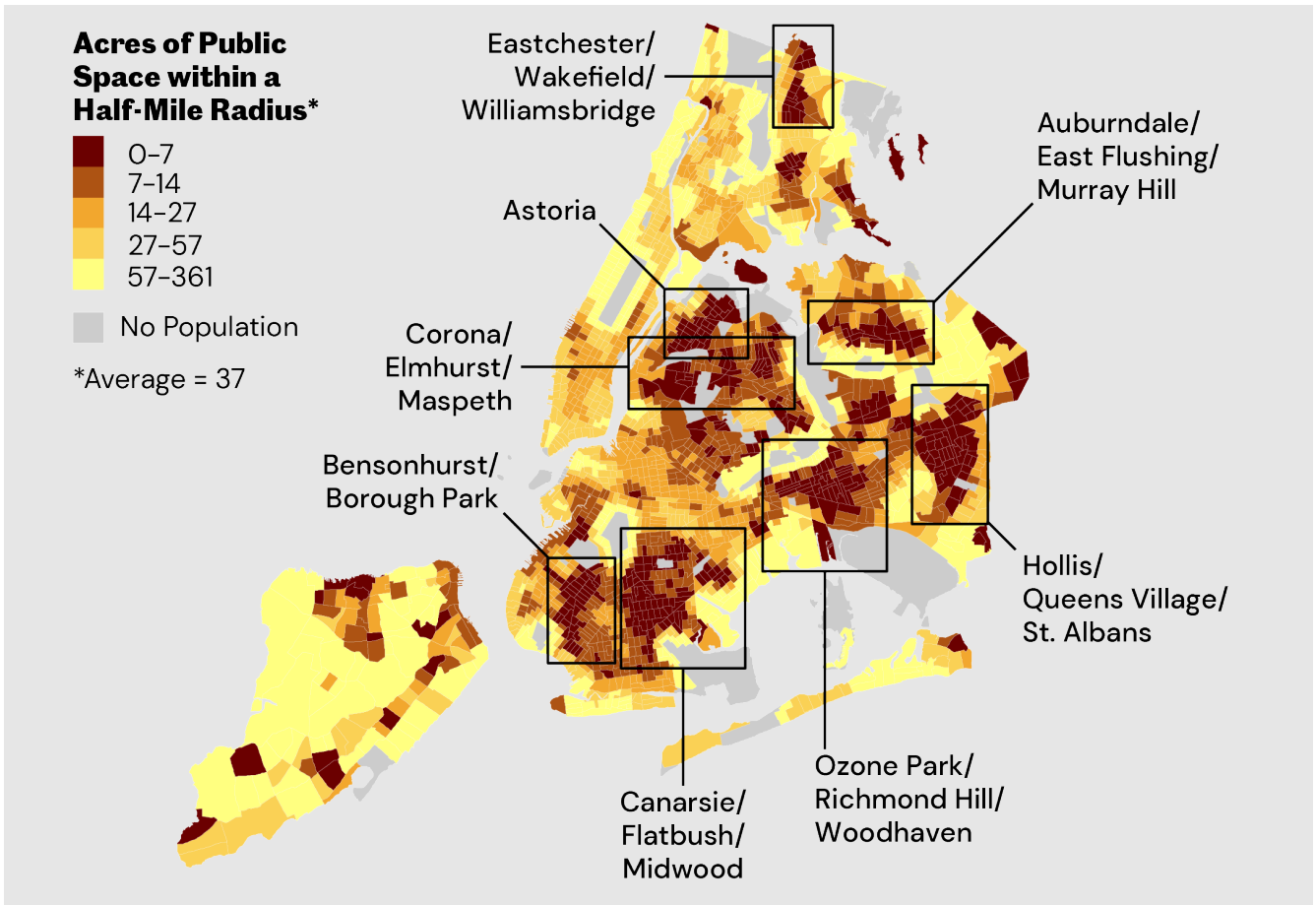
Built environment indicators displayed a similar yet somewhat more distinct set of spatial patterns. In general, issues like a lack of public transit and public space access were most apparent in neighborhoods further from Manhattan, such as Hollis and Cambria Heights in southeast Queens and Borough Park and Sunset Park in Brooklyn, respectively. In addition to a lack of public space, Sunset Park also has a high degree of population density. As a result, residents there may be more likely to rely on limited public, rather than private, space for sunlight and face greater competition from residents for the use of such space.

Neighborhoods with more favorable built environment scores varied significantly but included waterfront areas with large open spaces and ferry stops. They also included many Manhattan neighborhoods with access to large public parks and multiple forms of public transit. The presence of large public spaces along parkways also improved overall scores in some areas, such as Morris Park and Pelham Gardens in the Bronx, which border large green expanses along Pelham Parkway.

Areas with the greatest amount of available development rights risk losing sunlight access in the future due to the potential for newer and larger buildings. These areas were found to primarily include recently rezoned neighborhoods like East New York, Downtown Far Rockaway, and the string of Bronx neighborhoods lining the Jerome Avenue Rezoning corridor.



Distribution of built environment vulnerability by census tract



Acres of public space within a half-mile radius of census tracts

PUTTING IT ALL TOGETHER

Equitable health outcomes benefit all of society and are inherently tied to how we plan, design, and manage the public realm. It is surely no coincidence that many of the neighborhoods with lower rates of reported health issues are waterfront areas and those with large public open spaces. In neighborhoods such as Starrett City, Brooklyn, new public spaces like Shirley Chisholm State Park can make all the difference for elderly residents with physical disabilities and transit limitations.

As stated previously, our analyses point to the need for targeted, place-based solutions alongside citywide policies that consider sunlight and public space access from a broader health equity perspective. It is particularly important to home in on neighborhoods where there is a lack of sunlight, public spaces are at-risk, and social vulnerability persists. Our analyses provide initial insight into areas where these factors converge, such as the South Bronx, though further study of sunlight is needed to identify the full spectrum of geographies.

WHAT SHOULD NEW YORK CITY DO ABOUT IT?

New York City faces many pressing challenges, not the least of which is the budgetary deficit brought about by the COVID-19 pandemic. However, the pandemic has also proven that sunlight and public space are not fringe amenities, but critical elements in our urban infrastructure and the social life of the city. If access to sunlight is not included as a priority, the City will have missed an essential and relatively easy opportunity for moving New York towards a better future.

In this section we present a series of recommendations that would ensure more equitable access to sunlight across the city. Our recommendations fall into two major categories. The first, entitled "Leading by Example," are the ways in which the City can use its own investments to chart successful approaches to integrating sunlight access into its building and construction projects. The second, entitled "Shaping Development," focuses on how the City can better evaluate and regulate public and private development.

Lead by Example

Design guidelines outline best practices for architects, planners, urban designers, and others, providing direction on a wide range of features, from buildings and streets to the entire public realm. Design guidelines complement and inform regulations and are typically released by City agencies, non-profits, and professional associations.

Effective design guidelines and best practices should facilitate the outcomes under which all people, plants, and living organisms can thrive. While there are many design guidelines for New York City, the vast majority do not sufficiently address the vital role of sunlight in the public realm. The following recommendations are aimed at positioning New York City as a world leader when it comes to designing sunlight into public spaces.

Improve Design

Integrate Public Realm Sunlight Access Guidance into Existing Department of Design and Construction Building Design Guidelines

Unlike cities such as Toronto or London, New York City does not have building design guidelines that apply to all development types. Moreover, existing New York City guidelines do not have a comprehensive focus on buildings' impacts on the public realm, especially sidewalks.

The most substantive building design guidelines for New York City are those published by the Department of Design and Construction (DDC). These guidelines and principles apply to major public projects and include the *Design Consultant Guidelines* (2020), *Design and Construction Excellence 2.0 Guiding Principles* (2016), and *High Performance Building Guidelines* (1999).

Revision of these documents is a practical and immediate solution for creating building design guidelines that better serve the public realm. An update to the guidelines also demonstrates a commitment by the City to lead by example in integrating sunlight best practices into the design of public projects. This is especially important given the extent of City-owned assets across the five boroughs, including in socially vulnerable areas.

For example, the *Design Consultant Guidelines*, which is more of a process-oriented document, should specify the inclusion of sunlight analyses in several sections. It could be specified as part of the

Landscape Architectural & Civil Engineering Drawings portion of the Design Development Deliverables, which provide detail on the landscape architecture plan for the project site. While they require that applicants furnish technical specifications for many aspects of the project's landscape, sunlight availability is not a focus.

A revision of this section of the guidelines should involve disclosure, through technical engineering drawings, of areas within the project site and the nearby public realm where proposed projects would impact the availability of natural light. The guidelines should also request the inclusion of updated sunlight analysis submissions at additional points during the project proposal process and a final public realm disclosure submission. The guidelines would ensure that public development projects like libraries, firehouses, and courthouses lead by example through design outcomes that respect access to sunlight in the public realm.

Create Comprehensive, Cross-Agency Building Design Guidelines

Improving interagency collaborationhas the potential to create more cost-effective, efficient design and construction for development. But there is a particular utility to consider in robust cross-agency standards for building design, which can improve light and air access for new development.

Overhauled DDC design guidelines can serve as effective and immediate best practices guides for public projects but are less likely to influence design outcomes across private development projects. To do this, the City should take a comprehensive, multi-agency approach to building design guidance, as it has for active design. The Department of City Planning and the Department of Buildings are two agencies that should play a key role in the formation of new building design guidelines.

New cross-agency building design guidelines should provide criteria for designers to gauge the impact of buildings on the public realm. For example, Toronto's *Tall Building Design Guidelines* classify a building as "tall" in a local context if the building's height is greater than the width of adjacent street rights-of-way. New York City should do something similar, factoring in building height, bulk, and proximity to sunlight-sensitive resources like parks, playgrounds, and community gardens. This would allow building impacts to be gauged in all types of contexts.

A comprehensive set of building design guidelines should also encourage innovation in building massing and design scenarios containing a range of possibilities for achieving desired outcomes. This is especially important for the lower and middle portions of structures, which often has the greatest shadow impact on the public realm.

For example, providing guidance on the practice of solar carving, in which building forms scoop back from the street and have unique vertical variation (such as tapered and curved angles) to optimize sunlight penetration to the public realm. Studio Gang's Solstice on the Park building in Chicago helped pioneer this practice through orientation of building surfaces tailored to Chicago's latitude. The firm has applied solar carving to other building projects including One Hundred in St. Louis and 40 Tenth Avenue in Manhattan, which bends back from the sun's rays and allows maximal solar energy to reach the vegetation of the High Line.

The guidelines should also include situational or area-specific directives such as minimum tower setbacks from sunlight-sensitive resources, tower spacing or offsetting guidance in recently upzoned areas, consideration of the cumulative impacts of buildings in high-density districts, and guidance tailored to the dimensions and orientations of adjoining streets and open spaces. The guidelines should also provide strategies for architects and designers to minimize shadow impacts during the spring and fall shoulder seasons, and to incorporate shade during summer.

Toronto's CN Tower Plaza (Source: Flickr, The Commons, Caribb)

Guiding the Design of Toronto's Tall Buildings

Toronto's Tall Building Design Guidelines establish a unified set of performance measures for the evaluation of all tall building development applications citywide. In providing specific and measurable directions related to building massing, location, and materials, the guidelines "primarily illustrate how the public realm and built form policy objectives of the city's comprehensive plan can be achieved within a tall building development and within the area surrounding a tall building site."[7] These directives and performance measures are aimed at minimizing shadow and wind impacts as well as protecting sunlight and sky views for streets, parks, public and private open space, and neighboring properties.

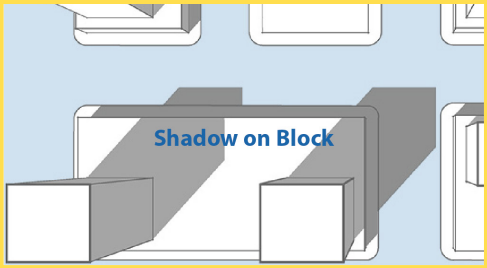
Renew the Active Design Guidelines with an Increased Focus on Sunlight in the Public Realm

Created in 2010, the City's *Active Design Guidelines* are the result of a partnership between several City agencies, including the Departments of City Planning, Health and Mental Hygiene, and Transportation, as well as the Office of Management and Budget and leading architectural and planning academics. This best practices strategy book outlines building and urban design tactics for creating neighborhoods, streets, buildings, and public spaces that encourage healthier lifestyles.

