



## DEPARTMENT OF ADMINISTRATIVE SERVICES

### PROPOSED CHANGE OF THE CONNECTICUT STATE BUILDING CODE AND FIRE SAFETY CODE

DATE SUBMITTED: April 2, 2024

#### CODE INFORMATION

Proposed change to:  Building Code  Fire Safety Code

Code section(s): **2021 INTERNATIONAL BUILDING CODE - CHAPTER 27 – ELECTRICAL - SECTION 2703 LIGHT POLLUTION CONTROLS - Change to Exemption 6**

#### PROPOSER INFORMATION

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#### PROPOSAL INFORMATION

Description of change and reason for change (attach additional information as needed):

Proposed text change, addition or deletion (attach additional information as needed):

**follows: 6. Low-voltage landscape lighting, (ADD) such as that used to illuminate fountains, water features, shrubbery, and trees, provided that they use no more than 10 watt incandescent bulbs**

Supporting data and documents (attach additional information as needed) **or LED equivalent or maximum of 150 lumens and not directed toward the right-of-way.**

#### See Attached

- This Proposal is original material.** (Note: Original material is considered to be the submitter's own idea based on or as a result of his/her own experience, thought or research and, to the best of his/her knowledge, is not copied from another source.)
- This Comment is not original material, its source (if known) is as follows:** (such as material / code development proposal from a prior development cycle or proposal submitted to model code committee etc.)

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- I would like to make an in-person presentation of my proposal.**

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Proponent's Signature

Meredith Barges

Printed Name

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## **REASON FOR CHANGE**

**Several exceptions under Sec. 2703.1 are ambiguous and out-of-date.** Exception 6 exempts “low-voltage landscape lighting;” however, that term is not defined in the CT State Building Code, creating unnecessary ambiguity in the law. It leaves open the question of how the provision should be interpreted, complied with, and enforced. It may be assumed that the term “low-voltage landscape lighting” refers to certain types of lower-intensity luminaires that do not require shielding because of their small size and/or low lumen output, however, this is unclear. A clear definition of the term “low-voltage landscape lighting” is needed in the CT State Building Code. This proposed code change would provide a clear definition of the term and bring it up-to-date.

**Most “low-voltage landscape lighting” exemptions in municipal codes set an upper limit of luminescence—in lumens or watts or a BUG rating—for this particular category of exemption.<sup>1</sup> However, Sec. 2703.1 does not.** As the law is currently written, light output at each light could be as high as 3,200 lumens or more, because some “low-voltage” (12-volt) outdoor lighting fixtures are capable of producing over 3,000 lumens. (See, for example, [the Westgate 12v, 32 watt landscape flood light.](#))

This proposed code change would set an upper limit of 100 lumens for LEDs or 10-watts for incandescent lights, which is comparable to 100 candles all burning at once from a distance of one foot away. **It should be noted, this level of luminescence is still quite high for landscape lighting.** For the sake of precision, “low-voltage” should not be the standard or metric used to limit shielding requirements for certain types of low-intensity landscape lighting. A better metric for regulating such luminaires is *lumens*.<sup>2</sup>

**Further, Sec. 2703.1 does not set a limit on the number of “low-voltage” luminaires that can be used to illuminate one feature or one site.** Under current the CT State Building Code, one landscape feature, like a tree, shrub, bridge, or pond, could be illuminated by multiple luminaires, cumulatively producing a very high level of luminescence at the feature. Therefore, it is all the more important to establish a reasonable upper limit for lumens or watts on unshielded “low-voltage landscape lighting,” in order to limit glare and unnecessary light pollution.

