CITY OF OAKLAND

BIRD SAFETY MEASURES

The following applies to all construction projects which include glass as part of the building's exterior AND at least one of the following:

a) **The project is located immediately adjacent to a substantial water body larger than 1 acre (i.e. Oakland Estuary, San Francisco Bay, Lake Merritt or other lake, reservoir or wetland). OR**
b) **The project is located immediately adjacent to a substantial recreation area or park (i.e. a region-serving park, resource conservation area, neighborhood park, linear park, or special use park and generally over 1 acre in size) which contains substantial vegetation. OR**
c) **The project includes substantial vegetated or green roof or green wall (roof or wall with growing medium and plants taking the place of conventional roofing such as asphalt, tile, gravel or shingles) but excluding container gardens OR**
d) **The project includes an existing or proposed substantial vegetated area (generally contiguous one acre in size or larger) located directly adjacent to project buildings.**
e) **The structure contains an atrium which will contain vegetation.**

I. Bird Collision Reduction Measures

A. Bird Collision Reduction Plan Required

Requirement: The project applicant shall submit a Bird Collision Reduction Plan for City review and approval to reduce potential bird collisions to the maximum feasible extent. The Plan shall include all of the following mandatory measures, as well as applicable and specific project Best Management Practice (BMP) strategies to reduce bird strike impacts to the maximum feasible extent. The project applicant shall implement the approved Plan.

B. Mandatory measures include **all** of the following:

1. Comply with federal aviation safety regulations for large buildings by installing minimum intensity white strobe lighting with three second flash instead of solid red or rotating lights.
2. Minimize the number of and co-locate rooftop-antennas and other rooftop structures.
3. Monopole structures or antennas shall not include guy wires.
4. Avoid the use of mirrors in landscape design.
5. Avoid placement of bird-friendly attractants (i.e. landscaped areas, vegetated roofs, water features) near glass unless shielded by architectural features taller than the attractant that incorporate the bird friendly treatments no more than two inches horizontally, four inches vertically, or both (the "two-by-four" rule).

C. Glazing Treatments

Apply bird friendly glazing treatments to no less than 90 percent of all windows and glass between the ground and 60 feet above ground or to the height of existing adjacent landscape or the height of the proposed landscape. Examples of bird friendly glazing treatments include the following:

1. Use of opaque glass in window panes instead of reflective glass.
2. Uniformly cover the interior or exterior of clear glass surface with patterns (e.g., dots, stripes, decals, images, abstract patterns). Patterns can be etched, fritted, or on films and shall have a density of no more than two inches horizontally, four inches vertically, or both (the "two-by-four" rule).
3. Install paned glass with fenestration patterns with vertical and horizontal mullions no more than two inches horizontally, four inches vertically, or both (the "two-by-four" rule).
4. Install external screens over non-reflective glass (as close to the glass as possible) for birds to perceive windows as solid objects.
5. Install UV-pattern reflective glass, laminated glass with a patterned UV-reflective coating, or UV-absorbing and UV-reflecting film on the glass since most birds can see ultraviolet light, which is invisible to humans.
6. Install decorative grilles, screens, netting or louvers, with openings no more than two inches horizontally, four inches vertically, or both (the "two-by-four" rule).
7. Install awnings, overhangs, sunshades, or light shelves directly adjacent to clear glass which is recessed on all sides. Another option is to use louvers with 2" x 4" spacing.
8. Install opaque window film or window film with a pattern or design or marketing message which also adheres to the 2" x 4" rule for coverage..

D. Reduce Light Pollution.
Examples include the following:

1. Extinguish nighttime architectural illumination treatments during bird migration season (February 15 to May 31 and August 1 to November 30).
2. Install time switch control devices or occupancy sensors on non-emergency interior lights that can be programmed to turn off during non-work hours and between 11:00 p.m. and sunrise.
3. Reduce perimeter lighting whenever possible.
4. Install full cut off, shielded or directional lighting to minimize light spillage, glare or light trespass.
5. Do not use beams of lights during the spring (February 15 to May 31or fall migration (Aug 15 to November 30).

E. Bird Safety
B.M.P.s to include the implementation of a building operation and management manual that promotes bird safety. Example measures in the manual include the following:

1. Donation of discovered dead bird specimens to an authorized bird conservation organization or museum (i.e. U.C. Berkeley Museum of Vertebrate Zoology) to aid in species identification and to benefit scientific study, as per all federal, state and local laws.
2. Distribution of educational materials on bird-safe practices for the building occupants. Contact Golden Gate Audubon or American Bird Conservancy for materials.
3. Asking employees to turn off task lighting at their work stations and draw office blinds, shades, curtains or other window coverings at end of work day.
4. Install interior blinds, shades, or other window coverings in windows above the ground floor visible from the exterior as part of the construction contract, lease agreement, or CC&Rs.
5. Schedule nightly maintenance during the day or to conclude before 11 p.m., if possible.

When Required: Prior to approval of construction-related permit
Initial Approval: Planning and Zoning Division
Monitoring/Inspection: Building Services Division

II. Implementation of Bird Collision Reduction Plan After Construction

Requirement: The project applicant shall continue to implement the approved Bird Collision Reduction Plan following construction of the project.
When Required: Ongoing
Initial Approval: N/A
Monitoring/Inspection: Building Services Division

City of San José
Voluntary Bird-Friendly Building Design Fact Sheet

Peregrine Falcon at San José City Hall

Designing a bird-friendly building does not have to add to the cost of construction. Retrofitting an existing building can often be done by simply targeting problem areas. Consider bird-friendly best practices early on in project development to meet your project budget and demonstrate environmental leadership.

THE IMPORTANCE OF BIRDS

Birds are essential for the healthy function of our local environment. The benefits birds provide include:

- plant pollination
- seed dispersal
- insect and pest control

BIRDS AND BUILDINGS

Birds can accidentally collide with buildings, causing a decline in the bird population.

Common Causes of Collisions:

- Reflective glass that birds perceive as trees, the sky, or another bird.
- Clear glass which shows habitat or sky
- Exterior spotlights which can cause birds to collide with structures, each other, or even the ground.
- Interior lighting at night that can attract birds.

BIRD-FRIENDLY BUILDINGS

These best practices can reduce bird collisions with buildings and are particularly important for buildings near bird habitat, such as open spaces and water.

- Reduce large areas of transparent or reflective glass.
- Strategically place landscaping:
  - Locate water features and other bird habitat away from building exteriors to reduce reflection.
  - Reduce or eliminate the visibility of landscaped areas behind glass.
- Reduce or eliminate spotlights on buildings.
- Turn non-emergency lighting off at night, especially during bird migration season (February - May and August - November). Visit www.pge.com for lighting control rebate opportunities.

The City applies the above bird-friendly principles to projects north of Highway 237 per policy ER-7.1 in Chapter 3 of the Envision San José 2040 General Plan. For more information, visit www.sanjoseca.gov/planning.

RESOURCES:

- The American Bird Conservancy's Bird-friendly Building Design guidelines: www.abcbirds.org/newsandreports/BirdFriendlyBuildingDesign.pdf
- Report Injured/Dead Birds: Contact the Wildlife Center of Silicon Valley at (408) 929-9453 or www.wcsv.org

Planning, Building and Code Enforcement
www.sanjoseca.gov/planning| Main: (408) 535-3555

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

City of Santa Cruz Bird-Safe Building Design Standards

When do the standards apply?

Bird-safe building design standards apply to any portions of buildings or structures that require design review and are located adjacent to or within 300 feet of and could reflect areas with a General Plan land use designation of CR, PR, NA, or AG, any open waterway mapped in the City-wide Creeks and Wetlands Management Plan, or any area deemed by the Zoning Administrator to need consideration for bird-safe design due to proximity to natural features.

Which architectural features require glazing treatment?

Treatment is required for 90 percent of all glazing within 40 feet above grade.

Glazing treatment standards

Staff will work with developers to decide on best design measures. Glazing treatment shall follow the 2" x 4" rule: spaces of untreated glazing must have a maximum height of two inches and a maximum width of four inches. Birds cannot see untreated glazing and may attempt to fly through "openings" greater than these dimensions. 2" x 2" spacing is highly encouraged. Pattern elements should be at least 1/8" thick. Glazing treatment shall include at least one of the following:

- Bird safe glass approved for use by the American Bird Conservancy
- Fritted windows
- Patterned windows
- UV pattern film (not appropriate for all locations)
- Window nets
- Window screens
- Any American Bird Conservancy approved product: https://abcbirds.org/get-involved/bird-smart-glass/
- Other design measures that have been identified by qualified professionals as providing adequate bird protections, subject to the discretion of the Zoning Administrator.

Lighting standards

Exterior lighting shall be downward cast only. Horizontal or upward cast lighting can attract or disorient birds and cause them to fly into windows.

Exceptions

The following may qualify for an exception to these requirements with approval of the Zoning Administrator :

- Projects on Historic buildings where meeting bird-safe glazing standards precludes the building from meeting Secretary of Interior's Standards or otherwise detracts from the design/historic character
- Where an assessment by the Zoning Administrator, in coordination with and a qualified biologist with a thorough knowledge of bird-safe design standards, determines that the project as designed will not be detrimental to bird safety
- First floor windows on buildings which require clear glazing due to the nature of the business or character of the area (e.g., retail uses).

Final

BIRD SAFE BUILDING DESIGN GUIDELINES

There are two types of design guidelines to address bird safe building. The first option is for projects within 300 feet of a body of water or projects adjacent to a landscaped or open space area larger than one acre in size. The second option is criteria to be used in reviewing new projects located in all other areas of the city.

Option 1: If within 300 feet of a body of water larger than one acre in size or located immediately adjacent to a landscaped area, open space or park larger than one acre in size.

If the project meets any of the prior criteria, projects should include specific bird safe design elements into the building and site design and operation. These would include:

1. Avoid the use of multi-floor expanse of reflective or transparent glass in the first 60 feet of the building design, specifically in these area facing the water or open space;
2. Building glass shall be limited to low reflectivity levels such as 25% or less;
3. Limit the amount of glass on ground level stories, especially in areas adjacent to landscaping;
4. Add architectural devices, such as louvers, awnings, sunshades or light shelves to building design to reduce massing of glass;
5. Consider use of opaque, fritted or etched glass on ground floor in areas adjacent to landscaped areas;
6. If site is near water features, use soil berms, furniture, landscaping or other features to prevent reflection of water in glass building facades;
7. Consider using angled glass (20-40 degrees) from vertical to reflect ground instead of adjacent habitat or sky buildings with an expanse of glass near water or landscaping areas
8. Avoid placing tall landscaping in front of highly reflective glass and the use of green roofs and water features near glass;
9. Avoid the funneling of open space towards a building face;
10. Avoid glass skyways or freestanding glass walls;
11. No up lighting or spot lights on site;
12. Ensure all site lighting uses shielded fixtures;
13. Turn building lights off at night or incorporate blinds into window treatment to use when lights are on at night;
14. Create smaller zones in internal lighting layouts to discourage wholesale area illumination;
15. Place signs at several locations near building with the telephone number an authorized bird conservation organization or museum to aid in species identification and to benefit scientific study;
16. Monitoring efforts shall include a bird-safe program developed by the project owner of the methods to ensure necessary steps are taken to reduce bird strikes. These efforts would include how each dead bird will be handled and donated to scientific study, providing a yearly inventory to the City of the number of birds found and locations, and the steps necessary to resolve any consistent location's bird deaths. Options include shades to reduce transparency and night lighting, fritted glass, netting, stickers, etc.

Option 2: All other locations in city

Efforts should be taken to reduce bird strikes in all locations of the city. The following items should be included regardless of location. These guidelines could be used as part of a project's review. Staff could include a discussion relative to the guidelines in staff reports in order to give decision-makers information necessary to review this aspect of a project's impact.

1. Avoid large expanse of glass near open areas, especially when tall landscaping is immediately adjacent to the glass walls;
2. Avoid the funneling of open space towards a building face;
3. Prohibit glass skyways or freestanding glass walls;
4. Avoid transparent glass walls coming together at building corners to avoid birds trying to fly through glass;
5. Reduce glass at top of building, especially when incorporating a green roof into the design;
6. Prohibit up lighting or spotlights;
7. Shield lighting to cast light down onto the area to be illuminated;
8. Turn commercial building lights off at night or incorporate blinds into window treatment to use when lights are on at night;
9. Create smaller zones in internal lighting layouts to discourage wholesale area illumination;

Monitoring efforts

The following options should be considered by each project owner for all locations in order to learn more about the subject and to avoid further issues:

1. Reduce the use of night lighting in the building without incorporating blinds into the window design;
2. Donation of discovered dead birds to an authorized bird conservation organization or museum;
3. Consider placing signs in several locations around the building with the telephone number an authorized bird conservation organization or museum to aid in species identification and to benefit scientific study.

SAN FRANCISCO
PLANNING
DEPARTMENT

Standards for
Bird-Safe Buildings

SAN FRANCISCO PLANNING DEPARTMENT | ADOPTED JULY 14, 2011

Adopted July 14, 2011

By the San Francisco Planning Commission

SAN FRANCISCO
PLANNING
DEPARTMENT

Acknowledgements

We express our appreciation to the Cities of Toronto, New York, and Chicago and the State of Minnesota, whose guidelines and standards provided a basis for these. Thanks also to the following people for their work to make the built environment safer for the winged animals who enrich our world, and with whom we share our City:

San Francisco Planning Commission:
Christina Olague, *President*
Ron Miguel, *Vice President*
Michael J. Antonini
Gwyneth Borden
Kathrin Moore
Hisashi Sugaya
Rodney Fong

San Francisco Planning Department:
John Rahaim, *Director*
Senior Management Team: Alicia John-Baptiste, *Assistant Director;* Scott Sanchez, *Zoning Administrator;* Bill Wycko, *Chief Environmental Review Officer;* Kelley Amdur, *Manager of Neighborhood Planning;* and David Alumbaugh, *Acting Manager of Policy Planning.*

Project Team: AnMarie Rodgers, *Legislative Manager;* Erika Lovejoy, *Project Manager and Senior Environmental Planner;* Sheila Nickolopoulos, *Senior Administrative Analyst*; Craig Nikitas, *Senior Urban Designer*; Joshua Switzky, *Planner* and Gary Chen, *Graphic Design*.

Private Contributors:
Christine Sheppard, PhD, *The American Bird Conservancy, Bird Collisions Campaign*
Noreen Weeden, *Golden Gate Audubon Society, Conservation Project Manager*
Mike Lynes, *Golden Gate Audubon Society, Director of Conservation*
Certain graphic images provide courtesy The American Bird Conservancy and the Audubon Society.

This document is based in part on guidelines published by: New York City Audubon Society, Inc., May 2007; the Audubon Minnesota, May 2010; and an unpublished draft of the National Guidelines by the American Bird Conservancy. In addition, material was drawn from many sources; every effort was made to cite those sources and any omissions are inadvertent.

NYC Audubon Bird-Safe Building Guidelines Credits:
Project Director: Kate Orff, RLA, Columbia University GSAPP ; Authors: Hillary Brown, AIA, Steven Caputo, New Civic Works; Project Staff: E.J. McAdams, Marcia Fowle, Glenn Phillips, Chelsea Dewitt, and Yigal Gelb.

Audubon MN Bird-Safe Building Guidelines Credits:
Project Director: Joanna Eckles, Audubon Minnesota. Contributor: Edward Heinen, Edward Heinen Architectural Consulting.

Table of Contents

Photo by Glenn Nevill

PREFACE: Purpose of the Standards

Photo by Robert Lewis

Varied Thrush

"The wide variety of native birds that thrive in urban areas underscores the importance of these artificial habitats to the survival of many bird populations. Creating greenspace in urban environments, landscaping with native plants in backyards and parks, adopting architecture and lighting systems that reduce collisions, and keeping pets indoors will provide the greatest benefit to breeding birds and migrants seeking safe places to rest and find food during their spectacular journeys."

- 2009 State of The Birds Report by the United States Government US Department of Interior

Pigeons and sparrows are readily visible in San Francisco. These ubiquitous city birds are not shy about sharing our urban spaces. But the casual observer may be shocked to learn that our City's birds are much more diverse. There are about 400 species of birds in San Francisco; remarkably, this is nearly half the species in all North America (*Kay 2009*). For those who look, the shyer species are just around the corner. This is due in part to the diverse habitats of the Bay Area and its position on the coastal migration path, the Pacific Flyway. Some birds are well-adapted to urban life, and they may remain here as year-round "residents." Others are migratory, passing through the City southward in autumn en route to their winter feeding grounds, then returning northward in spring to establish territories in summer breeding grounds.

Photo by Robert Lewis

Anna's Hummingbird

There are special problems posed for birds living in or flying through cities. Over 30 years of research has documented that buildings and windows are the top killer of wild birds in North America (*Banks 1979; Ogden 1996; Hager et al. 2008; Klem 2009; Gelb and Delacretaz 2009*). Structure collision fatalities may account for between 100 million and 1 billion birds killed annually in North America (*United States Fish and Wildlife Service 2002; Klem 2009*). According to the leading expert, Dr. Daniel Klem Jr., this toll strikes indiscriminately culling some of the healthiest of the species. "From a population standpoint, it's a bleeding that doesn't get replaced," he stated, estimating that between one and five percent of the total migratory population die in window crashes annually (*Klem, 2009*). Many of these are endangered or threatened species whose populations are already declining due to habitat loss, toxin loads, and other severe environmental pressures.

Juvenile residents and migrants of all ages — those least familiar with the urban setting — face the greatest risk of injury or death from the hazards of the city environment. Collision hazards include vehicles, bridges, transmission towers, power lines, and turbines, but the majority of avian deaths and injuries occur from impacts with building components such as transparent or reflective glass. Night-time lighting also interferes with avian migrations. Scientists have determined that bird mortality caused by collisions with structures is "biologically significant" for certain species (*Longcore et al. 2005*). In other words, building collisions are a threat of sufficient magnitude to affect the viability of bird populations, leading to local, regional, and national declines. Night-migrating songbirds—already imperiled by habitat loss and other environmental stressors—are at double the risk, threatened both by illuminated buildings when they fly at night and by daytime glass collisions as they seek food and shelter.

While species that are plentiful may not be threatened by structure collisions, many species that are threatened or endangered show up on building collision lists (*Ogden 1996 and references therein*).

Strategies that improve the urban design quality or sustainability of the built environment may help to make a more bird-safe city. For example, San Francisco has a long-standing policy prohibiting installation of mirrored glass, to meet aesthetic goals. This policy also benefits birds, which mistake reflections for real space and don't perceive the glass as a deadly barrier. The launch of the Golden Gate Audubon Society, Pacific Gas and Electric Company, and Department of the Environment's voluntary Lights Out San Francisco program in 2008 links smart energy policy with bird preservation strategies.

Occasionally policy goals may conflict, and we must balance the benefits and costs of one policy against the other. For instance, gains in energy and resource conservation provided by wind generators could also have negative environmental impacts if installations of those wind farms increase mortality among flying animals.

Photo courtesy New York Audubon's "Bird-Safe Guidelines"

A Red-Tailed Hawk may see its reflection as a territorial rival to be driven away, resulting in a collision.

WHAT THIS DOCUMENT DOES

Annual kills at high-risk structures are foreseeable and avoidable and merit protection (*Klem, 2009*). This publication serves as the Planning Commission's policy document for Section 139 of the Planning Code, "*Standards for Bird-Safe Buildings*." The controls described within aim to identify high-risk features in an urban setting and regulate these situations to the best of current scientific understanding. In areas where the risks are less well known, the Department does not propose to apply controls but instead recommends project sponsors use the checklist contained in this document as an educational tool to increase their understanding of potential dangers. Qualifications for achieving recognition as a Bird-Safe building are included in the document to acknowledge building owners who voluntarily take measures to help keep birds safe above and beyond the requirements. At this time, the Planning Department also urges local researchers to further explore the issue and for citizens to get involved in local monitoring efforts.

I. The Issue: Birds, Buildings, People and Cities

Changing Nature of North America and Building Design

The consequences of our population growth are well-known: sprawling development across the country compounds habitat loss and disrupts vital ecological functions. The rate of sprawl in the United States almost quadrupled between 1954 and 2000. An area of undeveloped land about the size of Connecticut is converted to urbanized landscapes annually in the United States (*U.S. Department of Agriculture 1997*). This loss of habitat exerts great pressures on our wildlife.

Less well-known to the general public are the effects of our specific development forms on wildlife. Buildings and birds have coexisted since people first sought shelter. Early blocky buildings posed little threat to birds as the building elements were quite visibly solid. The advent of mass produced sheet glass in 1902 greatly increased the potential for transparency. The innovation of steel frame buildings with glass curtain walls resulted in transparent high-rise buildings.

After the Second World War, these steel and glass buildings were widely used and became the iconic 20th Century American building. Today, planners and urban dwellers increasingly demand building transparency to achieve street activation and pedestrian interest. As glass surface area increases so do the number of bird collisions. After World War II birdwatchers began documenting major bird-building, single-event collisions that resulted in the deaths of hundreds of birds. The first recorded event occurred on September 10, 1948 when more than 200 birds of 30 species were killed upon collision with the Empire State Building (*McAdams 2003)*. Similar events have occurred every decade with notable events killing 10,000 to 50,000 birds at a strike (*Bower 2000*). In 2011, the New York Times reported, that "After 5,000 red-winged blackbirds fell from the sky in Arkansas on New Year's Eve, many Americans awakened to a reality that had not necessarily been on their radar: many birds die as a result of collisions with buildings" (*Kaufman 2011).* These single-event strikes are often tied to inclement weather, night migration, and brightly lit structures.

ABOVE: The proposed new Transbay Terminal presents a transparent façade with enticing vegetation visible both inside the building and on the roof. The façade is currently planned to include fritted glass.

ABOVE: Many historic buildings such as the old Transbay Terminal present a solid appearance.

Photo courtesy of Lundberg Design

ABOVE: The City's new bus shelters designed by Lundberg Design use a subtle frit pattern to indicate the barrier. This design, called "SF Fog," is effective in alerting both people and birds to the glass. INSETS show how the frit pattern is more dense at the bottom and dissipates like the City's fog at the top.

While single-event collisions are dramatic, the bulk of bird deaths result from the cumulative effects of a lone, confused bird mistaking glass for a safe flight path. The lone bird strike occurs over and over with conservative estimates calculating that each building kills 10 birds per year on average in the United States (*Klem 1990*). Poorly designed buildings kill hundreds per year (*Hager et al. 2008*). Current research finds that earlier estimates of up to 1 billion bird deaths per year due to building collisions were conservative (*Klem et al. 2009 and references therein*).

New trends in green architecture can either increase or decrease the risk for birds. Green design that facilitates bird safety includes: the avoidance of light pollution, reduced disturbance to natural landscapes and biological systems, and lowered energy use. Green design can also be hard on birds. Green buildings surrounded by lush landscaping may attract more birds. Window reflections of adjacent greenery lure birds to false trees. Green atria inside buildings too may call birds to an inaccessible haven only to have their journey harshly interrupted mid-flight. In 2011, the Chicago Tribune reported that birds were crashing into the FBI's Chicago office, a Platinum LEED Building, at a clip of 10 birds a day during migration (*DeVore 2011*).

