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Guidelines developed in Response to P.L. 2023 Chapter 221 (L.D. 670): An Act to Protect Birds and Wildlife in the Construction and Maintenance of Public Buildings

February 18, 2025

EXECUTIVE SUMMARY

In June 2023, the Maine Legislature passed L.D. 670, requiring the Department of Administrative and Financial Service's (DAFS's) Bureau of General Services (BGS or Bureau) to develop guidelines to integrate bird collision risk management into public improvements. Specifically, L.D. 670, enacted as Public Law 2023, Chapter 221, requires BGS "to develop guidance regarding the integration of bird collision risk management into public improvements. The Bureau, to the extent it determines appropriate considering all relevant factors, shall follow the guidance in the construction of public improvements and renovations of public improvements in which more than 50% of a building facade is substantially altered. The guidance is not applicable to public buildings, landscapes or districts listed on the National Register of Historic Places or determined by the Maine Historic Preservation Commission, created pursuant to Title 27, section 502, to be eligible for inclusion on the National Register of Historic Places, including the State House and the Blaine House.

BGS coordinated with Austin Smith, Partner and Principal, AIA, RLA, LEED AP at Simons Architects to develop the guidelines. Austin, in turn, engaged with issue-area experts from BirdSafe Maine, a collaboration among Maine Audubon, the Portland Society for Architecture, and the University of Southern Maine. BirdSafe Maine has been studying the bird collision issue in Maine for five years, monitoring incidences of dead and injured birds around the state. It's well documented that bird collisions with buildings contribute to the deaths of more than one billion birds in the United States each year. In preparing this report, local and national issue experts, representatives from federal and state agencies, and Maine's design and build community were consulted. The resulting guidelines are intended to provide the basics for those new to these concepts, and to supply easy steps for incorporating bird safe principles into buildings anywhere in Maine.

Highlights

- **More than 1 billion birds are killed in the United States each year** after colliding with glass windows, which confuse birds by reflecting the sky or habitat, or by appearing invisible when lit from within.
- **Dedicated studies in Portland reveal that an estimated 50,000 birds die within city limits each year**, with more collisions occurring at buildings with more glass.
- **There are many ways to incorporate bird-safe principles into building design** without adding additional costs or delays to the process.

Guidelines

Guideline 1: Reasonable actions count toward making buildings bird safe. A bird-safe building is one that takes reasonable available actions to reduce the threat to birds.

Guideline 2: Bird safety should be considered during the design stage. The most important single piece of information for those considering constructing bird-safe building is to consider bird safety as early as possible in the planning and design process.

Guideline 3: Minimizing the amount of glass is the cheapest way to improve the safety of a building. The amount of glass on a façade is the biggest predictor of bird

collisions. Therefore, reducing the amount of glass is the best way to make a building safe for birds.

Guideline 4: Lower floors are the most dangerous to birds. Though it may be counterintuitive to those thinking of migratory birds as flying high in the air, the vast majority of bird strikes occur on the first and second floors of buildings. Therefore, minimizing glass or using other bird-safe strategies on these lower floors will have the most beneficial effect.

Guideline 5: Certain architectural features are especially dangerous and should be avoided. The use of glass in certain architectural features can also pose a severe threat to birds, and should be avoided or mitigated. Dangerous features include glass railings, skywalks, corner windows, and glass entryways.

Guideline 6: Landscaping matters. The presence of landscaping is complicated, especially because of the many recognized benefits of street trees and native vegetation. In all cases, addressing the reflectiveness of the glass is the best way to reduce the threat.

Guideline 7: Light pollution can attract birds unnecessarily. Artificial light attracts birds, and brings them in closer proximity to glass. Reducing light pollution is the best way to avoid unnecessarily attracting birds.

Guideline 8: Glass treatments must be applied to the outside of the window. A common reaction for those wanting to break up window reflections in order to reduce bird strike threats is to pull interior curtains or take other actions inside. However, to be effective, treatments must be applied to the outside surface of a window.

Guideline 9: There are many different solutions. Anything that alerts a bird to the presence of glass is a solution, and new products and strategies are emerging from the marketplace.

Guideline 10: Existing buildings can be modified to reduce threats to birds. It is easier to design and build a bird-safe building from the start, but there are lots of ways to work with an existing building to reduce the number of bird collisions.

Department of Administrative and Financial Services

BIRD-SAFE BUILDING GUIDELINES FOR THE STATE OF MAINE

BIRD-SAFE BUILDING GUIDELINES for the State of Maine

We are grateful to the State of Maine's Department of Administrative and Financial Services (DAFS) for its support and assistance in the production of this report, including DAFS Commissioner Kirsten Figueroa, Deputy Commissioner Elaine Clark, and Director of the Bureau of General Services, Brian Keezer.

Produced by: This document was produced with contributions from the BirdSafe Maine Leadership Team, including Nick Lund, Advocacy and Outreach Manager, Maine Audubon; Austin Smith, AIA, RLA, LEED AP, Simons Architects; Dr. Chris Maher, Interim Dean, College of Science, Technology, and Health, University of Southern Maine; Jill Osgood; Sonya Kahlenberg; Eleanor Eckel; Melissa Kim, Director of Communications, Maine Audubon; Anna Dibble; Alex Haba, Whitten Architects; Cara Bionde, Kaplan Thompson Architects; Andrew Tufts, Bringing Nature Home Manager, Maine Audubon.

Valuable input was provided by Maine's Department of Inland Fisheries and Wildlife (DIFW), and we'd like to thank DIFW Commissioner Judy Camuso, DIFW Wildlife Biologist Danielle D'Auria, as well as Angela Tringali, Atlantic Flyway's Conservation Delivery Specialist for the U.S. US Fish and Wildlife Service.

Special thanks to: Addy Smith-Reiman, Cady Netland, Lee Foden, Eddie Woodin, Troy Moon, Dr. Christine Sheppard, Paul Groleau, Brandon Tate, Jane Alexander, Barbara Fiore, Lois Winter, Rep. Sophia Warren, Alan Hull, Tony Payne, Brian O'Connor, Nicole Colfer, Dave Dufour, Andy Shepherd, Jonathan Toews, Kelly Barden, Ed Parker, Lucas St. Clair, Tara Zuardo, Andrew Zarro, Dan Piselli, Jazmine Blazquez, Anikó Tótha, Bryan Lenz.

A note on style:
There is a lack of consistency in the world of bird-friendly architecture around the use of hyphens and slashes. The terms "bird-safe" and "bird safe," are used variably and sometimes interchangeably across the discipline, as are the terms "bird glass collisions," "bird/glass collisions" and "bird-glass collisions." For consistency in this document, we will typically use a hyphen when the term is modifying a noun, i.e. "bird-safe glass," "bird-safe buildings," "bird-friendly principles." In other instances, the terms will appear without a hyphen, as in "bird glass collisions," "bird strike victims," and similar. Complicating things further, the name of the group that monitors bird strikes in Maine is called BirdSafe Maine, without a space.

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INTRODUCTION

American birdlife is in trouble. Studies have revealed that 2.9 billion breeding adult birds have been lost since 1970, including birds in every ecosystem.
That's one in every four birds in the United States lost in fifty years.

