Bird collisions with glass can happen wherever and whenever the two co-occur. It is estimated that up to 1 billion birds are killed by building collisions each year in the United States (Loss et al. 2014). Despite popular association of collisions with tall buildings and nocturnal migration, nighttime collisions with tall buildings are usually limited to infrequent, episodic events when an abrupt change in weather, a low cloud ceiling, dense fog, and light pollution all interact to create conditions that conceal buildings, disorient birds, and force them to decrease their flight altitude (Loss et al. 2014, Winger et al. 2019). Instead, the overwhelming majority of collisions with buildings in both urban and non-urban areas occur during the daytime and near ground level, when lower-story windows reflect images of nearby trees and other vegetation (Klem et al. 2009, Loss et al. 2014).

NIGHTTIME COLLISIONS

Flight altitudes of nocturnally migrating birds vary with time of year, time of night, and numerous weather variables. However, based on radar data from multiple weather stations in New York, New Jersey, and Delaware, flight altitudes in the region typically range 443 to 3727 feet and average 1427 feet in the spring, and range 390 to 3153 feet and average 1480 feet in the fall (Horton et al. 2016). On the Teutonia Site, the Applicant proposes to construct a mixed-use project that would consist of two towers on a 6-story podium and have a maximum building height of 435 feet. The Chicken Island Project proposes to construct five buildings, with maximum heights of 400 feet (two buildings), 280 feet (two buildings), and 200 feet (one building). On the North Broadway Site, the Applicant proposes the construction of two 23-story towers that would both have a maximum height of approximately 300 feet. All of the proposed buildings would, therefore, be well below the average cruising altitudes of birds migrating over the Project Sites at night. While relatively short structures can still represent collision hazards to birds during special circumstances, when inclement weather combined with particular lighting conditions disorients and forces birds to decrease altitude (e.g., Van Doren et al. 2021), nighttime collisions of birds with the proposed buildings would likely be uncommon and minimal in number. For perspective, direct observations of nocturnal migrants from the top of the brightly illuminated and much taller Empire State Building in nearby New York City found that only 7 out of 33,800 observed birds collided with the building during autumn (DeCandido 2007) and 0 out of 3,415 observed birds collided during spring (DeCandido and Allen 2006).

The Proposed Project would limit the use of unnecessary indoor and outdoor lighting at night (particularly during spring and fall migration) and use flashing, white obstruction lights rather than steady-burning, red obstruction lights on their roofs. Both of these measures would even further minimize the chances of nighttime collisions by reducing the potential of the proposed buildings to have attractive or disorienting effects on migrating birds (Longcore et al. 2008, Gehring et al. 2009, Van Doren et al. 2021). With such measures in place, and with building heights that would not extend into the range of air space most commonly used by migrating birds, the Proposed Project would not be expected to result in significant numbers of nighttime bird collisions.

DAYTIME COLLISIONS

Daytime collisions of birds with buildings are a function of glass abundance and reflectivity, surrounding habitat characteristics, and the density and species of birds in the area (Hager et al. 2008, Klem et al. 2009, Gelb and Delecretaz 2009, Elmore et al. 2021). The more glass on a building, the more reflective that glass is, and the more migratory birds there are in adjacent habitats, the greater the potential for collisions, particularly near ground level (Hager et al. 2008, Loss et al. 2014). Collisions with glass also occur when glass is non-reflective and birds attempt to reach what is seen through the glass, on the other side. This see-through effect is commonly created by building features such as glass railings and skywalks, widows surrounding atria and similar indoor spaces with extensive vegetation, and corner windows where glass from two perpendicular sides of a building comes together. All of these factors are used to assess the likelihood of bird collisions with buildings, and are considered for each individual project below.

Teutonia Project

The Tuetonia Site is a vacant lot in a heavily developed, urbanized landscape that contains minimal habitat for birds. Vegetated habitat adjacent to the Site is limited to ruderal vegetation bordering the rail tracks that bound the Site to the west, a small cluster of trees in residential yards across Buena Vista Avenue to the east, and a small cluster of trees in a playground to the south. The lot to the north is fully developed and lacks vegetation. The bird community in the vicinity of the Teutonia Site is, therefore, composed of extremely urban-adapted, mostly non-native, resident species (e.g., house sparrow, European starling, and rock dove), which seldom collide with glass relative to migratory birds (O'Connell 2001, Sloan 2007). During spring and fall, migrating birds are expected to occur in the vicinity of the Teutonia Site only infrequently and in low abundance because there is no habitat to attract and support large numbers of migrants.

