Appendix C – Avian Collision Risk Assessment

H. T. HARVEY & ASSOCIATES

Ecological Consultants

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October 18, 2022

Marc Huffman
Lincoln Property Company
915 Wilshire Boulevard, Suite 2050
Los Angeles, CA 90017

Subject: 777 Airport Boulevard – Updated Avian Collision Risk Assessment (HTH #4583-01)

Dear Marc Huffman:

Per your request, H. T. Harvey & Associates has assessed avian collision risk and lighting impacts on birds in support of the proposed 777 Airport Boulevard Project located southeast of San Francisco International Airport and north of the Burlingame Lagoon in the Bayfront neighborhood of Burlingame, California. It is our understanding that the project will demolish the existing improvements on the site and construct a 13-story, 194-foot tall building with 403,425 square feet of office space and six levels of parking. We further understand that you are requesting our assistance to assess the potential for avian collisions to occur with the proposed building for purposes of California Environmental Quality Act (CEQA) review of the project. This report summarizes our analysis of bird collision and lighting hazards associated with the project and describes measures necessary, in our opinion, to mitigate potentially significant impacts to less-than-significant levels under CEQA.

The project site is aligned northeast-southwest, but compass directions as they refer to the project site throughout this report are referenced consistently with the project's plans, which refer to *northwest* as *north*, *northeast* as *east*, *southwest* as *west*, and *southeast* as *south*. Off-site features are referenced according to actual compass directions.

Methods

This assessment was prepared by H. T. Harvey & Associates wildlife ecologists/ornithologists Steve Rottenborn, Ph.D., and me. Briefly, our qualifications are as follows (résumés attached):

- S. Rottenborn has a Ph.D. in biological sciences from Stanford University, where his doctoral dissertation focused on the effects of urbanization on riparian bird communities in the South San Francisco Bay area. He has been an active birder for more than 35 years and has conducted or assisted with research on birds since 1990. He has served for 9 years as an elected member of the California Bird Records Committee (including 3 years as chair) and for 13 years as a Regional Editor for the Northern California region of the journal North American Birds. He is a member of the Scientific Advisory Board for the San Francisco Bay Bird Observatory, the Technical Advisory Committee for the South Bay Salt Ponds Restoration Project, and the Board of Directors of the Western Field Ornithologists.

- I am a wildlife ecologist with a B.S. in Ecology from the University of California, San Diego and an M.S. in Fish and Wildlife Management from Montana State University, where my Master's thesis focused on factors affecting the nest survival of yellow warblers (*Setophaga petechia*), dusky flycatchers (*Empidonax oberholseri*), and warbling vireos (*Vireo gilvus*). Trained as an ornithologist, I specialize in the nesting ecology of passerine birds, with a broad range of avian field experience from across the United States. I am an avid birder, and I volunteered as a bird bander for the San Francisco Bay Bird Observatory, where I banded, sexed, and aged resident and migrant passerine species from 2010–2020. I have spent hundreds of hours in the field conducting nesting bird surveys for H. T. Harvey & Associates' projects over the past 14 years, and have found hundreds of passerine nests as well as many nests of raptors.

In addition, H. T. Harvey & Associates Ecologist Jane Lien, B.S., conducted a reconnaissance-level survey of the project site on November 23, 2021 to characterize potential bird use of the site and immediately surrounding areas. Steve Rottenborn is also familiar with the project site from his prior work preparing a peer review of a biological resources report and assessment of avian collision risk for the TopGolf Burlingame Project, which is directly west of the proposed project.

Although the subject of bird-friendly design is relatively new to the West Coast, we have performed avian collision risk assessments and identified measures to reduce collision risk for a number of projects in more than a dozen Bay Area municipalities.

Assessment of Bird Use

Existing Conditions

The project site is located in the Bayfront neighborhood of Burlingame, which lies southeast of San Francisco International Airport between U.S. Route 101 to the south and the San Francisco Bay to the north (Figure 1). The site is bordered by the tidal waters of Burlingame Lagoon to the south, Anza Boulevard to the northwest, Airport Boulevard to the northeast, and a parking lot to the east. The open waters of the San Francisco Bay lie approximately 650 feet to the north, and Anza Lagoon is located approximately 800 feet to the northeast. The site is surrounded by commercial office buildings, hotels, a large parking lot, and several large sports fields to the west.

Figure 1. The project site (delineated in yellow) and its immediate surroundings to the north, east, and west are dominated by commercial uses. The tidal waters of Burlingame Lagoon lie directly to the south, and the San Francisco Bay and Anza Lagoon lie 650 feet to the north and 800 feet to the northeast, respectively.

Habitat conditions and bird occurrence in the immediate vicinity of the project site (i.e., on the site and on immediately adjacent lands) are typical of much of the urbanized San Francisco Bay Area. The 3.1-acre project site is currently occupied by an existing hotel and restaurant building surrounded by a paved parking lot. The margins of the parking lot are lined with mature landscape trees and small areas of nonnative landscape vegetation including low shrubs, herbaceous plants, and turf (Photos 1 and 2). Mature trees on the site are nonnative and primarily consist of nonnative red ironbark (*Eucalyptus sideroxylon*), with a smaller number of blackwood (*Acacia melanoxylon*) scattered amongst them. Smaller trees and shrubs are sparsely distributed, and include nonnative cotoneaster (*Cotoneaster* sp.), wattle (*Acacia* sp.), sweet pittosporum (*Pittosporum undulatum*), and crepe myrtle (*Lagerstroemia* sp.). A hedge of nonnative Italian buckthorn (*Rhamnus alaternus*) is located along the eastern margin of the parking lot, and also creates a screen along the fence surrounding the hotel's swimming pool.


Photos 1 and 2. The site consists of a hotel surrounded by a paved parking lot with mature, nonnative landscape trees and scattered small trees, shrubs, and turf.

The site and most of the rest of the Bayfront neighborhood of Burlingame provide low-quality habitat for most native birds found in the region due to the limited extent of vegetation, the lack of any native vegetation, the absence of well-layered vegetation (e.g., with ground cover, shrub, and canopy tree layers in the same areas), the small size of the vegetated habitat patches, and the amount of human disturbance by vehicular traffic and occupants of buildings on and/or adjacent to the project site, which is developed as a hotel. Nevertheless, these areas support a suite of common, urban-adapted bird species characteristic of such urban areas that are expected to occur on the site regularly. These include the native American robin (*Turdus migratorius*), Brewer's blackbird (*Euphagus cyanocephalus*), bushtit (*Psaltriparus minimus*), house finch (*Haemorhous mexicanus*), American crow (*Corvus brachyrhynchos*), and Anna's hummingbird (*Calypte anna*), as well as the nonnative European starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*). All of these birds are year-round residents that can potentially nest on or in the immediate vicinity of the project site. A number of other species, primarily migrants or winter visitors (i.e., nonbreeders), occur occasionally on and adjacent to the site as well, including the cedar waxwing (*Bombycilla cedrorum*), white-crowned sparrow (*Zonotrichia leucophrys*), golden-crowned sparrow (*Zonotrichia atricapilla*), and yellow-rumped warbler (*Setophaga coronata*). For example, low numbers of migrants are expected to forage in the ornamental vegetation on the site. However, no bird species are expected to occur on the site in large numbers, and all of the species expected to occur regularly are regionally abundant species. No special-status birds (i.e., species of conservation concern) are expected to nest or otherwise occur regularly on the site.

