

Cambridge Lighting Ordinance Task Force

10-22-15 Meeting, revised 10/25



Comments by Task Force Member Carol Lynn Alpert, Resident

Director, Strategic Projects, Museum of Science
Co-Director, Center for Integrated Quantum Materials
at Harvard, MIT, Howard, and MOS

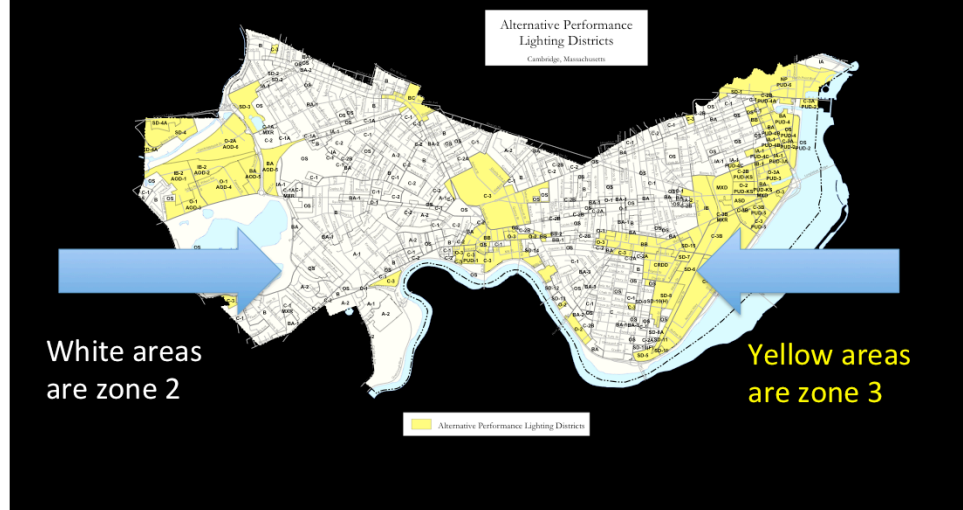
Thank you. I would like to begin by saying that I am pleased that several of the recommendations the Task Force made at the last meeting have been incorporated into the latest draft ordinance and the draft report. These include our interest in providing more timely relief for citizens needlessly suffering from intrusive light trespass from neighboring properties, which could be relieved by simple measures such as a change of light bulb, or a redirection of the fixture.

Also, last time, our interest in an upper limit of 3500K for color temperature was finally heard, and the truly offensive 8 lux trespass allowance at property boundaries was deleted. However, many of us do have persistent concerns, as well as new concerns, arising from other modifications that have or have not been made to the draft ordinances dated 10/15 and 10/22.

The new draft drops:

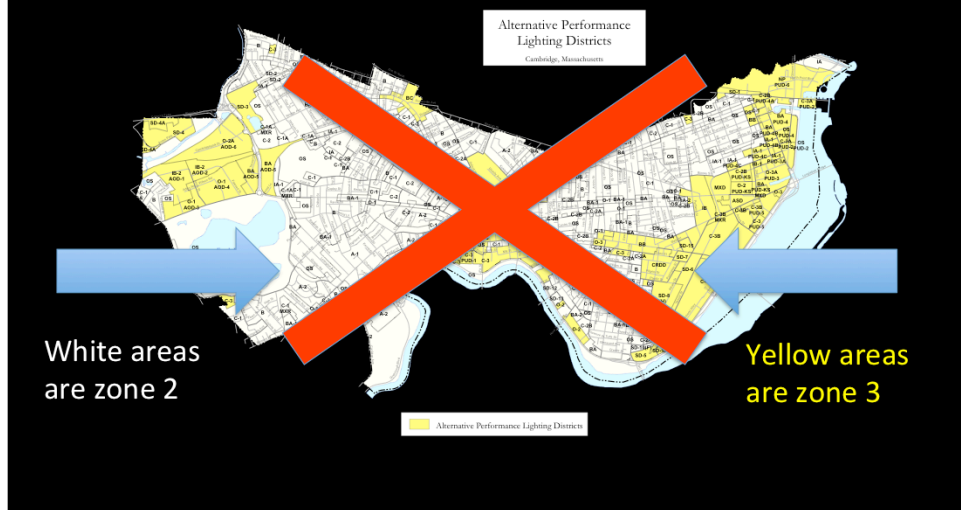
- The alternative performance standards
- Any reference to Lighting Zone districts
- Any light trespass limitations except in the case of new developments over 25,000 sf