**There have also been major changes in lighting technology and metrics and light pollution levels since Sec. 2703.1 was adopted in 2004.** The advent of affordable,

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<sup>1</sup> See, for example, City of Cupertino CA Municipal Code 19.102.040 B.1.a: “Low-voltage Landscape Lighting: Low-voltage landscape lighting, such as that used to illuminate fountains, shrubbery, trees, and walkways, do not have to be shielded fixtures and may use uplighting, provided that they use no more than ten (10) watt incandescent bulb or LED equivalent, or a maximum of 150 lumens (whichever is less), and not directed toward the right-of-way.” <https://codehub.gridics.com/us/ca/cupertino#/d3ef8742-594e-4e92-bb0d-0fb09d855bd/68dadeb1-0691-4c82-a9e1-11e6e40f268f/f5c5cc3c-2f84-411d-8ceb-6fbe361345dd>

<sup>2</sup> U.S. Department of Energy, “Lumens and the Lighting Facts Label,” <https://www.energy.gov/energysaver/lumens-and-lighting-facts-label#:~:text=Buy%20Lumens%2C%20Not%20Watts&text=When%20you're%20shopping%20for%20light%20bulbs%2C%20think%20about%20the,lumens%2C%20the%20brighter%20the%20lightbulb>

durable LED lights in the last twenty years has transformed outdoor lighting practices. With this new technology, there has been a dramatic increase in the availability of low-cost, high-intensity LED lighting that qualifies as “low-voltage.”<sup>3</sup> Most LED lights on the market can produce on average 75-110 lumens per watt, which is approximately seven times the lumen level per watt of incandescent light.<sup>4</sup> Further, high-performance LEDs can get up to 170 lumens per watt (approximately 15 times the incandescent lumen-per-watt level).<sup>5</sup> Luminaires up to 120 lumens are sufficient for lighting objects at ground level to 10 feet in height, such as pathways, sidewalks, decks, bushes, shrubs, hedgerows, trees, and other plant materials.<sup>6</sup>

**Light pollution in North America is increasing at a rate of 10.4% every year.<sup>7</sup> Part of the reason is the growing landscape lighting industry, which needs better regulation.** The global Outdoor Landscape Lighting market size has been forecasted to increase by 6% annually from 2022 to 2027.<sup>8</sup> The growth of the market depends in large part on the growing demand for LED lighting for different applications and the lack of clear regulations for landscape lightning.<sup>9</sup>

**To achieve the intent of Sec. 2703.1, to control light pollution, this rule should prevent uplighting wherever possible, especially at nonessential decorative lighting, like landscape lighting.** Other jurisdictions including in California, Colorado, and Washington specially regulate landscaping as a non-exempt category of outdoor lighting, requiring that landscape lighting not “generate excessive light levels, cause glare, or direct light beyond the landscaping into the night sky.”<sup>10</sup>

**Sec. 2703.1 should prevent glare from any source from being directed toward the right-of-way.** Uplighting at outdoor landscapes creates “glare,” which is defined as light directed above the horizontal line. Connecticut state law makes clear that public safety on roadways is prioritized above individual lighting choices of property owners at commercial and residential properties. This was established in CT Public Act 03-210, which prohibits floodlights intended to illuminate private property from being located in a

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<sup>3</sup> U.S. Department of Energy, “LED Lighting”: “The rapid development of LED technology has resulted in increased product availability, improved manufacturing efficiency, and lower prices.”

<sup>4</sup> VOLT Lighting, “Lumens To Watts Conversion Chart: Choose The Right LED Bulb”: “Depending on the bulb and the manufacturer, LED technology typically produces 75-110 lumens/watt. So, LEDs are generally about 7 times more efficient at producing light than incandescent bulbs.”

<sup>5</sup> Looking ahead, the U.S. Department of Energy has stated that “a target of above 200 lumens per watt is achievable” for LEDs. This means that lighting output per watt could dramatically increase in the decades ahead.

<sup>6</sup> Cast Lighting, “How to Choose the Right Light Level for Landscape Lighting,” May 15, 2023, <https://cast-lighting.com/blog/post/how-to-choose-the-right-light-level-for-landscape-lighting>

<sup>7</sup> Christopher C. M. Kyba *et al.*, “Citizen scientists report global rapid reductions in the visibility of stars from 2011 to 2022.” *Science* 379, 265-268 (2023). DOI: [10.1126/science.abq778](https://doi.org/10.1126/science.abq778)

<sup>8</sup> TechNavio, “Outdoor Landscape Lighting Market by End-user, Application, Source, and Geography - Forecast and Analysis 2023-2027,” 2023.