The Burlingame Lagoon, located directly adjacent to the southern boundary of the site, is a tidally influenced, linear lagoon with a shoreline armored by imported rock and riprap (Photo 3). During high tides, the lagoon provides open-water foraging habitat for waterbirds including the double-crested cormorant (*Nannopterum aruitum*), mallard (*Anas platyrhynchos*), elegant tern (*Thalasseus elegans*), common goldeneye (*Bucephala clangula*), greater scaup (*Aythaya marila*), lesser scaup (*Aythya affinis*), bufflehead (*Bucephala albeola*), green-winged teal (*Anas crecca*), American wigeon (*Mareca americana*), ruddy duck (*Oxyura jamaicensis*), northern shoveler (*Spatula clypeata*), and American coot (*Fulica americana*), which occur in flocks of varying size during winter and migration. During low tide, the lagoon provides foraging habitat for small numbers of shorebirds, including the western sandpiper (*Calidris mauri*), dunlin (*Calidris alpina*), semipalmated plover (*Calidris pusilla*), least sandpiper (*Calidris minutilla*), short-billed dowitcher (*Limnodromus griseus*), black-necked stilt (*Himantopus mexicanus*), and long-billed dowitcher (*Limnodromus scolopaceus*). The section of the lagoon on the opposite side of Anza Avenue southwest of the site supports tidal marsh habitat, with a more naturalized shoreline and apparent tidal channels surrounded by emergent marsh vegetation (Photo 4). This area supports many of the same bird species noted above, but in greater diversity and abundance compared to the section of the lagoon located immediately adjacent to the project site due to the higher-quality cover and foraging resources provided by the more complex physical and biological structure of the tidal marsh. The Alameda song sparrow (*Melospiza melodia pusillula*), a California species of special concern that is closely associated with salt marsh habitats around the San Francisco Bay, nests and forages in the marsh vegetation along this tidal marsh shoreline year-round.

Photo 3. Burlingame Lagoon, south of and adjacent to the site, is channelized with an armored shoreline.

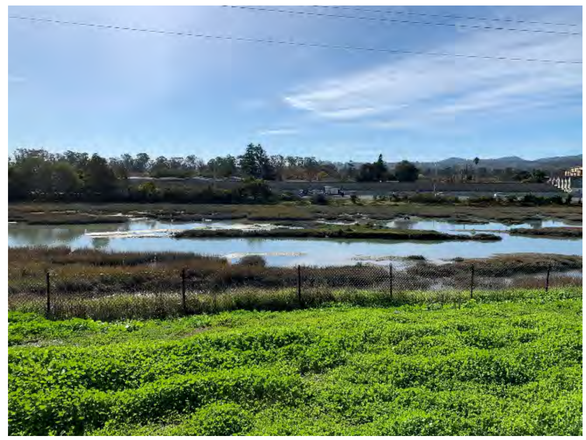

Photo 4. North of Anza Boulevard, Burlingame Lagoon is more naturalized, with tidal channels and emergent marsh vegetation.

The open waters of the San Francisco Bay, approximately 650 feet north of the project site, provide open-water and shoreline foraging habitat for the species of waterbirds and shorebirds listed above. In general, higher numbers of these birds are expected to occur within the open waters of the San Francisco Bay (for waterbirds) and along the Bay shoreline (for shorebirds) compared to Burlingame Lagoon due to the more extensive areas of foraging habitat present. In addition, Anza Lagoon, located approximately 800 feet northeast of the project site, supports similar open water and shoreline foraging habitats, and hosts similar species of birds in smaller numbers. Many of these birds will fly over the proposed project site while moving between the San Francisco Bay and Anza Lagoon to the north and northeast and Burlingame Lagoon to the south.

Due to its location along the edge of the San Francisco Bay, Burlingame Lagoon supports relatively high numbers and species of birds compared to areas located farther inland in Burlingame (Figure 2). Based on observations by birders over the years, approximately 136 different species of birds have been encountered in Burlingame Lagoon, including year-round resident, migrant, and wintering landbirds (associated with upland areas), shorebirds (associated with the shoreline), and waterbirds (associated with open water habitat) (Cornell Lab of Ornithology 2022). Ebird records suggest that some species of shorebirds and waterbirds can occur in these areas in large numbers (i.e., 100–200 individuals), but the majority of these species occur in smaller flocks.

A number of migrant bird species will remain in this area for days to weeks to rest and forage. As a result, even the limited amount of vegetation within and along the project site is expected to attract migrants in greater abundance than areas farther inland in urban areas of Burlingame. Resident birds that are present in the vicinity year-round are similarly attracted to the open habitats at Burlingame Lagoon in relatively large numbers for foraging opportunities (Cornell Lab of Ornithology 2022).

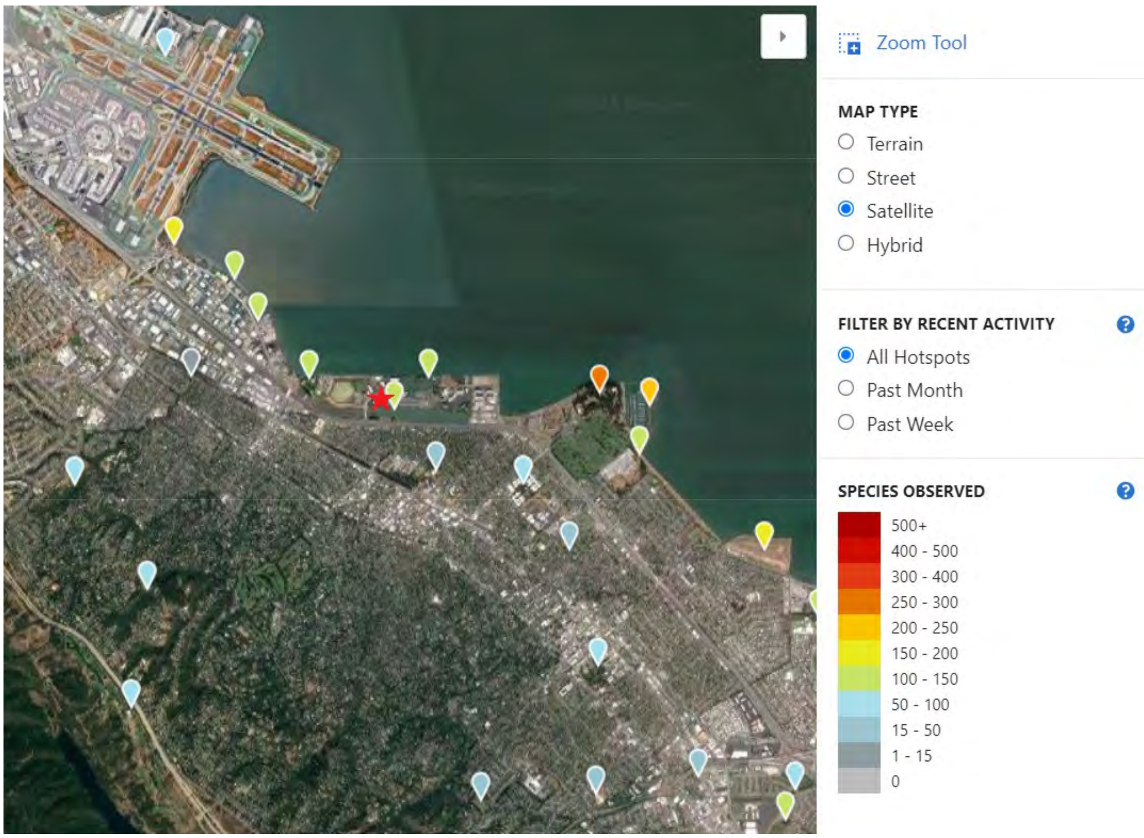

Figure 2. Map of eBird Hotspots in the project vicinity. The project site is indicated by a red star. Coyote Point is the hotspot with the orange marker (250–300 species observed).