Although migrating birds can be found using extremely small patches of vegetation in urban areas, the vast majority of birds over cities and in need of a stopover site will select large parks and other relatively large habitats that have more extensive forest cover (e.g., Buler et al. 2014) and provide better conditions for refueling (Simons et al. 2000, Buler et al. 2007, Ktitorov et al. 2008). In the Yonkers area, for example, most birds migrating overhead or along the Hudson River corridor that are in search of stopover habitat will be expected to select areas such as Palisades Interstate Park, Tibbetts Brook Park, and the woodlands surrounding the Saw Mill River Parkway rather than what is present around the Teutonia Site. With migratory birds expected to occur in the vicinity of the Teutonia Site in such low abundance, the potential for collisions with the proposed buildings would inherently be minor. Nevertheless, to further limit the possibility of bird collisions with the proposed building, the Applicant would use bird-safe glass (defined as glass scored by the American Bird Conservancy to have a "threat factor" of ≤ 30; ABC 2021) or other bird-safe design features (Sheppard and Phillips 2015) on the first three stories of the eastern and western facades, where there are clustered trees and other vegetation across Buena Vista Avenue and the rail tracks. No vegetation that could be reflected by glass and create a collision hazard exists to the immediate north or south of the proposed building's location. Bird-safe glass would also be used on all of the building's exterior that would be adjacent to and level with the height of trees that would be planted on a terrace above the 6th floor of the podium. Given the effectiveness of bird-safe glass (Sheppard and Phillips 2015, Sheppard 2019) along with the lack of habitat in the surrounding area to support large numbers of migrating birds, the Teutonia Project would not present a significant collision hazard to migrating birds.

Chicken Island Project

The Chicken Island Site is approximately 5.25 acres and is dominated by impervious surfaces, including a large municipal parking lot and two private streets. The eastern side of the Site, to the east of New School Street, contains the only area with trees and other vegetation, aside from weeds and other ruderal plants that occur along a parking lot at the northern end of the Site. This eastern area is characterized by a narrow, daylighted segment of the Saw Mill River, and small, isolated clusters of trees that occur around and between commercial properties on a triangular block between New School Street, Nepperhan Avenue, and Elm Street. The surrounding area is heavily urbanized and lacks any significant open space.

The only birds for which the majority of the Chicken Island Site represents suitable habitat are non-native house sparrows, rock pigeons, and European starlings. The eastern side of the site may provide habitat for some additional bird species that are extremely urban-adapted and common to small patches of greenspace within cities. Examples include American robin, song sparrow, and northern cardinal. During migration, there is low likelihood that nocturnal migrant songbirds, such as warblers (Parulidae spp.) and thrushes (Catharus spp.), occur in this area other than infrequently and in extremely low abundance. As noted above, the vast majority of birds migrating over Yonkers and in search of stopover habitat upon daybreak will select forested areas such as Palisades Interstate Park, Tibbetts Brook Park, and the woodlands surrounding the Saw Mill River Parkway rather than what is present around the Chicken Island Site.

The proposed Chicken Island Project would construct six buildings, the designs of which would likely feature extensive landscaping, including green roofs, landscaped terraces and courtyards, and tree-lined walkways. This would represent a substantial increase in greenery relative to existing conditions and would have the potential to attract more migrating birds to the site than at present (Partridge et al. 2018), bringing them into close proximity with the proposed buildings. The proposed buildings would therefore be designed with bird-safe glass (ABC 2021) and/or other bird-safe design features (Sheppard and Phillips 2015) on the first three levels of each building and anywhere there would be trees or other vegetation immediately adjacent to glass on the buildings' exteriors. This would include all windows and other glass surfaces adjacent to landscaped terraces and green roofs, to which migrating birds would potentially be attracted. With this measure in place, the proposed buildings would be able to provide potentially beneficial habitat for migrating birds (Partridge et al. 2018) without placing them at increased risk of collisions.

