

Exhibit F

Glass & Lighting Standards

A wildlife biologist (Environmental Science Associates) has provided a review of Project Mirage to confirm that the artwork meet Cupertino's bird safe development requirements. See the following pages for ESA memo.

The project design will comply with Cupertino's lighting requirements. A photometric will be provided for review prior to building permit issuance.

September 9, 2021

David Kang
Apple Real Estate and Development
Sent via email

Subject: Biological Review of the Mirage Sculpture

Environmental Science Associates (ESA) is providing this biologist report in support of Apple's proposed public glass sculpture, Mirage, at the Apple Park Visitor Center at 10600 North Tantau Avenue in the City of Cupertino. ESA avian biologist, Erika Walther, reviewed the architectural plans, description and artist renderings of Mirage and evaluated its bird-strike potential in the context of current science and local policies and guidelines related to reduction of bird strikes. Ms. Walther is familiar with bird-safe building ordinances, design guidelines, and standards published by the American Bird Conservancy (ABC) and San Francisco Planning Department, and the cities of Cupertino, San José, Sunnyvale, Mountain View, Richmond, Oakland, and Alameda. She also has extensive experience analyzing the potential impacts of, and writing mitigation measures for, bird collision hazards under the California Environmental Quality Act.

Urban Birds and Glass Collision Hazards

The San Francisco Bay Area is an important stopover point along the Pacific Flyway bird migration route. Most birds on migration are flying at approximately 1,000 feet in elevation, often at night, but descend to rest, forage, and escape inclement weather.^{1,2} Migratory birds may also fly short distances at lower elevations to correct their migration path. The San Francisco Bay Area is also home to many bird species that winter, breed, or live here year-round. These birds primarily move at lower elevations while accessing sites for perching, nesting, and foraging. The potential for bird collisions with windows and glass building facades is well-documented;^{3, 4,5} however, ESA is not aware of any documentation of bird strikes with outdoor glass installations other than windows and building facades. For the purposes of this report, we assume that the primary indicators for bird strike potential are the same for all outdoor glass: degree of reflectivity and/or transparency, and overall surface area.

¹ Standards for Bird-Safe Buildings. San Francisco Planning Department. Adopted July 14, 2011.

² Building Collisions are a Greater Danger for Some Birds Than Others. July 9, 2020. National Audubon Society. <https://www.audubon.org/news/building-collisions-are-greater-danger-some-birds-others>. Accessed September 7, 2021.

³ Christine Sheppard and Glenn Phillips. Bird-Friendly Building Design, 2nd Ed. (The Plains, VA: American Bird Conservancy, 2015).

⁴ Klem, Jr., Daniel. 2017. Collisions Between Birds and Windows: Mortality and Prevention. *Journal of Field Ornithology*, 61(1):120-128.

⁵ Banks 1979; Ogden 1996; Hager et al. 2008; Klem 2009; Gelb and Delacretaz 2009 cited in Standards for Bird-Safe Buildings. San Francisco Planning Department. Adopted July 14, 2011.

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The presence of glass that is highly reflective or transparent presents a strike hazard for birds in flight. Bird strikes with reflective glass are primarily associated with glass building façades and building windows. Glass façades that clearly reflect the surrounding natural environment can be mistaken by birds to be an extension of the natural environment (e.g., trees, shrubs, sky). Transparent glass that is used for balcony railings, building corners, courtyards, walkways between buildings or other structures through which the natural environment can be seen are mistaken by birds as an unobstructed pathway to the vegetation and sky on the opposite side of the glass. In general, the total area of glass, rather than the height of the glass or cardinal direction of the glass, is the strongest predictor of bird collision hazard.⁶ In addition, the hazard is exacerbated if the glass is located within 300 feet of open space of two or more acres that is dominated by vegetation, whether natural or landscaped/ornamental.

Project Understanding and Setting

Mirage entails installing 464 glass cylinders, each 6-ft-7-inch-tall and 6-inches in diameter. The cylinders will be arranged in three undulating rows of 132, 151, and 181 cylinders in an olive tree grove north of the Apple Park Visitor Center. Mirage will be fully accessible to the public via three access paths from the Visitor Center and from the Tantau Avenue sidewalk. The total area of glass will be approximately 1,527 square feet.



Figure 1. Layout of Mirage in olive orchard. Rows of undulating glass cylinders are shown in red; olive trees are shown in gray.

⁶ Christine Sheppard and Glenn Phillips. *Bird-Friendly Building Design*, 2nd Ed. (The Plains, VA: American Bird Conservancy, 2015).

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The glass cylinders are produced using sand from 58 deserts, representing every desert on earth. By design, the glass cylinders are manufactured to allow for bubbles, variation in color, and other unique attributes. The glass cylinders are minimally reflective and transparent, with the grass, trees, and sky that are seen through the glass appearing as blurry and distorted colored shapes. In addition, the arrangement of these cylinders in rows creates a scalloped surface, rather than a flat, smooth surface conducive to high reflectance or transparency. Lastly, the vertical lines created by the junction of each 6-inch cylinder with the next creates similar visual “noise” to bird-safe glass treatments, such as the vertical lines created by fritting and ultraviolet-reflective coatings, and vertical interior blinds.



Figure 2. Close-up of glass cylinders to be used for Mirage, showing blurry and distorted images reflected in, and seen through, the cylinders.

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Figure 3. Photo of sample glass cylinder at the project site illustrating the low transparency expected due to the distortions in the glass.

In addition, the glass sculpture will be publicly accessible, visible from the Apple Park Visitor Center as well as Tantau Avenue. This human activity may decrease bird activity in the immediate vicinity of the glass cylinders.



Figure 4. Artist rendering of completed installation of Mirage, showing vertical stripes that break up the glass, similar to bird-safe glass treatments.

Conclusion

In summary, Mirage does not pose a potential bird-strike hazard. Although Mirage will be installed within a natural, vegetated area, the inherent qualities of the glass, combined with the vertical lines created by placement of adjacent cylinders, minimizes glass reflectance and transparency that could lure birds into perceiving safe access to the natural environment where there is none. Importantly, the vertical pattern will be visible from greater than 10 feet away and will make the glass installation visible to birds, which ABC recommends to minimize bird collision hazards. In terms of comparable building products and bird-safe solutions, the Mirage cylinders are similar in design to Bendheim Channel Glass: Moire Fluted, a textured channel glass that is ABC-approved and meets ABC's "bird friendly" guidance.⁷ The similar transparency and appearance of this product

⁷ https://abcbirds.org/glass-collisions/products-database/?_paged=9



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relative to Mirage leads ESA to conclude that the Mirage glass, if tested, would also meet ABC standards as “bird friendly”.

Please feel free to contact me if you have any questions or need additional information.

Sincerely,

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