Many species of warblers, vireos, flycatchers, swallows, and other landbirds occur along the edge of the Bay in the project vicinity during migration. Coyote Point, located approximately 1.5 miles east of the site, supports dense stands of mature trees including many eucalyptus (*Eucalyptus* sp.) trees, which provide foraging habitat for these migrants. Due to the numerous large trees present here and its location along the edge of the San Francisco Bay, Coyote Point attracts very large numbers of landbirds during migration compared to other locations in the vicinity (Figure 2). Examples of high counts of individual bird species seen at Coyote Point include up to 160 violet-green swallows (*Tachycineta thalassina*), 315 cedar waxwings, 150 mourning doves (*Zenaida macroura*), and 156 white-crowned sparrows (Cornell Lab of Ornithology 2022). Even higher counts exist that are not in the eBird database, but that have been reported to the Peninsula-Birding list-serve (https://groups.io/g/peninsula-birding); examples include counts of 234 violet-green swallows and 2,065 cedar waxwings on May 12, 2019. Thus, despite the limited extent of vegetation present on the project site, given the site's landscape position relative to important bird habitats such as the San Francisco Bay, Burlingame Lagoon, and Coyote Point, relatively high numbers of migrant birds are expected to occur on the site, and/or fly past the site, compared to similar developed areas located farther inland in Burlingame.

Proposed Site Conditions

The number of birds that use the site may decrease initially following project construction due to removal of 125 trees on and immediately adjacent to the site. However, over the long term, bird abundance is expected to increase due to the replacement of these primarily nonnative landscape trees with a mix of 106 native and nonnative trees, shrubs, and forbs. The proposed landscape vegetation is divided into four planting palettes: the Shoreline Garden, Stormwater Garden, Ornamental Garden, and Streetscape Planting. The Shoreline and Stormwater Gardens will consist primarily of native plant species, while the Ornamental Garden and Streetscape Planting will consist primarily of nonnative landscape plant species. Trees proposed on the project site include native coast live oaks (*Quercus agrifolia*), a species notable for providing high-quality resources for native birds, which will be planted in the westernmost portion of the site along Anza Boulevard, the San Francisco Bay Trail, and the Sloped Garden area. Native toyon (*Heteromeles arbutifolia*) and coffeeberry (*Rhamnus californica*), which often grow as shrubs but are identified as 'trees' on the plans, will be planted throughout the Shoreline Garden areas including adjacent to the northwest corner of the building and along the site's southern boundary. Locally nonnative Monterey cypress (*Hesperocyparis macrocarpa*) and nonnative London plane trees (*Platanus* x *acerifolia*), sawleaf zelkova (*Zelkova serrata*), fern pines (*Afrocarpus gracilior*), and Marina madrones (*Arbutus marina*) will be planted in other areas. Shrubs and herbaceous landscape plants in the Shoreline Garden areas include native coyote brush (*Baccharis pilularis*), California buckwheat (*Eriogonum fasciculatum*), California fuchsia (*Epilobium canum*), monkey flower (*Mimulus* sp.), and salvia (*Salvia* sp.), as well as nonnative atlas fescue (*Festuca mairei*). The Sloped Garden area will incorporate primarily native plants including deer grass (*Muhlenbergia rigens*), manzanita, California sagebrush (*Artemisia californica*), gray rush (*Juncus patens*), coffeeberry (*Rhamnus californica*), and narrow leaf milkweed (*Asclepias fascicularis*). The Ornamental Garden will be composed of primarily nonnative plants, including harmony kangaroo paw (A*nigozanthos* sp.), flax lily (*Dianella* sp.), Mexican heather (*Cuphea hyssopifolia*), New Zealand iris (*Libertia grandiflora*), grassland sedge (*Carex divulsa*), lomandra (*Lomandra longifolia*), and a cultivar of one native plant, California fuschia. Streetscape Planting areas will incorporate nonnative fortnight lily (*Dietes grandiflora*), Mexican bush sage (*Salvia leucantha*), coast rosemary (*Westringia fruticosa*), and pine muhly (*Muhlenbergia dubia*). An illustrative site plan showing the extent of proposed vegetation on the site is provided as Figure 3.

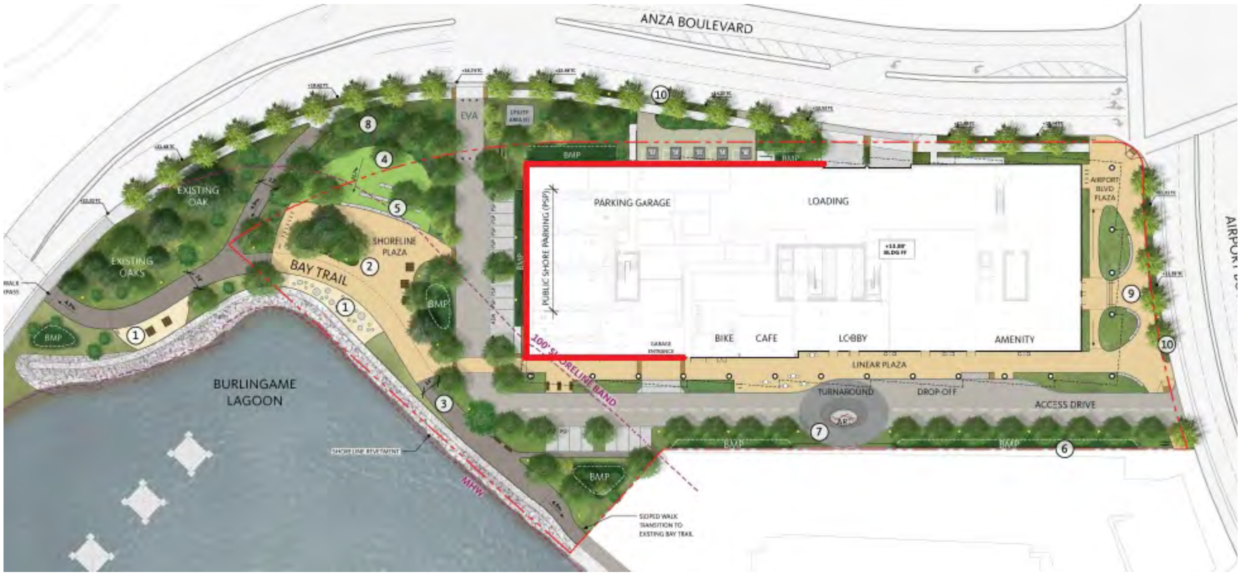

Figure 3. Illustrative site plan. Areas of heightened collision risk with the lower 60 feet of the building are identified in red.