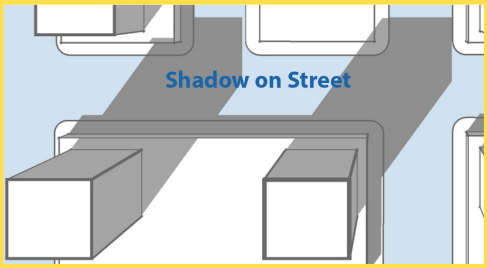
The guidelines contain an array of recommendations focused on maximizing physical comfort in public spaces. These include designing for different seasons and weather conditions, cultural preferences and age groups, and creating building massings that enhance nearby parks, plazas, and open spaces.

A soon-to-be-released update to the guidelines will also include a broader focus on health equity and social connection. Because of their breadth, cross-agency input, and continued relevance in New York City, the *Active Design Guidelines* provide a strong foundation for a more comprehensive set of strategies focused on sunlight in the public realm.

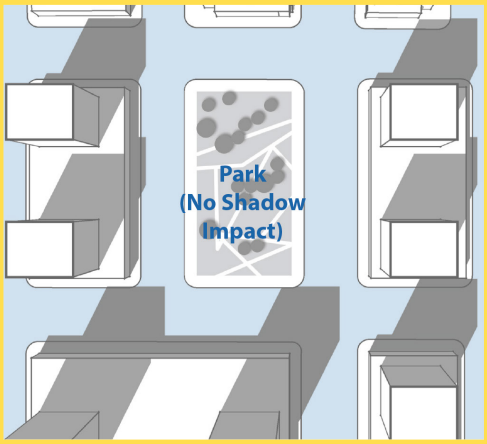
The guidelines should be improved by increasing the specificity of existing recommendations within the Parks, Open Spaces, and Recreational Facilities; Children's



Correct Placement



Not Desirable



Source: City of Mississauga

Strategic Tower Placement in Mississauga

Mississauga's *Downtown Core Built Form Standards* provide urban design direction and guidance for proposed development at the planning application stage to assess and fulfill the intent of the City's *Official Plan* policies and zoning. The Standards are intended to guide development so that impacts are greatly reduced by the time they are evaluated according to the City's *Standards for Shadow Studies*.

The *Downtown Core Built Form Standards* recommend situating towers and bulk on the portions of blocks that minimize shadow impacts on the public realm. They state that towers should be located on the sides of a block or development site so that shadows fall primarily within the block itself rather than on the street. For blocks on the southeast and southwest sides of a park, towers are expected to be located on the farthest side of the block from the park.

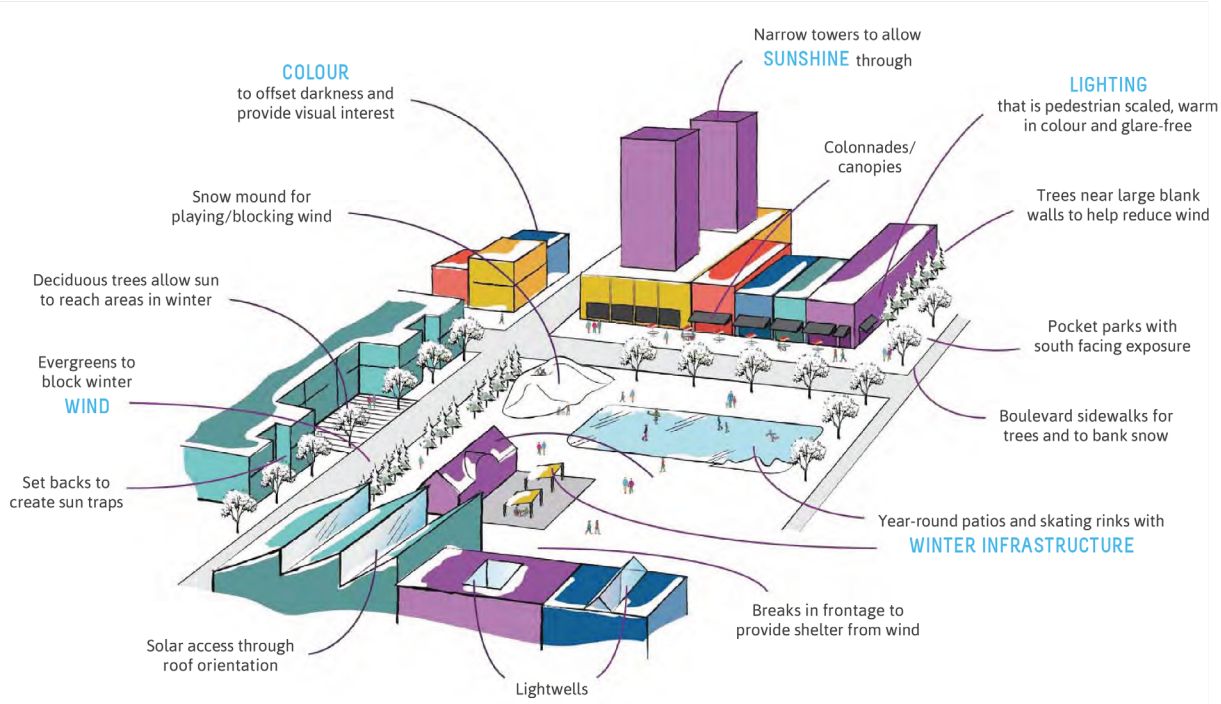
The *Downtown Core Built Form Standards* also recommend slimmer towers with smaller floor plates and a minimum of 30 meters of separation between existing and proposed towers in order to "maximize access to sky views, natural daylighting, adequate privacy, minimize wind conditions and collective shade on the streets, parks and open spaces."

Play Areas; Public Plazas; Designing Pedestrian Pathways; Programming Streetscapes; and Building Exteriors and Massing checklist topic areas, and by including new recommendations focused on sunlight.

For example, rather than just stating the need to design public spaces for a variety of climate environments, the guidelines should qualify what that means. What are the unique and optimal thermal comfort conditions for different types of public spaces? Which programming elements are most sunlight-dependent? How might this change over the course of the day or year? What impact does the orientation of public spaces, as well as the surrounding context, play? What design strategies would allow for extended use of the public realm during the colder months?

New York City's Privately Owned Public Space (POPS) Current Standards provide an example of this deeper level of thinking. The "Restrictions on Orientation" section states, "To provide both sunny and shaded areas in a POPS and to foster success of plantings, south-facing plazas are generally preferred, unless particular lot configurations prevent such orientation. Where lots do not have south-facing portions or where the south-facing portions are less than 40 feet in width, the plaza is permitted to face either east or west. In no cases are plazas permitted to be only north-facing."[9]

Addressing the types of aforementioned questions in both new and existing recommendations would provide more meaningful directive for desired outcomes



Source: City of Edmonton

Edmonton's Effort to Maximize Winter Thermal Comfort

Edmonton's *Winter City Guidelines* are intended to transform the city's public realm into a comfortable year-round destination through flexible design guidance and inspiration for future development. The guidelines include numerous sunlight-specific design recommendations for the public realm, such as:

- Locating public realm elements on the south-facing side of zoning lots in order to benefit from the penetration of sunlight.
- Giving preference to deciduous trees on the southern face of a building or outdoor area in order to allow sunlight to filter onto walkways and benches during winter.
- Creating sun traps through building setbacks or landscaping so that reflected or radiated heat within these spaces creates a warmer year-round environment.
- Using warmer materials like wood for benches and utilizing semi-transparent sun shades to provide both winter warming and summer shading.[10]

related to sunlight. It is also worth noting that designing for outdoor sunlight access tends to increase opportunities for daylight within indoor spaces like homes and offices, which is an explicit focus of the guidelines. In general, the *Active Design Guidelines* should build upon its new health equity focus by placing a greater emphasis on the role that sunlight plays in our physical, mental, and social well-being.

Revise other Public Realm Design Guidelines to Support the Active Design Guidelines

The City has a number of other design guidelines focused on particular types of public spaces. For example, *High-Performance Landscape Guidelines* are focused on quality park design, *Active Design: Shaping the Sidewalk Experience* examines sidewalks through the lens of habitable space, and the *Street Design Manual* considers the

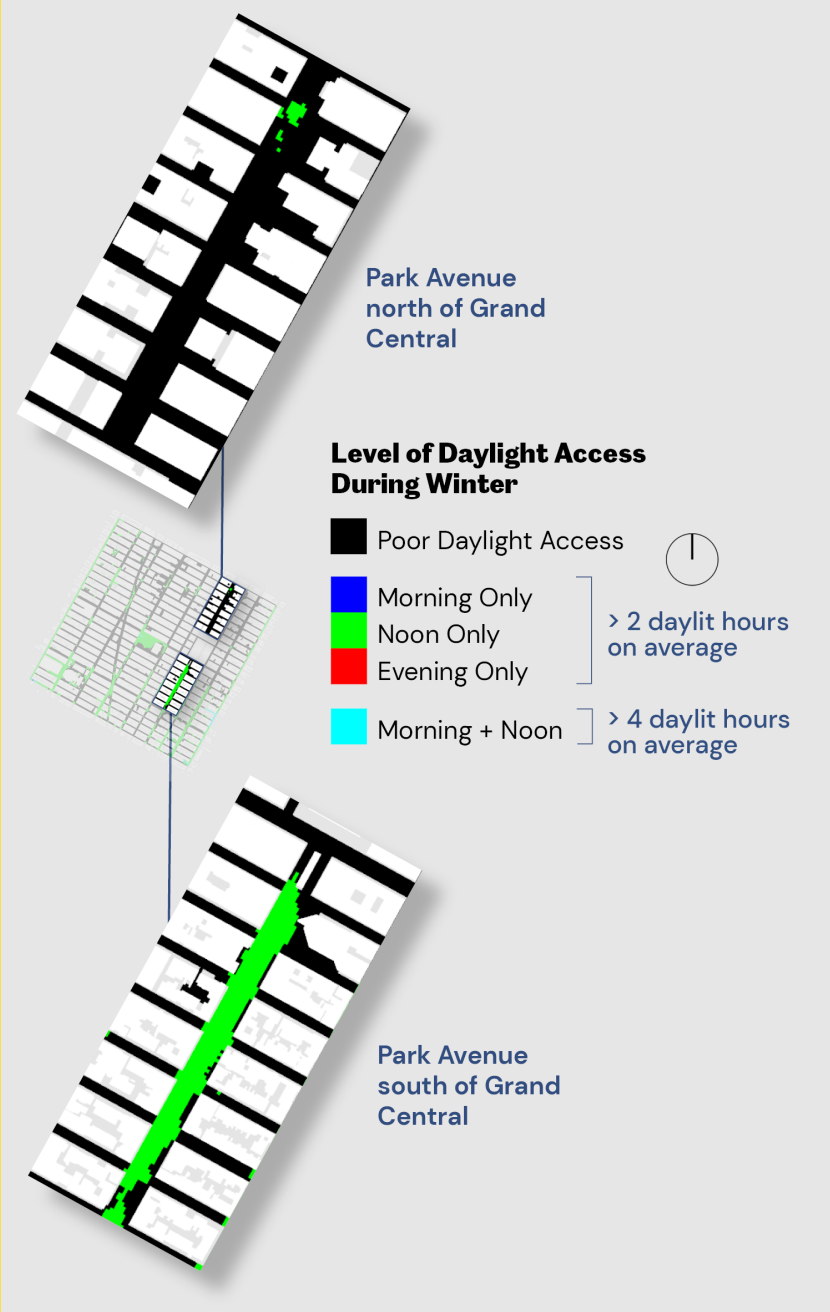
The Relationship Between Building Scale and Access to Sunlight

At nearly 150 feet wide, Park Avenue is one of the wider thoroughfares in New York City. The avenue features a landscaped median, and in Midtown there are several pedestrian plazas fronting the office buildings that line the corridor. Immediately north of Grand Central there is even discussion about returning much of the avenue to a park-like pedestrian oasis.

Due to its width and orientation, Park Avenue has the configuration for abundant daylight to be present. Yet the amount of available daylight varies along the avenue due to the scale of surrounding buildings.