Green building design can go hand-in-hand with bird-safe design. The Green Building Council rating system, LEED, challenges designers to assess the impact of building and site development on wildlife, and incorporate measures to reduce threats. Buildings may be certified as silver, gold, or platinum according to the number of credits achieved. A LEED a bird-friendly pilot may be developed as early as summer 2011, for testing and eventual inclusion into the main LEED structure. There is still room for improvement. In the future, green design should thoroughly consider the impact of design on wild flora and fauna.

BELOW: The California Academy of Sciences showcases many green design features including a green roof set within a lush, green landscape that is a natural respite for birds migrating through the city. Because its use of glass could also pose a collision risk, researchers at the Academy are studying the effects of the building on birds and testing various methods of improving bird safety, including the use of external screens, as shown on page 29.

http://slowmuse.files.wordpress.com/2008/10/cas1.jpg

The Basics: Birds and Buildings

BIRDS AND GLASS

Glass is everywhere and is one of the least recognized, but most serious, threats to birds; one that is increasing as humans continue to build within bird habitats across the planet. Clear glass is invisible to birds and to humans, but both can learn to recognize and avoid it. Unfortunately, most birds' first encounter with glass is fatal. They collide at full speed when they try to fly to sky, plants, or other objects seen through glass or reflected on its surface. Death is frequently not instantaneous, and may occur as a result of internal hemorrhage days after impact, far away from the original collision site, making monitoring the problem even more difficult. The two primary hazards of glass for birds are reflectivity and transparency.

REFLECTIVITY

Viewed from outside buildings, transparent glass often appears highly reflective. Almost every type of architectural glass under the right conditions reflects the sky, clouds, or nearby trees and vegetation. Glass which reflects the environment presents birds with the appearance of safe routes, shelter, and possibly food ahead. When birds try to fly to the reflected habitat, they hit the glass. Reflected vegetation is the most dangerous, but birds may also attempt to fly past reflected buildings or through reflected passageways.

TRANSPARENCY

During daylight hours, birds strike transparent windows as they attempt to access potential perches, plants, food or water sources and other lures seen through the glass. "Design traps" such as glass "skywalks" joining buildings, glass walls around planted atria and windows installed perpendicularly on building corners are dangerous because birds perceive an unobstructed route to the other side.

http://www.princeton.edu/pr/pictures/l-r/princeton_modern/

Photo by AnMarie Rodgers

TOP: Clouds and neighboring trees reflect in the glass curtain wall of Sherrerd Hall on the Princeton campus making it difficult for birds to distinguish real from reflection.

BOTTOM: A Market Street building with a transparent corner may lead birds to think the tree is reachable by flying through the glass.

GLAZING CHARACTERISTICS

Reflective and transparent glass each present hazards to birds (*Gelb and Delacretaz 2009*).

REFLECTIVITY

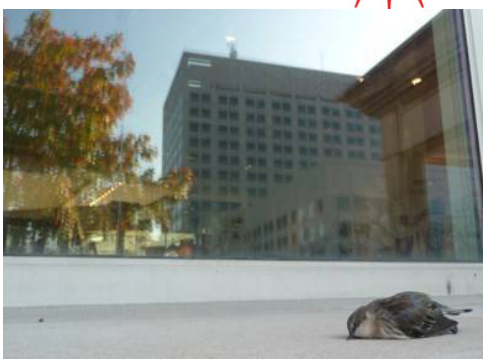
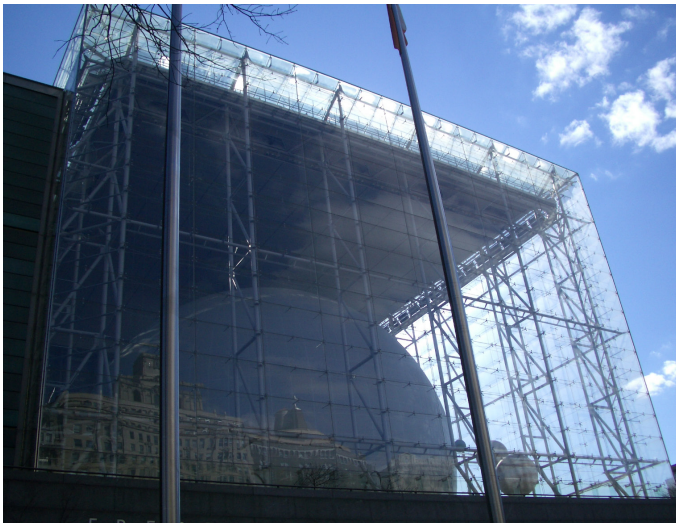


Image courtesy of Lightsoutindy.org

Photos Courtesy NY Audubon

TRANSPARENCY

Image courtesy of Lightsoutindy.org



TOP: Reflections: A bird looking for a perch may mistake the reflected tree for an actual tree.

BOTTOM: Transparent glass can be mistaken for a clear flight path.

GLASS RELATIVE TO BUILDING HEIGHT AND MASSING

Typically, as building size increases, so does the amount of glass, making larger buildings more of a threat. Lower stories of buildings are the most dangerous because windows here are at or below canopy height and are more likely to reflect trees and other landscape features that attract birds. This makes a long, low building more of a hazard than a tall one of equal interior square-footage. However, as monitoring programs access setbacks and roofs of tall buildings, they are finding that birds also collide with buildings at the higher floors. This is an area where more information is needed.

AMOUNT OF GLASS

Glass causes virtually all bird collisions with buildings. It's logical that as the amount of glazing increases on a building the threat also increases. A study in New York (*Klem et al, 2009*) found a 10% increase in the area of reflective and transparent glass on a building façade correlated with a 19-32% increase in the number of fatal collisions, in spring and fall, when visiting migrants are present.

TOP: SoMa's Foundry Square presents a full façade of highly reflective glass. While all glass can be reflective, glass manufacturers label glass with standards "reflectivity" ratings.

REDUCING KNOWN BIRD TRAPS

Photo Courtesy NY Audubon

Windowed courtyards and open-topped atria can be hazardous, especially if they are heavily planted. Birds fly down into such places, and then try to leave by flying directly towards reflections on the walls. Glass skywalks, handrails and building corners where glass walls or windows are perpendicular are dangerous because birds can see through them to sky or habitat on the other side.

ABOVE LEFT: This café on Market Street uses a glass wind barrier lined with attractive flowers that may entice birds.

ABOVE RIGHT: This glass walkway allows for a clear sightline though the passage. Without treatment to the glazing, this can create a hazards for birds.

CLEAR FLIGHT PATHS

Birds have evolved to fly through tree canopies at speed. This ability to navigate tight places is a benefit in most natural settings but may be a liability in the built environment. Early attempts to ward off bird collisions with glass panes included the unsuccessful attempts at placing falcon stickers in the middle of each pane. As the acrobatic bird below demonstrates and as current research has shown, collisions are most effectively reduced when flight paths are eliminated by the breaking of glass swaths to less than either 4" vertically or 2" horizontally (*Sheppard 2010*).

Hand Print Rule: Small birds may try to fly through any spaces that are about the size of a handprint.

Exceptional Acrobats: Some birds such as the barn swallow pictured here can easily fly through spaces that are more narrow. This bird is traveling at 35 mph through a 2-inch seam.

http://zuzutop.com/2009/07/a-job-for-superswallow/

We don't know exactly what birds see when they look at glass but we do know that the amount of glass in a building is the strongest predictor of how dangerous it is to birds. Other factors can increase or decrease a building's impact, including the density and species composition of local bird populations, the type, location and extent of landscaping and nearby habitat, prevailing wind and weather, and patterns of migration through the area. All must be considered when planning bird-friendly environments. Commercial buildings with large expanses of glass can kill large numbers of birds, estimated at 35 million per year in the US (*Hager et al 2008*). With bird kills estimated at 1-10 per building per year, the large number of buildings multiplies out to a national estimate of as much as a billion birds per year (*Klem et al 2009; Klem 1990, 2009*). As we'll discuss, certain particularly hazardous combinations can result in hundreds of deaths per year for a single building.

Photo by Hendrik Dacquin

BOTTOM A fatal bird-strike leaves behind a print of the bird's plumage as evidence of the force of the impact.

BIRDS AND LIGHTING

LIGHT

While recent research suggests that nighttime collisions may be more limited in scope than previously thought (*Gelb and Delacretaz 2009 and references therein*), at night artificial light degrades the quality of migratory corridors and adds new dangers to an already perilous journey. These conditions can be exacerbated by unfavorable weather and San Francisco fog, limiting birds' ability to see navigational markers like the stars and moon. Flood lights on tall buildings or intense uplights emit light fields that entrap birds reluctant to fly from a lit area into a dark one. This type of lighting has resulted in mass mortalities of birds (*Ogden 1996 and references therein*).

Lights disrupt birds' orientation. Birds may cluster around such lights circling upward, increasing the likelihood of collisions with the structure or each other. Importantly, vital energy stores are consumed in nonproductive flight. The combination of fog and light doubly affects birds' navigation and orientation. (*Ogden 2006*)

Besides reducing adverse impacts on migrating birds, there are significant economic and human health incentives for curbing excessive building illumination. In June 2009, the American Medical Association declared light pollution a human health threat and developed a policy in support of control of light pollution.

Overly-lit buildings waste tremendous amounts of electricity, increasing greenhouse gas emissions and air pollution levels, and of course, wasting money. Researchers estimate that the United States alone wastes over one billion dollars in electrical costs annually because poorly designed or improperly installed outdoor fixtures allow much of the light to go up to the sky. "Light pollution" has negative aesthetic and cultural impacts. Recent studies estimate that over two-thirds of the world's population can no longer see the Milky Way, a source of mystery and imagination for star-gazers. Together, the ecological, financial, and aesthetic/cultural impacts of excessive building lighting serve as compelling motivation to reduce and refine light usage (*Scriber 2008*).

Light at night, especially during bad weather, creates conditions that are particularly hazardous to night migrating birds. Typically flying at heights over 500 feet, migrants often descend to lower altitudes during inclement weather, where they may encounter artificial light from buildings. Water vapor in very humid air, fog or mist refracts light, greatly increasing the illuminated area around light sources. Birds circle in the illuminated zone, appearing disoriented and unwilling or unable to leave (*Ogden 2006*). They are likely to succumb to lethal collision or fall to the ground from exhaustion, where they are at risk from predators. While mass mortalities at very tall illuminated structures such as skyscrapers have received the most attention, mortality is also associated with ground level lighting and with inclement weather.

BELOW: Hazards can combine in downtown San Francisco. In this photo beacon lighting, light spillage, and fog mix.

Photo by AnMarie Rodgers

While we typically think of birds as early risers, during migration season many species will travel at night. White lights, red lights, skyglow, brightly lit buildings and interiors can distort normal flight routes (*Poot et al. 2008*). The risks vary by species. Songbirds, in particular, seem to be guided by light and therefore appear more susceptible to collisions with lit structures. Migrant songbirds have been documented by multiple sources to suffer single night mortalities of hundreds of birds at a single location (*Ogden 1996 and references therein*).

Image courtesy Lights Out SF

ABOVE: Lighting and Navigation: Birds migrate by reading light from the moon and stars, as well as by geomagnetic signals radiated from earth. Cumulative light spillage from cities can create a glow that is bright enough to obscure the starlight needed for navigation.

LEFT: Beacon Effect: Individual structures may be lit in a manner that draws birds like a moth to a flame. Beacon structures can draw birds towards land that may offer little shelter or food or towards collisions with glass. Once at the structure, birds may be hesitant to leave the lit area causing them to circle the structure until exhausted. (*Ogden 1996*)

RIGHT: Skyglow can be increased during periods of inclement weather. Current research indicates that red lights in particular may disrupt geomagnetic tracking. Red lights required for airline safety would be permitted (above image). Decorative red lighting, such as on the building below in New York, would be discouraged.

Image courtesy Lights Out SF

Image courtesy NY Audubon

Map courtesy of Texas Parks and Wildlife Department.

OTHER CAUSES OF COLLISIONS:

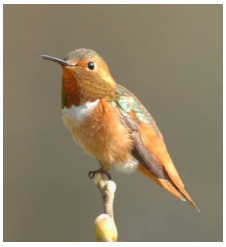
LOCATION: MACRO-SETTING

San Francisco is on the Oceanic Route of the Pacific Flyway. During migration, birds tend to follow rivers and the coastline. In this way migrants funnel southward together in the fall and disperse northward in the spring.

VISITING BIRDS

Migrating birds are unfamiliar with the City and may be exhausted from their flight. Instances of collisions rise during the migratory seasons as birds travel to lower elevations to feed, rest, and use light to recalibrate their navigation. (*Hager et al. 2008*).

LEFT: Millions of birds – more than 350 species – follow the Pacific Flyway. Of the two primary routes, the Oceanic Route passes through the Bay Area. Spring migration occurs between February through May, and fall migration begins in August and lasts through November. During this time, collisions with buildings can increase notably.



Photos by Eddie Barkley.

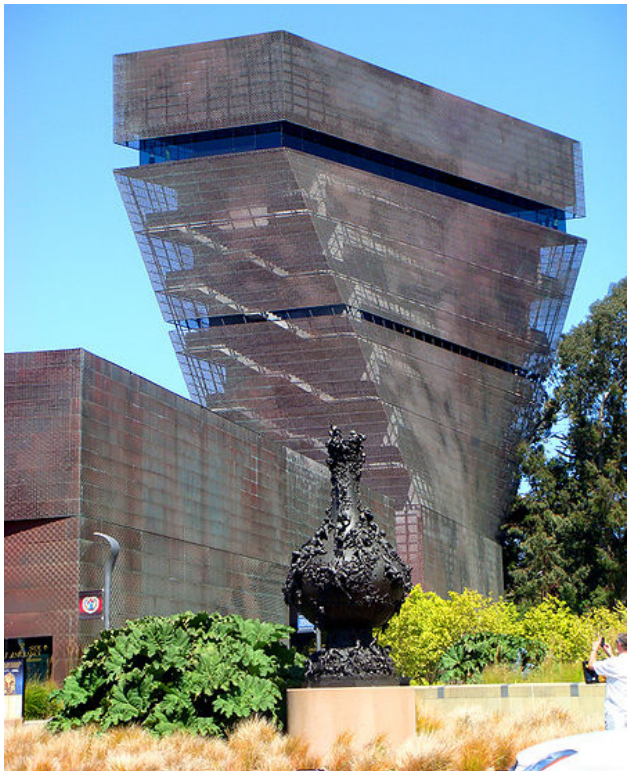
LEFT: According to the Golden Gate Audubon Society, over 250 species migrate through San Francisco Bay, many of them small songbirds such as warblers, thrushes, tanagers and sparrows that migrate at night and may be more susceptible to collisions with structures when descending for feeding and resting because of unfamiliar territory and confusing signals from the urban environment. Bird photos from left to right are Anna's Hummingbird, Yellow Warbler, and Lazuli Bunting.

LOCATION: MICRO-SETTING

How a building meets adjacent landscape features can be critical in determining the risk to birds. Buildings with large windows located adjacent to extensive vegetation present great hazards. In suburban areas, buildings with these features have been documented to kill 30 birds per year (*Klem 1990; and O'Connell 2001*). This combination may be even more lethal in urban areas. Studies of Manhattan structures with large swaths of glazing adjacent to large open spaces have recorded well over 100 collisions per year (*Gelb and Delacretaz 2009*).

BUILDING FEATURES

Well-articulated buildings orient people as well as birds, directing flow of traffic, creating enticing rest areas and adding aesthetic appeal.



RIGHT: Although located in a park setting, the De Young Museum minimizes hazards due to its low amount of glazing and perforated copper façade.

WEATHER CONDITIONS

Inclement weather can obscure obstacles and exacerbate skyglow conditions (*Ogden 1996 and references therein*).

http://izismile.com/2009/09/30/beautiful_pictures_of_san_francisco_covered_with_fog_10_pics_1_video.html

Implications for San Francisco

Three decades of researching bird/building collisions has yielded both many answers and posed new questions. The high number of North American bird deaths and the ecological importance of birds demonstrate that the problem exists on a national level, but it is natural to wonder if the dense nature of San Francisco presents the same compelling pressure for a local response. The short answer is yes—San Francisco has both an important population of birds and a potentially injurious built environment for them. As discussed previously, San Francisco is both home to many birds and is on a major migratory pathway. Locally, there are incidents of celebrated birds such, as the Peregrine Falcon, repeatedly losing their young due to collisions with downtown skyscrapers. With only a few studies currently underway in San Francisco and results not yet complete, anecdotally, local birders have monitored several buildings and have noted significant numbers of bird injuries and deaths (*Weeden, 2010*). San Francisco Animal Care and Control staff further reported collecting 938 wild birds over a two year period from May 2008 through June 2010, noting the majority of birds were found during the spring and fall migratory periods. The California Academy of Sciences in Golden Gate Park is spearheading their own research and bird-safe building methods, in a proactive effort to avoid bird fatalities at their facility. In lieu of large-scale local monitoring programs there are a great many studies of dense urban cities that we can further draw upon. These studies demonstrate that birds respond similarly to certain building and environmental features, regardless of geographic location.

SPOTLIGHT ON A LOCAL CELEBRITY

The Peregrine Falcon population suffered a huge blow to their numbers due to the use of pesticides including DDT beginning in the 1950s. In 1970 the California Peregrine Falcon population was reduced to only two known breeding pairs. The Santa Cruz Predatory Bird Research Group (SCPBRG) participated in the reintroduction of the species and has monitored the Peregrine Falcons nesting in San Francisco and other sites.

Natural cliff dwellers, the species adapted to nesting in bridges and downtown high-rises. As the population increased, Peregrine Falcons were reported in the San Francisco financial district and in 1987 a nest box was placed near a commonly used perch on the PG&E Headquarters Building. In 2003, Peregrine Falcons nested in the downtown for the first time and have been a closely watched since. SCPBRG trained citizens to participate in a group called “Fledge Watch” to increase understanding of how young falcons fare in the city. In 2009, 76 people volunteered for 5 hour shifts monitoring the 36-58 day old Peregrines from sunrise to sunset in either San Jose or San Francisco. The public could also view the falcons from the downtown building nest via a webcam.

According to Glenn Stewart of SCPBRG, “while there have been building collision fatalities, the target nest success of Peregrine Falcons in San Francisco was 1.5 per nest and has been exceeded at 1.6 young fledged per nest.”

It appears that several weeks after fledging, urban Peregrine Falcons recognize glass as a barrier. In the first few weeks when the young are learning to fly they are most at risk for a collision. In other habitats, falcons face predators like eagles, owls, and when on the ground by bobcats, and coyotes. Like other birds, Peregrine Falcons see in the ultra violet (UV) range.

The architects and designers of the downtown environment did not consider bird building collision as a potential risk. In the future when buildings are being designed and upgraded, the latest information and options should be considered.

- Noreen Weeden, *Golden Gate Audubon Society*

Photo by Glenn Nevill

A native San Franciscan juvenile Peregrine Falcon (deceased offspring of “Dapper Dan” and “Diamond Lil”) perched on sill near reflective glass. All three fledged young from that year (2009) died as a result of building collisions. Two more fledglings died from collisions in 2011.

LESSONS FROM MAJOR CITIES

Academic researchers and bird-rescue organizations in Chicago, Toronto, and New York City have documented thousands of structure collisions and come to some interesting conclusions.

Perhaps the most established monitoring program of bird-building collisions in a dense city is NYC Audubon's Project Safe Flight in Manhattan. Project Safe Flight documented over 5,400 collisions between 1997-2008. A recent study (*Gelb, Delacretaz 2009*) analyzed this data to determine the critical contributing factors for the structures with the largest number of bird fatalities.

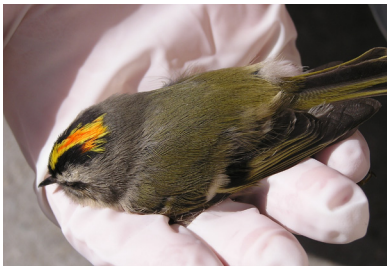
- The study looked at the 10 most deadly collision sites and found the combination of open space, vegetation, and large windows (greater than 1 meter x 2 meter) to be more predictive of death than building height.
- The frequency of collisions is highest along façades that have lush exterior vegetation and either reflective or transparent windows.
- The majority of the collisions occurred during the daytime and involved migrant species.
- High-rise buildings and night lighting presented less risk than windows adjacent to open spaces one hectare or greater in size.
- The majority of collisions are likely due to high-collision sites that feature glass opposite exterior vegetation.
- Urban mortalities may be higher than previously thought. Non-urban studies estimated that high-collision sites would have about 30 collisions per year. At the Manhattan collision sites examined in this study, well over 100 collisions were recorded per year.

The most dangerous building in this study was not a high-rise, but instead was a 6-story office building adjacent to densely vegetated open space.

Studies in Toronto and other eastern and Great Lakes cities have documented tens of thousands of bird fatalities attributable to building collisions. A 10-year study of bird-building collisions in downtown Toronto found over 21,000 dead and injured birds in the city's downtown core. A 25-year study by researchers from Chicago's Field Museum of Natural History documented a particularly problematic building in Chicago (McCormick Place Convention Center) with over 30,000 dead birds of 141 species. The lights at the McCormick Palace were left on at night until 2000. Anecdotal reports for this building cited an 80% decrease in the number of birds killed, by simply turning out building lights (*Kousky 2004*).

Other researchers have agreed that lights can cause a significant problem, but that turning off lights isn't the only answer *(Shephard, Klem 2011)*. As shown in the Manhattan study of ten buildings, daytime collisions were higher and occurred in areas with vegetation opposite glass. Toronto's approach to tackle this dual issue was to provide mandatory construction standards for daytime, while continuing to increase participation in their Lights Out program at night.

Photos courtesy NY Audubon



ABOVE: The windows of Morgan Mail Building in Manhattan are adjacent to green landscaped open spaces, making it the most dangerous for birds in a recent study.

RIGHT: Morgan Mail Building causality.

Spotlight on San Francisco's Migrant Birds

Bird collisions with buildings occur year-round, but peak during the migration period in spring and especially in fall when millions of birds travel between breeding and wintering grounds. Migration is a complex phenomenon, and different species face different levels of hazards, depending on their migration strategy, immediate weather conditions, availability of food, and anthropogenic obstacles encountered en route.

Photo by Noreen Weeden

Nocturnal migrants: Many songbirds migrate at night, possibly to take advantage of cooler temperatures and less turbulent air, and because they need daylight to hunt insects for food. Generally, these birds migrate individually, not in flocks, flying spread out across most of their range. Migrants depart shortly after sundown. The number of birds in flight peaks before midnight, then drops. Songbirds may fly as many as 200 miles in a night, then stop to rest and feed for one to three days, but these patterns are strongly impacted by weather, especially wind and temperature. Birds may delay departure, waiting for good weather. They generally fly at an altitude of about 2,000 feet, but may descend or curtail flight altogether if they encounter a cold front, rain, or fog. There can be a thousand-fold difference in the number of birds aloft from one night to the next. Concentrations of birds may develop in 'staging areas' where birds prepare to cross large barriers such as the Great Lakes or Gulf of Mexico.

Photo by Eddie Bartley

Diurnal migrants: Daytime migrants include raptors, which take advantage of air currents to reduce the energy needed for flight. Other diurnal migrants, including shorebirds and water-birds, often fly in flocks and their stopover sites are less dispersed because of their dependence on bodies of water. This means that daytime migration routes often follow land forms such as rivers and mountain ranges, and birds tend to be concentrated along these routes or 'flyways'. Not all songbirds migrate at night—species such as robins, larks, kingbirds and others migrate during the day. Birds' daytime flight altitudes are generally lower than their nighttime counterparts.