Under proposed conditions, the proposed mixed native and nonnative tree and plant species on the site will provide resources for birds such as food (e.g., seeds, fruits, nectar, or foliage that supports insect prey), nesting sites, roosting sites, and cover from predators. The presence of these resources will enhance the ecological value of the site for native resident, migrant, and wintering birds compared to existing conditions, helping to increase these populations of species that tolerate urban areas. Based on the proposed extent of vegetation on the site as well as the native vegetation and trees included in the planting plan (Figure 3), in our opinion this vegetation is expected to attract greater numbers of landbirds to the site, including both resident birds and migrating birds, compared to existing conditions. Migrant landbirds that may be concentrated along the edge of San Francisco Bay are expected to be attracted to vegetated open space areas on the site following landscaping, as these areas will be visible from above as potential resting and foraging opportunities along a densely developed urban shoreline. Thus, a moderate increase in the abundance of resident birds and a larger increase in the abundance of migrating birds is expected as a result of the proposed landscaping. Waterbirds are not expected to be attracted to the site's landscaping or to change in abundance or distribution as a result of the project.

Assessment of Collision Risk Due to Glazing

Because birds do not necessarily perceive glass as an obstacle (Sheppard and Phillips 2015), windows or other structures that reflect the sky, trees, or other habitat may not be perceived as obstacles, and birds may collide with these structures. Similarly, transparent windows can result in bird collisions when they allow birds to perceive an unobstructed flight route through the glass (such as at corners), and when the combination of transparent glass and interior vegetation results in attempts by birds to fly through glass to reach vegetation. A number of factors play a role in determining the risk of bird collisions with buildings, including the amount and type of glass used, lighting, properties of the building (e.g., size, design, and orientation), type and location of vegetation around the building, and building location.

As noted above, numerous native, resident birds occur in the project vicinity. Because resident birds are present within an area year-round, they are more familiar with their surroundings and can be less likely to collide with buildings compared with migrant birds (discussed below). However, the numbers of resident birds that collide with buildings can still be relatively high over time. Young birds that are more naïve regarding their surroundings are more likely to collide with glass compared to adult birds. In addition, although adult birds are often more familiar with their surroundings, they still collide with glass with some frequency, especially when they are startled (e.g., by a predator) and have limited time to assess their intended flight path to avoid glazed facades. As a result, a moderate number of resident (i.e., breeding or overwintering) landbirds may collide with the project buildings over time.

Migrant landbirds are also expected to be attracted to the project vicinity during migration periods in the spring and fall, especially along the shoreline where native oaks are currently present and more will be planted, but also along the margins of the parking areas where mature trees will be removed but more will, over time, take their place. When these birds arrive in the site vicinity they are tired from flying (usually at night), they are hungry, and they are less likely to be aware of risks such as glass compared to well-fed, local resident, summering, or wintering birds familiar with their surroundings. As these migrants descend from higher altitudes, they will seek suitable resting and foraging resources in the new landscape vegetation surrounding the buildings. During this reorientation process, migrants will be susceptible to collisions with the buildings if they cannot detect the glass as a solid structure to be avoided. Migrant birds that use structures for roosting and foraging (such as swifts and swallows) will also be vulnerable to collisions if they perceive building interiors as potential habitat and attempt to enter the buildings through glass walls.

Once migrants have descended and decided to settle into vegetation on or adjacent to the project site, they may collide with the glass because they do not detect it as a solid surface and think they can fly through the building. Foggy conditions may exacerbate collision risk, as birds may be even less able to perceive that glass is present in the fog. The highest collision risk would likely occur when inclement weather enters the region on a night of heavy bird migration, when clouds and fog make it difficult for birds to find high-quality stopover sites once they reach ground level.

The extent of glazing on a building and the presence of vegetation opposite the glazing are known to be two of the strongest predictors of avian collision rates (Delb and Delacretaz 2009, Borden *et al.* 2010, Cusa *et al.* 2015, Riding *et al.* 2020). Further, the greatest risk of avian collisions with glazed façades is in the area within 60 feet of the ground, because this is the area in which most bird activity occurs (San Francisco Planning Department 2011). Therefore, we would expect collision risk on the proposed building to be highest within approximately 60 feet of the ground where landscape vegetation or Burlingame Lagoon occurs adjacent to or opposite extensive areas of glass. In addition, because the proposed building is located in a landscape position such that natural areas are present close by on several sides (i.e., the San Francisco Bay to the north, Burlingame

Lagoon to the south, and Anza Lagoon to the northeast), relatively high numbers of birds are expected to traverse the airspace on the project site over time when traveling in between these habitats. Thus, collision risk may also be relatively high with glazed facades on the building's upper levels if this glazing is either transparent such that areas of sky are visible from one side of the building to the other, or reflective such that sky or water is reflected in the glazing.

Several features of the proposed building's architecture would reduce the frequency of avian collisions. In particular, the facades of the building up to 78 feet above grade incorporate extensive areas of perforated metal panels, and we expect birds using habitats on the site and in adjacent areas to be able to perceive these panels as a solid structure from a distance (rather than as reflected sky or vegetation), greatly decreasing the potential for collisions with these portions of the building (Figure 4). In addition, the visible reflectance of all glazing on the building will be 20% or lower. These measures are expected to reduce the potential for bird collisions with the building.