<sup>9</sup> Ibid.

<sup>10</sup> City of Seattle, Zoning Code, <https://www.codepublishing.com/WA/SeaTac/html/SeaTac17/SeaTac1744.html#17.44.030>

state highway right-of-way in order to “reduce hazardous road glare and light pollution.”<sup>11</sup>

**It should be noted, there is wide availability of attractive, effective shielding and design options for low-voltage landscape lighting.** There are many different styles and types of low-voltage landscape lighting on the market for commercial and industrial uses. These include both a wide variety of affordable, attractive shielded landscape lighting products and unshielded landscape lighting in the 5-100 lumen range.

**As Lights Out Connecticut, we are suggesting this code change because we know from our work to protect bird populations from the harmful effects of light pollution that unshielded nighttime lighting degrades the environment and harms fauna and flora.**

**It must be remembered that, first and foremost, landscaping is habitat. More than any other type of lighting, landscape lighting directly affects the habitats of a wide range of wildlife, plant life, and ecosystems in Connecticut, in addition to placing potential burdens on human health.**<sup>12</sup> The wide variety of trees, shrubs, flowers, grasses, and other flora used in landscape design in Connecticut, such as oak trees, pine trees, cherry trees, maple trees, conifers, and shrubs like hydrangea and rhododendron, provide habitat and food sources for a broad range of fauna species in Connecticut, both nocturnal and diurnal, which have evolved with natural patterns of night and day. These flora and fauna species together create functioning ecosystems. Therefore, landscape lighting requires closer regulation to limit its potentially harmful effects.

Artificial light is a form of pollution and disruptive contaminant that degrades the ecosystem,<sup>13</sup> with potentially negative impacts on the environment, no different from other artificial, unnatural, man-made contaminants and materials.

**Light pollution negatively impacts wildlife.** Many animals rely on darkness as part of their habitat and behavior, and artificial light at night (ALAN) can disrupt their natural cycles. Lighting used in landscaping creates nighttime lighting conditions that adversely impacts nocturnal animals and migratory birds.<sup>14</sup> Both birds and insects dwell and find food sources in many flora commonly used in landscaping. Most landscaping projects do not address the needs of wildlife, although all wildlife have a need for food, shelter,

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<sup>11</sup> State of Connecticut, Public Act 03-210, An Act Requiring Reduction in Hazardous Road Glare and Light Pollution from Private Area Floodlighting Located within the State Right-of-Way, <https://www.cga.ct.gov/2003/act/pa/2003pa-00210-r00hb-05686-pa.htm>

<sup>12</sup> Svechkina, A. et al. (2020) “The impact of artificial light at night on human and ecosystem health: a systematic literature review.” *Landsc. Ecol.* 35, 1725–1742.

<sup>13</sup> *Encyclopedia Britannica*, “Light Pollution,” <https://www.britannica.com/explore/savingearth/light-pollution>

<sup>14</sup> See, for example, Adams, C.A. et al. (2019) “Effect of anthropogenic light on bird movement, habitat selection, and distribution: a systematic map protocol.” *Environ. Evid.* 8, 13; and Davies, T.W. et al. (2013) “Artificial light pollution: are shifting spectral signatures changing the balance of species interactions?” *Glob. Change Biol.* 2013 May; 19(5): 1417–1423. doi: [10.1111/gcb.12166](https://doi.org/10.1111/gcb.12166)

water, and space, including natural cycles of daylight and darkness.<sup>15</sup> A landscaping strategy that recognizes the place of wildlife in a healthy ecosystem helps to stabilize wildlife populations and biodiversity levels, while decreasing energy use and associated greenhouse gas emissions.