Millions of birds, especially songbirds, are thus at risk, as they ascend and descend, flying through or stopping at or near populated areas. As city buildings grow in height, they become unseen obstacles by night and pose confusing reflections by day. Nocturnal migrants, after landing, make short, low flights near dawn, searching for feeding areas and running a gauntlet of glass in almost every habitat: in cities, suburbs and, increasingly, exurbs. When weather conditions cause night flyers to descend into the range of lighted structures, huge kills can occur around tall buildings. Urban sprawl is creating large areas lit all night that may be causing less obvious, more dispersed bird mortality.

- Christine Sheppard, *American Bird Conservancy*

THE IMPORTANCE OF MACRO-LOCATION (ON MIGRATION PATH) VS. MICRO-LOCATION (WITHIN A PARK-LIKE SETTING) AS A RISK FACTOR

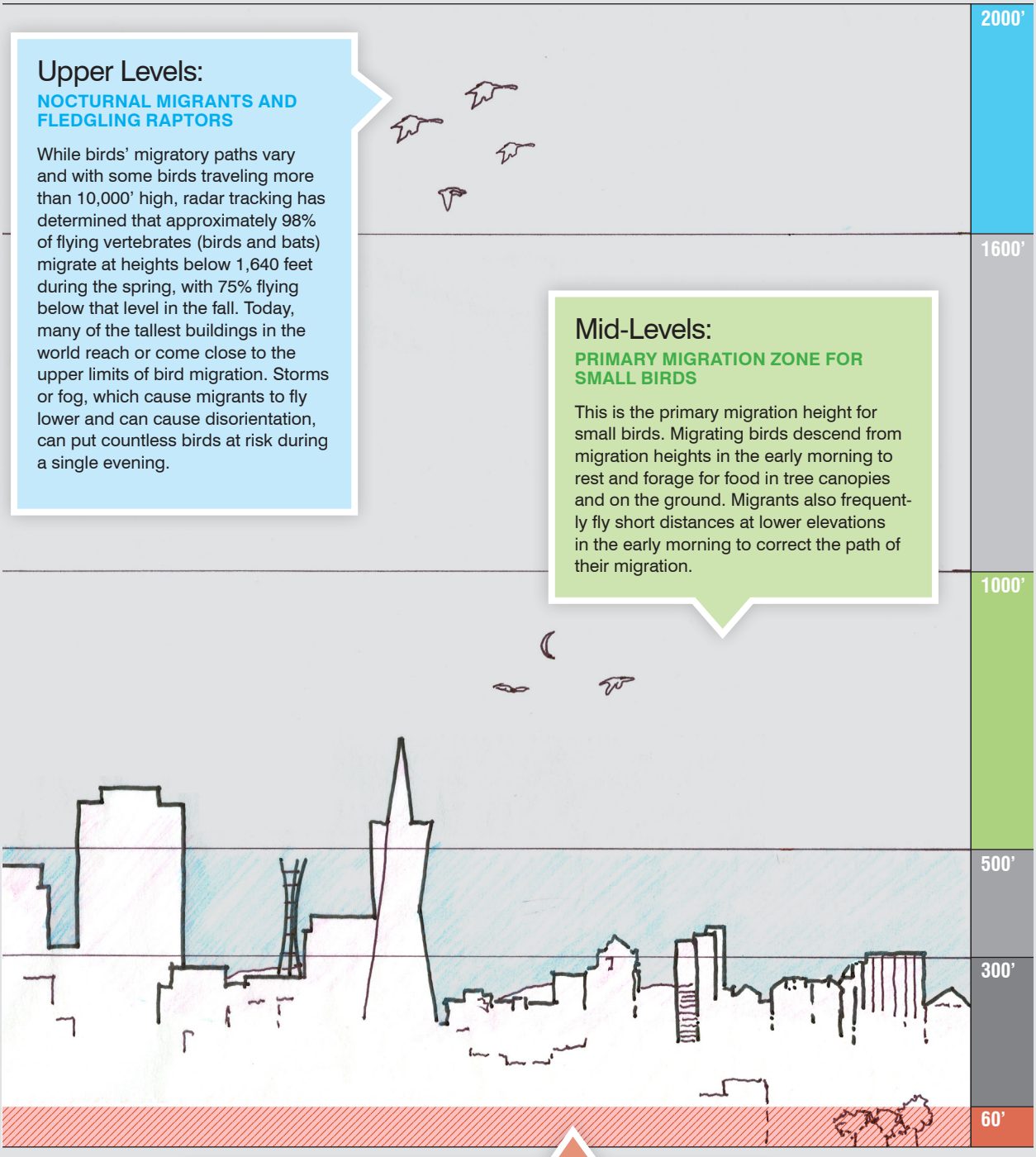
A study of collisions at suburban office parks in Virginia found a large mortality rate for migrant birds even though the office parks were not on a migratory route—suggesting that the combination of mirrored windows and vegetation was more of a collision risk to visiting birds (*O'Connell 2001*). This study also suggests that the location of the building relative to the flyway may be less important than other risk factors such as building design and siting relative to plantings and open space.

Photos by Eddie Bartley

By flying at night, migrants like the Orange-Crowned Warbler (NEAR RIGHT) and Western Tanager (ABOVE LEFT) minimize predation, and avoid overheating that could result from the energy expended to fly such long distances. This also enables them to feed during the day and refuel for the night.

Daytime migrants like this Cooper's Hawk (FAR RIGHT) and the Sharp-shinned Hawk (ABOVE RIGHT) depend on the heating earth for added lift. Riding rising air currents called thermals, these birds take advantage of this lift to rise to the top of one thermal, set their wings in the direction they want to travel and then coast to the next thermal.

Spotlight on Building Height and Bird Migration



Upper Levels:

NOCTURNAL MIGRANTS AND FLEDGLING RAPTORS

While birds' migratory paths vary and with some birds traveling more than 10,000' high, radar tracking has determined that approximately 98% of flying vertebrates (birds and bats) migrate at heights below 1,640 feet during the spring, with 75% flying below that level in the fall. Today, many of the tallest buildings in the world reach or come close to the upper limits of bird migration. Storms or fog, which cause migrants to fly lower and can cause disorientation, can put countless birds at risk during a single evening.

Mid-Levels:

PRIMARY MIGRATION ZONE FOR SMALL BIRDS

This is the primary migration height for small birds. Migrating birds descend from migration heights in the early morning to rest and forage for food in tree canopies and on the ground. Migrants also frequently fly short distances at lower elevations in the early morning to correct the path of their migration.

Bird Building Collision Zone:

INCREASED COLLISIONS FOR LOCAL BIRDS AND MIGRANTS SEARCHING FOR FOOD AND SHELTER

The most hazardous areas of all buildings, especially during the day and regardless of overall height, are the ground level and bottom few stories. Here, birds are most likely to fly into glazed façades that reflect surrounding vegetation, sky, and other attractive features.

II. Bird-Safe Treatments

A Survey of Treatments from Easy to Innovative

Effective bird-safe building treatments exist and have been employed on buildings of significant architectural stature. San Francisco has a local example of such treatments that has been recognized nationally. The new Federal Building is cited as an example of bird-safe building design in United States Representative Mike Quigley's (D-IL) pending bill,"Federal Bird-Safe Buildings Act of 2011" (*House Bill No. 1643*). This bill, if adopted, would require federal buildings to incorporate bird-safe design principals.

Bird-safe design options are limited only by the imagination. Safe buildings may have large expanses of glass but use screens, latticework, grilles and other devices, both functional and decorative, outside the glass or integrated into the glass. There are treatments for existing glass that will reduce mortality to zero. These treatments do provide a view from inside, though often presenting a level of opacity from the outside, a factor that can deter application of these solutions. Glass treatments that can eliminate or greatly reduce bird mortality, while only minimally obscuring the glass itself, are therefore highly desirable and encourage more 'bird-friendly' design.

RIGHT: The south façade sports perforated steel panels that filter sunlight and serve as thermal buffers but also may convince birds that the structure is solid.

BOTTOM: San Francisco's Federal Building's north façade boasts floor-to-ceiling glass buffered behind a grid of metal catwalks and opaque glass fins.

Photos by Kurt Rodgers, SF Chronicle
http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2007/02/25/MNG2DOATDN1.DTL

GLASS AND FAÇADE TREATMENTS

Reduction of bird strikes with new buildings can be achieved with simple and cost-effective means. Creating a visual signal, or "visual noise barrier," that alerts the birds to the presence of glass objects can be achieved with relatively little additional cost. Fritting, the placement of ceramic lines or dots on glass, is one method of creating a visual noise barrier. People inside the building see through the pattern, which has little effect on the human-perceived transparency of the window. Fritting can also reduce air conditioning loads by lowering heat gain, while still allowing enough light transmission for day-lighting interior spaces. There is now a commercially available insulated glass with ultra-violet patterns that are designed to deter birds while largely being imperceptible to humans.

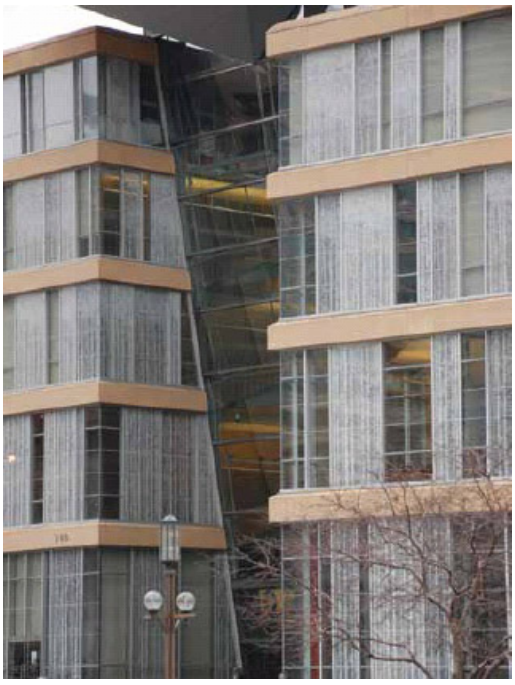
FRITTED AND FROSTED GLASS

Ceramic dots, or frits, are applied between layers of insulated glass to reduce transmission of light. These can be applied in different colors and patterns and can commonly be seen on commercial buildings. At Swarthmore College, external, densely fritted glass was incorporated into the design of the Unified Science Center. Virtually no strikes have been reported at either site. Fritting is a commonly-used and inexpensive solution that is most successful when the frits are applied on the outside surface.

ANGLED GLASS

While angled glass may be a useful strategy for smaller panes, it is generally not effective for large buildings. Birds approach glass from many angles, and can see glass from many perspectives. Generally, the desired angle for effective treatment is 20-40 degrees. These angles are difficult to maintain for large buildings, however, this strategy may work in low-scaled buildings with a limited amount of glass (*Ogden 1996 and references therein; and Klem et al. 2004*).

Minnesota Bird-Safe Building Guidelines



Minnesota Bird-Safe Building Guidelines

LEFT: Swarthmore College uses fritting on a large expanse of glass facing an open space.

RIGHT: The Minnesota Central Library's atrium features angled glass, a dramatic architectural feature that reduces reflections of habitat and sky from most angles. The likelihood of fatal collisions at this angle is lessened.

ULTRA-VIOLET GLASS

The Bronx Zoo uses glass that reflects UV light—primarily visible to birds, but not to people (*Klem 2009*). This glass may be about 50% more expensive than typical glass but is comparable to energy-efficient glass (*Eisenberg 2010*).

TOP RIGHT: The Bronx Zoo from the NYTimes.

http://www.nytimes.com/2010/08/29/business/29novel.html?ref=anne_eisenberg

FILM AND ART TREATMENT OF GLASS

Windows may be used as canvases to express building use through film and art. In certain instances, windows made bird-safe through an application of art may receive funding through San Francisco's One Percent for Public Art Program.

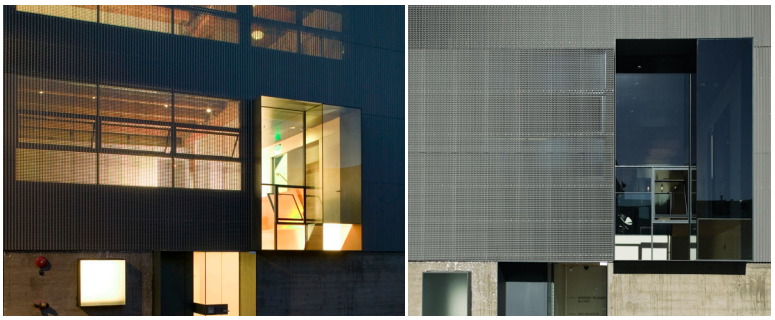
SECOND RIGHT: IIT Student Center, Chicago.

NY Bird-Safe Design Guidelines

EXTERNAL SCREENS

External screens are both inexpensive and effective. Screens can be added to individual windows for small-scale projects or can become a façade element of larger developments. This time-tested approach precludes collisions without completely obscuring vision. Before non-operable windows, screens were more prevalent. At the other end of the spectrum are solutions that wrap entire structures with lightweight netting or screens. To be effective, the netting must be several inches in front of the window, so birds don't hit the glass after hitting the net.

THIRD RIGHT: The Matarozzi/Pelsinger Building in San Francisco is a LEED Gold building designed by Aidlin-Darling. It has screens over the majority of its façade that protect birds from impact and allow views out for users of the building (left nighttime/right daytime)

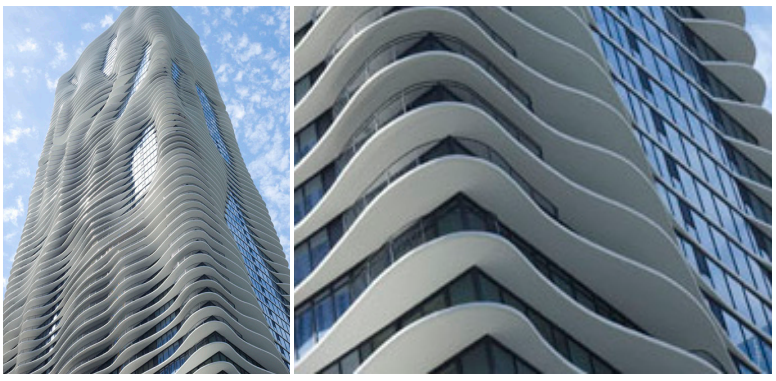


Minnesota Bird-Safe Building Guidelines

ARCHITECTURAL FEATURES

Overhangs, louvers, and awnings can block the view of the glass from birds located above the feature but do not eliminate reflections. This approach should be combined with window treatments to achieve results.

BOTTOM RIGHT: The award winning Aqua Tower, Chicago, uses overhangs and other features that provide bird-safe design as well as energy efficiency.



Steve Hall/Studio Gang

NETTING

Netting has proven to be a versatile and effective option for bird-safe window treatment. Netting is stretched several inches over windows or entry ways to prevent birds from hitting the glass. Specifically designed netting is almost completely invisible and does not require invasive installation techniques. It can be used for new buildings, retrofits to existing buildings, replacement glass façades, and for preserving original features of historic buildings.

During the spring and fall migrations, agency staff at the FBI building in Chicago discovered at least 10 birds a day crashing into windows outside of their first floor, plant filled indoor atrium. Seasonal netting was installed and bird collision monitors noted a substantial reduction in bird strikes, without compromising the look of the building or the ability to see into or out of the lobby (*DeVore 2011*).

Netting has also been used successfully to treat historic buildings, where it's critical to maintain the original character of the building. Prestigious historic preservation awards have been earned for netting work on famous buildings such as the American Museum of Natural History and the US Department of Justice. Other historically significant structures with netting include New York Metropolitan Opera, Independence Hall, and even Alcatraz Prison.

Heather Charles, Chicago Tribune

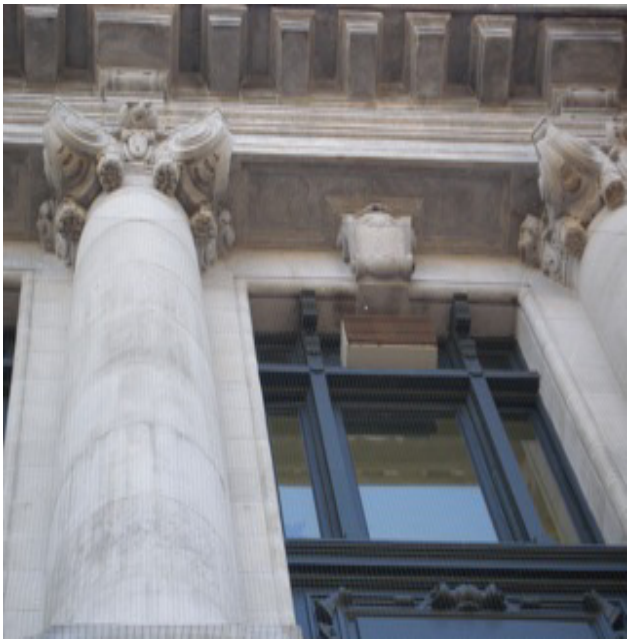


Photo Courtesy of Birdmasters, Inc.

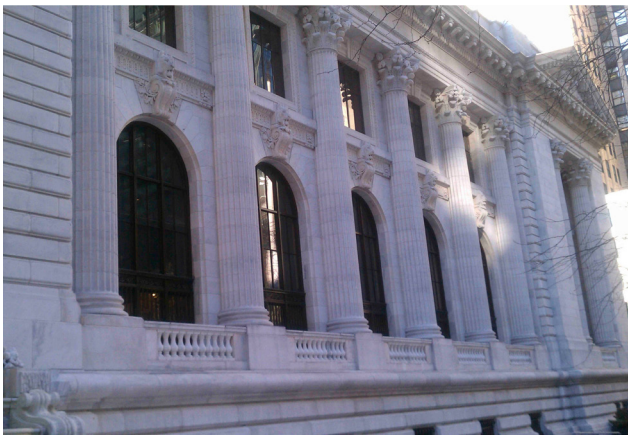


Photo Courtesy of Birdmasters, Inc.

TOP RIGHT: Special agent Julia Meredith discovered so many dead and injured birds on the ground outside the Chicago offices of the FBI that she lobbied to have special bird-friendly netting installed on the building's first floor windows. She estimates that the nets have reduced the number of birds crashing into the windows by 90 percent.

CENTER RIGHT: A close-up view of the New York Public Library barely shows the marble toned and clear netting over the building.

BOTTOM RIGHT: The netting placed over the windows at the New York Public Library is virtually invisible and helps prevent both bird strikes and building deterioration from pest species.

WIND GENERATORS

San Francisco has a policy to encourage the installation of on-site, renewable energy systems, such as small wind generators. Currently, there are two general types of wind generators available. One uses scoops or blades to spin on a vertical axis, shown at far left below. It is probable that birds would perceive this type as a solid barrier even when it's rotating.

The second design uses a propeller-like rotor to spin on a horizontal axis. This is a small-scale version of the most common generator used on large-scale wind farms throughout the world.

While it is unreasonable to believe that these small urban systems would cause the annihilation of birds such as the well-known disaster at Altamont, California (see discussion on adjacent page) a certain amount of caution is prudent in the absence of established scientific research. The Planning Department has exercised that caution by allowing a more widespread installation of vertical axis machines, and limiting locations of horizontal axis, open-bladed generators to areas that would seem to be less densely populated by birds, especially migrants and juveniles.

The only clear way at present to learn whether small urban wind generators will harm birds is to allow the installation of a few, and to monitor the interactions with animals, if any. For this reason, all approvals for wind generators have conditions that require monitoring and reporting of bird and bat strikes. These reporting protocols are in accord with recommendations made by the Mayor's Task Force on Urban Wind.

As of June 2011, none of the approved windmills have submitted monitoring information to the Planning Department.

LEFT: Horizontal axis and vertical access wind generators that do not present a solid appearance are discouraged, especially adjacent to water or open space larger than 2 acres.

ABOVE: Vertical axis wind generators may vary in appearance. Blades that present a solid appearance (such as the left image) are encouraged.

Golden Eagle photo by Eddie Bartley.

Spotlight on the Altamont Windmills

Golden Eagles, named for the golden feathering at the nape of their necks, are majestic raptors that can be found throughout most of California and much of the northern hemisphere. California protects these magnificent raptors as both a species of special concern and a fully protected species, making it illegal to harm or kill them. Golden Eagles are protected under the Bald and Golden Eagle Protection Act. Golden Eagle are also protected under the Federal Migratory Bird Treaty Act, which forbids the killing (even unintentional killing) of any migratory bird.

Golden Eagles typically prefer open terrain, such as the rolling hills of eastern Alameda County. The open grasslands, scattered oaks, and bountiful prey make this area ideal habitat for Golden Eagles. Today, it supports the highest-known density of Golden Eagle nesting territories in the world.

Conservation Issues

Every year, an estimated 75 to 110 Golden Eagles are killed by the wind turbines in the Altamont Pass Wind Resource Area (APWRA). Some lose their wings, others are decapitated, and still others are cut in half. The lethal turbines have been reduced from 6,000 to less than 5,000 which are still arrayed across 50,000 acres of rolling hills in northeastern Alameda and southeastern Contra Costa counties. The APWRA, built in the 1980s, was one of the first wind energy sites in the U.S. At the time, no one knew how deadly the turbines could be for birds. Few would now deny, however, that Altamont Pass is probably the worst site ever chosen for a wind energy project. According to a 2004 California Energy Commission (CEC) report, as many as 380 Burrowing Owls (also a state-designated species of special concern), 300 Red-tailed Hawks, and 333 American Kestrels are killed every year. The most recent study by Dr. Shawn Smallwood, a member of the Altamont Scientific Review Committee estimates that approximately 7,600-9,300 birds are killed here each year. (*Smallwood 2010*)

In 2004, Golden Gate Audubon joined four other Bay Area Audubon chapters (Marin Audubon, Santa Clara Valley Audubon, Mt. Diablo Audubon, and Ohlone Audubon) and Center for Biological Diversity and Californians for Renewable Energy (CARE) in challenging the renewal permits for this facility. The Audubon/CARE CEQA lawsuit settled, with terms requiring the wind companies to reduce avian mortality by 50% within three years and to complete a comprehensive conservation plan to govern operations in the Altamont.

Reducing the kill entirely may not be possible as long as the wind turbines continue to operate at Altamont. However, significant progress can be made. The CEC estimates that wind operators could reduce bird deaths by as much as 50 percent within three years–the goal stated in the settlement agreement–and by up to 85 percent within six years–all without reducing energy output significantly at APWRA. These reductions could be achieved by removing turbines that are the most deadly to birds and shutting down the turbines during four winter months when winds are the least productive for wind energy, combined with some additional measures. Anecdotal data indicate there may not be a substantial improvement for Golden Eagles and there may actually be much higher mortality for bats.