Lighting zone map presented on 9/16 to define the Alternative Performance Lighting Districts Zones 2 and 3



This is the lighting zone map we were presented with on 9/16 to define the Alternative Performance Lighting Districts Zones 2 and 3. In the last meeting, we objected to the notion that the city should allow 8 lux of light at property boundaries in all zones, and we said we wanted 1 lux as the limit at property boundaries in Zone 2 – the white areas – and 2 lux in Zone 3 – the yellow areas – as these are in keeping with the LEED performance standards that we wanted to go by for properties over 10,000 sf.

The new draft does away with Alternative Standards, lighting zones, and light trespass limits



The new draft ordinance does away with Alternative Standards, lighting zones, and light trespass limits for everything that currently exists in Cambridge now and in the future, except for properties over 25,000 sf GFA that will comply with LEED LPC standards.

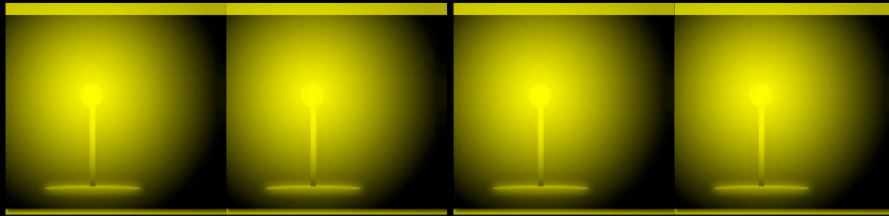
Instead, it says that

Any **existing** residential or commercial property in the city can host at any time now and into the future...

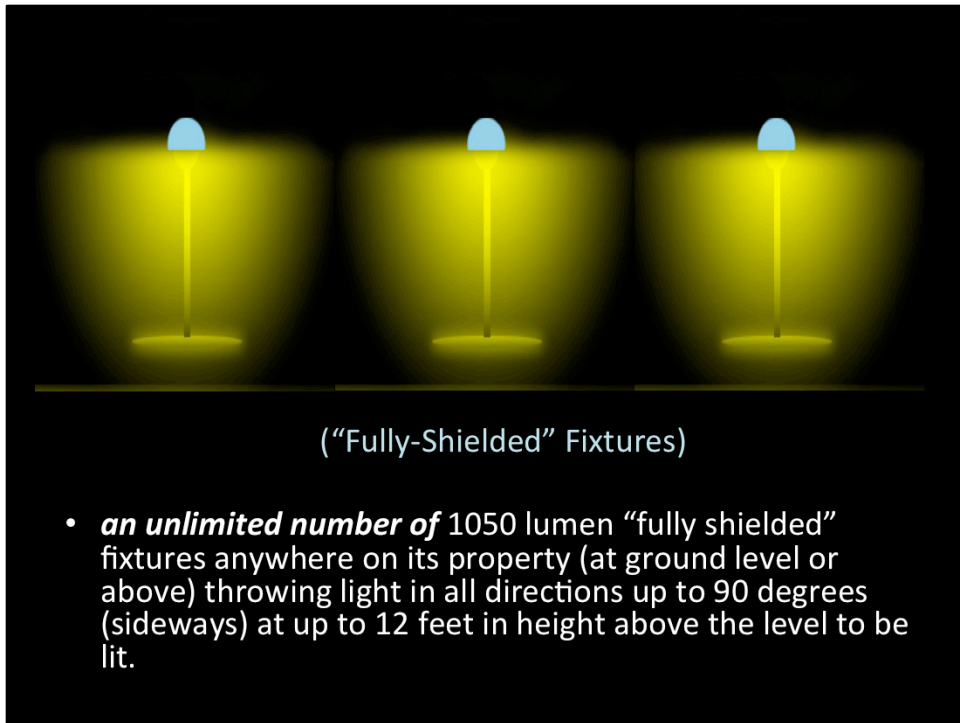
<http://www.delmarfans.com/educate/basics/lighting-pollution/>