The causes of this decline are widespread and varied, but all tie back to the impacts of humans.
The United States Fish and Wildlife Service tracks human-caused sources of bird mortality, and has measured the destructive impacts of poisoning, habitat loss, electrocution, vehicle collision, wind turbines, oil pits, feral cats, and more (Table 1; page 6).

Perhaps surprisingly, one of the leading sources of human-caused bird mortality is collisions with glass windows. A
2014 study estimated that between 365 million and 988 million birds die each year in the U.S. after striking glass, a number that was significantly increased in a 2024 paper which suggested a
toll of between 1.28 billion and 3.46 billion birds due to an improved understanding of the mortality of stunned birds.

It's a staggering number, especially because bird glass collisions are easy to overlook. Birds collide with glass windows and fall into bushes or gardens, or are eaten by predators out of sight of humans. But as the scientific understanding of the scale of the problem has grown, so too has the response from conservationists,
architects, and policymakers seeking to limit the damage. Working together, we now know how to make buildings safer and reduce the threat to birds.

These Bird-Safe Building Guidelines (Guidelines) are a product of legislation passed in Maine in September 2023.
Public Law 2023, c. 221 (An Act to Protect Birds and Wildlife in the Construction and Maintenance of Public Buildings) states that "The Department of Administrative and Financial Services, Bureau of General Services … shall develop guidance regarding the integration of bird collision risk management into public improvements."

The goal of these Guidelines is to examine the science behind bird glass collisions, describe the work done
in Maine to this point, and examine simple but effective strategies to make buildings safer for wildlife. The
methods promoted by these Guidelines are intended to apply to the planning, design, and operational stages of all kinds of buildings, in both urban and rural settings.

Table 1. Top Threats to Birds *(U.S. only. Ordered by Median Estimate of Bird Mortality Annually. As of 2017.)*

HAZARD/TYPE	MINIMUM RANGE	MAXIMUM RANGE	MEDIAN/AVERAGE *Estimated*
Habitat Loss/Conversion	N/A	N/A	**N/A 599,000,000**
Collision - Building Glass *Loss et al., 2014a*	365,000,000	988,000,000	
Collision - Communication Towers *Longcore et al. 2012*	6,600,000		**25,500,000**
Collision - Electrical Lines *Loss et al 2014c*	8,000,000	57,300,000	**214,500,000**
Collision - Vehicles *Loss et al. 2014b*	89,000,000	340,000,000	**2,324,012**
Collision - Land-based Wind Turbines *Loss et al. 2013b*	140,438	327,586	**N/A N/A**
Collision - Offshore Wind Turbines	N/A	N/A	**5,600,000**
Collision - Solar Panels Electrocution	N/A	N/A	**N/A**
Loss et al. 2014c **Burning - Solar Towers**	900,000	11,600,000	
Poison	N/A 72,000,000	N/A	**2,400,000,000**
Cats *Loss et al 2013a*	1,400,000,000		**750,000**
Oil Pits, *Trail 2006*	500,000	3,700,000,000	**3,324,184,012**
All	549,140,438	1,000,000	**2,019,218,024**
All (excluding cats)	542,390,438	5,182,427,586	**709,684,012**
Industry Only (excludes cats and vehicles)	453,140,438	1,476,827,586	
		1,136,827,586	

Credit: US Fish & Wildlife Service

PART I: THE SCIENCE OF BIRD GLASS COLLISIONS

Birds have been migrating through North America for millions of years. In that time they've witnessed countless changes to their environment—glaciers growing and receding, mountains and sea levels rising and falling—but they've never encountered anything quite like humans. In just a few thousand years, humans have altered vast areas of bird habitat in ways nature has never seen before.

Some of the impacts are well known—the conversion of millions of acres of land for human habitat and agriculture, the introduction of air and water pollution, the introduction of competition from invasive species, e.g.—but others are less obvious. Among them is the proliferation of glass windows.

Glass windows are not found in nature, and their very essence is an impossibility to birds. It tricks birds in two ways, depending on the lighting conditions. Glass is reflective in daylight hours, making birds believe they are flying through sky or into the safety of vegetation. At night, and when lit from within, glass appears invisible, giving birds no indication that they are flying into danger. Certain environmental factors can exacerbate the threat, including exterior lighting and nearby landscaping, and certain architectural features have proven to be more dangerous than others, including large panels of glass, "pass-through" conditions, corner windows, and more.

Most birds' first encounters with glass are fatal when they collide with it at full flight speed. Aspects of bird vision contribute to the problem. Whereas humans have eyes in the front of their heads and good depth perception, most birds' eyes are placed at the sides of their heads. Birds thus have little depth perception beyond the range of their bills but extensive fields of view to the side and behind. They judge their flight speed by the passing of objects to their sides, so their focus in flight is not necessarily ahead.

Though glass has long been known to pose a threat to birds, the science of bird glass collisions has ramped up in the past few decades. Community scientists working in the early 1990s in cities like Toronto, New York, and Chicago helped raise awareness of the scale of the issue in urban areas. Researchers looked more closely into the exact causes and impacts of bird strikes, as well as the relative effectiveness of various deterrents.

Solid science and growing public awareness have led to policy solutions, primarily municipal ordinances, which in turn have driven the demand for increasing architectural and design solutions.

CAUSES OF COLLISIONS

Birds strike glass windows for two reasons: **reflectiveness** and **transparency**.

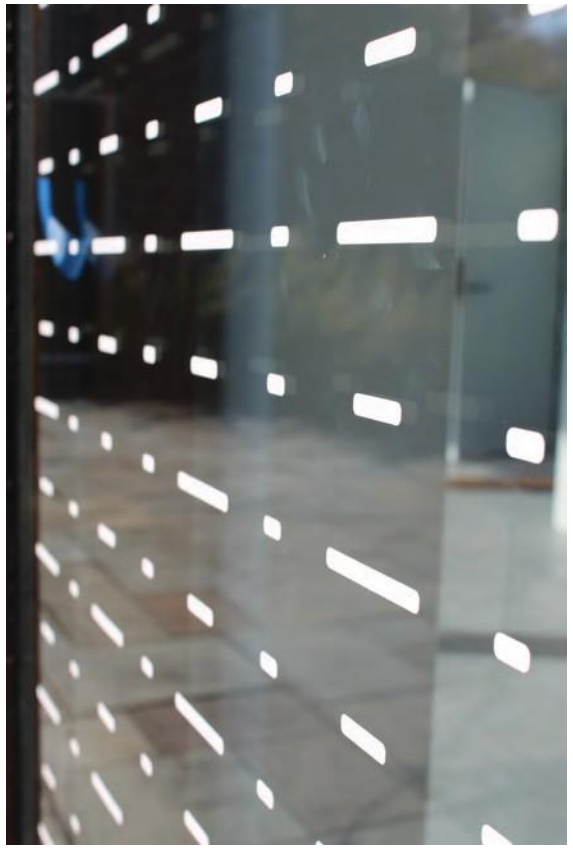
Reflectiveness: If the area behind a pane of glass is darker than the area in front of it, reflections appear on its smooth surface. Under the right conditions, glass on buildings can form a mirror, reflecting sky, clouds, or nearby habitat attractive to birds. When birds try to fly to the reflected habitat, they hit the glass. Reflected vegetation is the most dangerous, but birds also attempt to fly past reflected buildings or through reflected passageways, with fatal results. From outside most buildings, glass often appears highly reflective, increasingly so when seen from an oblique angle. Almost every type of architectural glass under the right conditions reflects the sky, clouds, or nearby trees and vegetation, reproducing habitat familiar and attractive to birds.