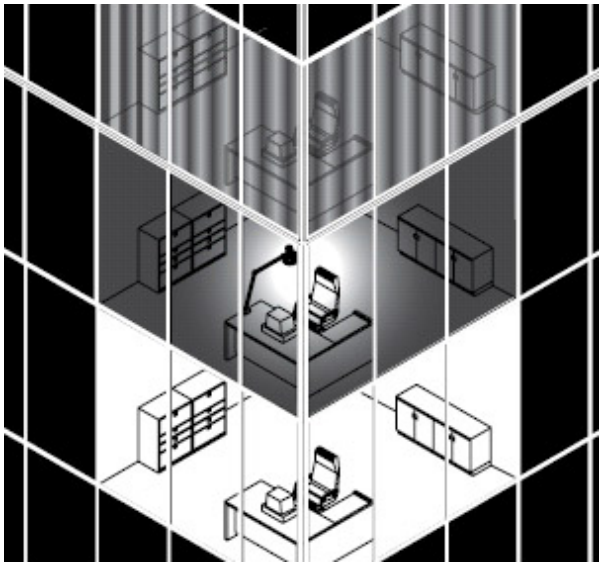
Golden Gate Audubon is working with Alameda County to ensure that the permits granted to the wind industry achieve reductions in bird mortality, in addition to other requirements that will help address the unacceptable bird kills at Altamont Pass over the long term. Pursuit of clean energy technology, when done correctly, can help reduce the risk of global warming and its impacts on wildlife.

Written by the Golden Gate Audubon Society.

LIGHTING TREATMENTS

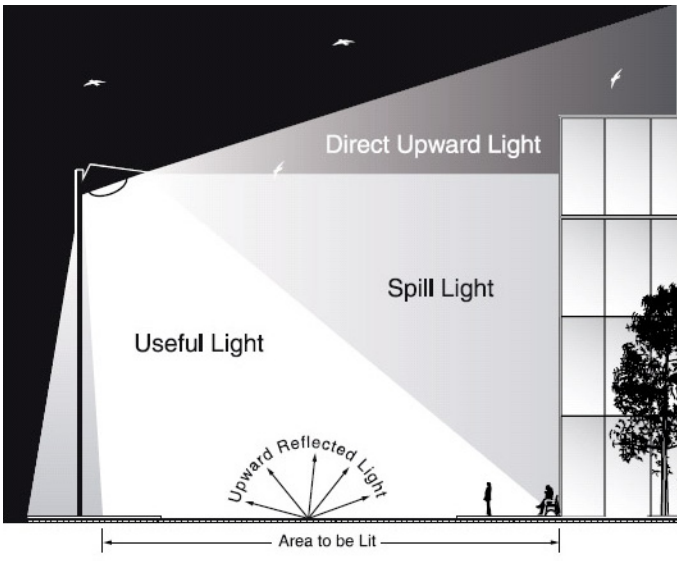
While the ultimate cause of collisions are invisible surfaces, light pollution can increase risk. Night migrants depend on starlight for navigation, and brightly-lit buildings can draw them off course. Once within the aura of bright lights, they can become disoriented, and may collide with buildings, or may fly in circles around the light source, until they drop to the ground from exhaustion, having expended their limited energy reserves needed to complete their migration. Architects and building owners should collaborate to address the two key lighting issues: design and operation.

Eliminating unnecessary lighting is one of the easiest ways to reduce bird collisions, with the added advantage of saving energy and expense. As much as possible, lights should be controlled by motion sensors. Building operations can be managed to eliminate or reduce night lighting from activities near windows. Minimize perimeter and vanity lighting and consider filters or special bulbs to reduce red wavelengths where lighting is necessary. Strobe lighting is preferable to steady burning lights. Exterior light fixtures should be designed to minimize light escaping upwards. Motion detectors are thought to provide better security than steady burning lights, because lights turning on provide a signal, and because steady lights create predictable shadows.



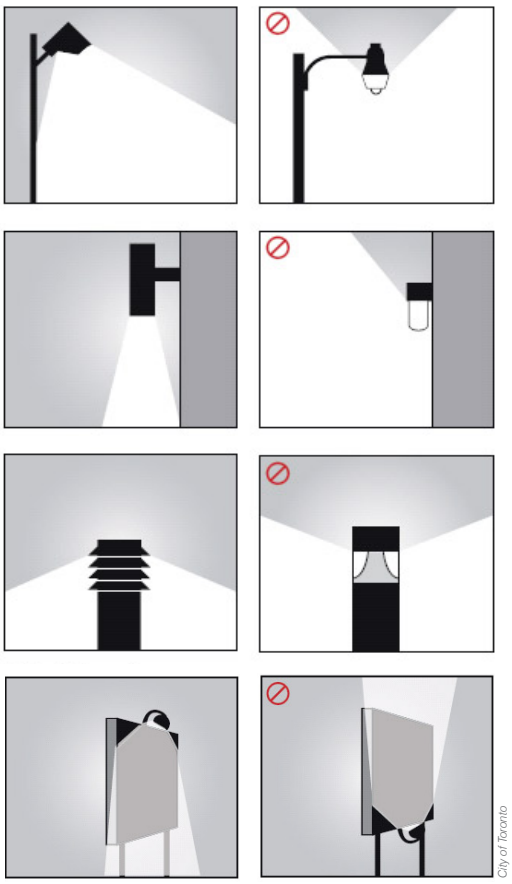
Minnesota Bird-Safe Building Guidelines

REDUCE: UNNECESSARY INTERIOR LIGHT



Minnesota Bird-Safe Building Guidelines

REDUCE: UNNECESSARY EXTERIOR LIGHT



City of Toronto

PREFERRED DISCOURAGED

The Tribute of Lights / Copyright (c) 2010 John de Guzman: http://johndeguzman.com

LIGHTING DESIGN

The built environment should be designed to minimize light pollution including: light trespass, over-illumination, glare, light clutter, and skyglow while using bird-friendly lighting colors when possible (*Poot et al. 2008*).

- → **Avoid uplighting**
- → **Avoid light spillage**
- → **Use green and blue lights when possible**

LIGHTING OPERATIONS

Unneeded interior and exterior lighting should be turned off from dusk to dawn during migrations: February 15 through May 31 and August 15 through November 30. Rooms where interior lighting is used at night should have window coverings that adequately block light transmission, and motion sensors or controls to extinguish lights in unoccupied spaces. Event searchlights are strongly discouraged during these times.

Several cities, including San Francisco, have launched citywide efforts to reduce unneeded lighting during migration. In addition to saving birds, these “Lights Out” programs save a considerable amount of energy and reduce pollution by reducing carbon dioxide emissions. The savings for a building can be significant. One participating municipal building in the Toronto Lights Out program reported annual energy reductions worth more than $200,000 in 2006.

Lights Out requires that building owners, managers, and tenants work together to ensure that all unnecessary lighting is turned off during Lights Out dates and times (during spring and fall migration February 15th through May 31st and August 15th through November 30th). Best practices for lighting include turning off unnecessary lights after dusk and leaving the lights off until dawn. If inside lights are needed, window coverings such as blinds or drapes should be closed.

LEFT: The white streaks are the time-exposed paths of birds attracted to, dazed by, and circling within the columns of light. Many succumbed to exhaustion and perished without completing their migration. Lights Out policies do not allow the use of searchlights during the Spring and Autumn migration periods for this reason.

III. Bird-Safe Requirements and Guidelines Across North America

When discussing human-caused threats to birds, the US Fish and Wildlife Service reports "that the incidental, accidental or unintentional take of migratory birds is not permitted by the Service and is a criminal violation of the Migratory Bird Treaty Act" but that the Service first attempts to work with industries and individuals who unintentionally cause bird death before pursuing criminal prosecution (*US Fish and Wildlife Service 2002*).

Several major cities are addressing the issue through local legislation.

- **Chicago:** In July of 2008, Cook County, Illinois, which includes Chicago, passed an ordinance requiring that all new buildings and major renovations incorporate design elements to reduce the likelihood of bird collisions. This ordinance established Chicago as the first major jurisdiction with a requirement for bird-safe elements. Other nearby local jurisdictions, such as Highland Park, are also following suit with new bird-safe architecture requirements.

- **Toronto:** This effort has evolved from voluntary ratings and incentive program to bird-friendly construction guidelines that became mandatory at the beginning of 2010. The bird-friendly guidelines were integrated into Toronto's local Green Development Standard, required for nearly all new construction. In addition, the City of Toronto offers an acknowledgement program that offers incentives to developers and building owners and managers who implement the Bird-Friendly Development Guidelines. Once a development has been verified by City staff as "bird-friendly", the City provides the owner with an original print by a local artist and the building may be marketed as "bird-friendly." A bird-friendly designation could give these buildings a competitive advantage by identifying these features to an increasingly environmentally concerned and aware marketplace. Toronto also has had great success with their Lights Out program which has been in effect since 2006. (See images on page 36.)

- **Minnesota:** As of 2009, the State of Minnesota requires that all state owned and leased buildings turn off their lights at night during migration. As of June, 2011, bird-safe building criteria are being developed for incorporation into the State of Minnesota Sustainable Building Guidelines.

- **Michigan:** Since 2006, the governor of Michigan has issued an annual proclamation, declaring "Safe Passage" dates during spring and fall migration, when buildings managers are asked to turn off lights at night.

- **Nationally:** In April 2011, Congressman Mike Quigley introduced a bill (*H.R. 1643*) into the U.S. Congress that, if passed, would mandate bird-friendly construction practices for federal buildings.

NY Bird-Safe Building Guidelines

IV. San Francisco's Bird-Safe Requirements

It is clear from studies done throughout the U.S. and Canada that certain building and landscape configurations can be especially dangerous to birds. These sites present heightened risks for collisions and necessitate requirements, which are included in Section 139 of the Planning Code, Standards for Bird-Safe Buildings.

NY Bird-Safe Building Guidelines

The following bird-safe measures apply in San Francisco.

Structure and/or siting characteristics that present the greatest risk to birds are called "bird-hazards" and include:

1 Location-related hazards

2 Building feature-related hazards

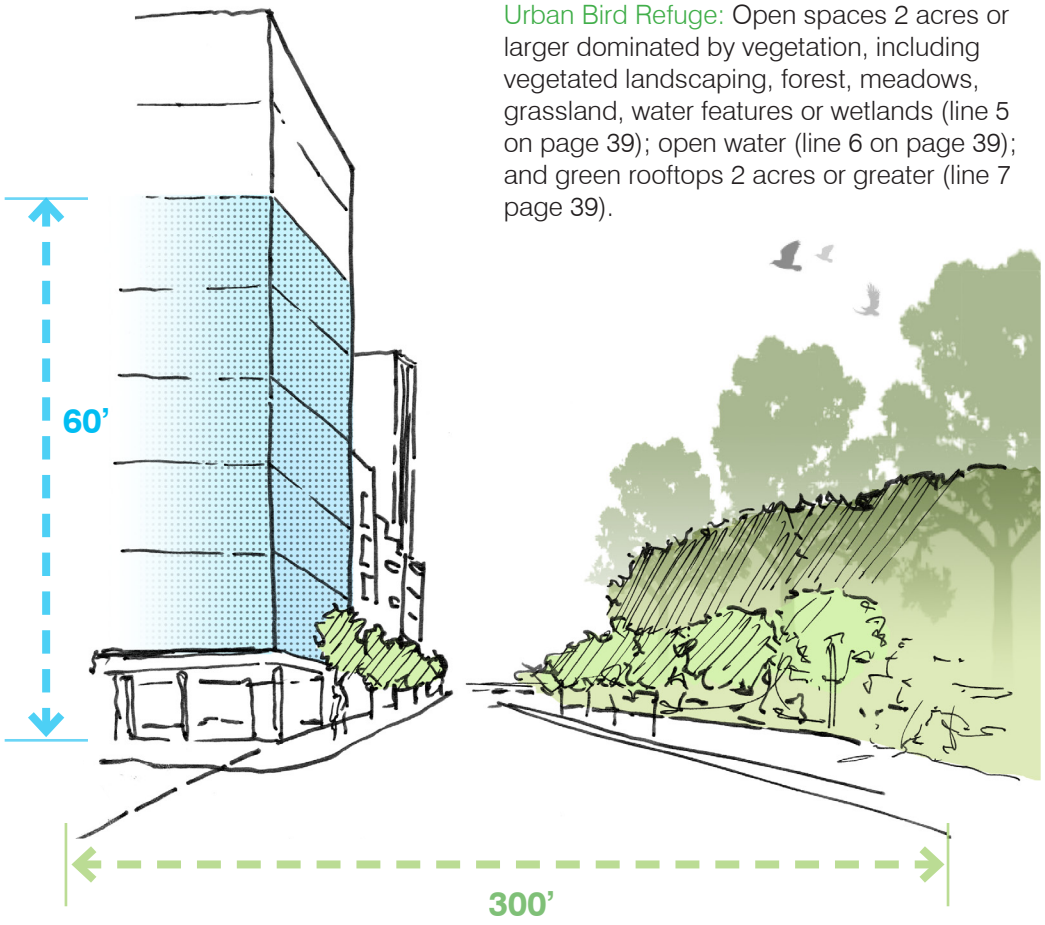
1 Requirements for Location-Related Hazards

What is a “location-related” hazard?

Location-Related Hazard: Buildings located inside of, or within a clear flight path of less than 300 feet from an Urban Bird Refuge (defined below) require treatment when:

- New buildings are constructed;
- Additions are made to existing buildings (Note: only the new construction will require treatment); or
- Existing buildings replace 50% or more of the glazing within the “bird collision zone” on the façade(s) facing the Urban Bird Refuge.

Bird Collision Zone: The portion of buildings most likely to sustain bird strikes. This area begins at grade and extends upwards for 60 feet. This zone also applies to glass façades directly adjacent to large landscaped roofs (two acres or larger) and extending upward 60 feet from the level of the subject roof.



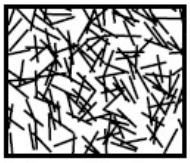
Urban Bird Refuge: Open spaces 2 acres or larger dominated by vegetation, including vegetated landscaping, forest, meadows, grassland, water features or wetlands (line 5 on page 39); open water (line 6 on page 39); and green rooftops 2 acres or greater (line 7 page 39).

What requirements apply to a “location-related” hazard?

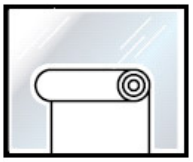
Treatment of Location-Related Hazards. Buildings located inside of or within a clear flight path from an Urban Bird Refuge shall implement the following applicable treatments for façades facing an Urban Bird Refuge.

- Façade Treatments: Bird-Safe Glazing Treatment is required such that the Bird Collision Zone consists of no more than 10% untreated glazing. Building owners are encouraged to concentrate permitted transparent glazing on the ground floor and lobby entrances to enhance visual interest for pedestrians.
- Lighting Design: Minimal lighting shall be used. Lighting shall be shielded. No uplighting shall be used. No event searchlights should be permitted for the property.
- Wind Generators: Sites should avoid horizontal access windmills or vertical access wind generators that do not appear solid.*

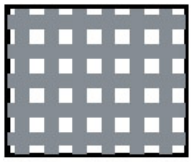
ABOVE: The California Academy of Sciences uses external screens 24 hours per day during spring and fall migration to reduce bird/building collisions.



Solution: Visual Noise



Solution: Use of plastic films, diachroic coatings and tints on facade



Solution: Screen / scrim / fritting

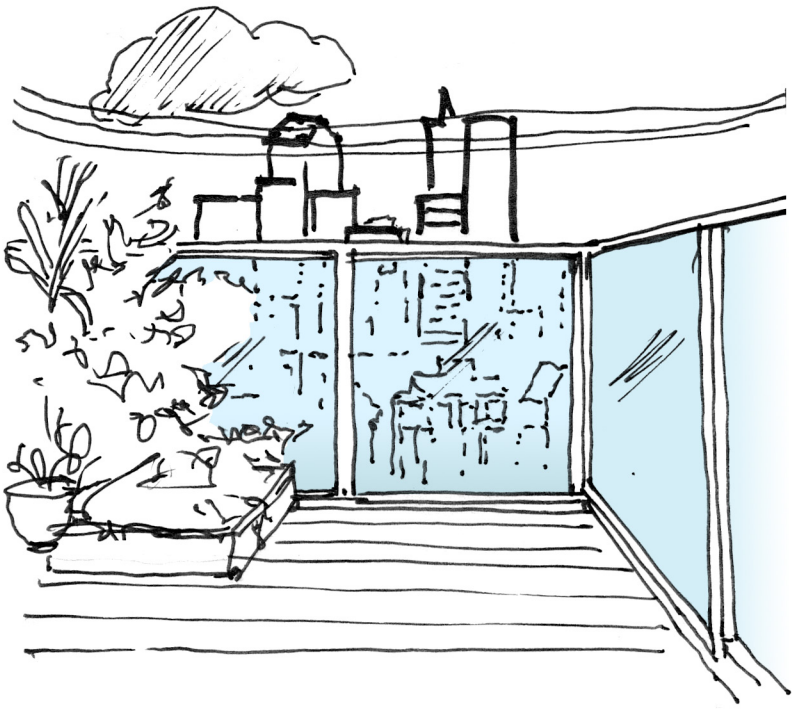
* The Planning Commission adopted a policy that would prohibit nonsolid or horizontal-axis wind generators via Resolution No. 18383. However, Ordinance No. 199-11, as adopted by the Board of Supervisors, does not expressly prohibit specific types of wind generators. Instead, the Planning Code requires that proposals for wind generation undergo individual project review to evaluate their specific risk to birds.

2 Requirements for Feature-Related Hazards

What is a “feature-related” hazard?

Building Feature-Related Hazard: Certain potential bird traps are hazardous enough to necessitate treatment, regardless of building location. A building-specific hazard is a feature that creates hazards for birds in flight unrelated to the location of the building. Building feature-related hazards include free- standing clear glass walls, skywalks, greenhouses on rooftops, and balconies that have unbroken glazed segments 24 square feet and larger in size. (See citywide bird-safe checklist, lines 19-22 on page 39). These features require treatment when:

- New buildings are constructed;
- Additions are made to existing buildings (Note: only the new construction will require treatment).



LEFT: These windows are an example of a feature-related hazard.

What requirements apply to a “featured-related” hazard?

Treatment of Feature-Related Hazards - Regardless of whether the site is located inside or adjacent to an Urban Bird Refuge, 100% of building feature-related hazards shall be treated.

Image courtesy of Lightsoutindy.org

LEFT: A transparent glass skywalk poses a “feature-related” hazard.

LEFT: This skywalk was intentionally treated with fritting by the Indiana Museum to avoid creating a “feature-related” hazard.

RIGHT: The fritting maintains transparency for pedestrians.

Images courtesy of Lightsoutindy.org

The Details: Exceptions and Specifications

Exceptions: Certain exceptions apply to the afore-mentioned controls.

1) Treatment of Historic Buildings. Treatment of replacement glass façades for structures designated as City landmarks or within landmark districts pursuant to Article 10 of the Planning Code, or any building Category I-IV or Category V within a Conservation District pursuant to Article 11 of the Planning Code, shall conform to Secretary of Interior Standards for Rehabilitation of Historic Properties. Reversible treatment methods such as netting, glass films, grates, and screens are recommended. Netting or any other method demonstrated to protect historic buildings from pest species that meets the Specifications for Bird-Safe Glazing Treatment stated above may also be used to fulfill the requirement.

2) Exceptions for Treatment of Location-Related Hazards for Residential Buildings within R-Zoned Districts.

→ *Limited Glass Façade:* Residential buildings less than 45 feet in height within R-Districts that have an exposed façade comprised of less than 50% glass are exempt from new or replacement glazing treatments, but must comply with feature-related and wind generation requirements below.

→ *Substantial Glass Façade:* Residential buildings within R-Districts that are less than 45 feet in height but have a façade with a surface area of more than 50% glass, must provide glazing treatments for location-related hazards such that 95% of all large, unbroken glazed segments that are 24 square feet and larger in size are treated.

3) Other Waivers or Modifications by the Zoning Administrator. The Zoning Administrator may either waive requirements for Location-Related Hazards or Feature-Related Hazards or modify the requirements to allow equivalent Bird-Safe Glazing Treatments based upon the recommendation of a qualified biologist.

Photo courtesy NY Audubon

A New York volunteer examining a window casualty.

Glazing Treatment Specifications: Bird-safe glazing treatment may include fritting, netting, permanent stencils, frosted glass, exterior screens, physical grids placed on the exterior of glazing or UV patterns visible to birds. To qualify as Bird-Safe Glazing Treatment, vertical elements of the window patterns should be at least 1/4 inch wide at a maximum spacing of 4 inches, or have horizontal elements at least 1/8 inch wide at a maximum spacing of 2 inches (*Klem 2009.*)

V. Recommended Actions and Bird-Safe Stewardship

Public Education and Outreach Partnerships

The Planning Department will partner with the Golden Gate Audubon Society to conduct outreach on bird-safe building practices. Staff will work collaboratively to increase awareness of bird/building issues, and disseminate educational materials on design and treatment options. A public education effort will proactively increase awareness of the issues and strive to make bird safety practices a part of the construction lexicon within this highly urbanized area. Developers, architects, planners, property owners, businesses, city residents and youth groups are encouraged to contact the Department about educational programs. Curriculum will include education about the standards for bird-safe buildings and exploring citizen involvement of monitoring bird/building collisions as well as general advocacy for bird conservation.

Photo courtesy Jessica Weinberg. http://www.jessicaweinberg.com/

Building Owner Bird-Safe Stewardship

Owners of new buildings and buildings proposing major renovations with a façade of greater than 50% glass are encouraged to evaluate their building against the Bird-Safe Building Checklist (pages 38-39) and provide future tenants with a copy of this document. Although requirements only apply to the most hazardous conditions, building owners and architects can become more aware of potential hazards and treatments. With the support of building owners who help educate future tenants, the people of San Francisco would become better educated about ways to enhance bird safety.

Building owners can help make their buildings safer by evaluating the risks of their buildings and retrofitting buildings with known hazards. Engaging in conservation measures outlined in this guide and granting access to collision monitoring groups help to address the issue and increase our understanding.

Encouraged Treatments

The following treatments are encouraged to enhance bird safety, in addition to meeting requirements:

- → Expanding treatment outside of the Bird Collision Zone: bird-safe treatments on building façades above the minimum height requirements.
- → Other window treatments: latticework, grilles and other devices, both functional and decorative, outside the glass or integrated into the glass spacing requirements;
- → Placement of trees or tall shrubs: should be located directly adjacent to glazing (with 3 feet) to slow birds down on approach, or placed far enough away to avoid reflecting canopies in the glazing.

Building Tenant Education

Some of the most effective treatments for making buildings bird-safe are those that require the cooperation of building owners and tenants. For this reason, the City should continue to use and should expand a “carrot”-based system to widely encourage participation in bird-safe efforts. San Francisco’s existing Lights Out for Birds Program seeks to educate residents and provide recognition of voluntary bird-safe measures. Since 2008, the City has urged building owners and managers to turn off unnecessary interior and exterior lights. Twenty-two of the City’s forty-four tallest buildings have been asked to participate.

To raise bird-awareness of building occupants, building owners may supply tenants with copies of this booklet. Building occupants can help make buildings bird-safe through the following good practices:

- → Interior plants should be moved so as not to be visible from the outside.
- → Consider limiting nighttime building use by combining motion operated light sensor with daytime cleaning services. This combination will reduce light pollution and increase energy conservation.
- → Where interior lighting is used at night, window coverings should be closed to block light transmission adequately.
- → Consider seasonal migration needs. Unneeded interior and exterior lighting should be turned off from dusk to dawn from February 15 through May 31 AND August 15 through November 30.