Most of Park Avenue to the immediate south of Grand Central (the eight blocks bounded by East 34th and East 42nd Streets and Lexington and Madison Avenues) receives at least two hours of noontime winter daylight. This stretch of Park Avenue is lined primarily with residential and commercial buildings averaging nine stories and a floor area ratio (FAR) of six.

Meanwhile, Park Avenue to the immediate north of Grand Central (the eight blocks bounded by East 46th and East 54th Streets and Lexington and Madison Avenues) rarely receives enough daylight to be considered brightly lit. This section of the avenue is lined primarily with high rise office towers averaging 26 stories and an FAR of 15.



Courtesy KPF

This inverse relationship between building scale and available daylight was found throughout each of the other case study areas. In general, KPF's analysis revealed that the amount of available daylight and the length of the growing season within public spaces tends to decrease significantly as built FARs approach 15. Below this number, the amount of daylight within public spaces is heavily determined by the quality of building design and massing.

entire street right of way. Meanwhile, the *Climate Resiliency Design Guidelines* outline recommendations for mitigating the effects of rising sea levels, heavy precipitation, and the urban heat island effect when it comes to designing City facilities.

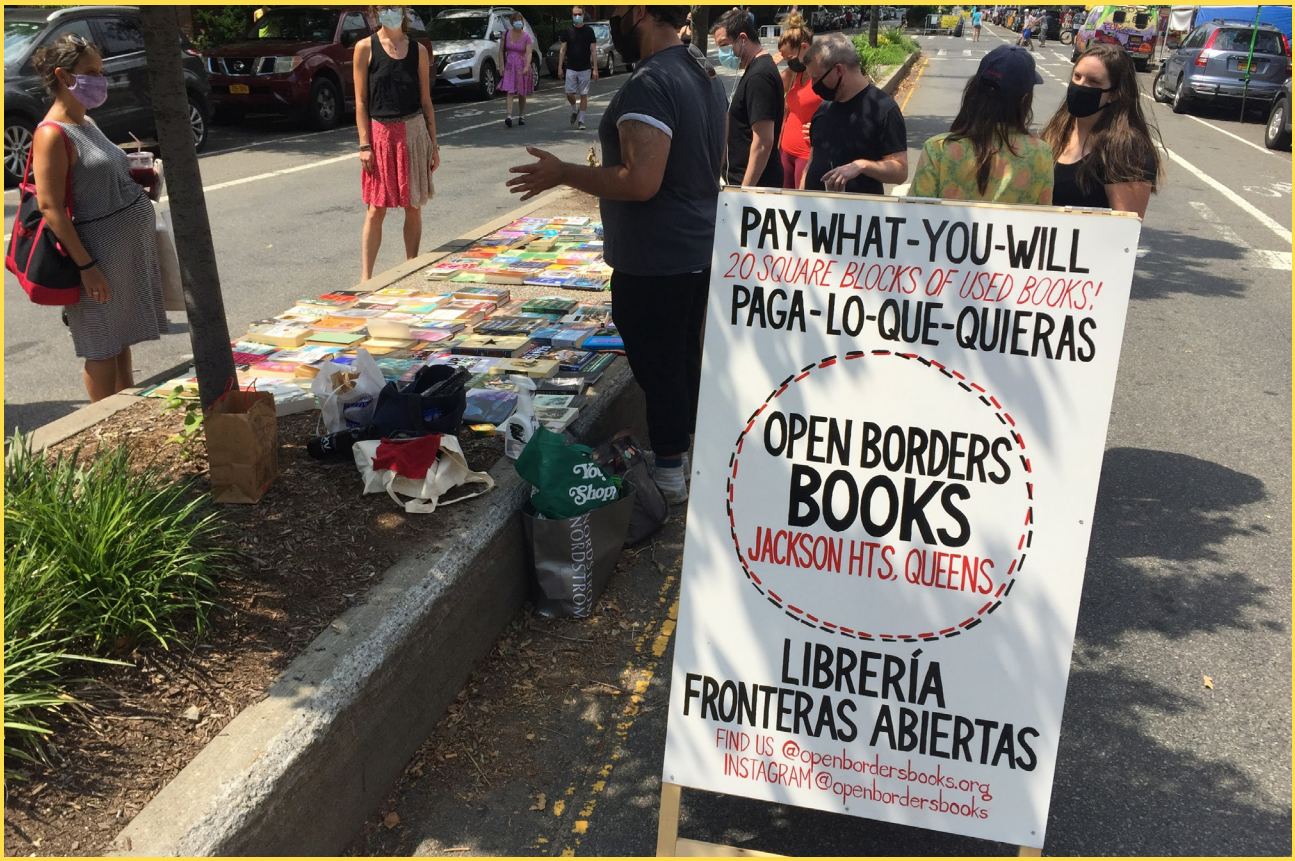
These guidelines continue to be relevant and highly focused in terms of topic areas, providing directives for public projects in ways that the *Active Design Guidelines* do not. Given the role they play, these guidelines should be revised to complement the *Active Design Guidelines*.

The aforementioned recommendations for the *Active Design Guidelines* also broadly apply to these documents in terms of the need for greater specificity, the inclusion of new recommendations, and the need for an increased focus on the importance of sunlight in public spaces. For example, the *High-Performance Landscape Guidelines* should include more detail on the sunlight needs of individual plant species and designing deciduous vegetation for both shade and solar penetration, depending on season. It should also provide directive on the amount of sunlight and canopy coverage that should be present within public spaces based on use and function.

Active Design: Shaping the Sidewalk Experience should be revised to include specific directive on the minimum amount of sunlight that should be preserved on sidewalks based on street function, orientation, and pedestrian traffic levels. Winnipeg's *Sun Shadow Study* document, for example, which guides development's impact on sunlight, has minimum sunlight requirements in spring and fall for the opposite side of the street from a proposed development, including the full width of the sidewalk.[11]

The COVID-19 pandemic has also demonstrated the need for new guidance around public space programming. The *Street Design Manual* includes a chapter focused on programming for different types of streets, but it should be updated to reflect increased uses for streets as a result of the COVID-19 pandemic and the possibility for an even greater number of uses in the future. It should also outline the management and coordination of tactical design strategies in the event of major crises like COVID-19.

The aforementioned recommendations would advance more sunlight-sensitive design, though there are undoubtedly other potential best practices that have not been identified. To facilitate further ideas generation from practitioners and non-practitioners, the City, nonprofits, or MAS's proposed Director of the Public Realm should host design competitions or community-driven workshops for guideline generation. These ideas could then be tested in pilot areas.



The 34th Avenue Open Street in Jackson Heights (Source: MAS)

The Value of New York City's Open Streets

In response to COVID-19, the Mayor's Office, City Council, NYPD, NYC Parks, DOT, BIDs and local community organizations have prioritized dozens of miles of street beds for pedestrians and cyclists under the Open Streets Program, broadening the types of spaces available for recreation and transportation. The City has closed over 67 miles of roadway, with a goal of creating over 100 miles of Open Streets. The effort has shown that little more than sawhorse traffic barriers and laminated signage is necessary for functional pedestrian space.

MAS examined Open Streets in KPF's five case study areas and found that the experience of many of these streets is heavily affected by the availability of sunlight. For example, along the East 140th Street and Pacific Street Open Streets in the South Bronx and Downtown Brooklyn, respectively, the sidewalks where parents and children congregate in front of public schools receive an average of less than two hours of thermally beneficial sunlight per day.

Along the West 46th Street Open Street in Midtown Manhattan, there are dozens of restaurants and bars that are using the expanded outdoor space for dining. Unfortunately, there is no section of the street that receives more than two hours of thermally beneficial sunlight per day. This effectively shortens the window for comfortable outdoor dining or forces these establishments to invest in and rely on artificial sources of heat.

These examples point to the need to prioritize the preservation of sunlight access along streets that serve as community gathering spaces. This is especially true as the City expands the Open Streets Program and permanently pedestrianizes many neighborhood thoroughfares.

Incorporate Public Realm Sunlight Access into Sustainability-Focused Rating Systems

While the aforementioned recommendations are actions the City should take, a discussion of best practices would not be complete without recommendations for rating systems that influence sustainable design outcomes.

LEED™ is perhaps the most widely known, comprehensive, and frequently updated green building rating system. Its standards can be applied to a wide variety of building phases, including construction, operations, and maintenance. LEED™ can be used on interiors as well as at the neighborhood level for new residential, non-residential, and mixed-use development.

The program includes a number of credits focused on building design and thermal comfort. For example, the Integrative Process prerequisite credit involves assessing shading, massing, orientation, thermal comfort, and other systems in order to reduce energy loads within buildings. The Daylight credit rewards designs that maximize natural light within buildings. Projects can also achieve a Site Assessment innovation credit by completing a site survey that includes a climate analysis comprising solar exposure, heat island effect, seasonal sun angles, prevailing winds, monthly precipitation, and temperature ranges.

Published by the International Living Future Institute, a Seattle-based nonprofit, the Living Building and Living Community Challenges are green rating systems that claim to go beyond the sustainability requirements of LEED™. The challenges are part of a broader Living Future Challenge and are each organized around seven performance areas ("petals"), such as Water, Energy, Health & Happiness, and Materials.

The Living Building and Living Community Challenges each include a focus on sunlight. Specifically, the "Universal Access" imperative of each challenge's "Equity" petal states that projects cannot block sunlight to adjacent building façades and rooftops above a maximum height nor shade the roofs of adjacent development. Maximum permitted shadows on adjacent façades are specified according to a project's location within one of five types of transects, with greater shadows allowed within denser transects.

However, despite their widespread use and strict sustainability requirements, these and other credit systems are either geared primarily towards buildings themselves or are focused on a comprehensive assessment of existing site conditions rather than site design outcomes. As written, a building could heavily shadow adjacent open space and still receive a high LEED™ rating.

Both credit systems should be expanded to include a greater focus on sunlight availability in the public realm. In the case of LEED™, it could take the form of a new Public Realm or Microclimate credit or an overhaul to the Open Space credit, which currently only offers rewards based on the amount of open space provided by new development, regardless of sunlight or thermal comfort levels. It could also be proposed and tested as a Pilot Credit. Ideally, improvements to LEED™ and the Living Future Challenge will catalyze similar changes to other green building certification systems.

Shape Development

New York City is facing the challenge of maintaining residential affordability and neighborhood character while also preparing for growth, shifts in land use, and greater demands on limited public space. Accompanying these challenges is a reluctance by the City to impose additional burdens on developers, especially those focused on affordable housing and smaller projects.

This section recommends changes to the City Environmental Quality Review (CEQR) process and the Zoning Resolution (ZR) that would improve public and private development outcomes with respect to sunlight in the public realm. It is important to note that the application of several of these regulations could vary depending on the size and composition of individual development projects.

Mitigate Impact

CEQR is New York City's public process by which environmental impacts of discretionary land use actions such as rezonings are evaluated. CEQR is a disclosure process intended to inform the public and decision-makers of potential consequences before a project is approved. Mitigating impacts and evaluating development alternatives are also part of the CEQR process.

CEQR evaluations are conducted according to the criteria outlined in the *CEQR Technical Manual* ("the Manual"), the methodology guidebook for environmental review. The Manual outlines requirements for assessing impacts on a wide range of environmental factors, such as land use, transportation, open space, socioeconomic conditions, and shadows. Shadow evaluations (as outlined in the "Shadows" chapter) address shadows cast from new structures (or additions to existing structures) of at least 50 feet in height or from new structures near sunlight-sensitive resources such as parks and historic districts.

Although the Manual's shadows evaluation methodology is detailed and technical, it focuses exclusively on shadows. Access to sunlight is not addressed. This section presents several recommendations for making CEQR a more comprehensive, accurate, and reliable process when it comes to addressing access to sunlight.

Expand the List of Sunlight-Sensitive Resources

The Manual defines sunlight-sensitive resources as those that "depend on sunlight or for which direct sunlight is necessary to maintain the resource's usability or architectural integrity."[12] Among these are existing public open spaces such as parks, playgrounds, and plazas; historic buildings with elaborate ornamentation or stained-glass windows that depend on direct sunlight for public enjoyment; natural resources; and green streets.

Despite the long list, CEQR evaluation criteria excludes several key features within the public realm that arguably meet the definition of sunlight-sensitive resources. For example, it omits project-generated open space—the new parks, plazas, and other publicly accessible spaces that are created as part of new development and that serve the same function as existing public open space.