Transparency: What makes an obstacle visible is its outer contours and its inner texture, and glass lacks both these things. Our human experience prepares us to expect glass at certain points in a building, lessons that birds cannot learn on their own.

Transparency, as opposed to reflection, occurs when the area behind the glass is more or less as bright as the area in front of it.
During daylight hours, birds strike transparent windows as they attempt to access potential perches, potted plants, water sources, and other lures inside and beyond the glass. The
trick of transparency is exacerbated when windows are installed on opposite sides of a building directly across from one another or at a corner, because birds perceive an unobstructed passageway and fly toward the glass with no awareness of an obstacle.

Birds Moving into Small Areas: The size of a window is not the only predictor of its threat. Songbirds are comfortable flying into tight areas— think of a sparrow darting into a dense bush or tree—and so even small windows reflecting sky or habitat can be a threat. This factor is why partial treatment of a window or reflective surface, a single decal, for example, is ineffective. Birds will simply avoid the
decal and strike against other reflective parts of the glass.

Researchers have found that horizontal lines spaced 2 inches apart, paired with vertical lines spaced 4 inches apart, were effective in breaking up
the reflection and alerting birds to a threat. For many years, this 2”x4” rule was the standard for solutions, though additional research has shown that even the 2”x4” rule may not protect our smallest birds, like hummingbirds. Leading authorities now recommend treatments at a 2”x 2” level, though the 2”x4” treatment is still demonstrated to reduce collisions significantly.



FACTORS AFFECTING BIRD GLASS COLLISIONS

Planning bird-safe environments for both new and existing buildings requires an assessment of existing conditions. Not every building presents the same threat to birds, and an understanding of the variety of factors contributing to bird collisions can help reduce the threat.

Migration

Millions of birds move through the state of Maine each year on their way to or from breeding grounds. In spring, invertebrate-eating birds like warblers, shorebirds, vireos, sparrows, and more fly up into Maine and parts north to take advantage of the improving habitat. They breed, and in fall are chased south by the cooling climate.

Migration increases collision risk by bringing birds into unusual locales. Birds typically migrate at night, as part of massive fronts that fan out and move as far as the darkness and weather allow. Migrant birds descend from the sky each morning to look for food and find refuge from diurnal predators, but they don't choose where they land. Sometimes migrant birds luck into good habitats, like a forest or large park, but other times they find themselves in an urban area. It's here that they must work their way through whatever meager habitats are available to them—building landscaping or street trees, usually—and in the process expose themselves to lots of glass windows.

In general, fall migration sees more strikes than spring migration, simply because there are more birds in the fall after adult birds fledged chicks over the summer. Many of these inexperienced young birds, migrating for the first time, become bird strike victims.

The majority of birds we find in cities are migratory songbirds. Warblers and sparrows make up the victims, but also vireos, flycatchers, woodpeckers, creepers, nuthatches, thrushes, and others. Many other species migrate seasonally but are not bird strike victims. Waterfowl, for example, stop over on water bodies, and hawks and eagles migrate during the day and are better equipped to avoid urban areas.

Exterior Lighting

Although most glass collisions take place during daylight hours, artificial lighting at night plays a role in the number and distribution of collisions across the built environment.

Artificial light attracts birds, though scientists are still working out the sometimes unpredictable and uncertain connections.

Songbirds seem to be particularly affected. Songbirds are ordinarily active by day and have eyes specialized for color vision and bright light. Although they migrate at night, these birds have poor night vision, instead relying mostly on innate magnetic senses and stars to direct themselves southward.

Nocturnal migrants call more in response to artificial light at night, which can attract more birds to buildings.

Lights may only impact birds as they end a migratory stage and come down close to the built environment, or lights may divert birds that would ordinarily pass by. Bad weather can cause birds to fly lower and closer to lights, while also eliminating any visual cues. The interactions that produce correlations between building light emissions and collisions may take place at relatively close range. Once birds come close to a light source, the electromagnetic radiation actively interferes with their magnetic orientation mechanism. Blue light has been proven to be especially attractive to birds.

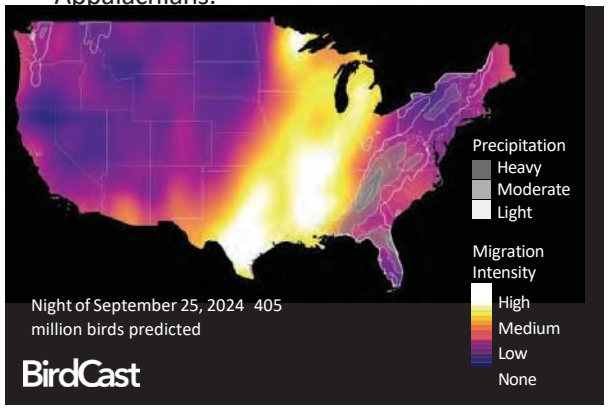
The science is clear on at least one point: reducing light pollution leads to safer outcomes. Cities around the country execute successful "lights out" programs during spring and fall migration to help birds fly safely, though none currently exist in Maine. The authors encourage all architects, designers, and municipalities to follow best practices related to exterior lighting and lighted sign standards, and limit light pollution wherever possible.

Photo: Paul vanderwerf/Flickr

Weather

Although nocturnal bird migration tends to take place at high altitudes, certain bird species fly at lower altitudes if there are headwinds, precipitation, or fog. These conditions work to reduce the navigational abilities of migratory birds and force them to lower altitudes in search of visual aids. These disoriented birds may be more susceptible to lures from artificial lighting, and may be more likely to find themselves over an urban area or other suboptimal habitat if forced out of the sky by severe weather.

The image below, from the BirdCast website of the Cornell Lab of Ornithology (https://birdcast.info/), shows predicted migrant bird intensity for the night of September 25, 2024. Note how major southbound migrants are blocked by precipitation, in gray, along the Appalachians.

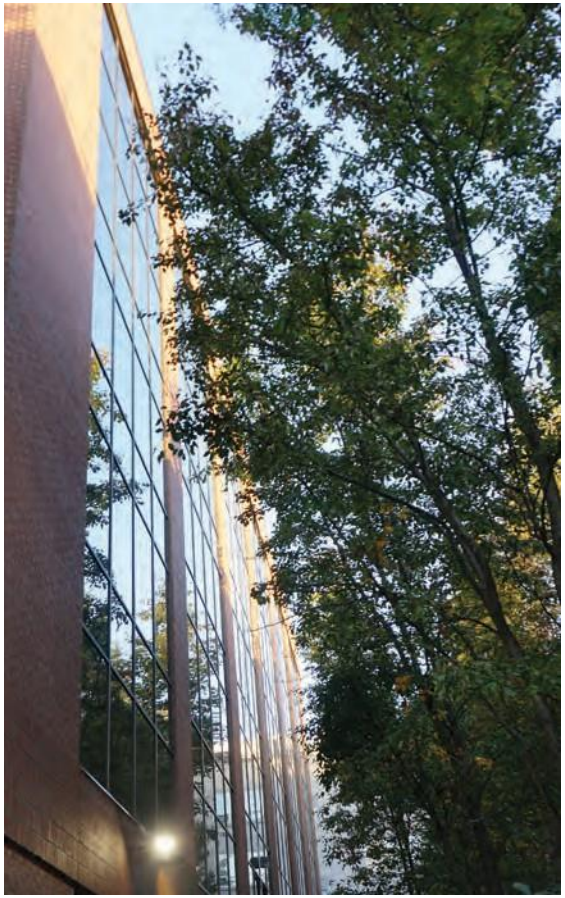


Landscaping

The majority of bird strikes in urban areas come from migratory birds, and so it is often assumed that collisions occur most often against north or south-facing windows. However, the cardinal direction of a façade is not a factor in its collision risk. The majority of collisions occur during the day, when migratory birds abandon their north/ south routes and move among the landscape in search of food and safety. These localized movements may take them in any direction, depending on the specifics of their surroundings.