Photo by Robert Lewis

Greater Scaup

Photo by Robert Lewis

Western Sandpiper

Bird/Building Collision Monitoring

Project Safe Flight in Manhattan has collected and documented over 4,000 dead and injured birds since 1997. In 2009 the Chicago Bird Collision monitors recovered more than 6,000 dead or injured migratory birds from more than 100 different species. In Toronto, Fatal Light Awareness Program (FLAP) volunteers patrol Toronto's downtown core in the early morning hours rescuing live birds and collecting the dead ones since 1993. In the summer of 2010, the Oregon Zoo funded a six-week sunrise study of Portland's newest and tallest buildings where volunteers collected dead and injured birds. Audubon Minnesota has collected over 3000 birds of 110 species from monitoring efforts between 2007-2011.

Aside from regular collection of injured or dead migratory birds throughout the City by San Francisco Animal Care and Control staff and bird group volunteers, the only large bird/building monitoring program currently being conducted by the California Academy of Sciences, read more on page 14 (*Flannery 2011)*. Additional regular monitoring of the hazard in San Francisco is needed to help in the evaluation of local conditions and refinement of appropriate controls. Collaborations between building owners and bird-research groups should be encouraged to help increase our understanding of San Francisco's unique conditions. With the publication of this document, the City calls for more local research to help achieve the goal of better characterizing the problem on a local level, as well as for testing of new bird-safe technologies that could be utilized along with those that are already available.

CONTACT THE SAN FRANCISCO BIRD-STRIKE HOTLINE TO REPORT BIRD-STRIKES

Report injured birds found outside of buildings by emailing ***safebirds@goldengateaudubon.org*** or by calling **Golden Gate Audubon Society** at **(510) 843-6551** with the following information:

Date:

Time:

Address including cross streets:

Location details:

Species of bird, if known:

Male or female, if known:

Adult or juvenile bird, if known:

Condition of bird:

Did you see or hear the collision?
If so, please provide a description:

Weather:

Please email a photo of the bird and building, if possible. If the bird appears to be injured, call **San Francisco Animal Care and Control** at **(415) 554-9400** and record the date and time you called.

Photo by Eddie Bartley

A 2008 San Francisco pilot study discovered a Green Heron in the Downtown area. Further monitoring may reveal other unexpected neotropical migrants passing through the City's dense core.

Lights Out for Birds San Francisco

The Golden Gate Audubon Society, Pacific Gas and Electric Company and the San Francisco Department of the Environment administer "Lights Out for Birds – San Francisco." This voluntary program helps building owners, managers and tenants save energy and money while protecting migratory birds. Lights Out for Birds asks participants to turn off building lights during the bird migration (February through May and August though November each year).

"Participants in the Lights Out for Birds program can save natural resources, money, and birds by turning off lighting after dusk each evening and leaving lights off until dawn," said Mike Lynes, Conservation Director for Golden Gate Audubon. "Over 250 species of birds migrate through San Francisco in the spring and fall, and many that migrate at night can become confused by the City's lights and collide with tall buildings and towers. The Lights Out for Birds program can reduce bird deaths while cutting energy costs and saving participants thousands of dollars each year."

The North American Bird Conservation Initiative—a joint effort of federal agencies and nonprofit conservation organizations—released the "2009 State of the Birds" in which it reported that the majority of migratory birds in North America are suffering significant population declines due to human-induced causes, including habitat loss and collisions. In addition to window treatments to reduce daytime collisions, effective Lights Out programs can help stem these population declines.

Participants in the Lights Out for Birds program also gain significant financial benefits. Building operators and tenants have reported significant savings on energy bills as a result of participation—one business in Toronto reported a savings of $200,000 in 2006. In 2010 Mayor Gavin Newsom announced energy efficient retrofit funding for 2,000 small to mid-sized businesses and 500 homes. By installing timers or motion detectors and turning off unnecessary lights, building owners and operators can significantly reduce their energy bill. Reduced energy consumption decreases overall greenhouse gas emissions, which is essential in the effort to combat climate change.

San Francisco was one of the first cities to implement a Lights Out program in 2008. Now over 21 cities in the US and Canada have a Lights Out program. Conservationists hope that the program extends to every major city in North America, to save birds, energy and money.

Photos of 2008 Lights Out Toronto by Dick Hemingway via WWF-Canada.

Toronto's established Lights Out Program creates a dramatic change in the skyline appearance. As San Francisco's program spreads we should be able to see seasonal changes as our skyline lights up in non-migratory months and dims down during migration.

Building owners, managers and tenants interested in an energy evaluation and current rebates should contact the San Francisco Department of the Environment or a PG&E representative. For more information on how to participate in the program and to learn about local bird populations and how to help, contact the Golden Gate Audubon Society at (510) 843-6551.

PARTICIPANTS IN SAN FRANCISCO LIGHTS OUT FOR BIRDS

101 California Street
Allsteel Inc.
Barker Pacific Group, Inc.
New Resource Bank
Pacific Gas and Electric Company
San Francisco Department of the Environment
Tishman Speyer

ABOVE: Rescued thrush resting safely in the hand of a Chicago Bird Collision Monitor volunteer.

Photo: Willowbrook Wildlife Center
http://www.chicagoaudubon.org/imgcas/21-02/rescuedthrush.jpg)

Beyond Requirements: Voluntary Treatments and Acknowledgment

San Francisco building owners who implement Bird-Safe treatments are strongly encouraged to seek recognition under the City's new Bird-Safe Building Certification and Acknowledgement Program. Buildings which avoid creating hazards or implement bird-safe treatments as identified in this document would be acknowledged by the City and could be marketed as such. Three levels of certification will be offered:

Bird-Safe Building:
The building meets the minimum conditions for bird-safety. This level focuses on ensuring "bird-hazards" and "bird traps" are not created or are remedied with bird-safe treatments.

Select Bird-Safe Building:
The building meets all of the minimum requirements; commits to "lights out" practices during migratory seasons; reduces untreated glazing beyond the requirements; and commits to educating future building occupants.

Sterling Bird-Safe Building:
This is the highest level of Bird-Safe Building certification possible. The building meets all of the conditions of the other certification levels, plus the building reduces the amount of glass on the façade, avoids or treats additional hazards—beyond the requirements, and features year-round best management practices for lighting.

The program will be administered by the Planning Department. Buildings that qualify will be awarded plaques and public recognition through the City's website and outreach materials. To find out if your building qualifies for Bird-Safe Certification, fill out the attached Bird-Safe Building Checklist on pages 38-39 of this document and contact the Planning Department at (415) 558-6377.

VI. Bird-Safe Building Checklist

Use of this checklist: This checklist serves three purposes: 1) assessing risk factors and determining risks which must be addressed by the requirements; 2) increasing awareness of risk factors that are de minimis and don't require treatment; and 3) evaluating buildings for certification as a bird-safe building.

1 REQUIREMENTS FOR THE MOST HAZARDOUS CONDITIONS: The conditions that warrant special concern in San Francisco are designated by red-shaded boxes. These red boxes indicate prohibited building conditions or conditions which are only permitted if the glazing is installed with bird-safe glazing treatments. If the project combines a glass façade with a high-risk location ("location-related hazard", line 5-7), glazing treatments will be required for the façade(s) such that the amount of untreated glazing is reduced to less than 10% for the façade facing the landscaping, forest, meadow, grassland, wetland, or water. If a project creates a new bird-trap or "feature-related hazard" (lines 19-22) or remodels an existing feature-related hazard, bird-safe treatment will be required.

2 INCREASING AWARENESS: Owners of buildings with a façade of greater than 50% glass (lines 9 -10) are strongly encouraged to evaluate the building against the checklist and to help provide future tenants with copies of this guide. Use this checklist to evaluate design strategies for building new structures and retrofitting existing buildings throughout the City. This checklist summarizes conditions that could contribute to bird mortality and will help to identify the potential risks. Interested neighborhood groups and trade associations are encouraged to contact the Department for suggestions on how to proactively increase awareness of the issue and make bird safety practices a part of the construction lexicon.

3 VOLUNTARY RATINGS: Project sponsors interested in submitting a project for "Bird-Safe Certification" may use this form. The Department will partner with local artists to produce appropriate artwork and/or plaques to acknowledge those who actively seek to reduce bird collisions on their property. The ratings system will create tiers certification to recognize projects that meet minimum requirements as well as those projects that exceed the requirements.

RISK ASSESSMENT LEGEND:

Potential Risk Factors: These shade indicate factors that may present hazards to birds. Note: actual risks vary greatly depending upon building and site-specific variables.

GRAY: This shade indicates potential increased risk. NOTE: *The net assessment of total risk varies with the combination of building factors. While every building in San Francisco will present some element of risk to birds, only combinations with "red" boxes present a risk level necessitating bird-safe treatments.*

RED: This shade indicates prohibited conditions or conditions which are prohibited unless bird-safe treatment is applied.

CERTIFICATION LEGEND:

Bird-Safe Building Certification and Acknowledgement: Buildings which avoid creating hazards or which enhance bird safety with treatments identified as effective in this document would be acknowledged by the City and could be marketed as such. This document proposes three levels of certification by the City. Certification is determined by applying the checklist criteria.

By checking all of the boxes for one (or more) of these colors on the Bird-Safe Building Checklist (page 39), a building owner is eligible to apply to the Planning Department for Bird-Safe Building Certification.

YELLOW:
Bird-Safe Building
The building meets the minimum conditions for bird-safety. This level focuses on ensuring "bird-hazards" and "bird traps" are not created or are remedied with bird-safe treatments.

GREEN:
Select Bird-Safe Building
The building meets all of the minimum requirements; commits to "lights out" practices during migratory seasons; reduces untreated glazing beyond the requirements; and commits to educating future building occupants.

BLUE:
Sterling Bird-Safe Building
This is the highest level of Bird-Safe Building certification possible. The building meets all of the conditions of the other certification levels, plus the building reduces the amount of glass on the façade, avoids or treats additional hazards—beyond the requirements, and features year-round best management practices for lighting.

BIRD-SAFE BUILDING CHECKLIST

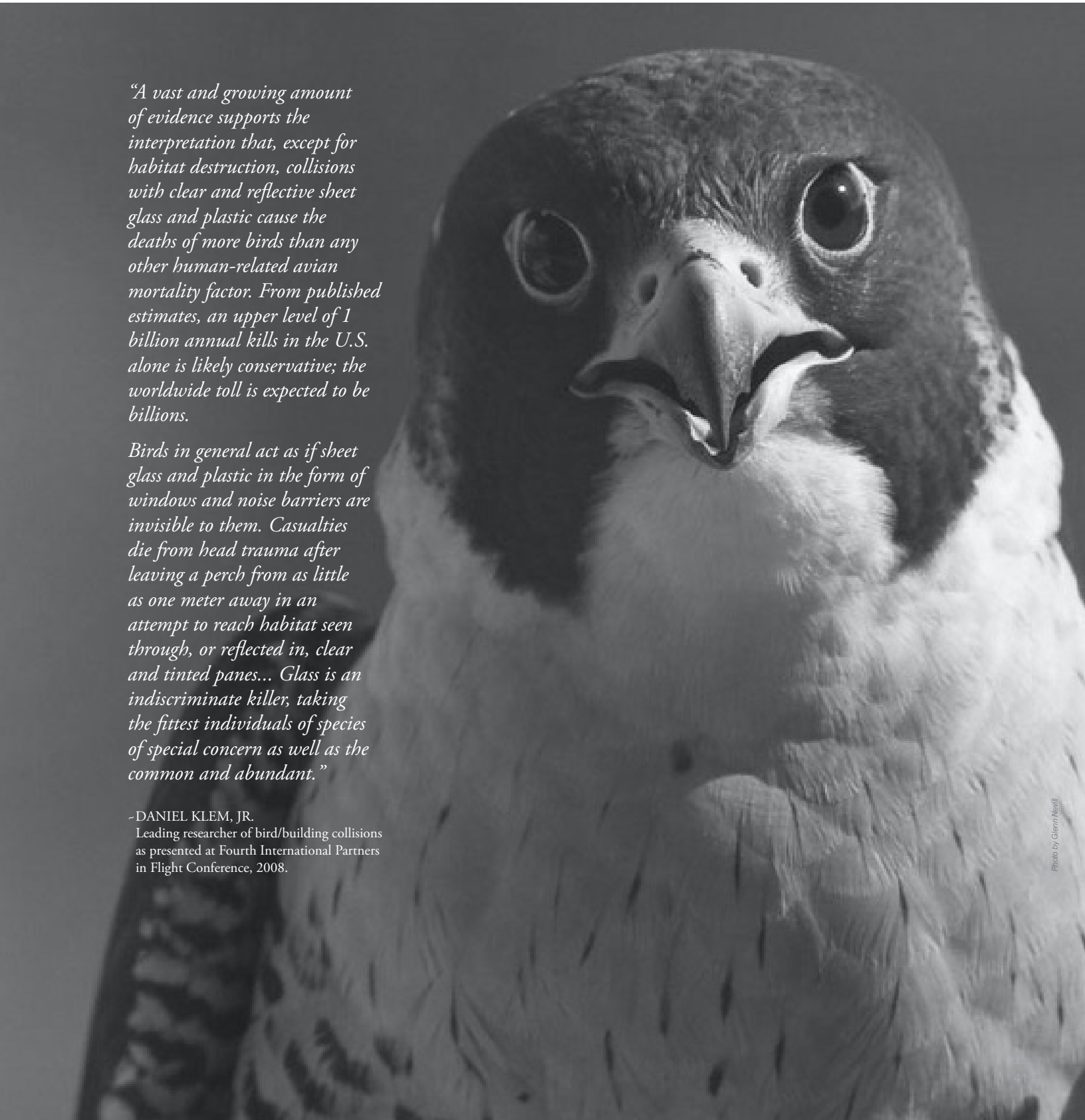
Using the key on the prior page, complete this checklist as a guide to help evaluate potential bird-hazards or eligibility for Bird-Safe Building Certification.

		QUESTION		YES	NO
MACRO-SETTING (PAGE 12, 16)	1	**Is the structure located within a major migratory route?** (All of San Francisco is on the Pacific Flyway)			
	2	**Is the location proximate to a migratory stopover destination?** (Within 1/4 mile from Golden Gate Park, Lake Merced or the Presidio)			
	3	**Is the structure location in a fog-prone area?** (Within 1/2 mile from the ocean or bay)			
MICRO-SETTING (LOCATION-RELATED HAZARD) (PAGES 13, 16, 28-29)	4	**Is the structure located such that large windows greater than 24 square feet will be opposite of, or will reflect interlocking tree canopies?**			
	5	**Is the structure inside of, or within a distance of 300 feet from an open space 2 acres or larger dominated by vegetation?** (Requires treatment of glazing, see page 28)			
	6	**Is the structure located on, or within 300 feet from water, water features, or wetlands?** (Requires treatment of glazing, see page 28)			
	7	**Does the structure feature an above ground or rooftop vegetated area two acres or greater in size?** (Requires treatment of glazing, see page 29)			
GLAZING QUANTITY (PAGE 8)	8	**Is the overall quantity of glazing as a percentage of façade:** (Risk increases with amount of glazing)	**Less than 10%?**		
			More than 50%? (Residential Buildings in R-Districts must treat 95% of unbroken glazed segments 24 square feet or greater in size if within 300 feet of an Urban Bird Refuge.)		
	9	**Will the glazing be replaced?**	**More than 50% glazing to be replaced on an existing bird hazard (including both feature-related hazards as described in lines 19-22 and location-related hazard as described in lines 4-7)?** (Requires treatment see pages 29 and 31.)		
GLAZING QUALITY (PAGE 6, 7)	10	**Is the quality of the glass best described as:**	**Transparent** (If so, remove indoor bird-attractions visible from outside the windows.)		
	11		**Reflective** (If so, keep visible light reflectance low (between 10-20%) and consider what will reflect in the windows. Note: Some bird-safe glazing such as fritting and UV spectrum glass may have higher reflectivity that is visible to birds.)		
	12		**Mirrored or visible light reflectance exceeding 30%.** (Prohibited by Planning Code.)		
GLAZING TREATMENTS (PAGE 18-21)	13	**Is the building's glass treated with bird-safe treatments such that the "collision zone" contains no more than 10% untreated glazing for identified "location-related hazards" (lines 4-7) and such that 100% of the glazing on "feature-related hazards" (lines 19-22) is treated?**			
	14	**Is the building's glass treated for required "bird hazards" (as described in line 13) *and* such that no more than 5% of the collision zone (lower 60') glazing is untreated but not for the entire building?**			
	15	**Is the building glazing treated (as described above in lines 14 and 15) *and* such that no more than 5% of the glazing on the exposed façade is left untreated?**			
BUILDING FAÇADE GENERAL (PAGE 8, 13)	16	**Is the building façade well-articulated (as opposed to flat in appearance)?**			
	17	**Is the building's fenestration broken with mullions or other treatments?**			
	18	**Does the building use unbroken glass at lower levels?**			
BUILDING FEATURE-RELATED HAZARDS AND BIRD TRAPS (PAGE 8, 30-31)	19	**Does the structure contain a "feature-related" hazard or potential "bird trap" such as:**	**Free standing clear-glass walls, greenhouse or other clear barriers on rooftops or balconies?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	20		**Free standing clear-glass landscape feature or bus shelters?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	21		**Glazed passageways or lobbies with clear sight lines through the building broken only by glazing?**		
	22		**Transparent building corners?**		
LIGHTING DESIGN (PAGE 10, 25)	23	**Does the structure, signage or landscaping feature uplighting?** (Prohibited within 300 feet of an Urban Bird Refuge)			
	24	**Does the structure minimize light spillage and maximize light shielding?**			
	25	**Does the structure use interior "lights-out" motion sensors?**			
	26	**Is night lighting minimized to levels needed for security?**			
	27	**Does the structure use decorative red-colored lighting?**			
LIGHTING OPERATIONS (PAGE 12, 24-25)	28	**Will the building participate in San Francisco Lights Out during the migration seasons?** (February 15-May 31 and August 15- November 30th) To achieve "sterling" certification the building must participate in year-round best management practices for lighting.			
OTHER BUILDING ELEMENTS (PAGE 23)	29	**Does the structure feature rooftop antennae or guy wires?**			
	30	**Does the structure feature horizontal access wind generators or non-solid blades?**			
CONSENT (PAGE 34)	31	**Does the building owner agree to distribute San Francisco's Bird-Safe Building Standards to future tenants?**			

Authorized Signature X _____ **Date:** _____

From City of Toronto Green Development Standard: "Bird-Friendly Development Guidelines."

Some of the birds killed by building collisions and collected during one migration season in Toronto's Financial District.



"A vast and growing amount of evidence supports the interpretation that, except for habitat destruction, collisions with clear and reflective sheet glass and plastic cause the deaths of more birds than any other human-related avian mortality factor. From published estimates, an upper level of 1 billion annual kills in the U.S. alone is likely conservative; the worldwide toll is expected to be billions.

Birds in general act as if sheet glass and plastic in the form of windows and noise barriers are invisible to them. Casualties die from head trauma after leaving a perch from as little as one meter away in an attempt to reach habitat seen through, or reflected in, clear and tinted panes... Glass is an indiscriminate killer, taking the fittest individuals of species of special concern as well as the common and abundant."

~DANIEL KLEM, JR.
Leading researcher of bird/building collisions as presented at Fourth International Partners in Flight Conference, 2008.

Photo by Glenn Nevil

NOTES / LITERARY CITATIONS

1. Banks, Richard. 1979. *Human Related Mortality of Birds in The United States*. United States Department of the Interior Fish and Wildlife Service. Special Scientific Report--Wildlife No. 215.

2. Bower, Joe. 2000. *The Dark Side of Light*. Audubon. Vol. 102(2): 92-94.

3. DeVore, Sheryl. April 13, 2011. Migratory Birds Run Afoul of Green Buildings. Chicago Tribune.

4. Eisenberg, Anne. 2010 *Warning to Birds: All-Glass Buildings Ahead.* New York Times. Aug. 28, 2010.

5. Flannery, Maureen. 2011. California Academy of Sciences. personal correspondence and interview.

6. Gelb, Yigal; Nicole Delacretaz. 2009. *Windows and Vegetation: Primary Factors in Manhattan Bird Collisions*. Northeastern Naturalist. 16(3):455-470.

7. Hager, Stephen, B., Heidi Trudell, Kelly J. McKay, Stephanie M. Crandall, and Lance Mayer. 2008. *Bird Density and Mortality at Windows*. The Wilson Journal of Ornithology. 120(3):550-564.

8. Kay, Jane. February 23, 2009. *San Francisco is a Bird Watcher's Paradise*. San Francisco Chronicle.

9. Knee, Karen. August 3, 2009. *Fatal Impact*. The Philadelphia Inquirer.

10. Klem, D. Jr. February, 1990. *Collisions Between Birds and Windows: Mortality and Prevention.* Journal of Field Ornithology. 61(1): 120-128.

11. Klem, D. Jr. February, 2009. *Avian Mortality At Windows: The Second Largest Human Source of Bird Mortality on Earth*. Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics. 244-251.

12. Klem, D. Jr., Christopher Farmer, Nicole Delacretaz, Yigal Gelb, Peter Saenger. 2009. *Architectural and Landscape Risk Factors Associated with Bird-Glass Collisions in an Urban Environment*. The Wilson Journal of Ornithology. 121(1):126-134.

12. Klem, D. Jr. 2011. Personal correspondence and interview.

13. Kousky, Carolyn. 2004. *A Building Less Bright.* Terrain Issue 15. Retrieved from: http://www.terrain.org/articles/15/Kousky.htm on 9/15/10.

14. Longcore, Travis, Ph.D. et al. February, 2005. *Scientific Basis to Establish Policy Regulating Communications Towers to Protect Migratory Birds*. WT Docket No. 03-187, Federal Communications Commission Notice of Inquiry.

15. McAdams, E. J. December 2003. *Rebuilding Lower Manhattan: A Bird's-Eye View.* Presented by New York City Audubon to the Lower Manhattan Development Corporation. Retrieved from: www.yigalgelb.com/site/pdf/ProjectSafeFlightBackgroundInfo.doc on 4/22/11.

16. O'Connell, Timothy. Fall 2001. *Avian Window Strike Mortality at a Suburban Office Park.* The Raven. Vol. 72(2): 141-149.

17. Ogden, Lesley, J. September, 1996. *Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds.* A Special Report for the World Wildlife Fund Canada and the Fatal Light Awareness Program.

18. Poot, H., B. J. Ens, H. de Vries, M. A. H. Donners, M. R. Wernand, and J. M. Marquenie. 2008. *Green Light for Nocturnally Migrating Birds.* Ecology and Society 13(2): 47. Retrieved from: http://www.ecologyandsociety.org/vol13/iss2/art47/ on 9/15/10.

19. Scriber, Brad. 2008. "*Light Pollution", "Ecological Light Pollution", "Got Milky Way", "Getting Back in Black", "Nighttime Savings", and "Lights and Safety"*. Nat. Geographic Magazine (October 17, 2008). Retrieved from: http://ngm.nationalgeographic.com/geopedia/Light_Pollution on 9/28/10.

20. Sheppard, Christine. 2010. American Bird Conservancy. Personal correspondence and interview.

21. Sheppard, Christine. 2011. American Bird Conservancy. Email correspondence.

22. Smallwood, K. Shawn. 2010. *Fatality Rates in the Altamont Pass Wind Resource Area 1998-2009.* Retrieved at: http://www.altamontsrc.org/alt_doc/p145_smallwood_fatality_monitoring_results_12_31_09.pdf on 9/29/10.