Streets and sidewalks are not considered sunlight sensitive resources aside from a limited number of "Greenstreets" (planted areas within the unused portions of roadbeds that are part of the City's program). Yet the presence or lack of sunlight on streets and sidewalks can make a major difference in terms of the pedestrian experience and the health of the urban tree canopy, as discussed earlier. Streets and sidewalks have taken on an even greater importance during the COVID-19 pandemic, with many streets now serving as de facto parks and bustling outdoor dining destinations.

Mississauga, Ontario (Source: Flickr, The Commons, [bastian.])

Evaluating Shadows on Mississauga's Sunlight-Sensitive Resources

Cities like Mississauga, Ontario include project-generated open space, streets and sidewalks, and solar panels in their shadows evaluation requirements. The City's *Standards for Shadow Study* (their equivalent of the *CEQR Technical Manual's* Shadows chapter) requires the evaluation of shadows on all residential streets, on public amenity areas that are part of a proposed or existing development, and on building faces to allow for the possibility of using solar energy. It even requires the evaluation of sunlight on private outdoor residential amenity space.[13]

Under CEQR, shadow impacts on solar panels are also not evaluated because they are not currently considered sunlight-sensitive resources, despite their increasing role in combatting climate change and their requirement on many new buildings in New York City. Leaving out solar panels from shadows evaluations jeopardizes their ability to function and may also deter solar installation by property owners concerned about the impacts of shadows on their investment.

The City should expand the Manual's definition of sunlight-sensitive resources to include:

- All publicly accessible project-generated open space
- Open Streets, Shared Streets, streets of cultural and historical significance, and priority commercial and residential streets with high levels of pedestrian activity
- Solar panels and green roofs on City-owned assets as well as public utility arrays

Doing so will improve the quality of New York City's new and existing public spaces and further the City's sustainability and alternative energy goals.

Create a Comprehensive and Clear GIS Dataset for Use in Shadows Evaluations

There is no uniform sunlight-sensitive resources dataset designated for use in CEQR evaluations. Rather, it is the responsibility of the evaluator to consult with the Department of City Planning (DCP) and other agencies on which datasets to use.

Even when appropriate datasets are identified, it is then up to the evaluator to navigate the complexities of the datasets themselves. There are at least a dozen relevant datasets whose entanglement of duplicative and unique records, semi-overlapping geographic boundaries, and sunlight-sensitive and non-sunlight-sensitive features need to be parsed.

For example, the often-used "Parks Properties" layer includes a variety of sunlight-sensitive and non-sunlight sensitive features managed primarily by the Department of Parks and Recreation (NYC Parks), such as buildings, parks, gardens, playgrounds, plazas, highway medians, recreation fields, undeveloped land, and natural areas. Yet the layer does not include State parks, notable open spaces like Bush Terminal Piers Park or much of Brooklyn Bridge Park, numerous POPS and outdoor plazas, and a number of community gardens and Jointly Operated Playgrounds. To include these features requires overlaying and parsing numerous additional datasets published by a variety of agencies.

This disorganization is inefficient, leads to inconsistent evaluation approaches, and has resulted in the failure to identify all sunlight-sensitive resources within a given project study area. This was the case with the recent Draft Environmental Impact Statement for the Two Bridges development in Lower Manhattan. The "Open Space (Parks)" layer was used to inventory open space in the study area but it omitted many publicly accessible open spaces such as the Orchard Collegiate Academy schoolyard, the PS 184 Shuang Wen schoolyard and playground, and local community gardens, all of which are considered sunlight-sensitive resources according to the Manual.

To improve the accuracy and efficiency of shadows evaluations, the City needs a uniform, regularly updated public space dataset that clearly indicates all individual sunlight-sensitive resources. In the absence of a comprehensive, one-stop dataset for public space, all CEQR shadows analyses should make use of an exhaustive list of City-generated GIS datasets to ensure that all sunlight-sensitive resources are identified.

Strengthen and Improve Transparency of Shadow Disclosure Requirements and Determinations of Significant Impact for Open Space and Natural Resources

When it comes to evaluating and disclosing shadow impacts, the Manual allows for significant discretion on the part of the evaluator. For example, for areas that would be cast in incremental shadow, the Manual merely states that it *may* be necessary to inventory vegetation, present this information in a site plan, and use the services of an expert to inventory, survey, and assess the sensitivity of open space to shadows.[14]

The Manual can also be inconsistent and unclear in terms of what is required. When it comes to project-generated open space, for example, the Manual notes that the assessment of shadows on project-generated open space *should be conducted* when such space is included qualitatively as part of the Open Space chapter.[15] Yet elsewhere in the Shadows chapter the Manual proceeds to state that the assessment of shadows on project-generated open space merely *may be warranted*.[16]

Some discretion is undoubtedly necessary. However, the degree of latitude and inconsistency within the Manual creates confusion as to what is actually required, expected, and considered significant for evaluators and readers alike. This is especially true for underserved communities that lack the resources and expertise required to understand the CEQR process. The result are CEQR evaluations that often draw questionable conclusions about shadow impacts and mitigation.

The Manual should be revised in a way that provides greater consistency, clarity, and accountability when it comes to disclosing and evaluating shadow impacts on open space and natural resources. Where applicable, it should require:

Greenacre Park (Source: Greenacre Foundation)

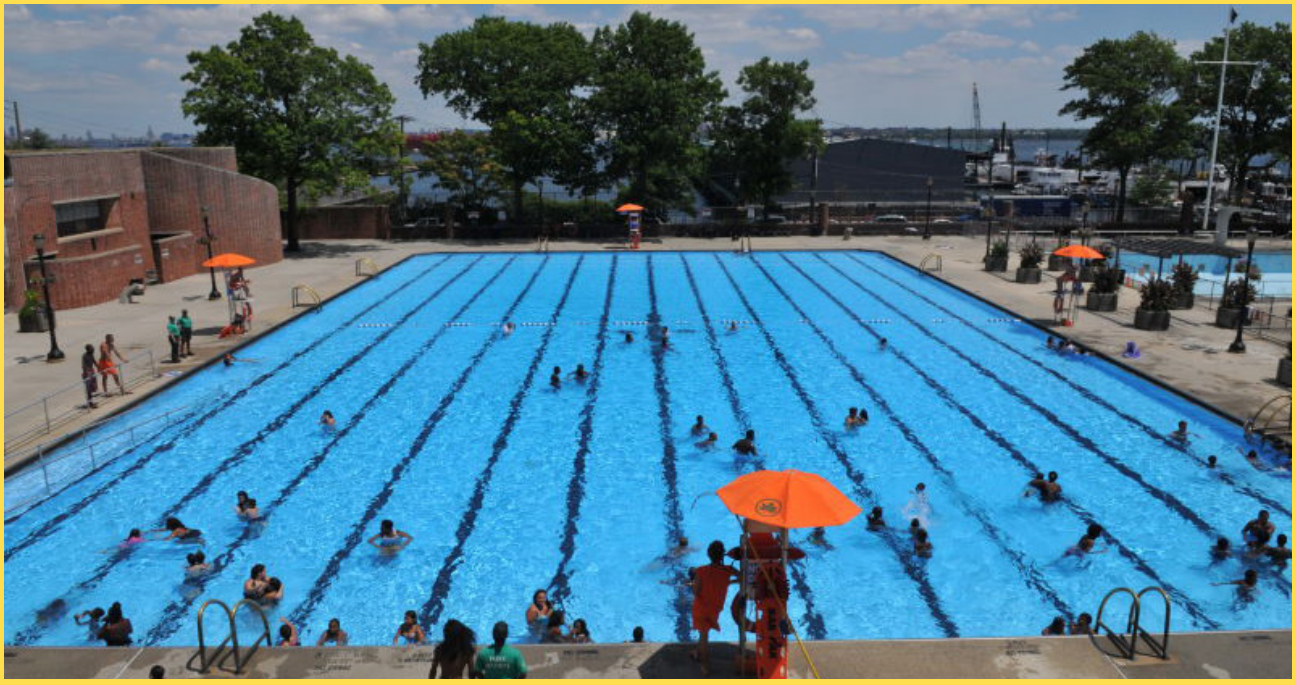
Inadequate Shadows Evaluation for Greenacre Park

The Greater East Midtown Rezoning Final Environmental Impact Statement (FEIS) drew questionable conclusions about shadow impacts on Greenacre Park. One of only three vest-pocket parks in the city, Greenacre Park features a variety of plants and trees, a waterfall, and seating areas. Although the FEIS disclosed that the park would be subject to incremental shadows that would affect plants and wildlife during the growing season (in June, the incremental shadow would have a combined duration of one hour and 41 minutes and at a time would cover the entire park) it concluded that no significant impact would occur.

The conclusion was based on several assumptions. First, despite the shadows from anticipated new development, at least 50 percent of the park would still be in direct sunlight during the morning and afternoon, which the FEIS claimed (without supporting evidence) would be sufficient to support flora in the park. It also asserted that because shade elements like trees and pergolas are an integral aspect of the park's design, additional shadows would not compromise the use and enjoyment of the park. Third, the FEIS stated that the impact of new shadows would be partially mitigated by the continued presence of reflected sunlight from existing buildings—a flawed substitute for direct sunlight. Finally, the FEIS stated that the building massings used in the analysis represented a conservative scenario and assumed that projected shadows would be "unlikely to be realized."[17]

- Inventory and disclosure of all existing and proposed vegetation, noting individual species, caliper, height, age, level of shade tolerance, and optimal sunlight requirements.
- That criteria for characterizing habitats be expanded to include access to sunlight.
- A full evaluation of the shadow impacts from new development on wetlands and other regulated water bodies based on a detailed habitat study for wetland species.
- Determination of significant adverse impact based on whether individual plant species can thrive rather than merely survive.
- Detailed maintenance requirements,

including the responsible agency, when new plantings are proposed.
- A detailed rationale for evaluating public enjoyment or use.
- Disclosure of all correspondence between NYC Parks and the CEQR lead agency.



Lyons Pool (Source: NYC Parks)

Some Public Spaces Benefit from Significant Summer Sunlight

While sunlight can be thermally uncomfortable or even harmful to humans for extended periods during the warmer months of the year, users of many of the city's public spaces benefit from a certain amount of direct sun on even very warm days. Lyons Pool in Staten Island is one such space.

The outdoor, Olympic-sized public swimming pool is a beloved community facility that receives more than six hours of daily summer sun. The pool has swimming, diving and wading areas, a gym, and bathhouses that together can accommodate thousands of bathers at any given time.