This localized movement, and especially the desire of songbirds moving in daylight to find safety in dense habitat, means that vegetation reflected in glass windows is a major threat. In short: vegetation around buildings will bring more birds into the vicinity of the building; the reflection of that vegetation brings more birds into close proximity to the glass. Collisions from just a few feet away from glass have been known to be fatal.

Additional landscaping features impact how birds move around buildings, either channeling them toward or away from glass. Birds often fly between landscape features, for example, two stands of trees, and may be at risk from structures along their route.



Likewise, taller trees and shrubs are more likely to attract birds and cause collisions. Movement patterns of birds within surrounding habitat may cause unanticipated collisions, but the collision risks can be mitigated if considered early during planning.

BIRD SAFE Maine

Maine Audubon, the University of Southern Maine, and the Portland Society for Architecture came together in 2020 to form BirdSafe Maine, a coalition dedicated to researching the problem of bird glass strikes in Maine, educating the local architecture and design community, and providing policy solutions.

Portland Data Collection

A cornerstone of BirdSafe Maine's work has been data collection in Portland and around the state. The coalition wanted to test whether the science around bird strikes applied to Maine, working to answer a pair of fundamental questions:

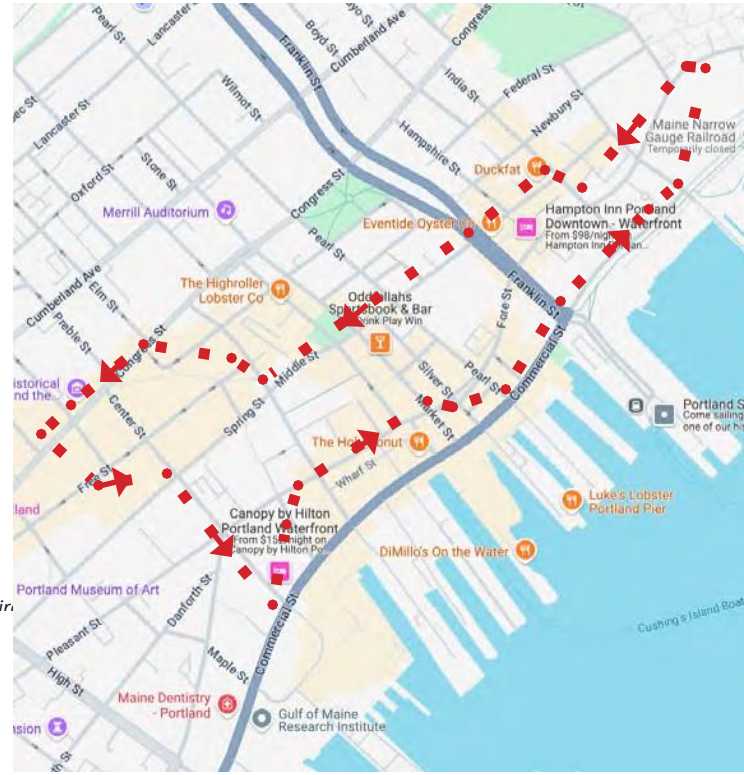
1) *Are birds striking glass windows in Maine? And,*
2) *Are they striking more often against buildings with large amounts of glass?*

After more than four years of mon- itoring, BirdSafe Maine believes it has answered both questions with an unequivocal *"Yes."*

Much of the data collection occurred on the streets of Portland, where BirdSafe Maine volunteers walked early-morning routes during spring (April and May) and fall (September and October) migrations beginning in the fall of 2020. Volunteers walked along an approximately 2-mile route between the Ocean Gateway building on Thames St. around the city north and east to the corner of Congress and Brown streets, then down toward Commercial Street to complete the loop. The route took volunteers past hundreds of buildings, including those with large amounts of glass on the façade and those with less glass.

Volunteers were instructed to search near buildings for dead or injured birds and record their sightings. If warranted and practicable, injured birds were directed to local rehabilitators at Avian Haven by volunteers. Reports and photographs were collected by Maine Audubon staff and organized by species, building, time of day, condition, and other factors.

In the four years since monitoring began, BirdSafe Maine volunteers found more than 600 dead and injured birds on the streets of Portland. At least 67 different bird species have been found on the streets, representing a wide variety of bird families.



Species found by BirdSafe Maine volunteers along the Portland route.

(Left to right, top to bottom): American Goldfinch, American Redstart, American Robin, American Woodcock, Bay-breasted Warbler, Belted Kingfisher, Black-capped Chickadee, Black- and-white Warbler, Blackpoll Warbler, Black-throated Blue Warbler, Black-throated Green Warbler, Blue-headed Vireo, Brown Creeper, Brown Thrasher, Common Grackle, Common Yellowthroat, Connecticut Warbler, Dark-eyed Junco, Downy Woodpecker, Eastern Phoebe, Eastern Towhee, Eastern Wood-Pewee, European Starling, Fox Sparrow, Golden- crowned Kinglet, Gray Catbird, Hermit Thrush, Herring Gull, House Finch, House Sparrow, House Wren, Indigo Bunting, Least Flycatcher.

(Left to right, top to bottom): Lincoln's Sparrow, Magnolia Warbler, Mourning Dove, Nashville Warbler, Nelson's Sparrow, Northern Flicker, Northern Mockingbird, Northern Parula, Northern Waterthrush, Ovenbird, Palm Warbler, Pine Warbler, Red-breasted Nuthatch, Red-eyed Vireo, Rock Pigeon, Rose-breasted Grosbeak, Ruby-crowned Kinglet, Ruby-throated Hummingbird, Savannah Sparrow, Scarlet Tanager, Sharp-shinned Hawk, Song Sparrow, Swainson's Thrush, Swamp Sparrow, Tennessee Warbler, Veery, White-breasted Nuthatch, White-crowned Sparrow, White-throated Sparrow, Wilson's Warbler, Wood Thrush, Yellow Warbler, Yellow-bellied Sapsucker, Yellow- billed Cuckoo, Yellow-rumped Warbler.

Each of these species is an expected species to one degree or another. Studies in other cities have found that certain species would be more commonly found than others, especially songbirds that spend the majority of their time on or near the ground, like Common Yellowthroats, White-throated Sparrows, and Ovenbirds. These have been, in fact, the most common species.