Any **existing** residential or commercial property in the city can host at any time now and into the future...

- ***an unlimited number of*** 630 lumen fixtures on its front border throwing light in all directions up and down, in a spherical 360 degrees...



<http://www.delmarfans.com/educate/basics/lighting-pollution/>



As the *Pattern Lighting Handbook* says, “Height limitations can be counter-productive when a property owner tries to save money by mounting fewer fixtures, and ends up stretching the capacity of each one by sidelighting.”

Photo credit:

<http://www.delmarfans.com/educate/basics/lighting-pollution/>



This is kind of nutty.

Under this draft, only NEW and “significantly rehabilitated” properties of at least 25,000 SF in gross floor area will have to comply with anything more meaningful than these “Prescriptive Standards”

(25,000 SF is nearly half a football field)



The idea that surfaced at the 9/16 meeting, that all properties more than 10,000 sf would have to adhere to the LEED LPC standards (and therefore would be restricted from emitting more than 1 lux at property boundaries in Zone 2, and 2 lux in Zone 3), has been gutted by this 250% threshold increase to 25,000 sf and its restriction to new properties. This means we either have to add lux limits at property boundaries, bring the threshold back down to 10,000, or tighten up the Prescriptive Standards, or some combination of the above.

The idea that surfaced at the last meeting, that all properties more than 10,000 square feet would have to adhere to the LEED LPC standards, and therefore would be restricted from emitting 1 lux at property boundaries in Zone 2 and 2 lux in Zone 3, has been gutted by this 250% threshold increase from 10,000 to 25,000 and its restriction to new properties. That means we either have to add lux limits at property boundaries, bring the threshold back down to 10,000, or tighten up the Prescriptive Standards, or some combination of the above.

Where do the Cambridge Ordinance Draft's Prescriptive Standards come from?

Outdoor Lighting Category	Maximum Initial Lumens Per Light Fixture	Maximum Height	Shielding and Direction
Unshielded or partly shielded light fixture (general)	315	12 feet above the surface of the area to be illuminated	Not applicable
Unshielded or partly shielded light fixture located in a front yard between the building and street	630	12 feet above the surface of the area to be illuminated	Not applicable
Fully shielded or shielded directional light fixture for entries, walkways, open spaces or buildings	1,050	12 feet above the surface of the area to be illuminated	Must be fully shielded or directed away from all properties that are abutting or located directly across a street
Fully shielded or shielded directional light fixture for automobile surface parking areas, driveways or outdoor loading bays	1,260	14 feet above the surface of the parking area, driveway or loading bay	Must be fully shielded or directed away from all properties that are abutting or located directly across a street

Now where do the Prescriptive Standards in the Draft Ordinance come from? I don't know. This table is a bastardization of what's in the Model Lighting Ordinance, as I pointed out in our last meeting.

These Model Lighting Ordinance prescriptive standards are for residential properties only. They don't include parking, pole heights, and they limit the location of unshielded fixtures to entry ways.