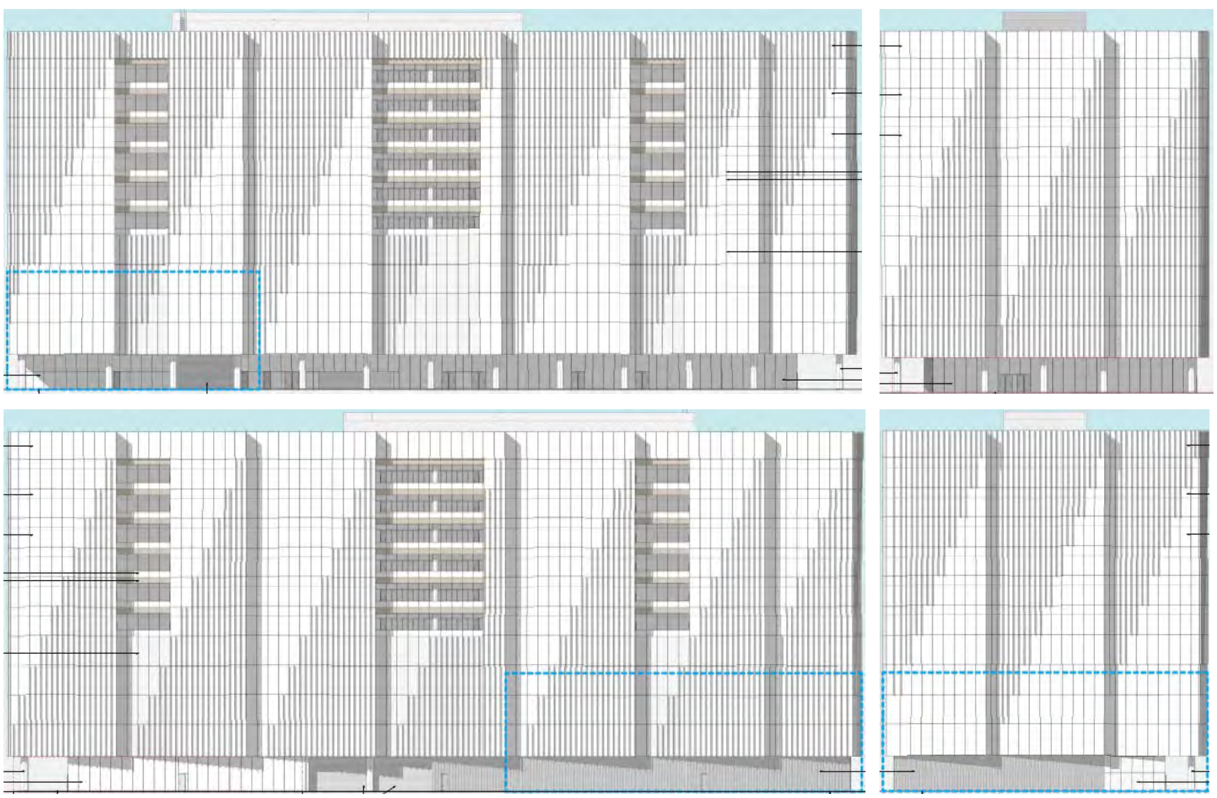

Figure 4. Views of the south (top left), east (top right), north (bottom left), and west (bottom right) facades of the proposed building. Translucent glazing is shown in blue, spandrel glazing is shown in gray, free-standing glass railings are shown in red, and perforated metal panels are shown in orange.

Spandrel glazing is proposed on the majority of the building's facades up to 78 feet above grade (Figure 4). Because spandrel glazing is not transparent, it eliminates collision hazards related to transparency (e.g., at glass corners, where a bird can potentially perceive a flight path through the glass to the far side of the corner). However, birds will collide with spandrel due to reflections of sky, water, or vegetation in this glazing. Although the project's spandrel will have a visible reflectance of 20% or lower, which is consistent with guidance from the City of San Francisco to ensure that glass is not excessively reflective to create a high-risk collision hazard (e.g., due to mirror-like conditions), based on our experience and information from the American Bird Conservancy[1,2], this spandrel is expected to cast reflections and birds are expected to collide with this glazing due to perceived reflections of sky, water, or vegetation in the glass. On the project site, birds are expected to occur in greatest numbers along Burlingame Lagoon and in the adjacent extensive area of landscape vegetation in the western portion of the project site (Figure 3). Birds using these areas are also expected to be drawn within areas of narrower, lower-quality landscape vegetation and trees (i.e., nonnative vegetation and vegetation that is relatively less extensive) that are "connected" to these higher-quality habitat areas, searching for food and cover. Therefore, collision risk is expected to be relatively higher with spandrel glazing located along the building's west façade, the westernmost portion of the north façade (facing landscape vegetation that is connected to the west) and the westernmost portion of the south façade (facing landscape vegetation that is connected to the south and west) (Figure 3). Collision risk is expected to be relatively lower with spandrel glazing on the remaining facades, which faces areas of limited vegetation that are not as connected to higher-quality habitat areas (Figure 3). To reduce the potential for collisions with spandrel glazing on the building, it is our understanding that the project will implement the following measures from the City of San Francisco's *Standards for Bird-Safe Buildings*:

- Glazing on building facades where collision risk is relatively high (as indicated on Figure 3 and pages A2.01–03 of the project's plans) will be treated with a bird-safe glazing treatment such that no more than 10% of the area from 0–60 feet above grade consists of untreated glazing. These façade areas are outlined in blue on Figure 4.
- Bird-safe glazing treatments may include fritting, netting, permanent stencils, frosted glass, exterior screens, physical grids placed on the exterior of glazing or UV patterns visible to birds. Vertical elements of the window patterns should be at least ¼-inch wide at a maximum spacing of 4 inches, and horizontal elements should be at least ⅛-inch wide at a maximum spacing of 2 inches.

In our opinion, these measures will effectively reduce the potential for collisions with spandrel glazing on the building by helping birds perceive the glass railings as solid objects to be avoided, and collision risk with this glazing is expected to be relatively low.

Free-standing glass railings are proposed on balconies on Levels 7–12 of the north and south façades (Figure 4). Where these features are located along potential flight paths that birds may use when traveling to and from landscape vegetation on the site, the risk of bird collisions is higher because birds may not perceive the intervening glass and attempt to fly to vegetation on the far side of the glass. It is unknown whether vegetation will be planted on these balconies; however, if vegetation is included in the design at these locations, birds would be expected to fly to the balconies and potentially collide with any glass railings located along their flight paths. As indicated on pages A2.01–03 of the project's plans, these railings will be treated with a bird-safe

[1] https://abcbirds.org/glass-collisions/threat-factor-rating/
[2] https://abcbirds.org/glass-collisions/learn-more-bird-friendly-legislation/

glazing treatment to reduce the potential for collisions at these locations. Per the recommendations that we provided, this treatment will consist of ¼-inch diameter dots spaced 2 inches apart horizontally and vertically. The density of this frit pattern is greater (and the effectiveness of the bird-safe treatment correspondingly higher) compared to that for the spandrel glazing discussed above due to the relatively higher risk of bird collisions with free-standing glass railings. In our opinion, this will effectively reduce the potential for collisions with free-standing glass railings by helping birds perceive the glass railings as solid objects to be avoided, and collision risk with these railings is expected to be relatively low.

Portions of Level 1 on the south, east, and north facades of the building incorporate translucent glazing (Figure 3). These glazed areas will face portions of the site that support no landscape vegetation or relatively sparse nonnative vegetation, as well as adjacent development and roadways (Figure 3). As a result, relatively low numbers of birds are expected to be attracted to the on-site vegetation located immediately opposite these glazed areas, reducing the potential for collisions with this glazing. Due to these combined factors, it is our opinion that the potential for bird collisions with the translucent glazing on Level 1 of the building will be relatively low.

On Levels 7–12, the building facades are extensively glazed, incorporating both translucent and spandrel glazing (Figure 4). If this glazing appeared transparent such that areas of sky were visible from one side of the building to the other, or cast reflections of sky or water, we would expect a high potential for birds to collide with these façade areas because many birds will encounter these facades in flight as they traverse this airspace when flying between surrounding habitats, as discussed above. However, the project plans indicate that the facades will employ extruded aluminum shadow boxes and mullions, which will help increase the visibility of the building to birds (Figure 4). In addition, the glazing will have a visible reflectance of 20% or lower, and hence would not be highly reflective. It is also our understanding from discussions with the project's architect that the renderings of the building in Figure 4 depict the expected appearance of the constructed building with reasonable accuracy, such that (1) the overall appearance of the building, as well as the tint of the glazing, will be a cool grey color that markedly contrasts with the sky behind it; and (2) the glazing will not be transparent or cast extensive reflections of sky, clouds, and water. Based on this assurance of design intent, it is our opinion that the majority of birds traversing the airspace on the project site would be able to distinguish the building as a solid structure as a distance, and collision risk with Levels 7–12 of the building will be relatively low.