BirdSafe Maine's survey route has found lots of bird strikes, though it has been more of an advocacy effort than a scientific experiment. Though there is always at least one volunteer per morning, there are more on other mornings, permitting better coverage of the route. Volunteers looking for victims also must contend with predators, especially gulls, which have repeatedly been reported eating strike victims before volunteers could arrive.

In addition to finding the species the group expected, BirdSafe Maine volunteers found bird strikes more often against buildings with large amounts of glass on the façade. Portland has a variety of architectural styles, including older stone and brick buildings with, often, smaller windows broken up by mullions and other features, and newer buildings with large areas of glass. Each season, the vast majority of bird strikes are found against glass-dominated buildings. In contrast, there are many large buildings along the route with smaller windows at which volunteers have never recorded a strike.

The survey has revealed a number of other issues that make buildings particularly dangerous. Certain buildings include architectural features that can exacerbate the strike risk, such as glassed-in corners and pass-through glass. Landscaping proved to play an important role in increasing risk, sometimes in unexpected ways. For more, see MEMIC case study (page 36).

Statewide Data Collection

In addition to collecting data in Portland via dedicated daily surveys, Maine Audubon also asked its members and supporters to report bird strikes they found elsewhere in Maine. Hundreds of volunteers from dozens of Maine towns have submitted reports to BirdSafe Maine. Strikes against rural and suburban windows are also common, but difficult to detect due to vegetation, remoteness, and lack of volunteer coverage. Still, Mainers reported lots of strikes at their homes. The species mix and timing also matched what was expected during the particular stage of spring or fall migration.

An ongoing partnership with York County-based animal rehabilitator Center for Wildlife also helped supply the project with data from outside Portland. Since 2022, Center for Wildlife staff has sent data on patients coming into the facility after striking windows.

Outreach to Maine's Architectural and Design Community

Portland Society for Architecture's (PSA) involvement in BirdSafe Maine has significantly increased the reach of the understanding of bird glass collisions in Maine. The issue is a new concept for many architects, as it is not a discipline taught in most architecture schools despite a relatively firm understanding of the various threats posed by glass and particular architectural features and a growing interest in "green" buildings.

PSA has worked since 2019 to raise awareness of bird glass collisions, hosting walks during migration season, lectures and presentations, workshops and site visits. With PSA's help, BirdSafe Maine has been able to build bridges across the architectural and design community that similar programs in other states have not achieved. These connections were vital when, for example, BirdSafe Maine wanted to pull together a team of local architects and designers to help draft an ordinance for the city of Portland.

BirdSafe Maine has also consulted with a number of building owners, architects and designers, and companies who are looking to design a building that incorporates bird-safe principles, or retrofit an existing building experiencing a high number of collisions. Some of these experiences are detailed in the Case Study section (pages 35-36).

Policy Solutions

Once it had proof that bird glass collisions were occuring, BirdSafe Maine began working to encourage policies that would reduce these collisions. A growing number of municipalities and states across the U.S. are adopting requirements for bird-safe materials or voluntary guidelines. In September 2023, the Maine Legislature passed Public Law 2023, c. 221, "An Act to Protect Birds and Wildlife in the Construction and Maintenance of Public Buildings," requiring the state to develop guidance regarding integration of bird and wildlife risk management into public improvements. In June 2024, the City of Portland passed Order 244-23/24 "Amendment to Portland City Code Chapter 6 RE: Bird Friendly Building and Design Requirements," requiring certain new buildings in the city to use bird-safe materials.

Public Law 2023, c. 221: "An Act to Protect Birds and Wildlife in the Construction and Maintenance of Public Buildings"

These guidelines are developed in response to the passage of state legislation in June 2023. Public Law 2023, Ch. 221 "An Act to Protect Birds and Wildlife in the Construction and Maintenance of Public Buildings" was sponsored by Representative Sophia Warren of Scarborough.

Public Law 2023, c. 221: An Act to Protect Birds in the Construction, Renovation and Maintenance of Public Buildings

Be it enacted by the People of the State of Maine as follows:

Sec. 1. 5 MRSA §1754 is enacted to read:

§1754. Guidance regarding integration of bird collision risk management into public improvements

The Department of Administrative and Financial Services, Bureau of General Services, referred to in this section as "the bureau," shall develop guidance regarding the integration of bird collision
risk management into public improvements. The bureau, to the extent it determines appropriate considering all relevant factors, shall follow the guidance in the construction of public improvements and renovations of public improvements in which more than 50% of a building facade is substantially altered. The guidance is not applicable to public buildings, landscapes or districts listed on the National Register of Historic Places or determined by the Maine Historic Preservation Commission, created pursuant to Title 27, section 502, to be eligible for inclusion on the National Register of Historic Places, including the State House and the Blaine House.

1. **Development of guidance.** The guidance for reducing bird collisions
with public buildings and improvements must:
   a. Be developed in consultation with expert stakeholders, including, but not limited to, state or federal natural resource agencies with expertise in bird conservation; nongovernmental organizations with expertise in bird conservation; representatives from the building and design community; and representatives of green building or bird safe building certification programs;
   b. Include an explanation of architectural design threats and landscape design threats to birds;
   c. Include an explanation of the cost differentials and comparative effectiveness of materials, designs and other methods for reducing bird collisions;
   d. Include an explanation of other considerations for reducing bird collisions; and;
   e. Be available on the bureau's publicly accessible website.
2. **Reports.** The bureau shall submit a report to the joint standing committee of the Legislature having jurisdiction over state and local government matters by December 31, 2026, and biennially thereafter, detailing use of the guidance under this section during the previous 2-year period, including reasons and factors for using or not using the guidance. The committee may submit legislation relating to the subject matter of the report to the session of the Legislature following receipt of the report. Sec. 2. Report. The Department of Administrative and Financial Services, Bureau of General

Services, referred to in this section as "the bureau," shall develop the guidance required by the Maine Revised Statutes, Title 5, section 1754 by December 31, 2024. The bureau shall submit a report to the joint standing committee of the Legislature having jurisdiction over state and local government matters no later than December 31, 2024 detailing the guidance developed. The committee may submit legislation relating to the subject matter of the report to the 132nd Legislature in 2025.

Definition of "Public Improvement"

5 MRSA §1741. Definitions
"Whenever the words "public improvement" or "public improvements" appear in chapters 141 to 155, those words mean and include the construction, major alteration or repair of buildings
or public works now owned or leased or constructed, acquired or leased by the State or any department, officer, board, commission or agency of the State, or constructed, acquired or leased, in whole or in part with state funds, and including the construction, major alteration or repair of school buildings, in excess of $25,000, by any school administrative unit and for which state school construction aid is to be paid, except that sections 1743 and 1745 are not applicable to construction, major alteration or repair of school buildings. This subchapter does not apply to contracts for
transportation-related services and contracts for construction and maintenance that,
by law, are under the supervision of the Department of Transportation or the Maine Turnpike Authority"
(legislature.maine.gov/statutes/5/title5sec1741.html)


The New York Times

PART II: GUIDELINES FOR BIRD-SAFE BUILDINGS IN MAINE

The following guidelines represent the fundamental principles of bird- safe architecture. They are meant to give architects, designers, and others involved with building "public improvements" in the state easy-to- follow tools on how to avoid bird glass collisions and make the state a safer place for migratory and resident birds.