According to NYC Parks, Lyons Pool was one of 11 immense outdoor public pools that opened during the heat waves of 1936. The landmark-designated pool was financed by the Federal Works Progress Administration as part of an effort to alleviate adverse health conditions and provide safe recreation in working-class neighborhoods. NYC Parks notes that Lyons Pool is distinguished by its sun deck and Italian bell tower and was designed to be sensitive to the site and topography.[18]

Despite this, the 2019 Bay Street Corridor Rezoning has allowed development to reduce sunlight on the pool by 1.5 daily hours during the summer. Even though sunlight is critical to the experience of the pool, environmental review documents concluded that "public enjoyment would not be significantly impacted" as a result of the rezoning.[19]

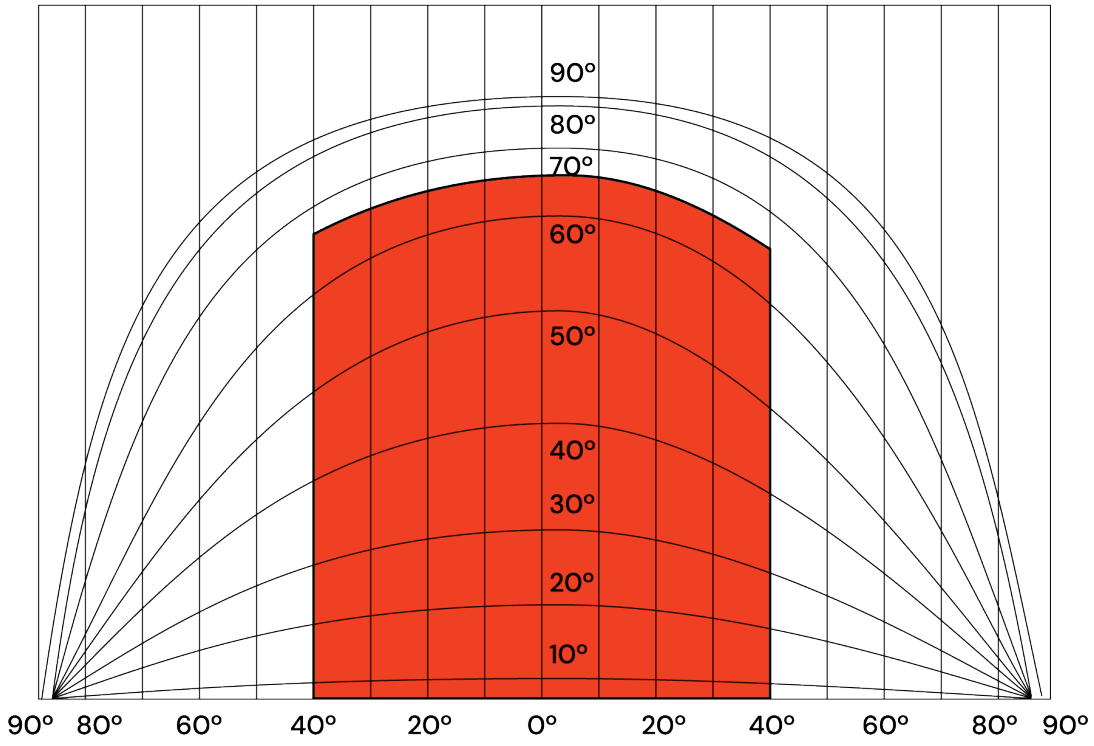
Introduce Sunlight as a New CEQR Technical Manual Evaluation Category

The aforementioned recommendations would strengthen the Manual's existing approach to shadows evaluations. However, shadows evaluations paint only a partial picture of sunlight availability. To fully understand and evaluate impacts on sunlight-sensitive resources, shadows evaluations must be paired with evaluations of sunlight through techniques such as climate-based daylight analysis, which measure illuminance values including direct and diffuse light.

Daylighting is already used in New York City zoning, having been incorporated into Manhattan's Special Midtown District height and setback zoning regulations in 1982 to preserve light and air. In contrast to a shadows analysis, daylighting assesses the amount of daylight blocked by a building that would ordinarily reach the public realm. The technique is modeled on the Waldram Diagram, a graphic representation of what a pedestrian would experience as they look down a street and at views 90 degrees to the left or the right. The diagram includes a grid of squares representing a building's lot frontage area that overlaps the shape of the building against the sky. The evaluation calculates the number of squares overlaid by the building to determine the percentage of available sky that is being blocked. Daylighting places penalties for each square that is covered by a building above a certain elevation and grants credits for the number of unblocked squares below a certain elevation, both of which affect the overall daylighting score.

The Special Midtown District's height and setback regulations require a minimum of 66 percent of the sky left open on any street frontage and an overall average zoning lot score of 75 percent of the sky left open above 70 degrees, the typical street wall height in Midtown. When the District was established, DCP asserted that the daylighting regulations in the district "give great flexibility in building design so long as the daylight standard is achieved..."[20]

The methodology for conducting daylighting evaluations is time-tested and well-established and could be seamlessly



The Waldram Diagram

incorporated into the overall CEQR analytical framework. Ideally, however, a more precise and comprehensive metric based on hourly illuminance (lux) values and climate data should be used instead.

Lux is the unit of illuminance and is used to measure the spectrum of direct, diffuse, and reflected light in a given area. It can be measured with a luxmeter or predicted through increasingly routine computer simulations. Unlike the daylighting approach used in Midtown, lux measures actual light levels and accounts for the impact of building materials on light reflection. When paired with daylight autonomy (percent of hours achieving an illuminance target), lux can provide a fuller and more accurate picture of available natural light.

As mentioned, KPF has assessed available daylight in five study areas and attempted to quantify acceptable daylight targets within the public realm. Their analysis suggests that it would be reasonable to assume a minimum illuminance target of 10,000 lux for a space to be perceived as brightly lit and to help mitigate seasonal mood and sleep disorders.

CEQR should require assessment of Daylight Autonomy (the percent of hours achieving an illuminance target) as well as the change in average hours of adequate daylight between existing conditions and the Reasonable Worst Case Development Scenario. The assessment should be modeled over the course of the day for a range of dates between November 1st and January 31st, when illuminance levels are lowest. KPF's analysis suggests that one way to determine impact significance is to identify sunlight-sensitive public spaces whose hours of 10,000 lux are reduced below one third of daylight hours on evaluation days. Such spaces would likely only offer acceptable daylight levels for one to two hours in the early morning or late afternoon, which would have a major impact on their quality and experience.

Strengthen Public Health Evaluation Criteria to Include Access to Sunlight

The purpose of a CEQR public health assessment is to determine if a project would cause adverse human health impacts and, if so, to identify mitigation measures. A public health evaluation is usually only required if there is an unmitigated significant adverse impact in other CEQR analysis areas such as air or water quality, hazardous materials, or noise. In such a case, the lead agency determines if a public health evaluation is necessary. Current CEQR public health evaluation criteria does not include access to sunlight.

Unfortunately, rigorous CEQR public health evaluations are rare in environmental review. Considering the widespread human health effects of the COVID-19 pandemic and the disproportionate impacts on vulnerable populations, CEQR public health evaluations are poised to gain importance. The Manual acknowledges the links between human health and the environment as an evolving and expanding field of research.

There is ample opportunity to require assessment of the effects of reduced access to sunlight on human health, particularly in vulnerable communities. Specifically, public health evaluations should be required if a project's shadows or daylight assessment shows an adverse impact and the project is located in an area shown to be "sensitive or vulnerable." Because CEQR public health evaluation methodology already includes examining potential sensitive or vulnerable populations, expanding the scope of public health analyses should be straightforward.

Eagle Slope Community Garden (Source: GrowNYC)

Sunlight's Importance to Community Gardens

Located on the northern edge of a sloped lot along Westchester Avenue in the Melrose neighborhood of the Bronx, the Eagle Slope Community Garden and Nueva Granja house over 20 raised planting beds, several greenhouses, picnic tables, benches, and a shed on a small 8,000 square foot lot. Eagle Slope and Nueva Granja were rebuilt in 2015 as a large community garden as part of the Gardens for Healthy Communities program within the Mayor's Obesity Task Force Initiative. The site receives ample sunlight as it is situated between a hard-topped play area at University Prep Charter High School to the south and elevated 2/5 subway tracks to the north.

Gardens increase access to affordable fresh food, promote physical activity, and provide spaces for community gathering. Throughout the Bronx, small community gardens help to address the disparity in local food access while also providing space to grow crops that match the cultural preferences of residents. Eagle Slope is also a garden partner of the Bronx-operated Small Axe Peppers. This mutually beneficial partnership turns space for pepper production into a sustainable funding system for garden programming and maintenance expenses. The partnership also uses local labor and allows for profit sharing from hot sauce sales. Previously, the garden depended on unreliable grants, donations, and out-of-pocket expenses. Without reliable access to sunlight, these critical community spaces would not be able to help stabilize the people and neighborhoods that rely on them.

Regulate Performance

Regulations such as zoning are common mechanisms for directing development. The degree to which regulations are successful, however, is often determined by their ability to channel clear and predictable development results while also providing flexibility.

This section examines how access to sunlight in the public realm can be advanced through changes to the New York City Zoning Resolution (ZR). A major focus is on providing a range of paths to achieve performance goals. The section also discusses the possibility of adopting Local Laws as an alternative to zoning reform.

Establish Clear Definitions and Broadly Applicable Standards within the Zoning Resolution

Unlike many other cities that use comprehensive planning to articulate and execute goals, policies, and infrastructure needs, New York City relies on the ZR to effectuate policy guidance for the built environment. The ZR governs all development in the city, the vast majority of which happens "as-of-right" and complies on a basic level with existing zoning regulations.

> "We are charged by state law that we must have a well-considered land use plan and what we have maintained historically is that the city zoning framework at any given time is the city's well-considered plan."[21]
>
> – Anita Laremont, General Counsel and Chief Data Officer at the Department of City Planning

First adopted in 1916 and substantially amended in 1961, the ZR regulates land use, building height and bulk, and streetscapes. The original ZR was founded on the basis of protecting daylight access in streets as a result of obstructions to light and air that came with the introduction of the modern steel-framed skyscraper.

The ZR has continued to evolve through text amendments, map changes, and the implementation of special districts which provide hyper-local contextual zoning to advance City policy. In the absence of truly comprehensive planning, the ZR's iterative evolution continues to shape the built environment.

Yet despite its original intent, the ZR's explicit focus on sunlight and the public realm remains limited. Sunlight, daylight, and other forms of light are not listed in the ZR's "Languages and Definitions" chapter, even though they are distinct concepts. New York City's growing season is not mentioned, nor is thermal comfort or microclimate. Moreover, while individual spaces like parks and plazas are defined, the collection of public spaces that comprise the broader public realm is not formally recognized.

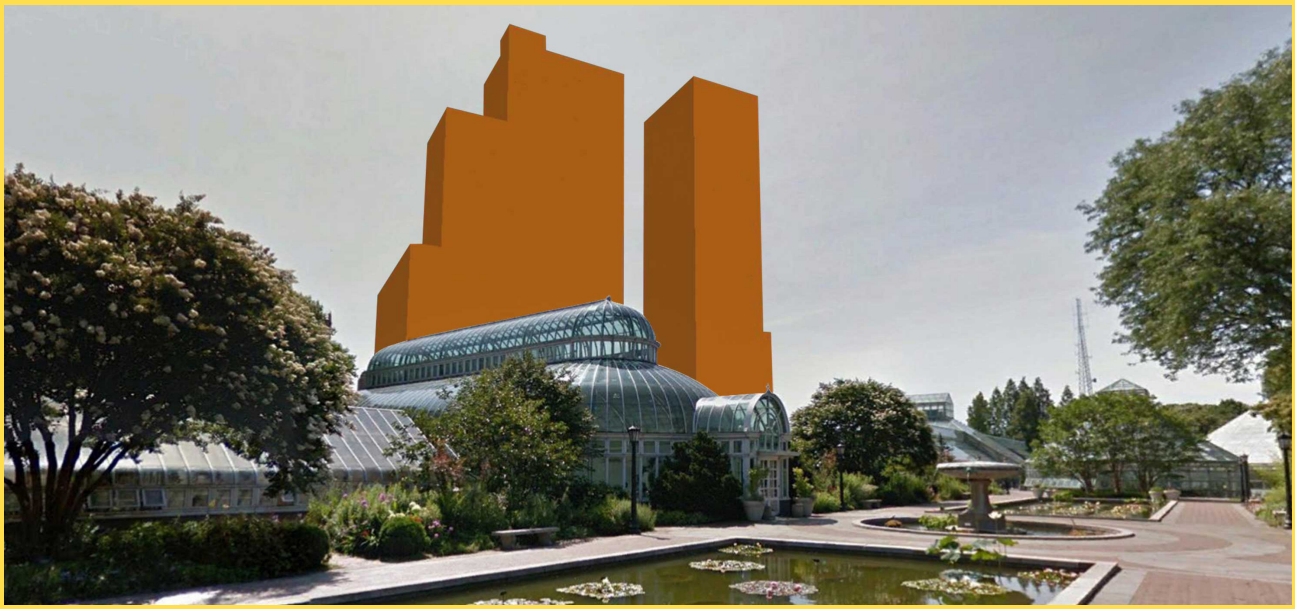
Where sunlight standards are recommended or required, it is typically through a narrow lens or applicable to a very limited geography. Detailed daylight analysis requirements are outlined for the Special Midtown District but not for waterfronts or high-density neighborhoods like the Financial District. Similarly, the ZR recommends that new development provide southern exposure to maximize sunlight, but only when it pertains to plazas developed prior to 2007.

For a document that purports to be the City's forward-thinking comprehensive plan, sunlight must be more directly addressed. Sunlight, daylight, the public realm, and other factors must be defined to ensure a shared understanding of their meaning and importance. The ZR should expand daylight assessment requirements to include additional areas beyond Midtown and broaden sunlight access standards to apply to other elements of the public realm, such as streets, parks, playgrounds, and community gardens.