23. United States Fish and Wildlife Service. January 2002. *Migratory Bird Mortality: Many Human-Caused Threats Afflict Our Bird Populations*.

24 Weeden, Noreen. October 2010. Golden Gate Audubon Society. Personal correspondence.

SAN FRANCISCO
PLANNING
DEPARTMENT

FOR MORE INFORMATION:
Call or visit the San Francisco Planning Department

Central Reception
1650 Mission Street, Suite 400
San Francisco CA 94103-2479

TEL: **415.558.6378**
FAX: **415.558.6409**
WEB: **http://www.sfplanning.org**

Planning Information Center (PIC)
1660 Mission Street, First Floor
San Francisco CA 94103-2479

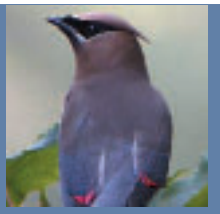
TEL: **415.558.6377**

Planning staff are available by phone and at the PIC counter. No appointment is necessary.

City of Toronto
Green Development Standard

March 2007

BIRD-FRIENDLY DEVELOPMENT GUIDELINES



City of Toronto Green Development Standard

BIRD-FRIENDLY DEVELOPMENT GUIDELINES

List of Participants

The City of Toronto would like to thank the following participants for their assistance in developing the Bird-Friendly Development Guidelines:

Cadillac Fairview Corporation Limited
Canadian Peregrine Foundation
Canadian Wildlife Service (CWS)
Daniel Klem Jr., Professor, Department of Biology Muhlenberg College, Allentown, Pennsylvania
Fatal Light Awareness Program (FLAP)
John Robert Carley, Architect Incorporated
Lights Out Toronto! Stakeholder Working Group
Monarch Corporation
Oxford Properties Group
Tom Bolton, Professor, David Dunlap Observatory, University of Toronto, Toronto, Ontario
Toronto Hydro Corporation

Illustrations provided by Jason W. Harris, Master's (Planning) Candidate in the Faculty of Environmental Studies, York University
Photographs used with permission.
www.toronto.ca/lightsout www.toronto.ca/environment/greendevelopment.htm
March 2007

Fatal Light Awareness Program FLAP TORONTO LIGHTS OUT TORONTO!

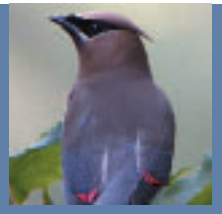


Photo: Mark K. Peck

INTRODUCTION

- Background
- Need for Policy and Action
- Policy Context
- Relevance to New, Existing and Heritage Buildings

The goal of these Bird-Friendly Development Guidelines is to prevent the needless deaths of migratory birds by suggesting ways to mitigate the dangers buildings pose to them.

A portion of dead migratory birds collected in Toronto's Downtown Financial District by the Fatal Light Awareness Program (FLAP) during one migration season.
An estimated minimum of one million migratory birds die each year in Toronto due to collision with buildings.
Photo: Mark Thiessen, National Geographic Photographer

Introduction

Background

These Bird-Friendly Development Guidelines are part of the Migratory Bird Policies adopted by City Council in January 2006. They are the result of an initiative taken by City Council on April 12, 13 and 14, 2005 when it adopted Motion J(17) regarding the "Prevention of Needless Deaths of Thousands of Migratory Birds in the City of Toronto". In addition to developing the Bird-Friendly Development Guidelines, the City of Toronto launched "Lights Out Toronto!", a public awareness campaign aimed at drawing attention to this issue and to ways that individuals, businesses, property owners and managers can help reduce migratory bird deaths. This annual campaign will coincide with the spring and fall migratory seasons. The City is also participating in the rescue, rehabilitation and release of injured migratory birds. In City-owned buildings, a 'lights-out' policy for after work hours and on weekends has been in place since 2005.

Birds exist naturally in urban areas, with some species becoming particularly adept at living in cities. These year round resident birds include pigeons, gulls, cardinals, House Sparrows and European Starlings. During the two annual migration periods, the resident bird population experiences a significant influx of migratory birds.

Eastern Kingbird
Photo: Mark K. Peck

These are birds observing their annual cycle of migration north in the spring to their summer breeding grounds and south in the fall to warmer regions where they spend the winter. Most migratory bird species are unable to adapt to living in cities. During their biannual flyovers they become confused by the combination of light pollution and the effects of glass in the urban environment. This often results in significant numbers of birds colliding with buildings.

WHEN DO BIRDS MIGRATE?
Spring Migration: mid-March to early June
Fall Migration: mid-August to early November

Bird 'collisions' or 'strikes' are a result of a variety of causes. Daytime strikes occur because birds cannot perceive images reflected in glass as reflections, and thus will fly into windows that they think are trees or sky. Clear glass also poses a danger as birds

Black-throated Green Warbler
Photo: Carol L. Edwards

(like humans) have no natural sense designed to perceive clear glass as a solid object. Birds will strike clear glass while attempting to reach habitat and sky seen through corridors, windows positioned opposite each other in a room, ground floor lobbies, glass balconies or where glass walls meet at corners. The impact of striking a reflective or clear window in full flight often results in death. While bird strikes occur throughout the year, they rise dramatically during the annual spring and fall migrations because many species of migratory birds travel at night. A combination of light from the moon and stars and geomagnetic signals from the earth provide natural cues for direction. Light pollution from urbanized areas obscures the light from the moon and stars. It is suspected that red light, commonly used on towers and other tall structures, interferes with birds' ability to track geomagnetic cues.

The light emitted from urban areas disorients migrating birds and draws them into brightly lit downtown areas, hence the term "fatal light attraction". Disoriented birds will often fly around until exhausted and drop to the ground or they may strike a building or window and fall to the pavement below. If they survive the fall, they must contend with predators (such as gulls) that have learned that this is a ready food source. If not eaten, then they are trapped within the unfamiliar built environment. At this point they frequently injure themselves while trying to seek shelter by flying into the glass surfaces of brightly lit ground level lobbies decorated

NEED FOR POLICY AND ACTION

Many of North America's migratory bird species are facing significant population decline.

Habitat loss, pesticide use, climate change and collisions with buildings and structures all contribute to this decline. As recorded by FLAP, of the 158 different species known to have been killed in Toronto by collision with buildings, at least 64 are classified as in decline. Millions of migratory birds are killed in North America each year as a result of collisions with buildings. Making the city safer for migratory birds will enhance the natural biodiversity with our urban environment and help reduce the decline in North American bird populations.

Birds are essential to a healthy ecology: they consume billions of insects daily, pollinate plants and disperse seeds. The beauty and diversity of birds also greatly enhance our experience of nature. They also contribute significantly to our economy as bird-watching has become the second most popular leisure activity in North America, after gardening.

One of the key ways to reduce migratory bird deaths is to reduce light pollution, which will also result in energy savings, lower building operating costs and reduced greenhouse gas emissions. By implementing bird-friendly development guidelines, Toronto's environment will be a safer and healthier place for both human and bird populations.

Peregrine Falcon
Photo: Canadian
Peregrine Foundation

with large trees and or plants. Not perceiving the invisible barrier, birds will fly towards the illuminated vegetation for safety and subsequently hit the glass. In poor weather at night during rainy, overcast and/or foggy conditions, the numbers of disoriented birds colliding with buildings are at their highest as the natural cues birds use to migrate are further obscured.

Urban night lighting attracts birds and poor weather traps them, which increases the density of migratory birds in urban areas. The increased density of migratory birds in the unfamiliar urban environment results in an increased number of bird collisions in subsequent daylight hours.

POLICY CONTEXT

The City of Toronto Official Plan

The City's Official Plan states that 'the natural environment is complex. It does not recognize boundaries and there are limits as to the stresses resulting from human activity that it can absorb.' It also asserts that 'environmental concerns must also be part of our everyday decision-making because interaction with the environment is constant.' In keeping with this policy objective, these Bird-Friendly Development Guidelines provide strategies for reducing the stress that the urban environment exerts on migratory bird populations, thereby enhancing the natural biodiversity found within Toronto.

The Toronto "Green Development Standard"

These Bird-Friendly Development Guidelines are part of the City of Toronto "Green Development Standard". This 'made in Toronto' Green Development Standard is intended to improve the overall quality of life in Toronto by encouraging sustainable site development to a standard that will increase energy efficiency, improve water quality, improve air quality, reduce greenhouse gas emissions, reduce waste and protect the urban forest and wildlife habitat. A 'bird-friendly' building is considered a component of a 'green development'.

The Natural Heritage System and Inventory

The natural heritage system is an evolving policy initiative that identifies and integrates significant natural features and functions within Toronto. The City of Toronto and the Toronto and Region Conservation Authority have identified and developed an inventory of components within the natural heritage system and have provided strategic direction for improving the natural ecosystem and increasing local biodiversity. The natural heritage system is illustrated on Map 9 of the City of Toronto's Official Plan. When development is proposed on or near lands shown as part of the natural heritage system, the proposed development's effect on the system is to be evaluated and an impact study may be required. The role of migratory bird routes in the natural heritage system is an important component of this inventory.

American Robin
Photo: Mark K. Peck

Cedar Waxwing
Photo: Mark K. Peck

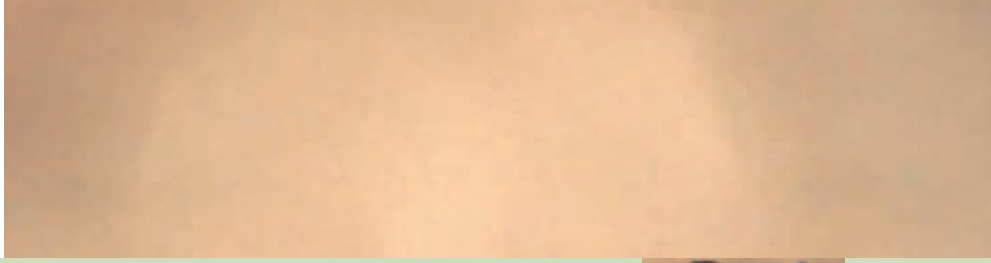
Relevance to New, Existing, and Heritage Buildings

These guidelines are intended to provide a list of design-based development strategies available to developers, building managers and owners, architects, landscape architects, urban designers and professional planners wishing to make new and existing buildings less dangerous to migratory birds. The specific context of each development will influence the strategies selected. These strategies may be applied to any type of development including high and low-rise residential, commercial, industrial and institutional projects.

For new developments, the developer will choose to incorporate some or all of the possible strategies. Consideration of bird-friendly features should be incorporated into the design process, beginning with the initial design concept and ultimately carrying through to the Site Plan.

For existing buildings, the viability of options will depend on the design of the existing building and site. Some options will be easier to implement than others.

These guidelines can also apply to heritage buildings in the City. Heritage buildings pose a particular challenge as the historical integrity of the building's design must be maintained. The strategies available to building owners and managers of existing heritage buildings wishing to implement bird-friendly options may be somewhat limited by these factors. Nevertheless, they are still strongly encouraged to participate wherever possible.



DESIGN-BASED DEVELOPMENT STRATEGIES FOR BIRD-FRIENDLY BUILDINGS

- Glass
- Visual Markers
- Strategies for Creating Visual Markers
- Strategies for Muting Reflections

Photo: Carol L. Edwards

Appropriate window applications for the first 12 metres above grade are essential for a building to be considered bird-friendly.

Hazard: Habitat reflected in untreated reflective glass is an extreme hazard. Treatment of these windows would make them bird-friendly.
Photo: FLAP

Design-based Development Strategies for Bird-Friendly Buildings

Glass

Creating Visual Markers and Muting Reflections

Natural features in the wild do not reflect images in the way glass does, rather they project 'visual markers' to birds, indicating to them that they are solid objects to be avoided.

There are two means of mitigating the danger glass poses to birds. The first and far more effective approach is to create visual markers. The second and less effective strategy is to mute reflections in glass.

These Bird-Friendly Development Guidelines offer examples and strategies to create visual markers and mute reflections in glass features of buildings. Applying these solutions to an entire building is ideal. However, the key critical area is the first 12 metres above grade. Window applications to the first 12 metres are essential for a building to be considered bird-friendly (these dimensions relate to the typical city tree heights).

White-throated Sparrow
Photo: Carol L. Edwards

This will be subject to the specific building design and site condition. For instance, if the site is close to a natural area such as a ravine or woodlot or other natural feature where the majority of the vegetation is generally higher than 12 metres, glass treatments in these areas should be applied to the height of the top of the surrounding tree canopy or the anticipated height of the surrounding vegetation at maturity. Similarly, for elevated landscapes such as podium gardens and green roofs, glass adjacent to or in the vicinity of these elements should be made bird-friendly.

Visual Markers

Birds begin to perceive buildings as objects to be avoided when the distances between features or patterns on glass is at approximately 28 cm, with the most effective pattern distance at 10 cm or less. Essentially, the denser the pattern the more effective it becomes in projecting itself as a solid object to birds.

Visual Markers – The denser the pattern in the design of the exterior, the more effective a building becomes in projecting itself as a solid object to birds.

This is a good example of a building that projects sufficient visual markers for birds to perceive as a solid object. Very few dead and injured birds are found at this facade.
Photo: FLAP

Strategies for Creating Visual Markers

Patterned or 'Fritted' glass

Patterned or 'fritted' glass has an image or abstract pattern embedded in it. By using dots of various sizes and densities, manufacturers can create any kind of image, translucent or opaque. The image in the glass then projects enough visual markers to be perceived by birds. Only non-reflective glass should be used in combination with fritted patterns.

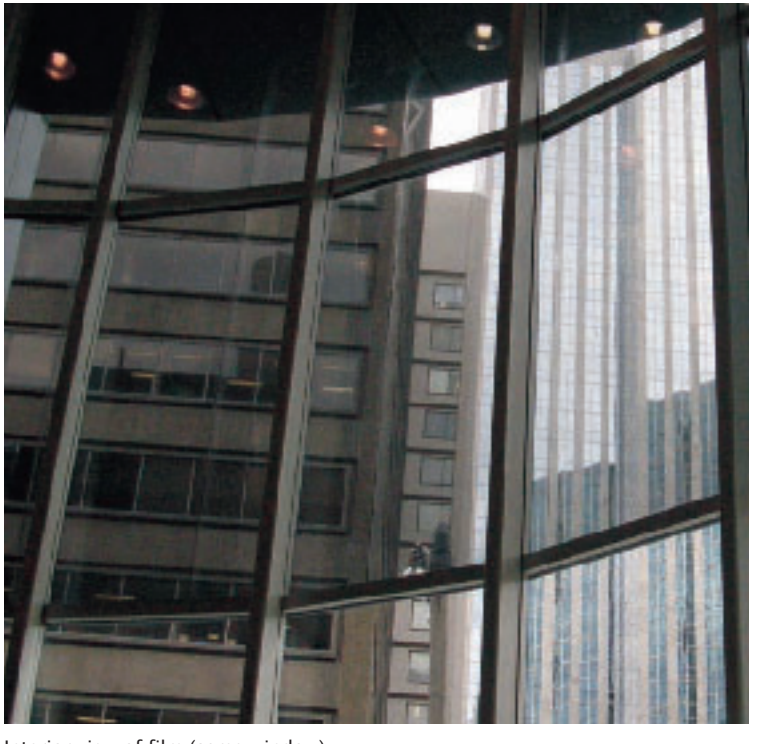
Hazard: Linkways are especially dangerous to birds as they will attempt to reach the habitat located beyond the glass. Glass treatments are strongly encouraged for these elements.
Photo: FLAP

Patterned glass with an embedded, decorative image.
Photo: Kelly Snow

Film

Patterns can also be applied to existing glass through the use of film products. Applied to external surfaces, including windows, film products can be designed with any image or pattern. Film laminates are often applied to downtown buildings for other purposes, such as security or advertising. Often these products are applied to transit vehicles for advertising purposes. On buildings, the film need not advertise particular products and could be integrated with the architectural design of the building.

Exterior view of film
Photo: FLAP



Interior view of film (same window)
Photo: FLAP

Decals

A pattern of decals applied externally can also create enough visual markers. However, if decals are used, a pattern with clear spaces of no more that 28 cm is required in order for the use of decals to be considered bird-friendly.

Externally-applied patterned decals can create sufficient visual markers for the glass to be perceived by birds
Photo: Allan Turner

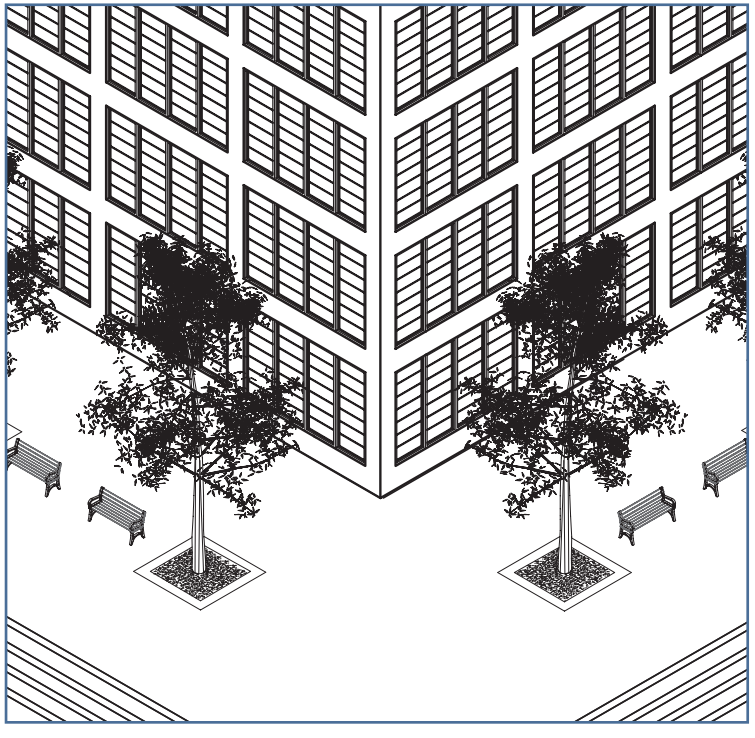
Fenestration Patterns

Multiple paned glass is an effective source of visual markers. The vertical and horizontal mullions create an image that is visible to birds, as long as the panes conform to the optimal range of 28 cm to 10 cm or less, with the smaller distances being more effective.

Fenestration patterns within glass
Photo: FLAP

Decorative Grilles and Louvres

Exterior decorative grilles are another means of projecting visual markers to birds. Exterior decorative grilles can serve as a bird-friendly development feature as long as they are within the optimal range of 28 cm to 10 cm or less, with the smaller distances being more effective.



Decorative Exterior Grille
Photo: FLAP

Artwork

Similarly, artwork installed on the interior or exterior of windows may provide enough visual markers for birds to perceive the glass as a solid object while allowing enough natural light into the interior space.

Exterior artwork
Photo: FLAP

Creative Design Solutions and Opportunities

Opportunities may exist for developments to explore design solutions for glass that address these Bird-Friendly Development Guidelines and the City's Percent for Public Art Guidelines. By thinking about these guidelines in combination at the conceptual stage, a development may successfully address, in part, some objectives of City Planning's Public Art Program and the goal of the Bird-Friendly Development Guidelines.

Emerging Technologies

Birds are able to perceive ultraviolet (UVA-A) light. Currently, there are glass products under development that either reflect or absorb UV wavelengths (ranging from 300 - 400 nanometers), that birds can see but humans cannot, which would enable a window to be clear and/or reflective to the human eye but appear solid to a bird's.

Also, photovoltaic panels can be incorporated into windows where photovoltaic vision glass substitutes a thin-film, semi-transparent photovoltaic panel for the exterior glass panel in an otherwise traditional double-pane glass window or skylight. These panels can be designed in such a way as to generate enough visual markers for birds to perceive windows as solid objects while also producing renewable energy.

The research of such technologies is supported in principle by the City of Toronto. If such products were to come to market, the City would consider them as acceptable bird-friendly design options.

Strategies for Muting Reflections

Angled glass

Angling glass panes in such a way as to project reflected images downward is a fairly effective way of reducing bird strikes, especially at ground level. Angles become effective at a minimum angle of 20 degrees with 40 degrees known to be more effective.

Angled glass
Photo: FLAP

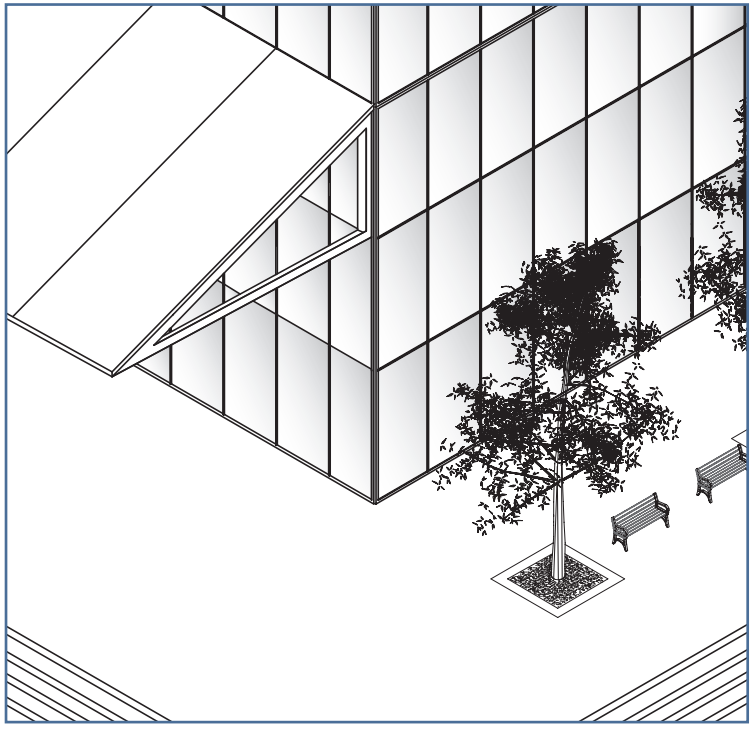
Internal Screens

Installation of internal screens may provide enough visual markers through non-reflective glass for birds to perceive windows as solid objects. To be most effective, they must be installed as close to the glass as possible so as to maximize the visual markers projected through the window.

Internal screens
Photo: FLAP

Awnings and Overhangs

Awnings and overhangs will cover windows in ground floor lobbies and mute image reflections in them. They can take on a variety of creative forms.



Sunshades

Sunshades are external features designed to reduce direct sunlight into a room while allowing indirect light, thus reducing the demands on cooling systems. They have many variations and can be incorporated into the design of a building in many interesting and creative ways. Sunshades mute the reflections in glass windows thereby reducing the likelihood of birds flying into them.

Detail of ceramic fritted glass sunshades
Photo: Teri Meyer Boake

LIGHT POLLUTION

- External Lighting Fixtures
- Types of Lighting
- Preferred Lighting
- Discouraged Lighting

Photo: Mark K. Peck

A “bird’s eye view” of Toronto at night.

Toronto at night
Photo: Vince Pietropaolo

Light Pollution

Light pollution creates “artificial sky glow”, which is an issue not just for migratory birds, but for people as well.