The field of bird-safe products is rapidly evolving as new products come onto the market and as increased demand drives innovation. More information on these guidelines, additional principles of bird-safe architecture, and updated lists of products and strategies can be found by contacting Maine Audubon **(birdstrike@maineaudubon.org)** or looking for more information in the Resources section of this document.

Guideline 1: Reasonable actions count toward making buildings bird safe.

Guideline 2: Bird safety should be considered during the design stage.

Guideline 3: Minimizing the amount of glass is the cheapest way to improve the safety of a building.

Guideline 4: Lower floors are the most dangerous to birds.

Guideline 5: Certain architectural features are especially dangerous and should be avoided.

Guideline 6: Landscaping matters.

Guideline 7: Light pollution can attract birds unnecessarily.

Guideline 8: Glass treatments must be applied to the outside of the window.

Guideline 9: There are many different solutions.

Guideline 10: Existing buildings can be modified to reduce threats to birds.

GUIDELINE 1

REASONABLE ACTIONS COUNTTOWARD MAKING BUILDINGS BIRD SAFE.

Defining “bird friendliness” is a difficult and subjective task. All windows and other reflective surfaces pose some level of threat to birds, but at what point does a building cross from being a threat to being “bird safe”?

In some areas, like the City of Portland and other municipalities around the country, “bird safety” is defined in statute or local ordinance. In many of those instances, exterior glazing on applicable buildings must meet or come below a Threat Factor level as set by the American Bird Conservancy, an organization which tests different bird-safe products and strategies. An updated list of “bird- safe” products can be found at: *abcbirds.org/glass-collisions/products-database/*

However, a bird-safe building does not need to use any products marketed as “bird safe” at all. Many architectural strategies and design elements can be employed to increase the relative safety of a building, most of them time-honored and cost-effective. Simply limiting the size of windows, employing mullions or insect screens, or avoiding features like glass corners and glass railings can all help reduce the threat of a building.

Maine’s Public Law 2023, Ch. 221 does not mandate the adoption of these guidelines into public improvements, and so the question of compliance is more complicated. In short, there is no set answer as to what makes a “bird safe buildings,” other than effort. The level of consideration given to these guidelines during the planning and design of a building is a good place to start. Therefore, ***a bird-safe building is one that takes reasonable available actions to reduce the threat to birds.***

...a bird-safe building is one that takes reasonable available actions to reduce the threat to birds.

GUIDELINE 2

BIRD SAFETY SHOULD BE CONSIDERED DURINGTHE DESIGN STAGE.

Perhaps the most important single piece of information for those considering constructing bird-safe building is to ***consider bird safety as early as possible in the planning and design process.***

It is easier and cheaper to build a bird-safe building than it is to begin to consider bird safety after the design process is settled, or especially to retrofit a dangerous building after it has been built.

When considering bird safety at the beginning, all options are on the table. The further the design progresses and decisions become locked in, the more limited the options become for taking cost-effective actions.

For example, if bird-safe principles are incorporated from the very beginning, a building could be constructed and landscaped in numerous ways to protect birds. But if a building begins to consider bird safety after it is decided that the building will feature 5'x5' windows, the architect is limited now only to purchasing specialty glass or installing various retrofit products. Finally, if bird safety is considered only after glass is ordered or installed, the options are limited now only to retrofit products.

It is easier and cheaper to build a bird-safe building than it is to begin to consider bird safety after the design process is settled.

GUIDELINE 3

MINIMIZING THE AMOUNT OF GLASS IS THE CHEAPEST WAY TO IMPROVE THE SAFETY OF A BUILDING.

The amount of glass on a façade is the biggest predictor of bird collisions. Therefore, ***reducing the amount of glass is the best way to make a building safe for birds.***

As glass has become a more popular building material due to its low cost and "modern" appearance, all-glass buildings have become more and more common. But it does not need to work this way. Architects have designed many bird-safe buildings—either intentionally or incidentally—in Maine and around the world.

Architecture across Portland, for example, has largely been bird safe, albeit incidentally. Brick, stone, and wood were the most commonly used building materials, due to their availability and ability to withstand varying temperatures. Buildings throughout Portland's architectural history, from the formal, Federal period between 1780 and 1830, the elaborate Italianate period in the mid-19th century, or the stately Classic Revival style in the early 20th century, all made use of small, divided windows and larger areas of solid material.[1] Even some modern buildings, like the iconic Portland Museum of Art, make prominent use of brick.
These are the styles that define Portland as a city, and yet they happen to be relatively safe for migratory birds.

...reducing the amount of glass is the best way to make a building safe for birds.

1 https://www.portlandlandmarks.org/architecture-defined

GUIDELINE 4

LOWER FLOORS ARE THE MOST DANGEROUS TO BIRDS.

Though it may be counterintuitive to those thinking of migratory birds as flying high in the air, ***the vast majority of bird strikes occur on the first and second floors of buildings.*** Therefore, minimizing glass or using other bird-safe strategies on these lower floors will have the most beneficial effect.

Migrating birds do indeed fly high—thousands of feet in the air, typically—as they move north or south each night. However, songbirds don't migrate during the day, instead coming to the ground to feed and find safety from predators. During the day, grounded migrant birds move around their new landscape in search of food and shelter, flying between areas of vegetation. It is during these times of reorientation and local movement that migratory birds are most likely to encounter reflective glass.

Some municipal ordinances require the use of bird-safe materials only up to a certain height. Ordinances in New York City and Portland, Maine, for example, require certain materials to be used up to a height of 75 feet. This height requirement can be re-set where green roofs, vegetated patios, or other features act as bird attractants.

If pressed due to budgets or design requirements, etc., it is recommended to focus the bird-safe efforts starting with the first and second floors.

...the vast majority of bird strikes occur on the first and second floors of buildings.

GUIDELINE 5

The use of glass in certain architectural features can also pose a severe threat to birds, and should be avoided or mitigated.

CERTAIN ARCHITECTURAL FEATURES ARE ESPECIALLY DANGEROUS AND SHOULD BE AVOIDED.

Reflective glass windows are a primary source of danger to birds, but they are not the only place on a building where glass may pose a threat. ***The use of glass in certain architectural features can also pose a severe threat to birds, and should be avoided or mitigated.***

The danger from certain of these features derives from the transparency of glass creating "pass-through" conditions, where a bird looks through one or more panes of glass to see potential habitat beyond.

1. *Glass Railings or Handrails*
   The transparency of glass railings, whether near ground level or along an upper-level balcony, can be dangerous and should be avoided.

2. *Skywalks*
   Glass skywalks connecting two buildings can be convenient, but can be especially dangerous when either reflective or transparent.

3. *Corner Windows*
   Windows that meet to form the corner of a building create a pass-through scenario that can be dangerous in a number of conditions.

4. *Glass Entryways*
   Elaborate glass entranceways can appear to provide clear pathways around the front of buildings, especially when combined with bird-attracting plantings.

GUIDELINE 6

LANDSCAPING MATTERS.

Landscaping attracts birds, and can bring them into proximity to glass.

In urban settings, birds looking for refuge among the buildings fly toward whatever habitat they can find. BirdSafe Maine volunteers found a strong correlation between landscaping and bird strikes, varying from shin-high bushes along the edge of a glass-dominated building to large trees and pocket parks in other parts of the city.