**Several at-risk species in Connecticut are sensitive to light pollution.** Dozens of animals that appear on the list of Connecticut Endangered and Threatened Species depend on regular periods of darkness for feeding, reproduction, and safety.<sup>16</sup> These species include the Least Shrew, Blue-Spotted Salamander, Long-Eared Owl, and Short-Eared Owl.

**Light pollution contributes to higher rates of bird building collisions.** Several bird species protected under federal and state laws, including species of concern and endangered species such as the Northern Parula and Bicknell's Thrush, shelter in different types of urban green spaces and landscaping during periods of peak bird migration. It is estimated that every year nearly one billion birds are killed in building collisions in the United States, mostly migratory songbirds, a problem that is exacerbated by excessive artificial lighting.<sup>17</sup> light pollution that lures migratory birds into unsafe urban/suburban areas. In this regard, it is important to remember that many species of North American migratory songbirds are in steep decline, experiencing significant population loss linked with loss of habitat, building collisions, and light pollution.<sup>18</sup>

**Light pollution impacts flora.** Artificial lighting can extend the "day length" and can change leafing and flowering patterns of plants.<sup>19</sup> In many areas, artificial light in the night-time environment is sufficiently bright to induce a physiological response in plants, affecting their metabolic cycles, growth, and resource allocation.<sup>20</sup> For normal growth and development, trees and other plants depend on the quality of light (wavelength or color), its intensity (brightness), and the duration of light over a 24-hour cycle (photoperiod). Light pollution does not just affect plants and their metabolic cycles directly, it also affects them indirectly by interfering with the life cycles of the pollinators and other animals that interact with them. "As artificial lights disrupt how nocturnal pollinators interact with plants, their pollen output can be affected, which may, in turn,

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<sup>15</sup> *Enlighten Journal* 2(2), "Environmentally Responsible Lighting Design: A lighting expert shares her how-to's on avoiding light trespass," <https://www.landscapeforms.com/enlighten/pages/2-2/Environmentally-Responsible-Lighting-Article.aspx>

<sup>16</sup> Connecticut Department of Energy and Environmental Protection, "Connecticut Endangered and Threatened Species Fact Sheets," <https://portal.ct.gov/DEEP/Wildlife/Learn-About-Wildlife/Connecticut-Endangered-and-Threatened-Species-Fact-Sheets>

<sup>17</sup> Scott R. Loss *et al.*, "Bird-building collisions in the United States: Estimates of annual mortality and species vulnerability," *The Condor*, 116(1): 8-23 (2014). DOI: <https://doi.org/10.1650/CONDOR-13-090.1>

<sup>18</sup> Kenneth V. Rosenberg *et al.*, "Decline of the North American avifauna." *Science* 366, 120-124 (2019). DOI: [10.1126/science.aaw1313](https://doi.org/10.1126/science.aaw1313)

<sup>19</sup> Monika Czaja and Anna Kolton, "How light pollution can affect spring development of urban trees and shrubs," *Urban Forestry & Urban Greening*, 77, 2022, 127753, <https://doi.org/10.1016/j.ufug.2022.127753>

<sup>20</sup> Jonathan Bennie *et al.*, "Ecological effects of artificial light at night on wildplants," *Journal of Ecology*, 2016, 104, 611-620. DOI: [10.1111/1365-2745.12551](https://doi.org/10.1111/1365-2745.12551)

impact how well bees and other diurnal pollinators can fertilize them during the daytime.”<sup>21</sup>

**A special case should be made for limiting lighting at natural water features, such as ponds, streams, waterfalls, fountains, and bird baths.** These are important sites for birds, mammals, and other creatures to access hydration and sanitation, especially during hot, dry summer months. They also benefit local ecosystems. Because of this, special precautions should be taken to avoid degrading water features with excessive nighttime lighting. Some landscape design firms, like Clanton & Associates, will not light waterways because of the negative effects of artificial nighttime light on fish.<sup>22</sup>

**As we look for nature-based solutions to address climate change, which several CT municipalities have identified as a climate emergency, we need to limit the burdens we place on wildlife, vegetation, waterways, and ecosystems, including through light pollution.** Our environment is undergoing significant changes due to intensive human development and urbanization resulting in habitat loss and climate disruption that is experienced by most species, including humans, as increased environmental burdens and negative health consequences.