Table G - Residential Lighting Limits

Lighting Application	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Row 1 Maximum Allowed Luminaire Lumens* for Unshielded Luminaires at one entry only	Not allowed	420 lumens	630 lumens	630 lumens	630 lumens
Row 2 Maximum Allowed Luminaire Lumens* for each Fully Shielded Luminaire	630 lumens	1,260 lumens	1,260 lumens	1,260 lumens	260 lumens
Row 3 Maximum Allowed Luminaire Lumens* for each Unshielded Luminaire excluding main entry	Not allowed	3 lumens	315 lumens	315 lumens	5 lumens
Row 4 Maximum Allowed Luminaire Lumens* for each Landscape Lighting	Not allowed	Not allowed	1,050 lumens	2,100 lumens	2,000 lumens
Row 5 Maximum Allowed Luminaire Lumens* for each Shielded Directional Flood Lighting	Not allowed	Not allowed	1,260 lumens	2,100 lumens	2,000 lumens
Row 6 Maximum Allowed Luminaire Lumens* for each Low Voltage Landscape Lighting	Not allowed	Not allowed	525 lumens	525 lumens	525 lumens

* Luminaire lumens equals Initial Lamp Lumens for a lamp multiplied by the number of lamps in the luminaire.

Model Lighting Ordinance, pg. 33.

The Model Lighting Ordinance's Prescriptive Standards are for Residential – not commercial - areas. They don't include anything about parking areas. And they limit unshielded 630 lumen fixtures to one entry only, and they include guidance on landscape lighting. There are no pole heights. And they are backed up by wording elsewhere in the ordinance that says that "direct glare is not visible from adjacent properties," and not "aimed onto adjacent properties. (p. 19)

From the Pattern Lighting Handbook: [http://www.nofs.navy.mil/about NOFS/staff/cbl/OLCHB1.14/lc-hb-v1-14](http://www.nofs.navy.mil/about_NOFS/staff/cbl/OLCHB1.14/lc-hb-v1-14):

4.4 Light Trespass Standard. Beyond the shielding requirements of Section 4.1, all light fixtures shall be located, aimed or shielded so as to minimize stray light trespassing across property boundaries. Particularly, any lamp installed on a residential property and visible from any other residential property must be shielded such that it is not directly visible from that property.

In contrast, the Cambridge Draft's Prescriptive Standards are meant to include commercial AND residential areas.

Outdoor Lighting Category	Maximum Initial Lumens Per Light Fixture	Maximum Height	Shielding and Direction
Unshielded or partly shielded light fixture (general)	315	12 feet above the surface of the area to be illuminated	Not applicable
Unshielded or partly shielded light fixture located in a front yard between the building and street	630	12 feet above the surface of the area to be illuminated	Not applicable
Fully shielded or shielded directional light fixture for entries, porches, patios, balconies or buildings	1,050	12 feet above the surface of the area to be illuminated	Must be fully shielded or directed away from all properties that are abutting or located directly across a street
Fully shielded or shielded directional light fixture for automobile surface parking areas, driveways or outdoor loading bays	1,660	14 feet above the surface of the parking area, driveway or loading bay	Must be fully shielded or directed away from all properties that are abutting or located directly across a street

Parking included. This could be good for limiting height and lumens in addition to the zoning ordinance, but damaging for residential areas.

Cambridge's Draft Prescriptive Standards don't distinguish between commercial and residential areas and property features. The Cambridge Draft Prescriptive standards includes a row, that seems to regulate parking areas, driveways, and outdoor zoning bays, but leaves out the important protection 6.46 provides, "Off street parking facilities which are used at night shall be provided with adequate lighting installed and maintained in such a manner so as not to reflect or cause glare on abutting or facing residential premises nor to cause reflection nor glare which adversely affects safe vision of operators of vehicles moving on nearby streets."

This seems to be a relic from a year ago, in which the Cambridge Lighting Ordinance was going to supplant the Zoning Ordinance residential area protections in article 7.20 and parking area lighting in 6.41, 6.46, and 6.93.] Charlie unearthed that document last week. If, instead, this is meant to supplement the Zoning ordinance, perhaps it is good to have additional restrictions on lumens and height, but there definitely needs to be an upper limit of total lumens for residential areas and more cautionary light trespass language.