In suburban and rural areas, the presence of vegetation has a similar effect, and attracts birds outside of the migratory seasons. Glass windows along forest edges can reflect trees from a great distance, tricking birds as they fly across open areas. In summer, when birds are on territory in Maine, attracting mates and raising young, they may fall victim to reflective windows as they fly about their territories. There are fewer birds in Maine in the winter, especially songbirds, but those that do overwinter here, like finches and American Robins, are often found feeding on berries growing on exotic landscaping trees.

The presence of landscaping is complicated, especially because of the many recognized benefits of street trees and native vegetation. ***In all cases, addressing the reflectiveness of the glass is the best way to reduce the threat.***

In all cases, addressing the reflectiveness of the glass is the best way to reduce the threat.

GUIDELINE 7

Reducing light pollution is the best way to avoid unnecessarily attracting birds.

LIGHT POLLUTION CAN ATTRACT BIRDS UNNECESSARILY.

As outlined earlier, artificial lighting at night plays a role in the number and distribution of collisions across the built environment. Artificial light attracts birds, and brings them in closer proximity to glass.

Reducing light pollution is the best way to avoid unnecessarily attracting birds. There are many ways to achieve this, including simply using lighting fixtures that limit the amount of light loss. Many municipalities in Maine, as well as lands under the jurisdiction of the Land Use Planning Commission, have their own standards for lighting, and those should be followed to reduce light loss. More information on bird-safe lighting standards can be found on the website of the U.S. Fish and Wildlife Service.

Some cities have LightsOut campaigns which ask building owners to shut off lights during peak migration nights. Advancements in weather forecasting and radar have improved our ability to understand when and where migration may be at its heaviest, and solutions can be tailored to those particular evenings, rather than asking people to invest in timers, new light fixtures, etc.

GUIDELINE 8

GLASS TREATMENTS MUST BE APPLIED TO THE OUTSIDE OF THE WINDOW.

A common reaction for those wanting to break up window reflections in order to reduce bird strike threats is to pull interior curtains or take other actions inside. Certainly, taking action inside a building would be an easier way to address bird strikes, especially on upper floors. However, ***to be effective, treatments must be applied to the outside surface of a window.***

Reflections are caused by the outside surface of the panel, and so treatments placed on the inside of the glass will be overwhelmed and obscured by reflections on the outside.

Interior shades or other items may help reduce the effectiveness of "pass- through" situations by working to obscure sightlines through the glass, but are only effective in certain conditions where reflections are not also a problem.

...to be effective, treatments must be applied to the outside surface of a window.

GUIDELINE 9

...anything that alerts a bird to the presence of glass is a solution.

THERE ARE MANY DIFFERENT SOLUTIONS.

Architects and designers who want to build a bird-safe building have a lot of options in front of them. It can be tempting to begin by looking at products marketed as bird safe, such as specialty windows. Those products are effective, but they are not the best place to start.

In short, ***anything that alerts a bird to the presence of glass is a solution.*** Any way to break up a reflection, reduce reflection, or make birds aware of glass on an otherwise transparent surface, will work to reduce collisions. In addition to specialty glass and other products outlined elsewhere in this document, architects and designers can and should consider: employing smaller windows; breaking up windows with sills or mullions; using readily available glass products, including frosted, waved, etched, or privacy glass; using insect screens or other screening; adding seasonal installations including paint or exterior curtains; and many more.

Some buildings built to be bird safe are elaborate and futuristic, but many others use nothing but time-honored and well-known architectural styles and principles. The only limits are the imaginations of architects.

GUIDELINE 10

EXISTING BUILDINGS CAN BE MODIFIED TO REDUCE THREATS TO BIRDS.

Public Law 2023, c. 221 specifies that these guidelines be followed "in the construction of public improvements and renovations of public improvements in which more than 50% of a building facade is substantially altered." However, many existing buildings suffer from bird strikes, and building residents are increasingly seeking ways to remedy strikes at the buildings they occupy.

It is easier to design and build a bird-safe building from the start, but ***there are lots of ways to work with an existing building to reduce the number of bird collisions.***

The first step may be to identify the source of the problem. If there are particular windows or other architectural features that are a frequent cause of bird strikes, those may be able to be addressed first. Listening to building occupants and organizing frequent checks for victims can help identify problem areas. Particular areas to pay attention to include: windows that reflect vegetation; windows near trees that have berries in winter; and large areas of glass near an entryway. The organization BirdSafe Canada has developed a Self-Assessment Tool that can help building owners understand the scope of their issues.

Potential treatments depend on the type and size of the glass, glazings or other coatings, the window frame, and other factors. Popular solutions for building retrofits include decals, like those from Feather Friendly or CollidEscape; hanging exterior curtains like those from Acopian BirdSavers; and temporary, seasonal solutions including tempura paint. The range of products is increasing rapidly due to demand, and those looking to treat an existing building should look for new options before beginning.

...there are lots of ways to work with an existing building to reduce the number of bird collisions.

PART III: BIRD-SAFE BUILDING PRODUCTS AND SOLUTIONS

There are many cost-effective and widely known methods to make buildings bird safe without using specialty products. As stated above, any product or technique that warns birds about the presence of glass before they strike is a solution. Some of the most common solutions are discussed below.

EFFECTIVE SOLUTIONS

1. Limiting the Amount of Glass

The easiest and cheapest way to reduce a building's overall threat to birds is by limiting the amount of glass on a façade. Buildings across Maine, both modern and historic, have unintentionally created relatively bird-safe buildings simply by choosing to limit the size or number of windows.

Left: 433 Fore St., Portland has limited glass compared to many similar hotels.

*Right:*15 Middle St., Portland has limited glass and makes use of mullions to break up reflective surfaces.

2. Screens, Grilles, Shutters, Exterior Shades, Mullions

Breaking up a single surface of reflective glass with an exterior pattern is an excellent way to incorporate bird-friendly elements into a window while still providing the benefits of light and views. There are many ways to accomplish this goal. Simple insect screens, for example, are a widely accepted window treatment that also happen to be a very effective bird strike deterrent.

Exterior screening can take many forms, and incorporate other functions. Exterior, motorized screens can protect against bird strikes while also controlling heat and light, and increase security.

Bubble Bromo Clear

3. Patterned Glass

The transparency of glass has always been an issue. Many buildings with glass doors have patterns etched or printed onto the panels to help alert human users. In the age of a growing awareness of bird collisions, these patterned glass technologies are being applied more widely. Such patterns, often printed as ceramic dots, or "frits," have proven very effective when applied to the outside surface of a glass panel within the recommended 2"x4" or 2"x2" rule.

An increasing number of companies are producing patterned or fritted glass, in a diversity of styles.

4. Opaque and Translucent Glass

Similar to patterned or fritted glass, frosted or opaque glass has long been utilized in order to secure the benefits of glass while still offering privacy and safety. A number of different products or styles are available.

INEFFECTIVE TREATMENTS

1. Ultraviolet Glass

Certain species of birds, including most songbirds, can see light into the ultraviolet (UV) spectrum, while humans cannot. Therefore, glass
panels treated with ultraviolet coatings or with ultraviolet strips have the potential to be the best of all worlds: glass that appears solid to a bird but completely clear to a human. A number of companies produce UV-patterned glass.