In summary, relatively high numbers of resident and migrant landbirds, shorebirds, and waterbirds occur on and adjacent to the project site. We expect some collisions of these birds with glass facades on the proposed building to occur. However, the project design incorporates extensive opaque metal panels below 78 feet; bird-safe glass at spandrel glazing on the lower 60 feet of the building facing Burlingame Lagoon and areas of landscape vegetation where birds are most likely to occur; bird-safe glass at free-standing glass railings; glazing that is not highly reflective; and shadow boxes, mullions, and tinted glass on Levels 7 and above that helps the building appear as a solid structure to birds in flight. In our opinion, these design features reduce the potential for the relatively high number of birds in the vicinity to collide with the building, and we do not expect the number of collisions to be so high over time as to result in a significant impact under CEQA.

Assessment of Lighting Impacts

Project Measures to Minimize Lighting

It is our understanding that a number of general guidelines have been established for the project's lighting plan to address potential impacts related to lighting, as indicated on plan pages A2.01–03. These are as follows:

- Provide minimal nighttime lighting, both indoor and outdoor, as an additional way to make building more bird-friendly,
- provide shielded lighting fixtures,
- provide fixtures with seal of approval of Dark-Sky association or equally performing luminaires,
- no upward lighting shall be provided,
- provide astronomical controls with manual override for night time dimming,
- provide interior shading at perimeter, and
- provide astronomical controls with manual override for operation of interior shading devices.

Specifically, the project will implement the following measures to minimize lighting effects on birds:

- All exterior lighting shall be fully shielded to block illumination from shining outward towards Burlingame Lagoon to the south. All fixtures on the site shall have a BUG rating of U0, and any fixtures located along the site's southern property line shall have a BUG rating of B0, as follows:
    - U0: 0 lumens (90–180 degrees).
    - B0: 110 lumens high (60–80 degrees), 220 lumens mid (30–60 degrees), and 110 lumens low (0–30 degrees)
- Except as indicated in the measure above, fixtures shall comply with lighting zone LZ-2, Moderate Ambient, as recommended by the International Dark-Sky Association (2011) for light commercial business districts and high-density or mixed-use residential districts. The allowed total initial luminaire lumens for the project site is 2.5 lumens per square foot of hardscape, and the BUG rating for individual fixtures shall not exceed B3 or G2, as follows:
    - B3: 2,500 lumens high (60–80 degrees), 5,000 lumens mid (30–60 degrees), 2,500 lumens low (0–30 degrees)
    - G2: 225 lumens (forward/back light 80–90 degrees), 5,000 lumens (forward 60–80 degrees), 1,000 lumens (back light 60–80 degrees asymmetrical fixtures), 5,000 lumens (back light 60–80 degrees quadrilateral symmetrical fixtures)

- Exterior lighting shall be minimized (i.e., total outdoor lighting lumens shall be reduced by at least 30% or extinguished, consistent with recommendations from the International Dark-Sky Association [2011]) from 10:00 p.m. until sunrise, except as needed for safety and City code compliance.
- Interior or exterior blinds shall be programmed to close on all windows from 10:00 p.m. to sunrise in order to block lighting from spilling outward from these windows.

Overview of Potential Lighting Impacts on Birds

Numerous studies indicate that artificial lighting associated with development can have an impact on both local birds and migrating birds. Below is an overview of typical impacts on birds from artificial lighting, including lighting impacts related to general site lighting conditions and up-lighting.

Impacts Related to General Site Lighting Conditions

Many animals are sensitive to light cues, which influence their physiology and shape their behaviors, particularly during the breeding season (Ringer 1972, de Molenaar et al. 2006). Artificial light has been used as a means of manipulating breeding behavior and productivity in captive birds for decades (de Molenaar et al. 2006), and has been shown to influence the territorial singing behavior of wild birds (Longcore and Rich 2004, Miller 2006, de Molenaar et al. 2006). While it is difficult to extrapolate results of experiments on captive birds to wild populations, it is known that photoperiod (the relative amount of light and dark in a 24-hour period) is an essential cue triggering physiological processes as diverse as growth, metabolism, development, breeding behavior, and molting (de Molenaar et al. 2006). This suggests that increases in ambient light may interfere with these processes across a wide range of species, resulting in impacts on wildlife populations.

Artificial lighting may indirectly impact birds by increasing the nocturnal activity of predators such as owls, hawks, and mammalian predators (Negro et al. 2000, Longcore and Rich 2004, DeCandido and Allen 2006, Beier 2006). The presence of artificial light may also influence habitat use by breeding birds (Rogers et al. 2006, de Molenaar et al. 2006) by causing avoidance of well-lit areas, resulting in a net loss of habitat availability and quality.

Evidence that migrating birds are attracted to artificial light sources is abundant in the literature as early as the late 1800s (Gauthreaux and Belser 2006). Although the mechanism causing migrating birds to be attracted to bright lights is unknown, the attraction is well documented (Longcore and Rich 2004, Gauthreaux and Belser 2006). Migrating birds are frequently drawn from their migratory flight paths into the vicinity of an artificial light source, where they will reduce their flight speeds, increase vocalizations, and/or end up circling the lit area, effectively "captured" by the light (Herbert 1970, Gauthreaux and Belser 2006, Sheppard and Phillips 2015, Van Doren et al. 2017). When birds are drawn to artificial lights during their migration, they may become disoriented and possibly blinded by the intensity of the light (Gauthreaux and Belser 2006). The disorienting and blinding effects of artificial lights directly impact migratory birds by causing collisions with light structures, buildings, communication and power structures, or even the ground (Gauthreaux and Belser 2006). Indirect impacts on migrating birds might include orientation mistakes and increased length of migration due to light-driven detours.

Impacts Related to Up-Lighting

Up-lighting refers to light that projects upwards above the fixture. There are two primary ways in which the luminance of up-lights might impact the movements of birds. First, local birds using habitats on a site may become disoriented during flights among foraging areas and fly toward the lights, colliding with the lights or with nearby structures. Second, nocturnally migrating birds may alter their flight direction or behavior upon seeing lights; the birds may be drawn toward the lights or may become disoriented, potentially striking objects such as buildings, adjacent power lines, or even the lights themselves. These two effects are discussed separately below.

Local Birds. Seabirds may be especially vulnerable to artificial lights because many species are nocturnal foragers that have evolved to search out bioluminescent prey (Imber 1975, Reed et al. 1985, Montevecchi 2006), and thus are strongly attracted to bright light sources. When seabirds approach an artificial light, they seem unwilling to leave it and may become “trapped” within the sphere of the light source for hours or even days, often flying themselves to exhaustion or death (Montevecchi 2006). Seabirds using habitats associated with the San Francisco Bay to the north include primarily gulls and terns. Although none of these species are primarily nocturnal foragers, there is some possibility that gulls, which often fly at night, may fly in areas where they could be disoriented by up-lights under conditions dark enough that the lights would affect the birds. Shorebirds forage along the San Francisco Bay nocturnally as well as diurnally, and move frequently between foraging locations in response to tide levels and prey availability. Biologists and hunters have long used sudden bright light as a means of blinding and trapping shorebirds (Gerstenberg and Harris 1976, Potts and Sordahl 1979), so evidence that shorebirds are affected by bright light is well established. Though impacts of a consistent bright light are undocumented, it is possible that shorebirds, like other bird species, may be disoriented by a very bright light in their flight path.