Current wording in Zoning Ordinance
on parking areas:

Article "6.46 Parking Areas Lighting" specifies that "Off street parking facilities which are used at night shall be provided with adequate lighting installed and maintained in such a manner so as not to reflect or cause glare on abutting or facing residential premises nor to cause reflection nor glare which adversely affects safe vision of operators of vehicles moving on nearby streets. A recommended standard for lighting is a minimum intensity of one (1) foot candle on the entire surface of the parking facility."

(WISH WE COULD AMEND THAT LAST SENTENCE, but we could put a maximum in the Lighting Ordinance.

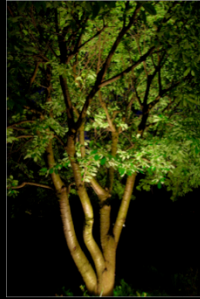
Could we use the Lighting Ordinance Prescriptive Table to provide better guidance on light trespass as well as limit height and lumens?

A lot of things lumped together here...

Outdoor Lighting Category	Maximum Initial Lumens Per Light Fixture	Maximum Height	Shielding and Direction
Unshielded or partly shielded light fixture (general)	315	12 feet above the surface of the area to be illuminated	Not applicable
Unshielded or partly shielded light fixture located in a front yard between the building and street	630	12 feet above the surface of the area to be illuminated	Not applicable
Fully shielded or shielded directional light fixture for entries, walkways, open spaces or buildings	1,050	12 feet above the surface of the area to be illuminated	Must be fully shielded or directed away from all properties that are abutting or located directly across a street
Partly shielded or shielded directional light fixture for automobile surface parking areas, driveways or outdoor loading bays	1,260	14 feet above the surface of the parking area, driveway or loading bay	Must be fully shielded or directed away from all properties that are abutting or located directly across a street

The wording circled here seems to include any part of any building and anywhere within the property boundaries.

Don't we also need to allow reasonable landscape lighting and reasonable shielded spotlighting and cowled uplighting of architectural and landscape structures? The Prescriptive Table deletes the part of the MLO prescriptive table that deals with these.



Draft Prescriptive Standards

Outdoor Lighting Category	Maximum Initial Lumens Per Light Fixture	Maximum Height	Shielding and Direction
Unshielded or partly shielded light fixture (general)	315	12 feet above the surface of the area to be illuminated	Not applicable
Unshielded or partly shielded light fixture located in a front yard between the building and street	630	12 feet above the surface of the area to be illuminated	Not applicable
Fully shielded or shielded directional light fixture for entries, walkways, open spaces or buildings	1,050	12 feet above the surface of the area to be illuminated	Must be fully shielded or directed away from all properties that are abutting or located directly across a street
Fully shielded or shielded directional light fixture for automobile surface parking areas, driveways or outdoor loading bays	1,260	14 feet above the surface of the parking area, driveway or loading bay	Must be fully shielded or directed away from all properties that are abutting or located directly across a street

And, while language in column 4 for rows 3 and 4 says the fixtures must be “fully shielded **OR** directed away from all properties that are abutting or located directly across a street,” this wording is so vague and ill-defined that it begs the same enforcement questions for which the zoning ordinance provisions were found wanting. First of all, fully shielded is defined by this Ordinance as fully shielded above the horizontal plane of the fixture only, and the horizontal plane is allowed to be 12 or 14 feet above any surface being illuminated – it could be a roof deck, or balcony. Secondly, “directed away from” has absolutely no meaning or definition in this ordinance, and thirdly, why is it an OR between these two clauses rather than an AND? Finally, why aren’t people in the street or on the sidewalk protected from this unlimited number of 12 or 14 foot-high 1050 lumen fixtures? Why do they have to be directly ACROSS the street?

As a backstop to unreasonable behavior, we need to have an enforceable light trespass limitation of vertical lux at the property line.

What we recommended last time:

- 1 lux in Zone 2
- 2 lux in Zone 3

PB says these levels are undetectable. I'm seeing light meters on the market that have accuracy to .1 lux. What should we do to solve this?