Establish Performance Districts

While the aforementioned changes would elevate the importance of sunlight and help establish broad standards, additional zoning protection is needed to ensure sunlight access in critical areas. In New York City, protection for sensitive areas or features is typically accomplished through special districts.

Special districts are a zoning tool used to apply specific requirements for the land use and building form of a particular area. New York City has many neighborhood-specific and citywide special districts, such as Special Coastal Risk Districts, Special Mixed-Use Districts, and Special Scenic View Districts. Perhaps most analogous to this discussion is the Special Natural Area District (NA) in parts of the Bronx, Queens, and Staten Island. The purpose of the NA is to provide an additional level of oversight for development in areas with unique natural characteristics, such as forests, rock outcrops, steep slopes, and creeks. In these districts, proposals for new development, enlargements, and site alterations are required to obtain site plan approval from the City Planning Commission before building permits are issued.



Renderings of proposed development at 960 Franklin Avenue (Source: MAS)

960 Franklin Avenue and the Need for Performance Districts

A proposed development at 960 Franklin Avenue in Crown Heights, Brooklyn demonstrates the need for performance-based zoning protections. Buildings on the site are currently limited to 80 feet in height under a 1991 contextual rezoning that was intended to preserve neighborhood character and minimize shadow impacts on the nearby Brooklyn Botanic Garden. Yet the developers are seeking a special permit and additional zoning waivers to build towers of up to 424 feet in height–more than five times what is currently allowed. The project would cast significant new shadows on the Botanic Garden and nearby Jackie Robinson Playground, local resources that are dependent on sunlight for their success and vital to a neighborhood where open space is limited.

Performance districts would require projects like 960 Franklin Avenue to meet specific sunlight standards—regardless of special permits and waivers—thereby minimizing or completely eliminating shadow impacts on sunlight-sensitive resources like the Botanic Garden and Jackie Robinson Playground.

Performance districts are an alternative to special districts and conventional zoning. Rather than establishing specific area and bulk standards to govern development, performance districts regulate the design and location of development according to a set of operational standards or criteria. In other words, performance districts prescribe ultimate outcomes but do not dictate the particular elements that might contribute to achieving those results. Performance districts are appealing to developers and communities alike in that they can achieve desired environmental goals while providing a greater degree of building design and land use flexibility than traditional zoning. Partly because they increase the range of design possibilities and encourage innovation, performance districts have the potential to result in greener buildings and a more resilient and thermally comfortable public realm.

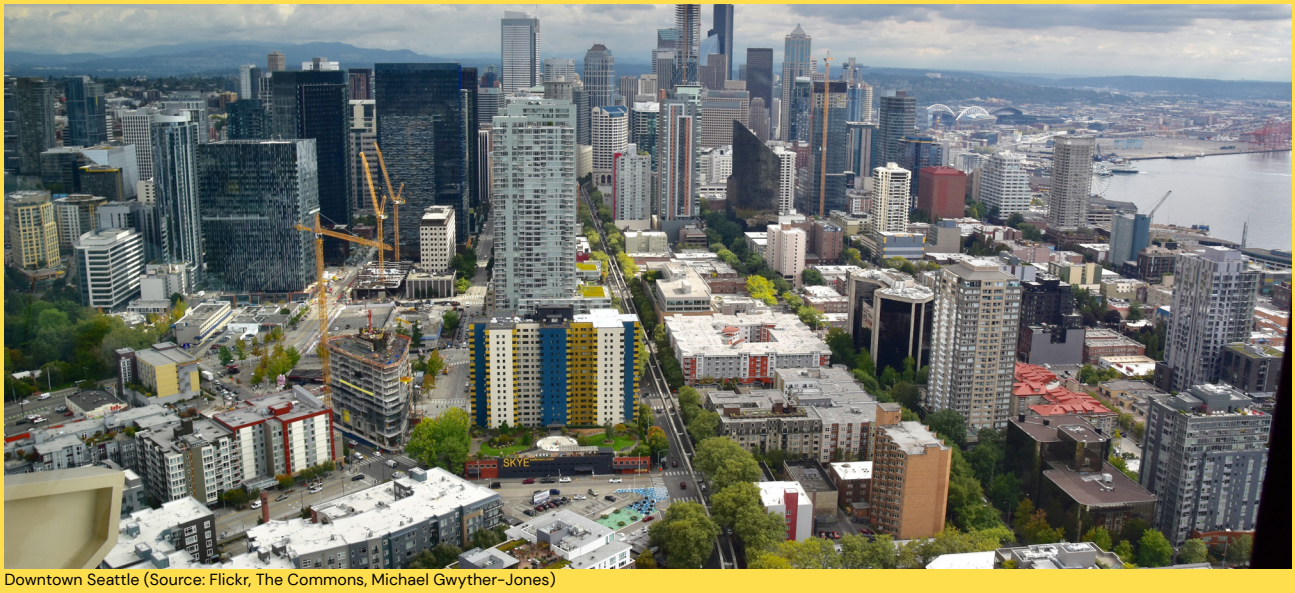
Shadows on Central Park (Source: Flickr, The Commons, Dave Winer)

Building off Previous Sunlight Zoning Recommendations

Performance standards for sunlight access is not a new concept. In 1991, *Preserving Sunlight in New York City: A Zoning Proposal*, a report commissioned by the Parks Council (a predecessor to New Yorkers for Parks) introduced the idea of a solar access standard for managing the impact of shadows cast on parks by new buildings.

The report introduced a performance method which specified that the shadow of a new building would need to fall within the average depth of existing shadows cast on a park or within the shadow of an existing building. The study also tested a more prescriptive method but concluded that "the more precise zoning envelope resulting from use of the performance method accommodated greater development potential than that permitted under the prescriptive method, without diminishing the sunlight standard for the affected park."[22]

At the time of its publication, the study found that about 700 parks—roughly half of the City system—were at risk of being shadowed by future development. Nearly three decades later, New York City has the opportunity to revamp this performance standard to balance flexibility in building design with concrete, broadly applicable standards for protecting sunlight-sensitive resources.



Downtown Seattle (Source: Flickr, The Commons, Michael Gwyther-Jones)

Learning from Seattle's "Green Factor"

Seattle uses Green Factor as a score-based code requirement that increases the amount and improves the quality of landscaping in new development. The Green Factor is designed to provide developers with a toolkit to respond to unique context and feasibility constraints while encouraging improved design and function. Outcomes include improved urban design, storm water management, thermal comfort, microhabitat, and neighborhood character. Scores are modulated by intensity of use, with consideration given across site design and density levels.[23]

The following sections describe what these new performance districts would do, where they should be implemented, and the role of incentives in driving outcomes.

What Would They Do?

Like NAs, the rationale for performance districts is to preserve and enhance a finite natural resource within critical areas. In addition to mandating sunlight-sensitive development in targeted locations, the districts would ideally include performance requirements for other microclimate considerations such as wind in order to achieve larger environmental systems goals. Performance districts would protect vegetation and maximize the public's ability to use the public realm without excessively restricting development.

To accomplish this, the City should adopt a sunlight rating system to evaluate all new development within performance districts. The system would follow the site review aspect of NAs but provide zoning and design flexibility for developers so long as a minimum sunlight score is achieved.

The rating system should assign objective and measurable points for performance across a variety of sunlight-related factors in order to assess the appropriateness and cumulative benefits of projects within hyper-local contexts. The table below outlines potential factors and evaluation metrics for inclusion in a rubric. While the table does not consider the relative importance of individual factors, it may be appropriate to weight certain ones more heavily. Performance requirements should also vary across districts depending on the function and needs of sunlight-sensitive resources that are being protected. For

Goal	Evaluation Metric
Maintain or expand sunlight on sensitive resources	• Change in available shadow/daylight on current and proposed sunlight-sensitive resources
Create new opportunities for sunlight access	• Amount of newly created sunlit public space
Increase vegetation	• Change in the amount and diversity of vegetation
Encourage solar energy production	• Area of newly installed solar panels • Impact on solar energy potential of nearby buildings
Increase thermal comfort throughout the year Mitigate the urban heat island effect	• Change in street level Universal Thermal Climate Index measurements • Installation of cool and green roofs • Use of warm or reflective building material • Installation of flexible shade structures, wind screens, and other tactical design strategies

example, a commercial thoroughfare would have different sunlight performance targets and objectives than a park or a residential street. Further research is needed to examine how the system would function within a particular pilot study area in New York City.

The system could be implemented within the ZR as well as the Building Code, as some aspects are explicit to the public realm while others are wholly addressed at the building level. To offset the additional staffing and review costs associated with performance districts, the City could request a special application fee from applicants. The initial experience across performance districts would inform refinement of the scoring system over time.

Where Would They Apply?

Designation of performance districts should be carefully considered and determined by a range of physical and social criteria including sunlight dependency of land use, current and expected sunlight availability, and social vulnerability. As emphasized earlier, it is particularly important to target those places where sunlight-sensitive features and vulnerable populations overlap.

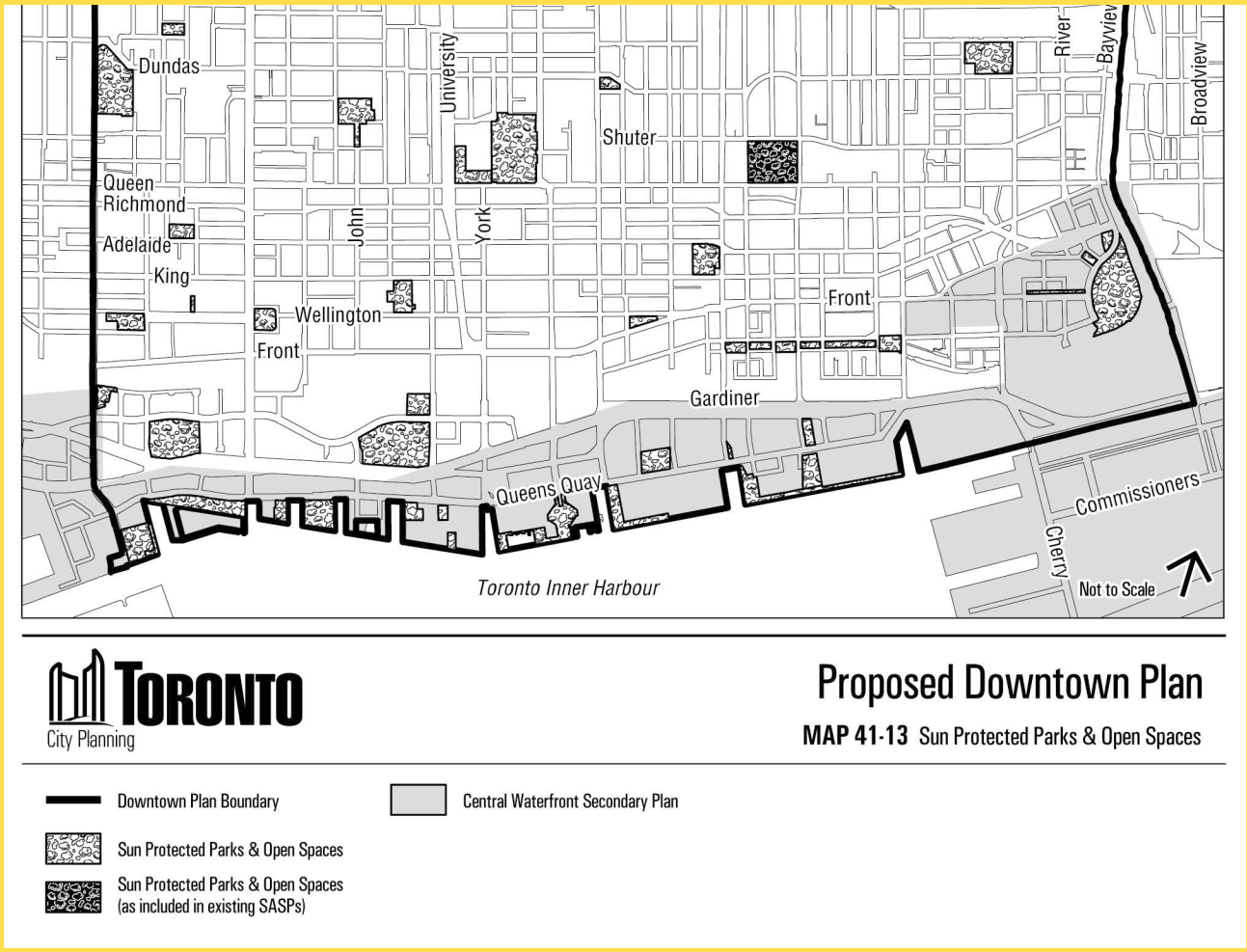
The size of individual performance districts could vary from small corridors to larger geographic areas. The following sections elaborate on the necessity of performance districts and where they would be most suitable.