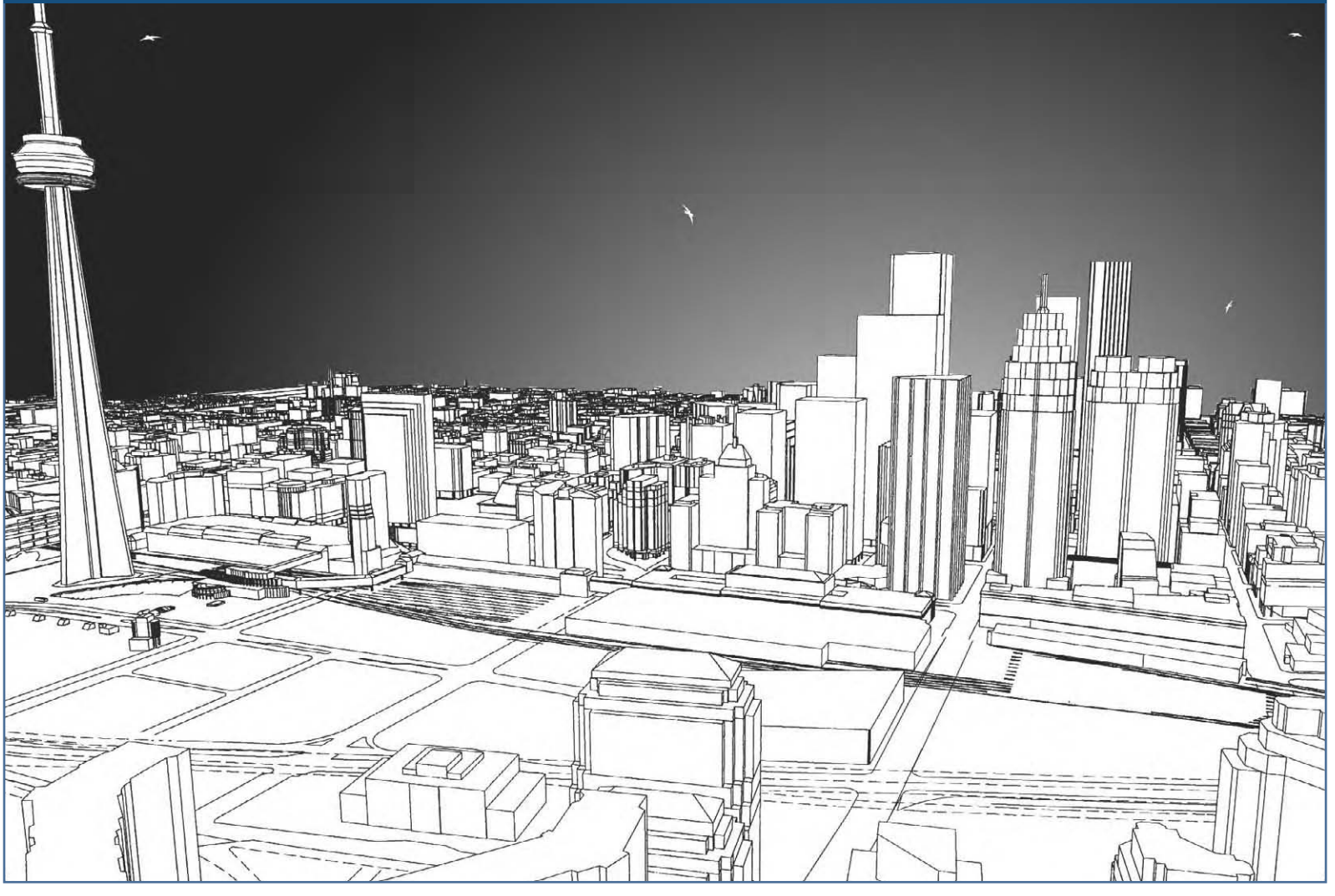
Reducing light pollution will not only reduce the needless deaths of hundreds of thousands of migratory birds each year, it will save energy, enhance the visibility of the night sky’s stars, and improve security and safety for people and property through the use of efficient, properly designed lighting fixtures.

Artificial sky glow is the unnatural brightening of the night sky through excessive and unnecessary light, which is wasted energy, hence the term “light pollution”. Light pollution is caused by inefficient and poorly designed lighting fixtures that project light upward. It is also a result of lights left on unnecessarily in and around buildings, excessive use of vanity lighting, excessively-lit advertising fixtures and festival lighting.

Yellow Warbler
Photo: Mark K. Peck

Light pollution in North America

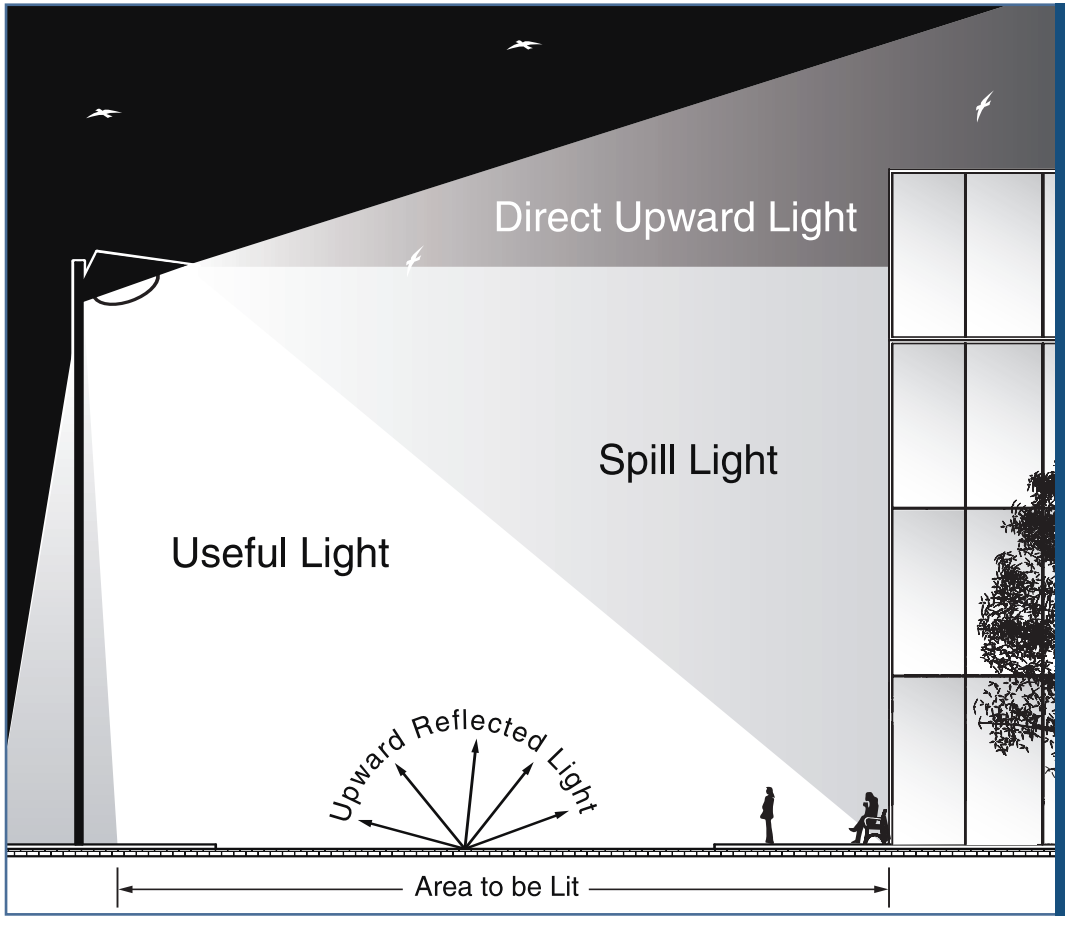
Artificial sky glow is the unnatural brightening of the night sky through excessive and unnecessary light, which is wasted energy, hence the term “light pollution”.



External Lighting Fixtures

Inefficient external lighting is a significant source of light pollution.

For a building to be bird-friendly, light pollution from external lighting must be minimized. This can be achieved by implementing several design features and operational practices related to vanity and architectural lighting, site lighting, lighting for advertising, event and festival lighting.



THE OBJECTIVES ARE TO:

- **Eliminate direct upward light**
  Direct upward light is projected directly upward by inefficient lighting fixtures.

- **Reduce spill light**
  Spill light spills beyond areas that need to be lit for safety and security reasons but is not projected directly upward.

- **Optimize useful light**
  Useful light is used to illuminate urban areas that need to be lit for safety.

Types of Lighting

External lighting used to illuminate the surrounding site of a building should be efficient while providing enough illumination to effectively make the site safe and secure at night. Light fixtures should project light downward to minimize direct upward light, spill light, glare and artificial sky glow.

Several conceptual examples are provided to indicate bird-friendly types of light fixture designs. Likewise, examples of undesirable light fixture design are also provided. Site lighting is also addressed in the section "Site Design Strategies."

Decorative Lighting

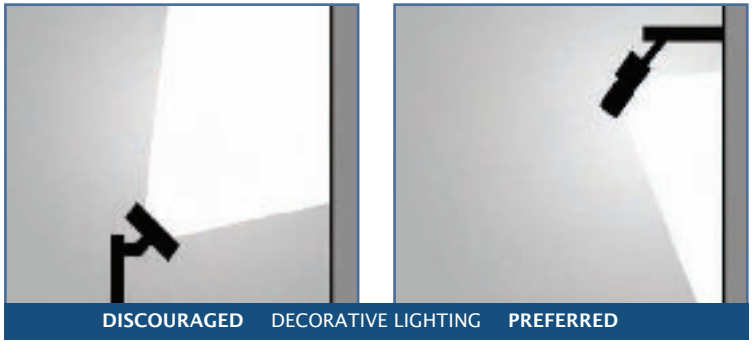
The external lighting of building features, known as 'vanity' or 'architectural' lighting, should be eliminated at best or projected downwards. For existing buildings, vanity and architectural lighting should be turned off during the migratory seasons. In cases where architectural lighting is used for aeronautical navigation purposes, the use of strobe lights is preferred as a suitable option.

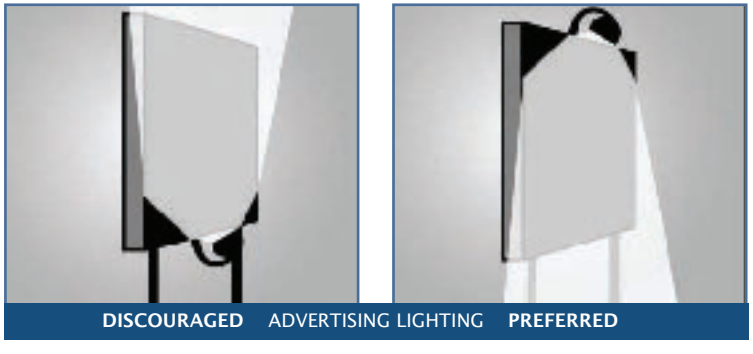
Advertising Lighting

Advertising can be designed to produce less light pollution by ensuring that the illuminated area is lit from above to minimize the amount of light unnecessarily being projected into the night sky.

Event and Festival Lighting

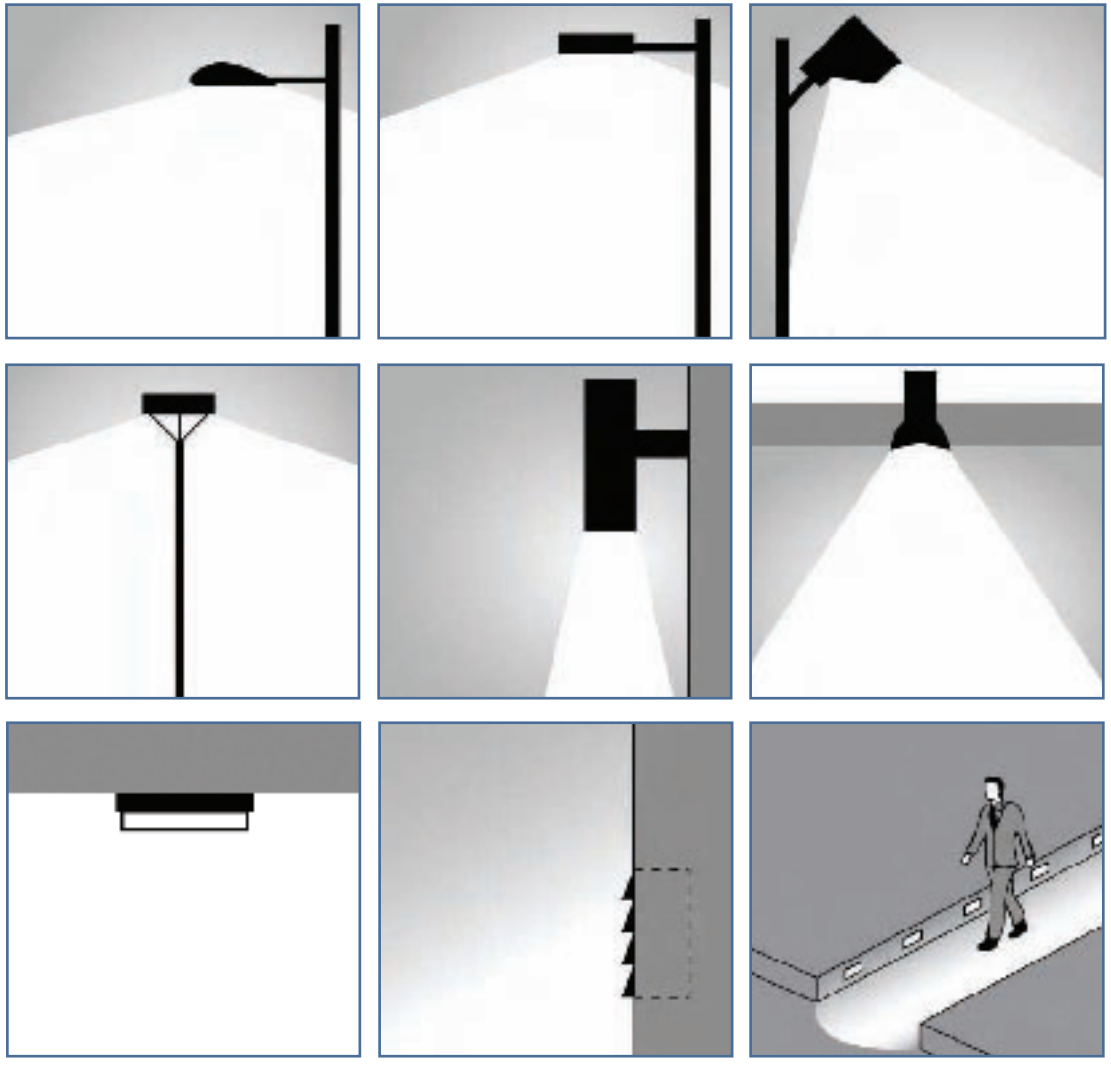
Event lighting, such as spotlights and searchlights should be prohibited during the migratory seasons.





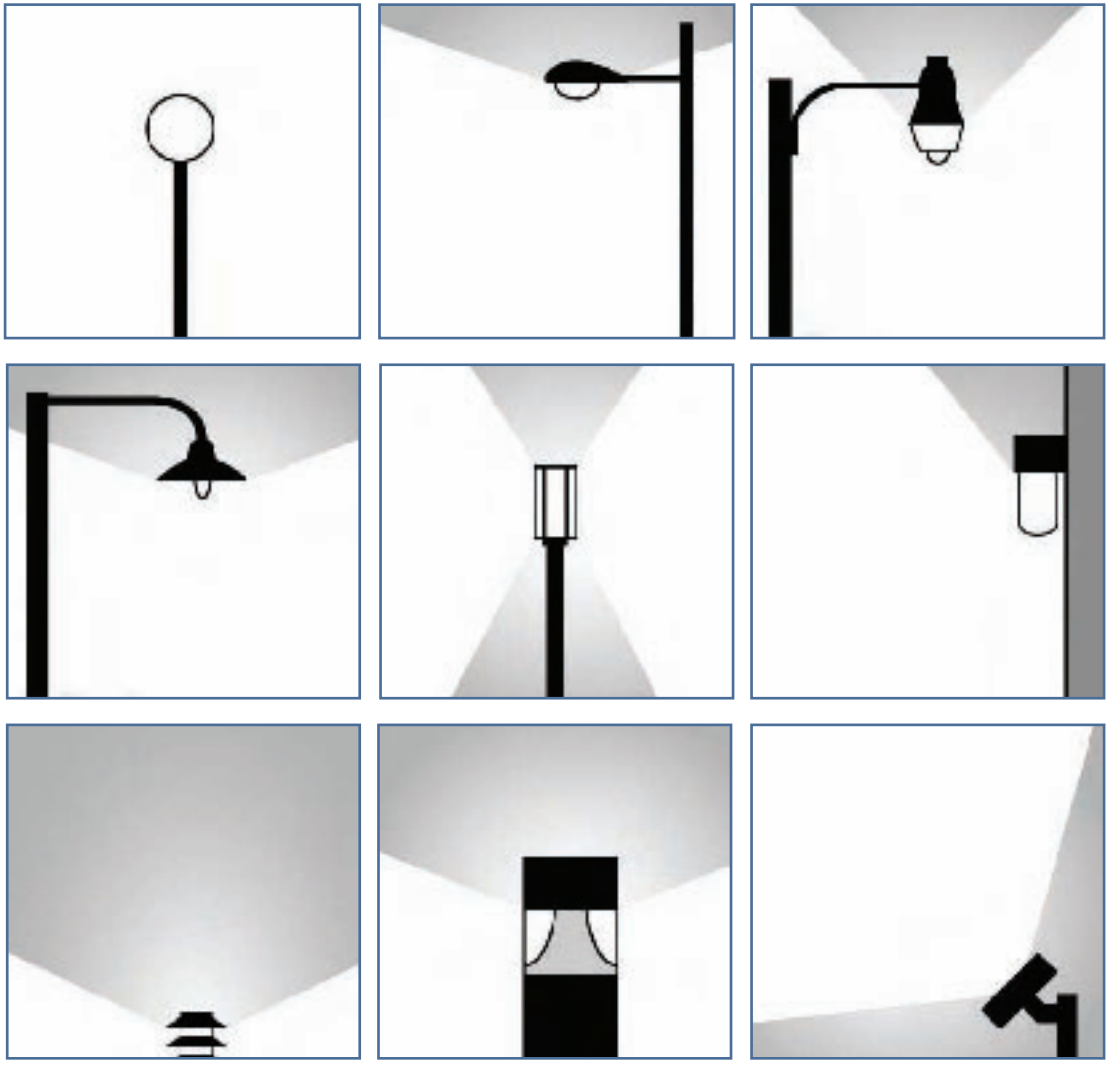
Preferred Lighting

Examples of lighting fixtures that effectively project light downwards, minimizing direct upward light, spill light, glare and artificial sky glow. Use of these types of lighting fixtures is **encouraged** for external site lighting.



Discouraged Lighting

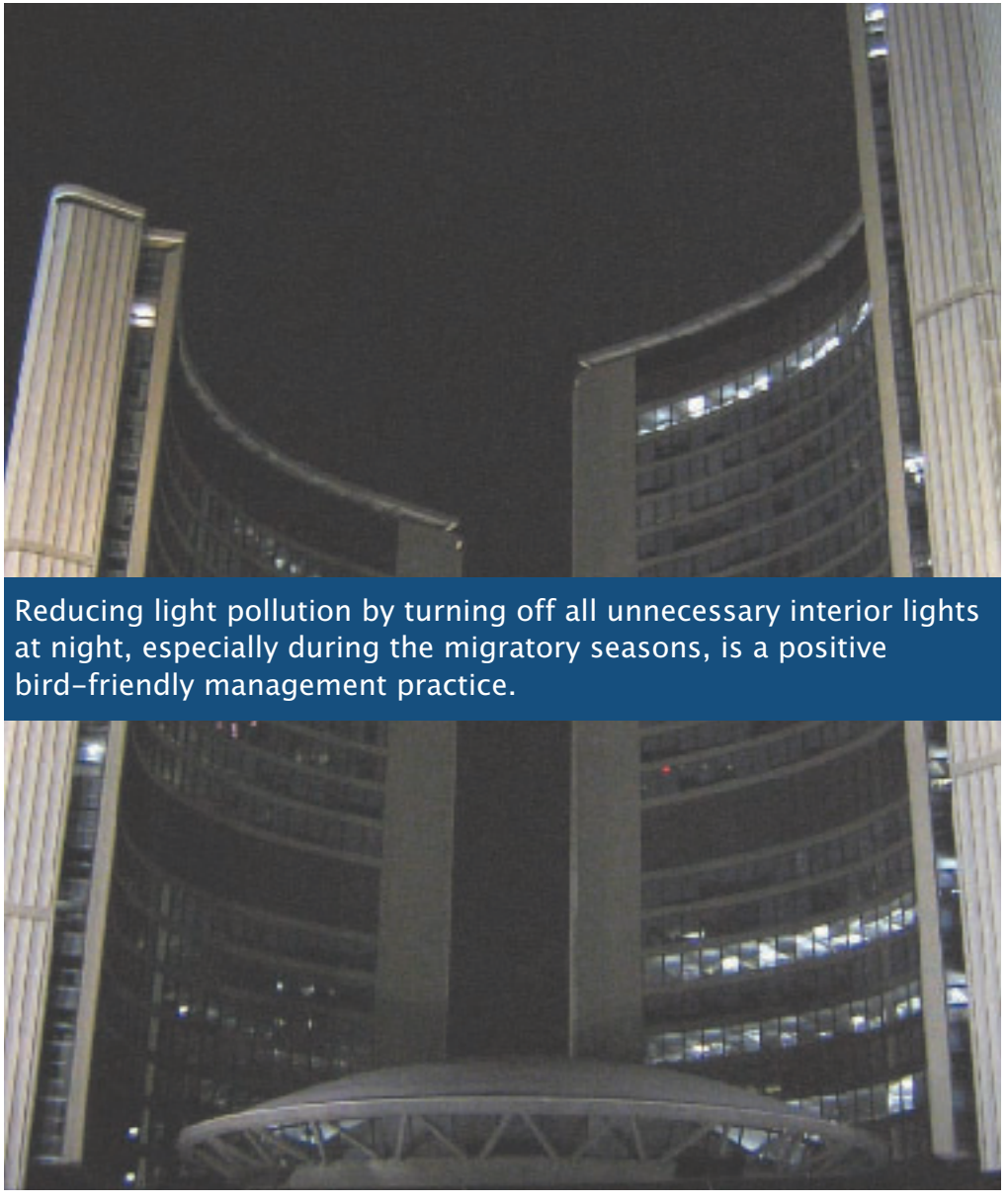
Examples of inefficient lighting fixtures that project light upwards, increasing spill light, glare and artificial sky glow. Use of these types of lighting fixtures is **discouraged** for external site lighting.



BUILDING MANAGEMENT OPERATIONS

- Reducing Light Pollution from Interior Lights
- Cleaning During the Day
- Internal Location of Greenery

Photo: Jim Flynn



Reducing light pollution by turning off all unnecessary interior lights at night, especially during the migratory seasons, is a positive bird-friendly management practice.

Toronto City Hall, April 2006, 12:00 a.m.
Photo: Kelly Snow

Building Management Operations

In addition to implementing design and lighting elements to make a building bird-friendly, developers, building owners, managers and tenants can incorporate operational practices and systems that will help reduce migratory bird deaths.