North Broadway Project

The North Broadway Site is approximately 1.85 acres and consists of a mix of undeveloped parcels and parcels developed with commercial and residential uses. There are small clusters and rows of trees on these parcels that provide suitable habitat for only the most urban-adapted, disturbance-tolerant species of birds, such as house sparrow, European starling, and American robin. During spring and fall, migrating birds have the potential to occur within the site infrequently and only in extremely low abundance. As with the Chicken Island Site immediately to its south, the area surrounding the North Broadway Site is heavily urbanized and lacks any significant greenspace to provide habitat for a high abundance or diversity of resident or migratory birds.

The proposed North Broadway Project would construct two new buildings on the site, which would likely be designed to include green roofs, landscaped terraces, and other landscaping features. These landscaping features would have the potential to attract migrating birds to the site, albeit in low abundance given the limited amount of greenery there would be and the extremely

urbanized surroundings of the Site. The proposed buildings would therefore be designed with bird-safe glass (ABC 2021) and/or other bird-safe design features (Sheppard and Phillips 2015) on the first three levels of each building, and anywhere there would be trees or other vegetation immediately adjacent to glass on the buildings' exteriors. This would include all windows and other glass surfaces adjacent to landscaped terraces and green roofs, to which migrating birds would potentially be attracted. With this measure in place, the proposed buildings would have the potential to provide habitat for migrating birds without placing them at increased risk of collisions.

CONCLUSION

Nighttime collisions of actively migrating birds account for a minority of building collision mortality in the New York metropolitan area and elsewhere, and are mostly limited to isolated events (DeCandido and Allen 2006, Klem 2006, DeCandido 2007, Klem et al. 2009, Loss et al. 2014). They occur significantly more often at relatively tall structures (> 500 feet) than at shorter ones (Kerlinger 2000, Longcore et al. 2008). The buildings of the Proposed Project would be well below the average flight altitudes of birds migrating over the Project Sites at night (Horton et al. 2016). The proposed buildings would also be designed to limit the use of unnecessary indoor and outdoor lighting at night (particularly during spring and fall migration), and use flashing white obstruction lights rather than steady-burning red obstruction lights to even further minimize the chances of nighttime collisions (Longcore et al. 2008, Gehring et al. 2009, Van Doren et al. 2021). For these reasons, nighttime collisions of birds with the proposed buildings would be expected to be uncommon and minor in number.

Daytime collisions near ground-level, which account for the majority of building collision mortality (Loss et al. 2014), are a function of the amount and type of glass on a given building, and the abundance and diversity of birds supported by adjacent habitats (Hager et al. 2008, Klem et al. 2009, Gelb and Delecretaz 2009, Elmore et al. 2021). None of the Project Sites or their surrounding areas currently contain habitat to attract or support large numbers of migrating birds, inherently limiting the potential for daytime collisions. Certain design features of the proposed buildings, including green roofs, landscaped terraces and courtyards, and tree-lined walkways would increase the amount of greenery in the Project Sites relative to existing conditions and have the potential to attract more migrating birds to the Sites than at present, although abundance would still remain extremely low. The proposed buildings would therefore be designed with bird-safe glass (ABC 2021) and/or other bird-safe design features (Sheppard and Phillips 2015) on the first three levels of each building and anywhere there would be trees or other vegetation immediately adjacent to glass on the buildings' exteriors. This would include all windows and other glass surfaces adjacent to landscaped terraces and green roofs, to which migrating birds would potentially be attracted.

Given the effectiveness of the measures that would be implemented by the Proposed Project, including bird-safe glass (Sheppard and Phillips 2015, Sheppard 2019), limited indoor and outdoor lighting (Parkins et al. 2015, Van Doren et al. 2021), and flashing white obstruction lighting (Gehring et al. 2009), combined with the low abundance of migrating birds that would have the potential to occur in the area, the proposed buildings would not represent a significant collision hazard to birds. Overall, both nighttime and daytime collisions of birds with the buildings of the Proposed Project would be expected to be uncommon, low in magnitude, and of insignificant impact to local and migratory bird populations.

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