Surrounding Critical Public Spaces

New Yorkers would benefit from performance districts that guarantee sunlight availability in large individual open spaces and clusters of smaller spaces. KPF's findings suggest that performance districts should be used to protect public spaces that are particularly at risk—those receiving an average of between two and four hours of adequate daylight. They should also be used to protect public spaces with the greatest amount of remaining natural light available, or those with more than four hours of adequate daylight. Absent protections, development will continue to erode the sunlight in these spaces.

Along High Priority Streets

Performance districts should be used to protect sunlight along corridors that are the lifeblood of neighborhoods. For example,



Source: City of Toronto

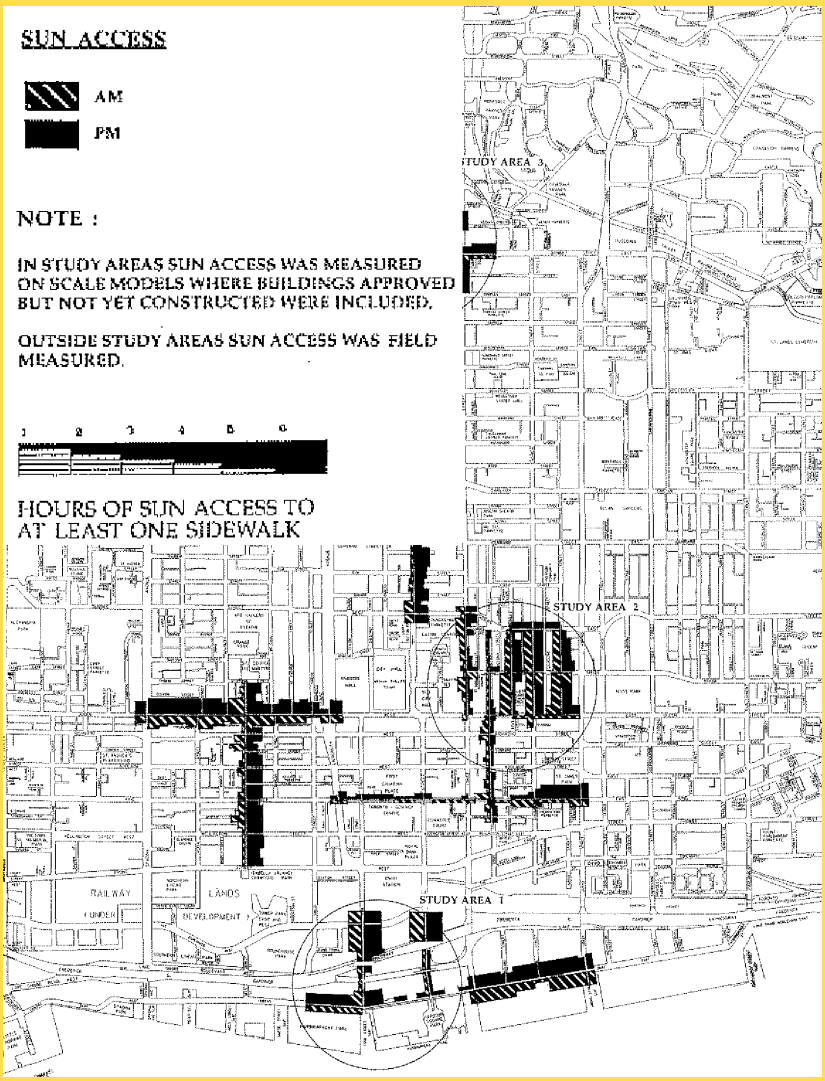
Toronto's "Sun Protected Parks and Open Spaces"

New York City could take a cue from Toronto, whose *Downtown Plan* includes specific "Sun Protected Parks and Open Spaces" that are subject to a no-net-new shadow law. Many of these spaces are included in Site and Area Specific Policies that target particular areas and supplement the City's *Official Plan*.[24]

protecting sunlight along Shared and Open Streets, avenues and boulevards with significant tree canopy or sun during the growing season, and ensuring that denser neighborhoods have at least one major protected commercial thoroughfare, such as Park Avenue in East Midtown or Fulton Street in Downtown Brooklyn. The City should also protect clusters of streets where existing sunlight is severely fractured. The decision must be based on a combination of street function, orientation, width, pedestrian traffic levels, existing sunlight availability, and surrounding land use and building density, among other potential factors.

In Socially Vulnerable Areas

While protecting individual public spaces is important, it must be considered within the context of social vulnerability and health equity. An equity-focused approach recognizes that all neighborhoods are not starting from the same place. Some areas have benefited unfairly from long-established patterns of investment, policy focus, and protection. Other areas continue to reflect a history of uncoordinated planning, underfunding, and disenfranchisement. Performance districts that account for social vulnerability would lead to more equitable outcomes by eliminating disparities in



Source: City of Toronto

Prioritizing Sunlight in Toronto's Streets

Official Downtown Toronto and Mississauga planning documents outline sunlight standards for different types of streets, such as priority retail streets and those of cultural and historical heritage. Toronto's policies were influenced by *Sun, Wind, and Pedestrian Comfort: A Study of Toronto's Central Area* (1991), which recommended a street classification standard for preserving sunlight on sidewalks. Business streets were determined to require the least amount of sunlight (a three-hour time window), with increasingly stringent requirements for promenades and historic streets, medium density residential and mixed-use streets, and low density residential streets.[25]

process, distributing benefits and burdens, and accounting for historical context.

Our analysis suggests that many neighborhoods would benefit from an area-specific policy that has health equity at its center. The South Bronx and southeast Brooklyn are the most obvious. However, other areas such as Corona, Sunset Park, and southeast Queens also have exceptionally high levels of social vulnerability that merit attention. Further study is needed to comprehensively identify those neighborhoods where issues of social vulnerability overlap with a lack of sunlight and public space access.

Incentives and Hardship Relief

The success of the performance district and associated rating system will be driven by its ability to improve design outcomes while facilitating development. To achieve this, performance districts should incentivize and reward performance that exceeds minimum requirements and also provide relief in situations in which performance is not feasible. For example:

- Awarding increased Floor Area Ratio (FAR) for designs that modify a building's massing and materials to achieve a certain sunlight rating score.
- Granting an accelerated City Planning Commission review process for designs

that achieve a certain score.

- Allowing for the transfer of development rights (TDR) from parcels unable to achieve a passing sunlight score.[26] TDRs would be limited to the confines of the performance district, provided that the transfer would not result in a failing score for the receiving site. Transfers could be as-of-right if they fall within the existing building envelope or subject to a special permit for substantial shifts in bulk. Because of the complexity of TDR systems, further study would be needed to examine its effectiveness and impact.
- Allowing contributions to a district-wide public realm improvement fund to help achieve a passing score.

The Solar Carve Building, as seen from the High Line (Source: Studio Gang)

Incentivizing "Solar Carving"

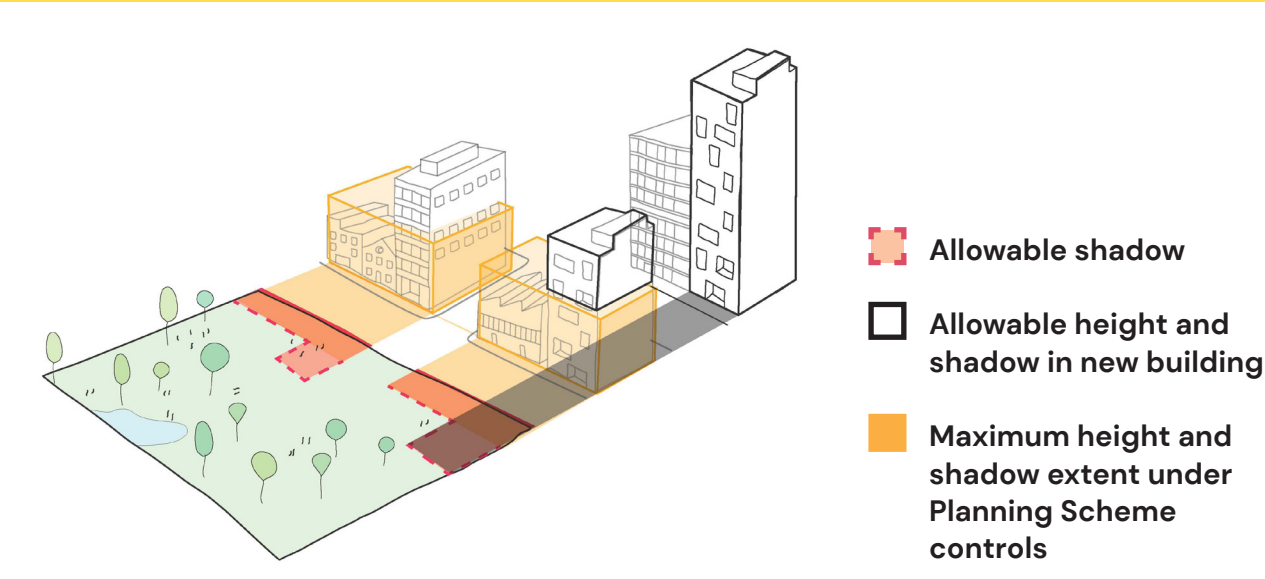
One of the world's best examples of building design that prioritizes access to sunlight is Studio Gang's new office building at 40 Tenth Avenue in New York City's Meatpacking District. Known as the "Solar Carve," the east-facing rear of the building directly abuts the High Line, where development is rapidly shadowing the natural features of the park. Had the building been constructed as-of-right, the massing would have cast significant shadow on the sunlight-sensitive vegetation of the High Line's Washington Grasslands and Woodland Edge.

To avoid this outcome, Studio Gang used height and setback variances to address unique site conditions and adopted the practice of solar carving, by which the building's form was manipulated based on the sun's pathways. However, the required variances added substantially to the project's timeframe and budget, as existing City regulations did not allow for such a building design. Had Solar Carve been located in a performance district that incentivized its design, the project's approval process could have been streamlined.

Pass a Local Law for Sunlight Access in the Public Realm

While zoning is the preferred method for regulatory change, the City should pass a Local Law for sunlight access should there prove to be insufficient support for zoning change. New York City already has dozens of Local Laws related to energy conservation, solar and green roofs, bird-friendly materials, and other environmentally friendly measures. The City also just passed a Local Law that will require the Mayor's Office of Resiliency to conduct a five-year pilot program of the *Climate Resiliency Design Guidelines* and the development of a resiliency scoring metric that will ensure City capital projects are built to stringent resiliency standards. Given the critical role that sunlight plays in climate change and urban livability, a Local Law for sunlight access would align with current legislation.

A sunlight-oriented Local Law could focus on building performance as it pertains to the public realm. Ideally, it would include an evaluation rating system that would accomplish the types of goals described previously for the performance district. The Law could be part of a broader thermal comfort-focused law or paired with an existing law like Local Law 95, which requires letter grades on midsize and large buildings that show how energy-efficient they are.



Source: City of Melbourne

Legal Protections for Sunlight in Boston and Melbourne

Several cities around the world have legal and policy protections for sunlight access in urban environments. In Boston, a pair of state laws (the Boston Common Shadow Law and the Public Garden Shadow Law) restrict new shadow on the Boston Common and the adjacent Public Garden to the first hour after sunrise or the last hour before sunset.[27]

Melbourne's Sunlight to Public Spaces Local Policy preserves sunlight access in public open spaces between 11am and 2pm in spring and autumn. In 2018, the City Council undertook a revision of the policy and its codification in the *Melbourne Planning Scheme*. Though still undergoing public review, the revised policy recommends additional regulations that prohibit new shadowing on all parks between 10am and 3pm in winter, specifically to support healthy living throughout the year.[28]

CONCLUSION

More than a century ago, New York changed the way cities looked at light and air. The passage of the 1916 Zoning Resolution was an act of courage, an attempt to see beyond the growing turf war between public space and private development and forge creative solutions that allow a city to grow without sacrificing its most basic natural resources. Over the last 105 years, we have lost sight of that beacon. Too often, we have allowed essential elements of our infrastructure to be treated as bargaining chips, trading one priority for another, to the detriment of our neighborhoods.