We could try tightening up the Prescriptive Standards and the language around trespass and also reduce the square footage LEED LPC threshold, at least in residential areas.

We could try tightening up the Prescriptive Standards and the language around trespass and also reduce the square

Some Preliminary Recommendations

1. This ordinance should specifically confirm that residential zones A, B, C, and C1 retain their protection against light trespass as guaranteed by Zoning Ordinance Article 7.20

"Any permanent lighting...shall be continuous, indirect, and installed in a manner that will prevent direct light from shining onto any street or adjacent property."



Most of the white areas are currently protected from trespass

Zoning Article "7.20 Illumination"

"In Residence A, B, C, and C-1 districts, no outdoor floodlighting or decorative lighting, except lighting primarily designed to illuminate walks, driveways, outdoor living areas, or outdoor recreational facilities, and except temporary holiday lighting in use for not longer than a four week period in any calendar year, shall be permitted.

Any permanent lighting permitted by the preceding sentence shall be continuous, indirect, and installed in a manner that will prevent

Recommendations

2. The prescriptive table and standards need to be redrafted with careful attention to descriptive categories and trespass protections, as are the standards in the Model Lighting Ordinance and those of most other communities working off the Model Ordinance. (We need to motivate people to use down-angled lighting as in full cutoff or BUG – rated light fixtures).

www.delmarfans.com

NONCUTOFF SEMICUTOFF CUTOFF FULL CUTOFF

“Full Cutoff” has been replaced by the BUG rating system, designed to direct most lighting at a downward angle toward the ground where it's most needed, reducing dangerous glare. We need to find some way to guide people in this direction.

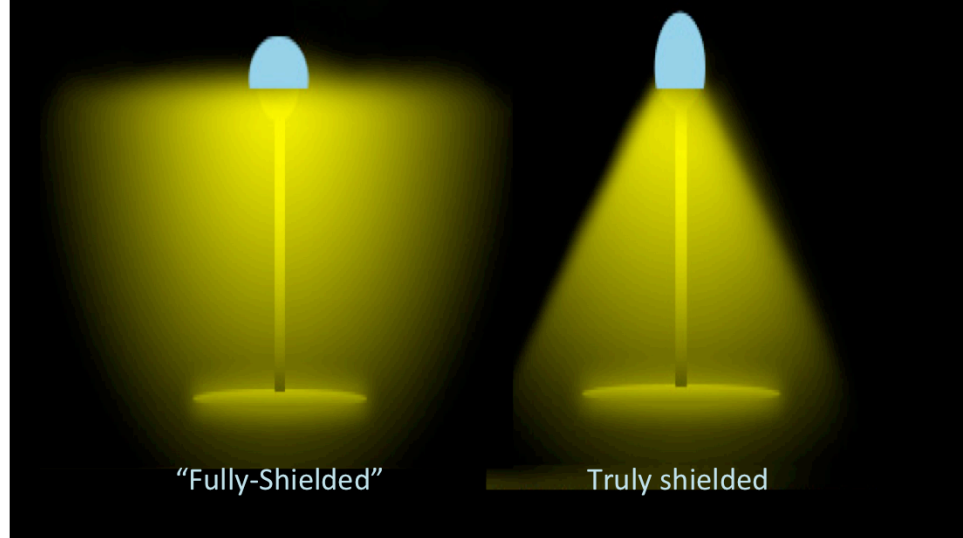
The three components of BUG ratings are based on IES TM-15-07 (revised):

Backlight, which creates light trespass onto adjacent sites. The B rating takes into account the amount of light in the BL, BM, BH and BVH zones, which are in the direction of the luminaire OPPOSITE from the area intended to be lighted.