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<sup>21</sup> Ally Hirshlag, “How light pollution disrupts plants' senses,” *BBC*, March 8, 2023, [www.bbc.com/future/article/20230308-how-light-pollution-disrupts-plants-senses](http://www.bbc.com/future/article/20230308-how-light-pollution-disrupts-plants-senses)

<sup>22</sup> “We will light a bridge but all of the light has to be contained on the bridge surface.” *Enlighten Journal* 2(2), “Environmentally Responsible Lighting Design: A lighting expert shares her how-to's on avoiding light trespass.”

## **REASON FOR CHANGE**

The purpose of this proposed Code Change is to clarify Exception 2 of Section 2703.1 and bring it in line with current best practices.

### **A. Exception 2 is ambiguous and needs clarification.**

**Sec. 2703.1 provides two conflicting exceptions for different types of “landscape lighting.”** First, under exception 2 it broadly exempts luminaires intended to illuminate “**landscape and water features**” and, then under exception 6, it exempts “**low-voltage landscape lighting**.” As written, exception 2 could suggest that all landscape lighting is exempted, although exception 6 only exempts a certain type of landscape lighting. If exception 2 was meant to exempt all landscape lighting, then there would have been no reason to exempt “**low-voltage landscape lighting**” under exception 6. This results in ambiguity in the law, making it difficult to interpret and enforce.

**Sec. 2703.1 too broadly exempts “other objects” from the shielding requirement without clearly defining that term.** Sec. 2703.1 exception 2 broadly exempts luminaires intended to illuminate “other objects,” but does not define what is meant by “other objects,” opening up the possibility that many different types of objects could be exempted from the Building Code’s important shielding requirement. The lack of specificity creates ambiguity in the law.

### **B. There have been major changes in lighting technologies and light pollution levels since 2004, when Sec. 2703.1 was adopted.**

**With the advent of LEDs in the 2000s, there have been major advances in lighting technology and products.** In particular, there has been a dramatic increase in the availability of low-cost, high-intensity LED lighting that qualifies as “low-voltage” since the adoption of Sec. 2703.1 in 2004.<sup>1</sup> Most LED lights on today’s market can produce on average 75-110 lumens per watt, which is approximately seven times the lumen level per watt of incandescent light.<sup>2</sup>

**The growing landscape lighting industry.** The growth of the landscape lighting market depends in large part on the growing demand for LED lighting for different applications and the lack of clear regulations for landscape lightning.<sup>3</sup>

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<sup>1</sup> U.S. Department of Energy, “LED Lighting”: “The rapid development of LED technology has resulted in increased product availability, improved manufacturing efficiency, and lower prices.”

<sup>2</sup> VOLT Lighting, “Lumens To Watts Conversion Chart: Choose The Right LED Bulb”: “Depending on the bulb and the manufacturer, LED technology typically produces 75-110 lumens/watt. So, LEDs are generally about 7 times more efficient at producing light than incandescent bulbs.”

<sup>3</sup> Ibid.

**Light pollution in North America is increasing 10.4% annually.** A 2023 study found that light pollution in North America is increasing at a rate of 10.4% each year.<sup>4</sup> This is unsustainable.