Passerine species have been documented responding to increased illumination in their habitats with nocturnal foraging and territorial defense behaviors (Longcore and Rich 2004, Miller 2006, de Molenaar et al. 2006), but absent significant illumination, they typically do not forage at night, leaving them less susceptible to the attraction and disorientation caused by luminance when they are not migrating.

Migrating Birds. Numerous bird species migrate nocturnally in order to avoid diurnal predators and minimize energy expenditures. Bird migration over land typically occurs at altitudes of up to 5,000 feet, but is highly variable by species, region, and weather conditions (Kerlinger 1995, Newton 2008). In general, night-migrating birds optimize their altitude based on local conditions, and most songbird and soaring bird migration over land occurs at altitudes below 2,000 feet, while waterfowl and shorebirds typically migrate at higher altitudes (Kerlinger 1995, Newton 2008).

It is unknown what light levels adversely affect migrating birds, and at what distances birds respond to lights (Sheppard and Phillips 2015). In general, vertical beams are known to capture higher numbers of birds flying at lower altitudes. High-powered 7,000-watt (equivalent to 105,000-lumen) spotlights that reach altitudes of up to 4 miles (21,120 feet) in the sky have been shown to capture birds migrating at varying altitudes, with most effects occurring below 2,600 feet (where most migration occurs); however, effects were also documented at the upper limits of bird migration at approximately 13,200 feet (Van Doren *et al.* 2017). A study of bird responses to up-lighting from 250-watt (equivalent to 3,750-lumen) spotlights placed on the roof of a 533-foot tall building and directed upwards at a company logo documented behavioral changes in more than 90% of the birds that were visually observed flying over the building at night (Haupt and Schillemeit 2011). One study of vertical lights projecting up to 3,280 feet found that higher numbers of birds were captured at altitudes below 650 feet, but this effect was influenced by wind direction and the birds' flight speed (Bolshakov et al. 2013). These studies have not analyzed the capacity for vertical lights to attract migrating birds flying beyond their altitudinal range, and the potential for any project up-lights to affect birds flying at various altitudes is unknown. Thus, birds that encounter beams from up-lights are likely to respond to the lights, and may become disoriented or attracted to the lights to the point that they collide with buildings or other nearby structures, but the range of the effect of the lights is unknown.

Observations of bird behavioral responses to up-lights indicate that their behaviors return to normal quickly once up-lights are completely switched off (Van Doren et al. 2017), but no studies are available that demonstrate bird behavioral responses to reduced or dimmed up-lights. In general, up-lights within very dark areas are more likely to "capture" and disorient migrating birds, whereas up-lights in brightly lit areas (e.g., highly urban areas, such as Burlingame) are less likely to capture birds (Sheppard 2017). Birds are also known to be more susceptible to capture by artificial light when they are descending from night migration flights in the early mornings compared to when they ascend in the evenings; as a result, switching off up-lights after midnight can minimize adverse effects on migrating birds (Sheppard 2017). However, more powerful up-lights (e.g., 3,000 lumen spotlights) may create issues for migrating birds regardless of the time of night they are used (Sheppard 2017).

Analysis of Potential Project Impacts on Birds due to Lighting

No detailed information regarding the project's proposed lighting design was available for review as part of this assessment. Nevertheless, construction of the project will create new sources of lighting on the site. Lighting would be the result of light fixtures illuminating buildings, building architectural lighting, pedestrian lighting, and artistic lighting. Depending on the location, direction, and intensity, this lighting can potentially spill into adjacent natural areas, thereby resulting in an increase in lighting compared to existing conditions. Areas immediately to the north, west, and east of the project site are primarily developed urban habitats that do not support bird communities that might be substantially affected by illuminance from the project. However, birds inhabiting more natural habitat areas along Burlingame Lagoon to the south may be affected by an increase in lighting.

Lighting from the project also has some potential to attract and/or disorient birds, especially during inclement weather when nocturnally migrating birds descend to lower altitudes. As a result, some birds moving along the

San Francisco Bay at night may be (1) attracted to the site, where they are more likely to collide with buildings; and/or (2) disoriented by night lighting, potentially causing them to collide with the buildings. Certain migrant birds that use structures for roosting and foraging (such as swifts and swallows) would be vulnerable to collisions if they perceive illuminated building interiors as potential roosting habitat and attempt to enter the buildings through glass walls. Similarly, migrant and resident birds would be vulnerable to collisions if they perceive illuminated vegetation within buildings as potential habitat and attempt to enter a building through glass walls.

Thus, because the project site is located in the immediate vicinity of natural areas along the San Francisco Bay, especially Burlingame Lagoon immediately south of the site, lighting associated with the project has a greater potential to (1) spill southwards into sensitive habitats along Burlingame Lagoon, and (2) attract and/or disorient migrating birds during the spring and fall, compared to buildings located farther inland in Burlingame.

The project will implement a general strategy to minimize lighting, as well as specific measures to ensure that the spill of lighting upwards and outwards into adjacent natural areas will be minimized to an appropriate level. With the implementation of these measures, which are listed under *Project Measures to Minimize Lighting* above, project impacts on birds due to lighting are less than significant under CEQA, in our professional opinion.

Summary

Because birds are present in the vicinity of the proposed building, and glazed façades of the building may not always be perceived by birds as physical impediments to flight, we expect some avian collisions with the proposed building to occur. We expect collisions occur where glazing is located opposite vegetation or water within 60 feet of the ground, at transparent glass railings on vegetated balconies, and with areas of extensive glazing on the building's upper floors. However, the project design incorporates extensive opaque metal panels below 78 feet; bird-safe glass at spandrel glazing on the lower 60 feet of the building facing Burlingame Lagoon and areas of landscape vegetation where birds are most likely to occur; bird-safe glass at free-standing glass railings; glazing that is not highly reflective; and shadow boxes, mullions, and tinted glass above 78 feet that helps the building appear as a solid structure to birds in flight. In our opinion, these design features effectively reduce the potential for birds to collide with the building, and we do not expect the number of collisions to be so high over time as to result in a significant impact under CEQA.

Because the project site is located in the immediate vicinity of natural areas along the San Francisco Bay, especially Burlingame Lagoon immediately to the south, lighting associated with the project has a greater potential to (1) spill southwards into sensitive habitats along Burlingame Lagoon, and (2) attract and/or disorient migrating birds during the spring and fall, compared to buildings located farther inland in Burlingame. However, the project will implement a general strategy to minimize lighting, as well as specific measures to ensure that the spill of lighting upwards and outwards into adjacent natural areas will be minimized to an appropriate level. With the implementation of these measures, which are listed under *Project Measures to Minimize*

Lighting above, project impacts on birds due to lighting are less than significant under CEQA, in our professional opinion.

Please feel free to contact me at (408) 677-8737 or rcarle@harveyecology.com, or Steve Rottenborn at (408) 722-0931 or srottenborn@harveyecology.com, if you have any questions regarding this assessment. Thank you very much for contacting H. T. Harvey & Associates about this project.