As New York City continues to grow, how we regulate the private and public realms must be rebalanced. We are not saying that sunlight is more important than the myriad factors that new projects, developers, and the City must consider. We are asserting that access to sunlight is a fundamental element of our city that must be prioritized, accounted for, and integrated into how our city changes.

The COVID-19 pandemic has underscored the necessity of sunlight and public space in urban life, especially for the most vulnerable New Yorkers. Parks, playgrounds, streets, and sidewalks have become our living rooms, gyms, classrooms, and so much more. Sunlight allows the public realm to be used and programmed throughout the year, and a lack of sunlight means that even spaces that thrive in the summer lay dormant during the spring, fall, and winter. In a city where space is at the ultimate premium, it is simply unacceptable to resign ourselves to a public realm that is stripped of natural light for half of the year or more. The Mayor, City Council, City Agencies, Community Boards, advocates, designers, and builders must do more to ensure our public spaces are bright, equitable, and sustainable.

We are not alone in this task; unlike in 1916, today we have examples from numerous global cities that have taken the precedent MAS set all those years ago and found ways to prioritize sunlight through planning and policy making. It is time for New York City to lead by example and shape development through robust design guidance, a more comprehensive environmental review process, and innovative zoning.

From public health to climate mitigation, sunlight is essential to our city infrastructure. We deserve a public policy and political leadership that safeguards this resource for all New Yorkers.

METHODOLOGY

The following sections outline the methodologies used to create the sunlight availability and social vulnerability assessments.

Modeling Sunlight Availability

Daylight Access in Winter

The simulation was developed using a 3D model of existing buildings based on New York City Department of City Planning (DCP) data. Average light reflectance values for streets, landscape, and building materials were assumed for the model. Local sky conditions (in terms of direct and diffuse illuminance) were modeled using typical meteorological year data (TMY3) for Central Park as made available by the U.S. Department of Energy (DOE). Hourly illuminance values were then modeled using a radiance-based raytracing engine to calculate the amount of direct, diffuse, and reflected light at street level.

The analysis was conducted for the three months with the lowest available illuminance levels in New York City: November, December, and January. Assuming a minimum illuminance target for a "well-daylit" open space of 10,000 lux, the percent of hours where that target was met was calculated for each part of the day (morning, noon, and evening). Whenever a public space showed more than 50 percent of hours, it was considered as having sufficient daylight during that part of the day. In contrast, "Poorly Daylit" areas did not achieve at least 50 percent of hours with 10,000 lux during either of these three times of day. In other words, while these spaces may receive some natural light throughout the day (mostly reflected from building facades), they rarely provide lux levels over 10,000 in winter, a target recommended by the medical community to mitigate the effects of sleep and seasonal disorders.

Thermal Benefit and Harm

The simulation of sun hours was developed using a 3D model of existing buildings based on DCP data as well as solar altitude and azimuth information for New York City's latitude. The evaluation of solar benefit and harm was developed by calculating the Universal Thermal Climate Index (UTCI) effective temperature for every hour of the year, with and without direct solar access and holding all other parameters equal. UTCI temperatures were calculated using TMY3 data for Central Park as made available by the U.S. DOE. Street-level wind speeds were estimated as the monthly average for a given hour in New York City based on the average urban density of the particular neighborhood.

Thermal comfort was assumed between UTCI effective values of 57 and 82 degrees Fahrenheit. Beneficial sun was then defined for any hour where its presence would bring UTCI values into the comfort range, and harmful sun for any hour where its presence would bring UTCI out of the range. Finally, beneficial and harmful sun hours were averaged by season and mapped.

Sunlight for Trees

Using a sun path for New York City that accounted for the light blocked by existing buildings, the number of direct-sun hours per day was calculated for each study area for a single day per week for the study's growing season (defined as April 1st to October 31st). These results were then binned to the percent of weeks that receive at least six (full sun) and at least three (partial sun) hours of direct sunlight per day.

A layer of existing tree canopy was then overlaid along with a layer of existing parks, plazas, and other public spaces. Locations where existing tree canopy had 50 percent or fewer weeks in the growing season with full or partial sun were considered "at risk." Meanwhile, public spaces with over 90 percent of weeks in the growing season with full or partial sun were considered to be "areas of opportunity" for additional tree planting.

Mapping Social Vulnerability

MAS began the study by conducting an extensive literature review of social vulnerability assessments and best practices from New York City and elsewhere. These included, among others, the *New York City Panel on Climate Change 2019 Report*, New York City Department of Health and Mental Hygiene's *Heat Vulnerability Index*, and Seattle's *Outside Citywide initiative*.

MAS then inventoried a range of potential social and physical indicators, evaluating each in terms of data availability, commonality in other assessments, and relevance to our study's particular focus. In total, MAS reviewed and analyzed more than 75 potential indicators, with decision-making input from outside peer reviewers.

Ultimately, MAS chose 19 indicators, which were categorized and grouped into one of three broad factors: Socioeconomic, Health, and Built Environment. The final list of included indicators is shown below.

Socioeconomic data was downloaded from the 2018 American Community Survey 5-Year Estimates, while health data came from the CDC 500 Cities Project. All data was available at the census tract level. The built environment data was based primarily on tax lot level information from the New York City Department of City Planning's MapPLUTO database as well as several open data layers. MAS cleaned, consolidated, and aggregated much of this data to the census tract level.

The data associated with each indicator was broken into five bins to generate scores for each census tract. Depending on the indicator, bins were determined based on either the quantile or equal interval statistical methods. Scores were then tallied for each indicator and aggregated to generate total scores for each census tract. Each indicator was assigned equal weight, though future iterations of the map may weight indicators differently.

Factor	Category	Indicator	Description	Rationale
Socioeconomic	Poverty/ Income	Below poverty level	The share of all people whose income in the past 12 months is below the federal poverty level	An absolute measure of financial stability; those with fewer financial resources are less likely to have the means to travel and enjoy the benefits of sunlight, less likely to live in areas that provide access to a range of quality public spaces where sunlight is present, and more likely to have associated underlying health issues
		Median household income	Median household income in the past 12 months	A measure of financial stability that considers a broad range of incomes; those with fewer financial resources are less likely to have the means to travel and enjoy the benefits of sunlight, less likely to live in areas that provide access to a range of quality public spaces where sunlight is present, and more likely to have associated underlying health issues
	Age	65 years and over	The share of the population age 65 years and over as a percentage of the total population	Seniors are generally less mobile and more dependent on available sunlight close to home
		Under 18 years	The share of the population under 18 years old as a percentage of the total population	Children and young adults are generally less mobile and more dependent on available sunlight close to home

Factor	Category	Indicator	Description	Rationale
	Race	People of color	The share of the population not identifying as "non-Hispanic white alone"	People of color have been systemically disadvantaged; compared with more advantaged non-Hispanic white populations, people of color are less likely to have the means to travel and enjoy the benefits of sunlight, less likely to live in areas that provide access to a range of quality public spaces where sunlight is present, and more likely to have associated underlying health issues
	Disability	With a disability	Total civilian noninstitutionalized population with a disability	Those with a disability are less mobile and more dependent on limited sunlight close to home
	Commute	Mean commute time	Mean commute time in minutes for workers age 16 and older who do not work at home	Workers with longer commutes are less likely to have the leisure time to enjoy the benefits of sunlight
	Overcrowding	Households with 1.51 occupants or more per room	Share of occupied housing units with 1.51 occupants or more per room	Individuals in crowded households are more likely to rely on public, rather than private space for sunlight
Health	Mental Health	Mental health	The share of respondents at least 18 years old who report 14 or more days during the past 30 days during which their mental health was not good	Sunlight regulates physiological functions throughout the body, and a lack of sunlight can contribute to depression and mood disorders

Factor	Category	Indicator	Description	Rationale
	Obesity	Obesity	The share of respondents at least 18 years old who have a body mass index of at least 30.0 kg/m²	Sunlight regulates physiological functions throughout the body, and a lack of sunlight can contribute to obesity
	Sleep	Sleep	The share of respondents at least 18 years old who report usually getting insufficient sleep (<7 hours for those at least 18 years old, on average, during a 24-hour period)	Sunlight regulates physiological functions throughout the body, and a lack of sunlight can disrupt the sleep-wake cycle
	Physical Activity	Leisure-time physical activity	The share of respondents at least 18 years old who answered "no" to the following question: "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"	Those who participate in less leisure-time physical activity are less likely to enjoy the benefits of sunlight in outdoor recreational spaces or to live in areas that provide such spaces, and more likely to have associated underlying health issues
	General Health	Physical health	The share of respondents at least 18 years old who report 14 or more days during the past 30 days during which their physical health was not good	Those with poor physical health are less likely to enjoy the benefits of sunlight in public spaces or to live in areas that provide such spaces

Factor	Category	Indicator	Description	Rationale
Built Environment	Access to Public Space	Population density	People per acre	Those in denser areas are more likely to be reliant on public, rather than private space for sunlight, and less likely to have access to sunlit public spaces due to shadows from bulkier buildings and competition for access among other residents
		Public space acreage	Acres of available public space	Those with less nearby public space have fewer options for enjoying sunlight in the public realm
	Access to Public Transit	Access to the subway	Walking distance to MTA subway station entrances, based on 1/4 mile, 1/2 mile, 3/4 mile, 1 mile, and greater than 1 mile distance calculations	A lack of subway access limits the amount of sunlit public space that can be accessed
		Access to Select Bus Service (SBS)	Walking distance to SBS stops, based on 1/4 mile, 1/2 mile, 3/4 mile, 1 mile, and greater than 1 mile distance calculations	A lack of SBS access limits the amount of sunlit public space that can be accessed
		Access to the NYC Ferry	Walking distance to NYC Ferry landings, based on 1/4 mile, 1/2 mile, 3/4 mile, 1 mile, and greater than 1 mile distance calculations	A lack of ferry access limits the amount of sunlit public space that can be accessed, especially because much of the city's sunlight is along the waterfront
	Future Development	Unused develop-ment rights	Percentage of available FAR, according to underlying zoning	An indication of where individuals may lose access to sunlight in the future

ENDNOTES

1 The public realm is considered in the broadest sense to encompass all publicly accessible exterior spaces such as streets, sidewalks, parks, playgrounds, plazas, and Privately Owned Public Spaces (POPS).
2 Thermal comfort is the human perception and experience of a space in which the body is neither overheated nor excessively cold. It is a collective measure of solar radiation, wind velocity, air temperature, and humidity, as well as one's clothing insulation and metabolic heat levels.
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About the Municipal Art Society

The Municipal Art Society of New York (MAS) lifts up the voices of the people in the debates that shape New York's built environment and leads the way toward a more livable city from sidewalk to skyline. MAS envisions a future in which all New Yorkers share in the richness of city life—where growth is balanced, character endures, and a resilient future is secured.

Over more than 125 years of history, our advocacy efforts have led to the creation of the New York City Planning Commission, Public, Design Commission, Landmarks Preservation Commission, and the Tribute inLight; the preservation of Grand Central Terminal, the lights of Times Square, and the Garment District; the conservation of more than 50 works of public art; and the founding of such civic organizations as the Public Art Fund, the New York Landmarks Conservancy, P.S. 1, the Historic Districts Council, the Park Avenue Armory Conservancy, and the Waterfront Alliance.

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About New Yorkers for Parks

NY4P conducts research and develops tangible policy recommendations around our findings related to park development, management and sustainability. This research becomes the foundation for our advocacy campaigns; NY4P drives both immediate actions and long-term policies that protect and enhance the city's vast network of parks, ensure adequate and equitable distribution of open space resources to all neighborhoods, and inform and empower communities throughout New York City to advocate for their open space needs. To support our efforts, NY4P builds and maintains strategic partnerships with government officials and agencies, local parks groups and conservancies, academic institutions, and other key stakeholders in the public and private sectors.

ny4p.org **ny4p@ny4p.org** **@newyorkersforparks** **@NY4P**

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