However, this technology has not yet delivered on its potential. For one, current UV glass products are simply less visible, only viewable from certain angles, for example, or overwhelmed in harsh light. Secondly, many birds, like hummingbirds and kingfishers, cannot see light in the ultraviolet spectrum at all, making the technology completely ineffective. Thirdly, commercially available UV glass is currently the most expensive of all treatment options.

2. Awnings and Overhangs

Overhangs and awnings may limit the view of a glass window from above, or from certain other angles, but generally are ineffective at eliminating reflections from straight ahead—the direction from which most birds approach a panel. Awnings and overhangs may be effective at eliminating reflections or blocking glass in certain circumstances, and should be evaluated on a case-by- case basis.

3. Angled Glass

In certain circumstances, glass walls tilted downwards may reduce the chance of bird collision. Tilted glass reflects the ground, rather than horizontal vegetation, and also may improve the angle at which birds strike the glass. However, the relative safety of angled glass may vary depending on other conditions, including nearby landscaping, and should be evaluated on a case-by-case basis.

4. Solutions Applied to Interior Glass

As stated above, the outside surface of a glass panel causes the reflection,
and so treatments placed on the inside of a window are, for the most part, ineffective. Interior screens or curtains do help reduce the threat from pass- through glass, where a bird looks through two glass windows to see habitat on the other side, but such treatments may exacerbate reflections by providing a solid background.

PART IV: CASE STUDIES

Tekakapimək Contact Station

Katahdin Woods and Waters NM

Alisberg Parker Architects reached out to BirdSafe Maine in January 2022 in the early stages of planning for what became the Tekakapimək Contact Station at Katahdin Woods and Waters National Monument, near Stacyville, Maine. The design team said they were considering several large blocks of windows to achieve a strong connection between visitors and the surrounding forest. Staff at the National Park Service had raised the issue of bird glass collisions, however, and they hoped to reduce the potential threat.

After internal discussion and product comparison, the design team decided to utilize glass manufactured with exterior ceramic frits. They used AviProtek glass in pattern 226, offered by Walker Glass. The bird safe windows join a number of other design features employed in the building including an innovative use of nominal lumber, on-site landscaping material, off-grid and mainly passive utilities include solar, shading, ventilation, radiant floor heat, and thermal mass Trombe walls, to create one of the most beautiful and forward-thinking buildings in Maine.

The Tekakapimək Contact Station, shown here, was built with glass manufactured with exterior ceramic frits to ensure a bird-friendly *building.*

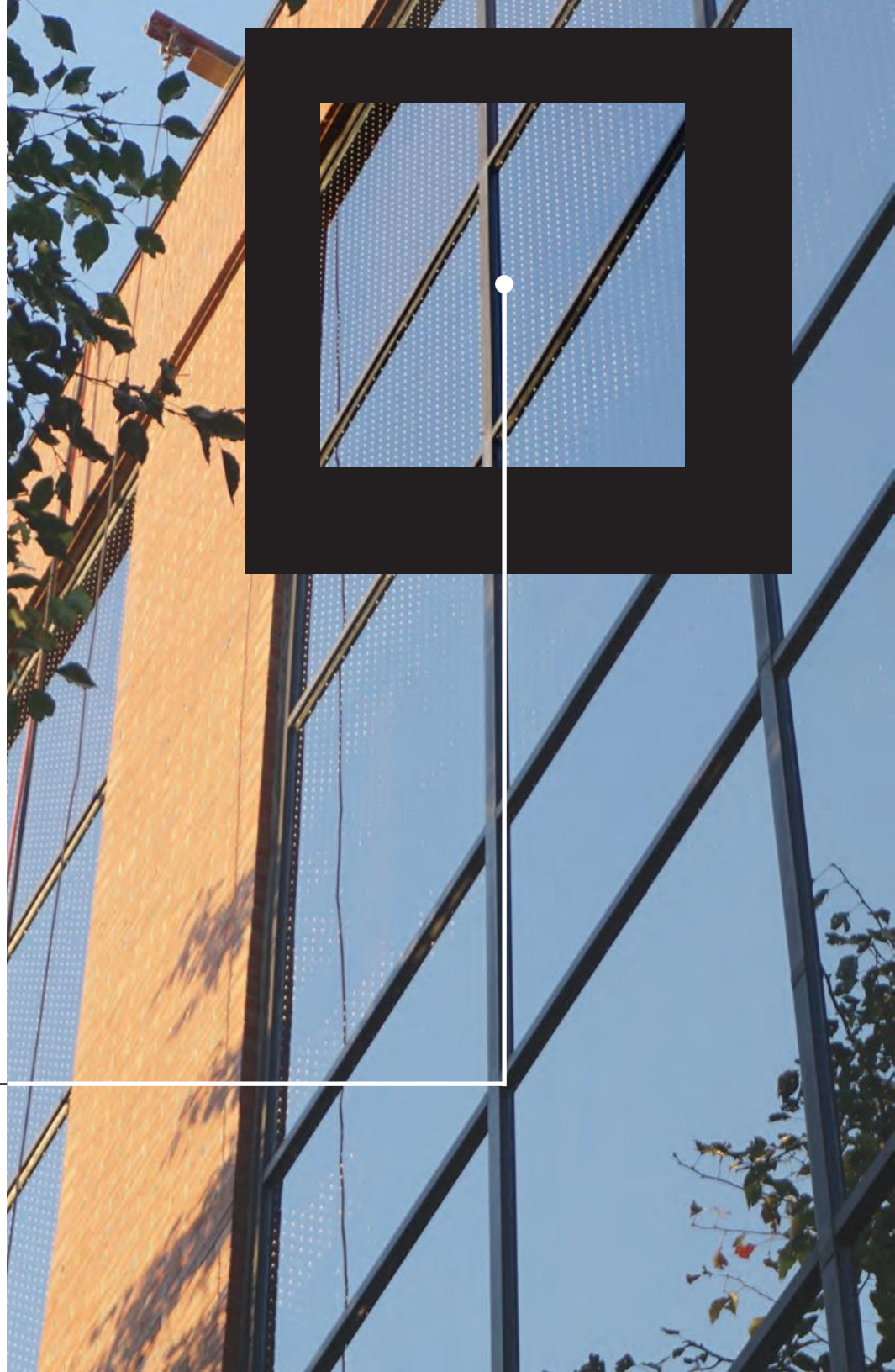
MEMIC Building

Portland, Maine

For several monitoring seasons, the alleyway between the 261 Commercial Street building and the adjacent vegetated courtyard in Portland, occupied by the MEMIC company, was the deadliest building on BirdSafe Maine's Portland route. Trees planted atop an adjacent parking garage brought migratory birds in close proximity to large reflective windows on the MEMIC building, resulting in a high number of fatalities.

BirdSafe Maine approached MEMIC staff to make them aware of the issue. The company was receptive, and agreed to install rows of Feather Friendly Commercial decals on the most dangerous windows.

Installation, in the fall of 2023, was difficult and costly. Labor costs and equipment rentals (the company needed to hire a lift to reach the upper floors) added to the cost of the product. The experience highlights the importance of pre- planning for bird safety rather than retrofitting. However, the treatment was a complete success, and BirdSafe Maine volunteers did not find a single dead bird in the MEMIC alleyway in the fall of 2024.



Though difficult to see with the naked eye, Feather Friendly decals on MEMIC's windows are an effective deterrent.

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