Sincerely,

Robin Carle, M.S.
Senior Associate Wildlife Ecologist/Project Manager

Attachments: Résumés

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H. T. HARVEY & ASSOCIATES
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Highlights

- 28 years of experience
- Avian ecology
- Wetlands and riparian systems ecology
- Endangered Species Act consultation
- Environmental impact assessment
- Management of complex projects

Education

PhD, Biological Sciences, Stanford University

BS, Biology, College of William and Mary

Professional Experience

Principal, H. T. Harvey & Associates, 1997–2000, 2004–present

Ecology section chief/environmental scientist, Wetland Studies and Solutions, Inc., 2000–04

Independent consultant, 1989–97

Memberships and Affiliations

Chair, California Bird Records Committee, 2016–19

Member, Board of Directors, Western Field Ornithologists, 2014–20

Scientific associate/advisory board, San Francisco Bay Bird Observatory, 1999–2004, 2009–18

Member, Board of Directors, Virginia Society of Ornithology, 2000–04

Publications

Erickson, R. A., Garrett, K. L., Palacios, E., Rottenborn, S. C., and Unitt, P. 2018. Joseph Grinnell meets eBird: Climate change and 100 years of latitudinal movement in the avifauna of the Californias, in Trends and traditions: Avifaunal change in western North America (W. D. Shuford, R. E. Gill Jr., and C. M. Handel, eds.), pp. 12–49. Studies of Western Birds 3. Western Field Ornithologists, Camarillo, CA.

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Professional Profile

Dr. Steve Rottenborn is a principal in the wildlife ecology group in H. T. Harvey & Associates' Los Gatos office. He specializes in resolving issues related to special-status wildlife species and in meeting the wildlife-related requirements of federal and state environmental laws and regulations. Combining his research and training as a wildlife biologist and avian ecologist, Steve has built an impressive professional career that is highlighted by a particular interest in wetland and riparian communities, as well as the effects of human activities on bird populations and communities. Steve's experience extends to numerous additional special-status animal species. The breadth of his ecological training and project experience enables him to expertly manage multidisciplinary projects involving a broad array of biological issues.

He has contributed to more than 800 projects involving wildlife impact assessment, NEPA/CEQA documentation, biological constraints analysis, endangered species issues (including California and Federal Endangered Species Act consultations), permitting, and restoration. Steve has conducted surveys for a variety of wildlife taxa, including a number of threatened and endangered species, and contributes to the design of habitat restoration and monitoring plans. In his role as project manager and principal-in-charge for numerous projects, he has supervised data collection and analysis, report preparation, and agency and client coordination.

Project Examples

Principal-in-charge for **bird-safe design support for more than 40 development projects** in more than 10 cities throughout the San Francisco Bay area. This work has entailed preparation of avian collision risk assessments, sections of CEQA documents, assessments of project compliance with requirements of the lead agency, design recommendations (e.g., related to the selection of bird-safe glazing), and avian collision monitoring plans.

Senior wildlife ecology expert on the South Bay Salt Pond restoration project — the largest (~15,000-acre) restoration project of its kind in the western United States.

Served on the **Technical Advisory Committees/Expert Panels for the Santa Clara Valley Water District's Upper Penitencia Creek, One Water, Science Advisory Hub, San Tomas/Calabazas/Pond A8 Restoration, and Coyote Creek Native Ecosystem Enhancement Tool** efforts; selected to serve on these panels for his expertise in South Bay wildlife, restoration, and riparian ecology.

Led H. T. Harvey's work on the biological CEQA assessment and permitting for extensive/regional **facilities and habitat management programs for the Santa Clara Valley Water District, San Jose Water Company, County of San Mateo, and Midpeninsula Regional Open Space District**.

Contract manager/principal-in-charge for **Santa Clara Valley Water District's Biological Resources On-Call contract** (four successive contracts, with over 120 task orders, since 2009).

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HIGHLIGHTS

- 14 years of experience
- Avian ecology
- Environmental impact assessment
- Endangered Species Act consultation and compliance
- Nesting bird and burrowing owl surveys and monitoring
- Other special-status wildlife surveys and habitat assessments
- Bird-safe design

EDUCATION

MS, Fish and Wildlife Management, Montana State University

BS, Ecology, Behavior, and Evolution, University of California, San Diego

PERMITS AND LICENSES

Listed under CDFW letter permits to assist with research on bats, California tiger salamanders, California Ridgway's rails, and California black rails

USFWS 10(a)(1)(A) for California tiger salamander

PROFESSIONAL EXPERIENCE

Associate ecologist, H. T. Harvey & Associates, 2007–present

Volunteer bird bander, San Francisco Bay Bird Observatory, 2010–2020

Avian field technician, West Virginia University, 2006

Graduate teaching assistant, Montana State University, 2003–06

Avian field technician, Point Blue Conservation Science (formerly PRBO Conservation Science), 2004

PROFESSIONAL PROFILE

Robin Carle is an associate wildlife ecologist and ornithologist at H. T. Harvey & Associates, with more than 14 years of experience working in the greater San Francisco Bay Area. Her expertise is in the nesting ecology of passerine birds, and her graduate research focused on how local habitat features and larger landscape-level human effects combine to influence the nesting productivity of passerine birds in the Greater Yellowstone region. She also banded, sexed, and aged resident and migrant passerine birds with the San Francisco Bay Bird Observatory for 10 years. Her expertise extends to numerous additional wildlife species, and she has conducted surveys and assessments for burrowing owls; diurnal, nocturnal, and larval surveys for amphibians; acoustic and visual surveys for roosting bats; surveys and nest resource relocations for San Francisco dusky-footed woodrats; San Joaquin kit fox den surveys; trail camera surveys to document wildlife movement; and burrow-scoping surveys using fiber-optic orthoscopic cameras.

With an in-depth knowledge of regulatory requirements for special-status species, Robin has contributed to all aspects of client projects including NEPA/CEQA documentation, bird-safe design assessments, biological constraints analyses, special-status species surveys, nesting bird and raptor surveys and monitoring, construction implementation/permit compliance, Santa Clara Valley Habitat Plan/Natural Community Conservation Plan applications and compliance support, and natural resource management plans. Her strong understanding of CEQA, FESA, and CESA allows her to prepare environmental documents that fully satisfy the regulatory requirements of the agencies that issue discretionary permits. She manages field surveys, site assessments, report preparation, agency and client coordination, and large projects.

BIRD-SAFE DESIGN EXPERIENCE

Provides bird-safe design support for **development projects for major technology companies in Sunnyvale and Mountain View** including the preparation of avian collision risk assessments, sections of CEQA documents, assessments of project compliance with City requirements, design recommendations (e.g., related to the selection of bird-safe glazing), avian collision monitoring plans, and calculations of qualification for LEED Pilot Credit 55.

Provided bird-safe design support for a **development project in Berkeley** including the preparation of an avian collision risk assessment and development of bird-safe design options that could be incorporated into the project.

Provided bird-safe design support for a **large development project in Menlo Park** with unique architecture and extensive glazing. Services included the preparation of an avian collision risk assessment and development of bird-safe design standards to reduce project impacts due to bird collisions to less than significant levels under CEQA.