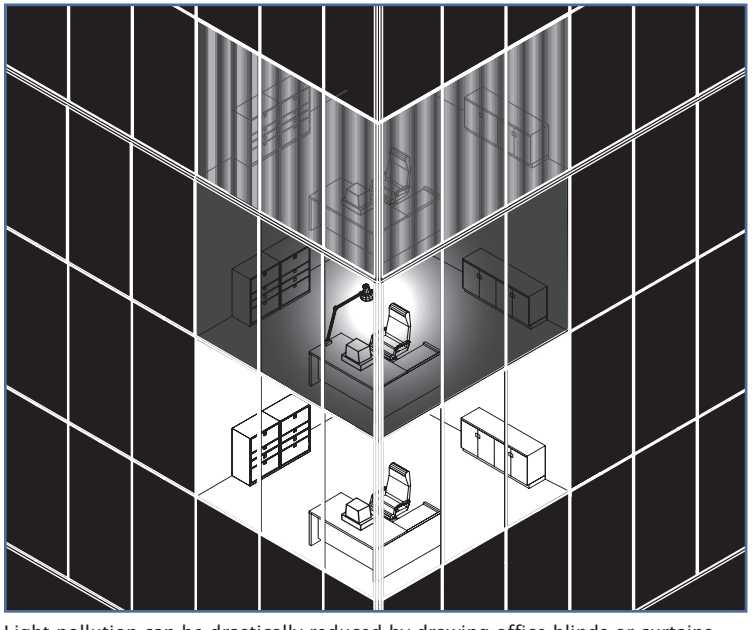
Reducing Light Pollution from Interior Lights

As birds migrate, they are disoriented by and drawn towards light pollution escaping from urban areas, which often leads to their collision with buildings resulting in injury or death.

Reducing light pollution by turning off all unnecessary interior lights at night, especially during the migratory seasons, is a positive bird-friendly management practice that is cost effective for existing buildings. Installation of motion-sensitive lighting in lobbies, walkways and corridors and retro-fitting operational systems that automatically turn lights off during after-work hours are other ways to reduce light pollution and fatal light attraction.

For tenants of existing buildings, using task lighting at one's workstation and drawing office blinds or curtains at night are ways that individuals can help to reduce migratory bird deaths.

Red-winged Blackbird
Photo: Mark K. Peck



Light pollution can be drastically reduced by drawing office blinds or curtains (top), or using task lighting at work stations (middle). Doing neither (bottom) is energy inefficient and dangerous for migrating birds.

Building managers and owners can assist in raising awareness of these helpful individual practices by notifying and reminding their tenants of these 'best practices' throughout the migratory seasons.

For new developments, the process is straightforward. The developer's responsibility is to ensure that bird-friendly options are provided in the design of the building, while the building manager and tenants are ultimately responsible for operating the bird-friendly features appropriately. In open concept offices, lighting systems that automatically adjust lighting levels and turn off unnecessary lights can be installed. Blinds should also be installed along with the task lighting so that tenants can also help reduce light pollution.

Cleaning During the Day

Commercial office cleaning has traditionally been done during the evening, after normal work hours when most tenants have left for the day. This system requires office lighting to be on while cleaning staff are working in the building at night, resulting in increased light pollution, which negatively impacts migratory birds.

Cleaning during the day is becoming a popular operational option to traditional evening cleaning as it reduces energy consumption and subsequently results in cost savings. It also reduces greenhouse gas emissions and enhances building security. Buildings are encouraged to institute the practice of cleaning during the day as a bird-friendly building management operation.

Dark-eyed Junco
Photo: Carol L. Edwards

Example of Potential Energy and Money Savings

Building surface area: 22,000 m^2
Illumination strength: 9 W / m^2, lights on 24 hours, 365 days/year

22,000 m2 x 9 W/m^2 x 24 hours x 365 days x 1/1000 = 1,734,480 kWh power used annually

At 5 cents per kWh = $86,724 annual energy costs

By turning off lights from 11 pm to 5 am = savings of $21,681 in annual energy costs

By turning off lights from 7 pm to 7 am = savings of $43,362 in annual energy costs

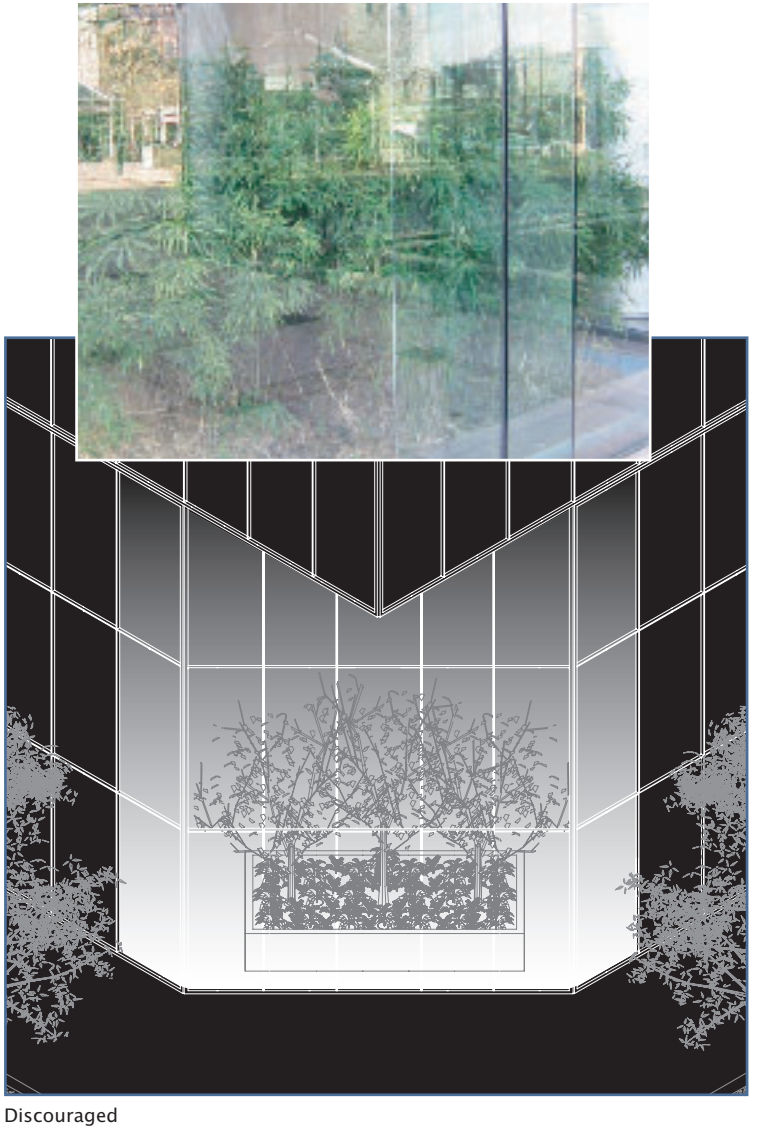
Internal Location of Greenery

The location of interior plants, large and small, on the ground floor levels of buildings can also have a negative impact on birds.

Ground floor lobbies and walkways are often decorated with trees and shrubs and designed with clear glass fenestration. These lobbies are often brightly lit at night, dramatically highlighting any greenery that may be inside.

Brightly lit lobbies with greenery features are extremely dangerous to a migratory bird that has been drawn into the city by light pollution and become trapped in the unfamiliar urban environment. Birds, like humans, cannot perceive clear glass and thus will attempt to fly towards the greenery that is perceived as safe habitat. This often results in injury and death as they crash into the window.

To minimize bird collisions, building managers and owners are encouraged to locate any greenery away from clear glass. They are also encouraged to minimize lighting levels through motion-sensitive lighting systems in ground floor lobbies, walkways and corridors, and to retrofit clear glass wherever possible with translucent, 'fritted' glass, or to apply window film. These retrofit and application options will produce 'visual markers' to enable birds to perceive the glass as a solid object.



Discouraged
Photo: Kelly Snow

SITE DESIGN STRATEGIES

- Lighting
- Other Site Features
- Comprehensive Bird-Friendly Site Strategy

Photo: Mark K. Peck

Site Design Strategies

Site design strategies should always be implemented in conjunction with glass treatment at lower levels.

The overall site strategy of a bird-friendly building can influence migratory bird deaths through the placement of bird-friendly exterior lighting fixtures, design of glass elements on site and type of ventilation grates used on site. Bird-friendly site strategies are developed as a result of understanding and anticipating where birds will be in relation to the glass in the structures located on a particular site. Ideally, migratory birds are less likely to be drawn into a building site within an urban area once light pollution levels are minimized.

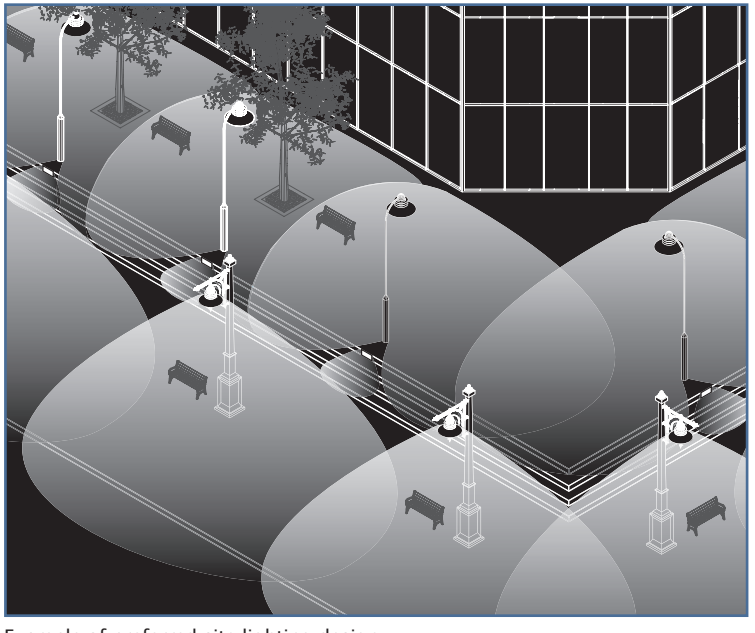
Lighting

Lighting fixtures on a building site must conform to proper building and safety codes. Within the parameters of these codes, exterior site lighting fixtures should be directed downward, oriented and placed in such a way as to project light only on non-reflective surfaces on the site. This will help reduce light pollution from reflections and glare off glass within the site.

Other Site Features

Glass design features on a site such as windbreaks, solariums and greenhouses should be treated in a way that creates enough visual

Ruby-throated Hummingbird
Photo: Terry Flynn



Example of preferred site lighting design

markers for birds to perceive them. Such treatments would entail the same treatments for glass described in the section "Design-Based Development Strategies for Bird-Friendly Buildings".

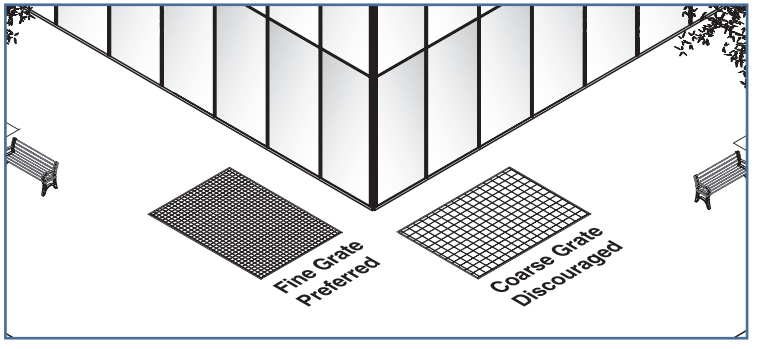
Glass windbreaks treated in a way that creates visual markers
Photo: Kelly Snow

Use of Mirrors in Gardens

Increasingly, landscape architects and garden designers are specifying mirrors (large and small) in their designs, with the intent to create a reflection and, at times, an infinite repetition, of their design; and in small gardens, to create an illusion of a larger space. Unfortunately, these surfaces kill and maim birds, as birds cannot distinguish the reflected habitat from real habitat. Mirrors should be avoided in landscape design.

Site Ventilation

Ventilation grates on a site also present a deadly hazard for birds. An injured and helpless bird that falls onto a ventilation grate with a porosity large enough for the bird to fall through will find itself trapped when it recovers enough to attempt flight. Ventilation grates should have a porosity no larger than 2 cm x 2 cm or should be covered with netting in order to prevent birds from falling through. Also, ventilation grates should never be up-lit for this would produce light pollution.



Use of Transparent Noise Barriers

Noise barriers erected at highways and railway rights-of-way to protect adjacent communities from noise present similar problems if portions of the barriers are transparent. Increasingly, portions of noise barriers are constructed with clear polymethyl methacrylate (PMMA) panels. These transparent panels are perceived by birds as non-existent and hence the birds fly into them and are killed or seriously injured. These panels present the same dangers to birds as do the glass panels of buildings. Use of glass or methacrylate panels in noise barriers should be avoided. When transparent barriers are present, they should be treated in a way so as to create enough visual markers for birds to perceive them.

COMPREHENSIVE BIRD-FRIENDLY SITE STRATEGY

A: Treatment applied to glass projecting enough visual markers to make it visible to birds

B: Task lighting in use after dark

C: Blinds drawn after dark

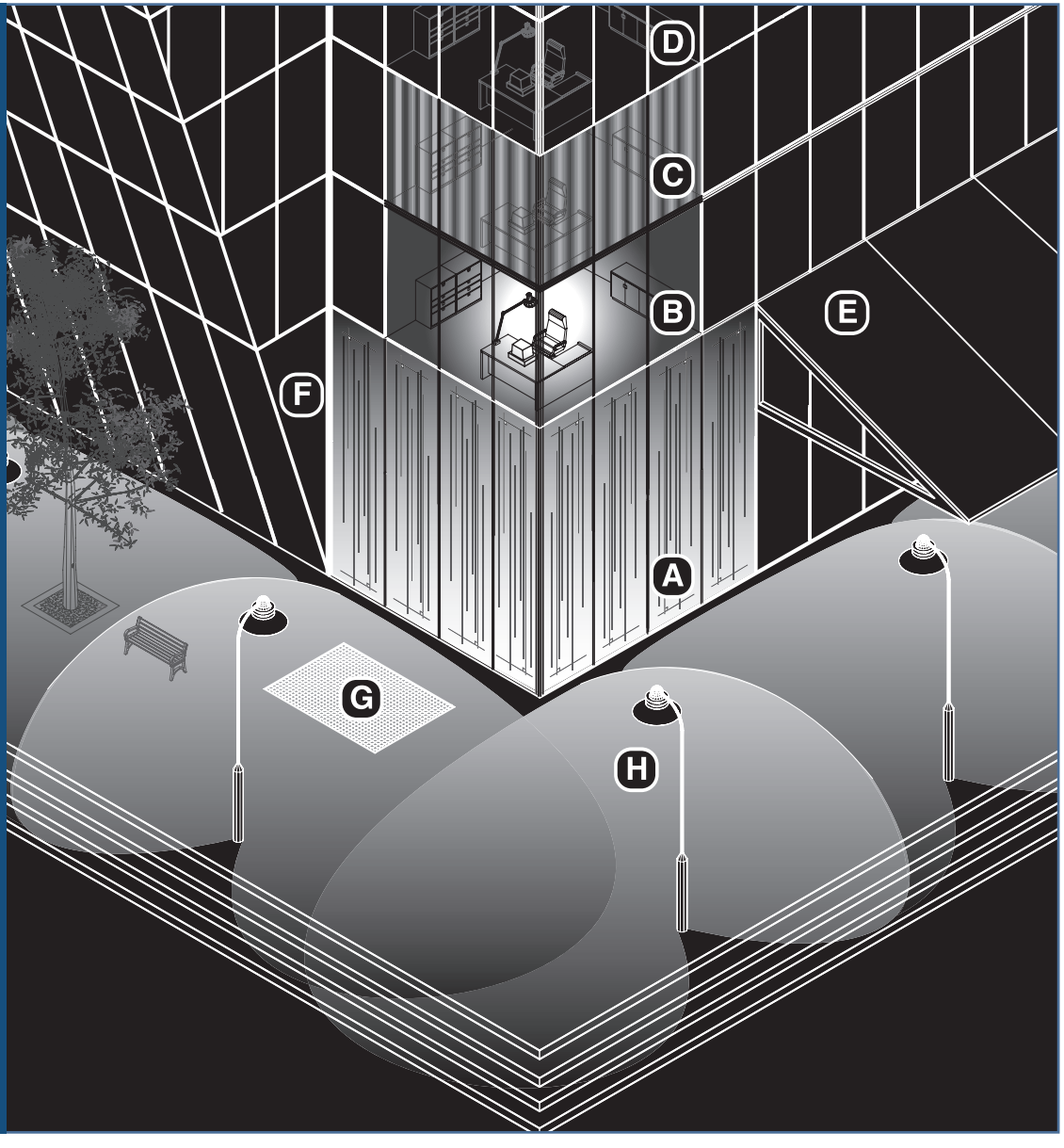
D: Lights turned off after work hours

E: Awning for muting reflections on lobby windows

F: Glass effectively angled to project reflections downward

G: Bird-friendly site ventilation grates

H: Use of lighting fixtures effectively projecting light downward



CONCLUSION

- Glossary

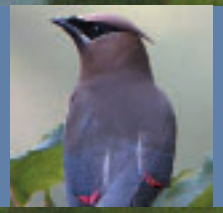
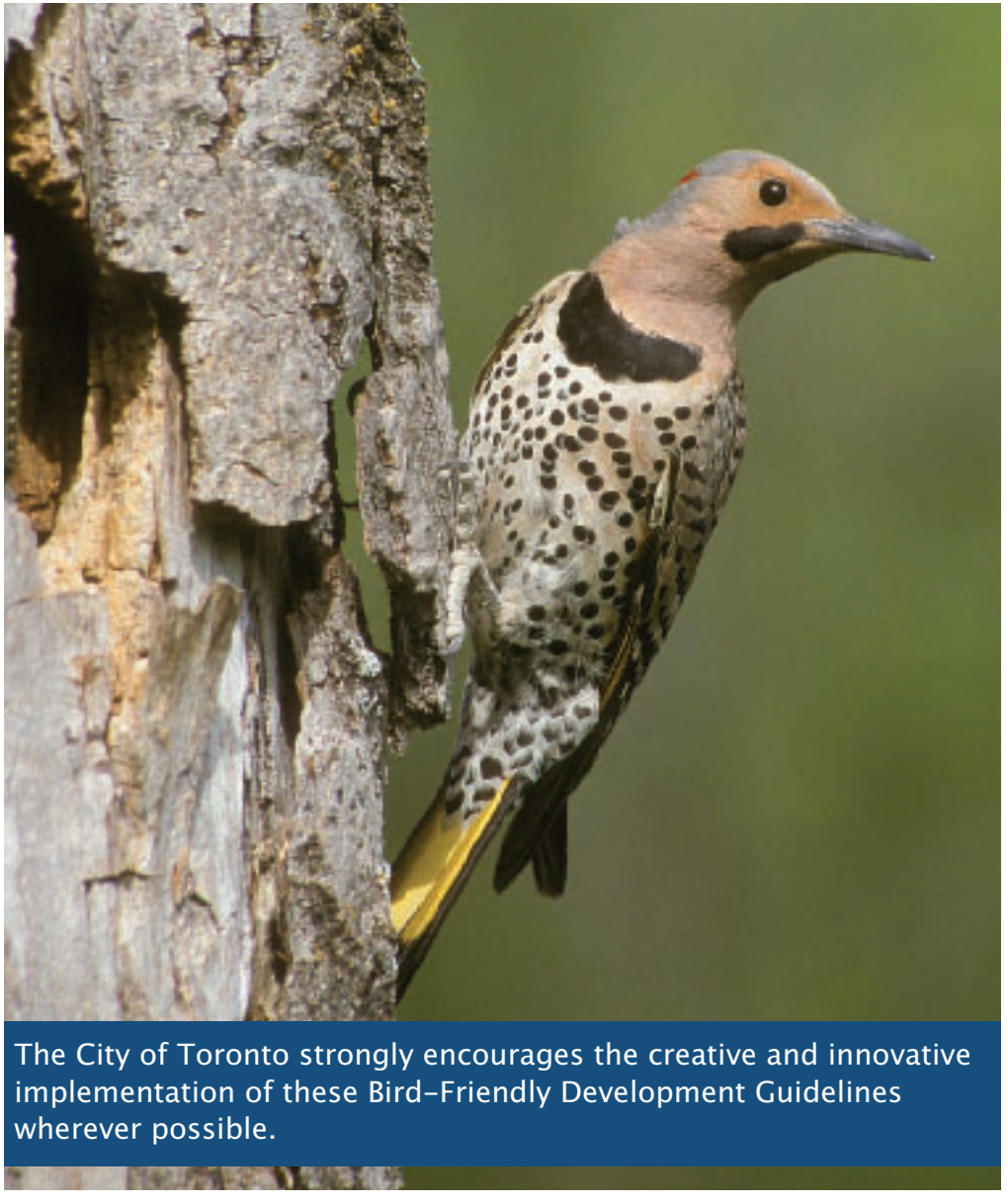


Photo: Mark K. Peck



The City of Toronto strongly encourages the creative and innovative implementation of these Bird-Friendly Development Guidelines wherever possible.

Northern Flicker
Photo: Mark K. Peck

Conclusion

Birds have been migrating through this region for thousands of years. The dangers posed to migratory birds by today's urban landscapes are relatively new in evolutionary time scales and birds have been unable to alter their instinctive behaviour in response to this recent product of human activity. Bird populations are depleting rapidly throughout North and South America and it is inconceivable that they can evolve quickly enough to adjust to massive urbanization, deforestation and other factors threatening them. Cities are the key places that the changes in human behaviour necessary for bird conservation can occur. Education and involvement of individuals will help to reconcile the needs of the human and non-human worlds and help mitigate the negative impact of the built environment on the natural environment.

The City of Toronto has worked in partnership with the private sector, bird advocacy organizations and other levels of government to develop these Bird-Friendly Development Guidelines. Residents of Toronto can all play a role in reducing migratory bird deaths and together architects, developers, urban designers, planners, building owners, managers and tenants can make a positive difference to our city's natural environment and help to ensure the survival of migratory bird populations for future generations.

Eastern Bluebird
Photo: Jim Flynn

Golden-winged Warbler
Photo: Mark K. Peck

Glossary

Artificial sky glow: the artificial brightening of the night sky caused in large part by inefficient lighting fixtures that project light upward.

Direct upward light: light that is projected directly upward by inefficient lighting fixtures. Direct upward light contributes greatly to artificial sky glow.

Fatal light attraction: the instinctive reaction of birds to fly toward artificial bright light that often results in death by collision with buildings.

Fenestration: the arrangement of glass panels and/or windows in a wall.

"Fritted" glass: glass that is manufactured with a visible embedded pattern.

Heritage buildings: buildings that are listed on the Inventory of Heritage Properties for their historical and architectural significance.

Migration: animal species' long distance movement from one habitat to another, according to the seasons and on an annual cycle.

Mullions: the bars between panes of glass in a window.

Resident bird: non-migrating birds that reside year-round in the urban environment.

Spill light: artificial light that is projected indirectly by lighting fixtures.

Useful light: artificial light that is efficiently and directly projected by lighting fixtures, which has a necessary purpose and use in the urban environment.

Visual markers: a term used to describe birds' visual perception created by solid/opaque surfaces.