**C. Sec. 2703.1 should not provide broad exemptions for landscape lighting, facade lighting, or lighting at water features.**

**Section 2703.1 should not exempt landscape and water-feature lighting from shielding requirements.** More than any other type of exterior lighting, landscape lighting should be closely regulated and limited because it can negatively affect and disrupt the behaviors and habitats of a wide range of wildlife, plant life, and ecosystems, in addition to placing potential burdens on human health.<sup>5</sup> The wide variety of trees, shrubs, flowers, grasses, and other flora used in landscape design in Connecticut, such as oak trees, pine trees, cherry trees, maple trees, conifers, and shrubs like hydrangea and rhododendron, provide habitat and food sources for a broad range of fauna species in Connecticut, both nocturnal and diurnal, which have evolved with natural patterns of night and day. These flora and fauna species together create functioning ecosystems. Therefore, high-intensity landscape lighting requires closer regulation to limit its potentially harmful effects.

**Sec. 2703.1 should not exempt all facade lighting from shielding requirements.**

Under current international lighting best practices, all façade lighting should be downshielded, in order to reduce glare, sky glow, and light trespass to the greatest extent possible. **The 2021 International Energy Conservation Code closely regulates this type of decorative lighting**, requiring that all facade lighting be equipped with lighting controls that are set to automatically turn off within one hour of business closing or no later than midnight.<sup>6</sup> This demonstrates that decorative facade lighting should be minimized. Uplighting of building façades causes light to scatter into the night sky, rather than effectively illuminating the desired area of the building facade. Downward-directed lighting at a building facade, by contrast, helps to control the light distribution and prevents light from escaping as light diffusion and glare.

**Section 2703.1 should not exempt luminaires at “water features” from shielding requirements, because many waterways and bodies of water can serve as vital habitat.** Many water features used in landscaping, including ponds, streams, and waterfalls, provide important habitat for fauna and flora and serve as sites for birds, mammals, and other creatures to access hydration and sanitation, especially in hot summer months. They also provide a range of benefits for local ecosystems. Because of this, special precautions should be taken to avoid degrading water features through

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<sup>4</sup> Christopher C. M. Kyba *et al.*, “Citizen scientists report global rapid reductions in the visibility of stars from 2011 to 2022.” *Science* 379, 265-268 (2023). DOI: [10.1126/science.abq778](https://doi.org/10.1126/science.abq778)

<sup>5</sup> Svechkina, A. *et al.* (2020) “The impact of artificial light at night on human and ecosystem health: a systematic literature review.” *Landsc. Ecol.* 35, 1725–1742.

<sup>6</sup> International Code Council, International Energy Conservation Code (2021), C405.2.7.2 “Building facade and landscape lighting.”

the use of high-intensity nighttime lighting. Some landscape design firms, like Clanton & Associates, will not light waterways because of the negative effects that light has on fish: “We will light a bridge but all of the light has to be contained on the bridge surface.”<sup>7</sup>

**D. There is wide availability of attractive, effective shielding and design options.**

**Downlighting of facades is an aesthetic option.** Facade-mounted and roof-mounted downshielding of facade lighting is an attractive design option that can be used to accentuate architectural features, create visual contrast, visual storytelling, and highlight the architectural silhouette of a building.

**There is wide availability of attractive, affordable shielded facade and landscape lighting products.** A wide variety of affordable and attractive landscape lighting products for commercial and industrial uses are available in the range of 5 to 100 lumens (see attached).

**E. Unshielded nighttime lighting and light pollution degrades the environment and harms fauna and flora.**

**Light pollution negatively impacts wildlife.** Many animals rely on darkness as part of their habitat and behavior, and artificial light at night (ALAN) can disrupt their natural cycles. Lighting used in landscaping creates nighttime lighting conditions that adversely impacts nocturnal animals and migratory birds.<sup>8</sup> Both birds and insects dwell and find food sources in many flora commonly used in landscaping. Most landscaping projects do not address the needs of wildlife, although all wildlife have a need for food, shelter, water, and space, including natural cycles of daylight and darkness.<sup>9</sup> A landscaping strategy that recognizes the place of wildlife in a healthy ecosystem helps to stabilize wildlife populations and biodiversity levels, while decreasing energy use and associated greenhouse gas emissions.

**Several at-risk species in Connecticut are sensitive to light pollution.** Dozens of animals that appear on the list of Connecticut Endangered and Threatened Species

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<sup>7</sup> *Enlighten Journal* 2(2), “Environmentally Responsible Lighting Design: A lighting expert shares her how-to’s on avoiding light trespass.”

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<sup>9</sup> *Enlighten Journal* 2(2), “Environmentally Responsible Lighting Design: A lighting expert shares her how-to’s on avoiding light trespass,” <https://www.landscapeforms.com/enlighten/pages/2-2/Environmentally-Responsible-Lighting-Article.aspx>

depend on regular periods of darkness for feeding, reproduction, and safety.<sup>10</sup> These species include the Least Shrew, Blue-Spotted Salamander, Long-Eared Owl, and Short-Eared Owl.

**Light pollution contributes to higher rates of bird building collisions.** Several bird species protected under federal and state laws, including species of concern and endangered species such as the Northern Parula and Bicknell's Thrush, shelter in different types of urban green spaces and landscaping during periods of peak bird migration. It is estimated that every year nearly one billion birds are killed in building collisions in the United States, mostly migratory songbirds, a problem that is exacerbated by excessive artificial lighting.<sup>11</sup> light pollution that lures migratory birds into unsafe urban/suburban areas. In this regard, it is important to remember that many species of North American migratory songbirds are in steep decline, experiencing significant population loss linked with loss of habitat, building collisions, and light pollution.<sup>12</sup>

**Light pollution can harm and degrade some flora species.** Artificial lighting can extend the "day length" and can change leafing and flowering patterns of plants.<sup>13</sup> In many areas, artificial light in the night-time environment is sufficiently bright to induce a physiological response in plants, affecting their metabolic cycles, growth, and resource allocation.<sup>14</sup> For normal growth and development, trees and other plants depend on the quality of light (wavelength or color), its intensity (brightness), and the duration of light over a 24-hour cycle (photoperiod). Light pollution does not just affect plants and their metabolic cycles directly, it also affects them indirectly by interfering with the lifecycles of the pollinators and other animals that interact with them. "As artificial lights disrupt how nocturnal pollinators interact with plants, their pollen output can be affected, which may, in turn, impact how well bees and other diurnal pollinators can fertilize them during the daytime."<sup>15</sup>

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<sup>10</sup> Connecticut Department of Energy and Environmental Protection, "Connecticut Endangered and Threatened Species Fact Sheets," <https://portal.ct.gov/DEEP/Wildlife/Learn-About-Wildlife/Connecticut-Endangered-and-Threatened-Species-Fact-Sheets>

<sup>11</sup> Scott R. Loss *et al.*, "Bird-building collisions in the United States: Estimates of annual mortality and species vulnerability," *The Condor*, 116(1): 8-23 (2014). DOI: <https://doi.org/10.1650/CONDOR-13-090.1>

<sup>12</sup> Kenneth V. Rosenberg *et al.*, "Decline of the North American avifauna." *Science* 366, 120-124 (2019). DOI: [10.1126/science.aaw1313](https://doi.org/10.1126/science.aaw1313)

<sup>13</sup> Monika Czaja and Anna Kołton, "How light pollution can affect spring development of urban trees and shrubs," *Urban Forestry & Urban Greening*, 77, 2022, 127753, <https://doi.org/10.1016/j.ufug.2022.127753>

<sup>14</sup> Jonathan Bennie *et al.*, "Ecological effects of artificial light at night on wildplants," *Journal of Ecology*, 2016, 104, 611-620. DOI: [10.1111/1365-2745.12551](https://doi.org/10.1111/1365-2745.12551)

<sup>15</sup> Ally Hirshlag, "How light pollution disrupts plants' senses," *BBC*, March 8, 2023, [www.bbc.com/future/article/20230308-how-light-pollution-disrupts-plants-senses](https://www.bbc.com/future/article/20230308-how-light-pollution-disrupts-plants-senses)