Uplight, which causes artificial sky glow. Lower uplight (zone UL) causes the most sky

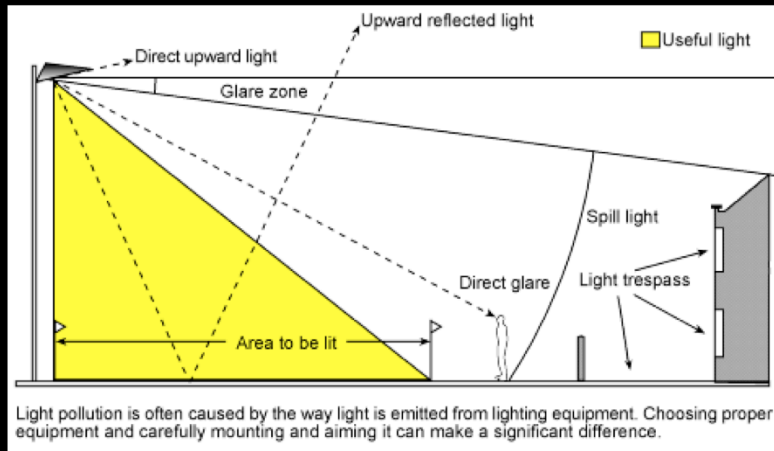
<http://www.delmarfans.com/educate/basics/lighting-pollution/>

If you have downward directed light, instead of what Cambridge is calling “fully shielded,” you can be much more efficient in preventing light trespass and glare



<http://www.delmarfans.com/educate/basics/lighting-pollution/>

http://www.nofs.navy.mil/about_NOFS/staff/cbl/OLCHB1.14/lc-hb-v1-14.html#blulm



Example of useful light and light pollution from a typical pole-mounted outdoor luminaire

Image from RPI Lighting Research Center

Recommendations, cont'd.

3. We should consider putting the property threshold size that should trigger a mandatory LEED Light Pollution Credit back to 10,000 sf, at least in residential LZ2 zone area. Owners DO have 5 years to comply.

(It would be helpful for us to see some examples of 10k sf to 25k sf buildings.)

**OR, WE COULD TIGHTEN THE PRESCRIPTIVE
STANDARDS AND BRING BACK THE LUX LIMIT
AT THE BOUNDARIES.**

Recommendations

4. The term “voluntarily” should be struck from the second sentence under the “F. Prescriptive Standards” on p. 5. (It says “Any other lighting that does not meet the standards set in the table below may be permitted in the City only if it voluntarily meets the Performance Standards...”)

Recommendations

5. We need to define “significant rehabilitation.”

Recommendations

6. Under “H. Exemptions” (p.6) we need a definition of “public ways” and a clearly defined meaning of the statement “...when the purpose of the luminaire is to illuminate areas outside the public way.” We want some measure of commitment to protection against lighting trespass from municipal lighting.

Recommendations

7. Under “Administrative Exemption.” (p.7):
In all fairness, neighborhood abutters should be given notice and the opportunity to provide comment when a property owner asks for Administrative Exemption from amending a lighting situation that has been the subject of a complaint.

Recommendations

8. The ordinance should mandate that a method of taking in citizen complaints and investigating them is established, with adequate inspection and enforcement timelines and capabilities.

I have also a set of edits to make to the edited definitions, but will do that in writing.

Thank you.

The draft report....

The current CLOTF report draft (9/22) fails to adequately describe what was in fact the major motivation for this ordinance. It was not primarily energy efficiency or environmental protection. It was concern about the health effects of light pollution and the desire for safe enjoyment of one's own living space and safe passage without vision-obstructing glare on public ways.

A good summary of scientifically-validated health effects can be found in the "Light Pollution" article on Wikipedia (accessed 10/22/15).

Finally, the current CLOTF report draft fails to adequately describe what may be the major motivation for this ordinance – which was not energy efficiency or environmental protection. It was concern about the health effects of light pollution and the desire for safe enjoyment of one's own living space and safe passage without vision obstructing glare on public ways.

I will submit a marked up copy of the 10-15 ordinance with further suggestions to solve the outstanding problems.

Thanks.

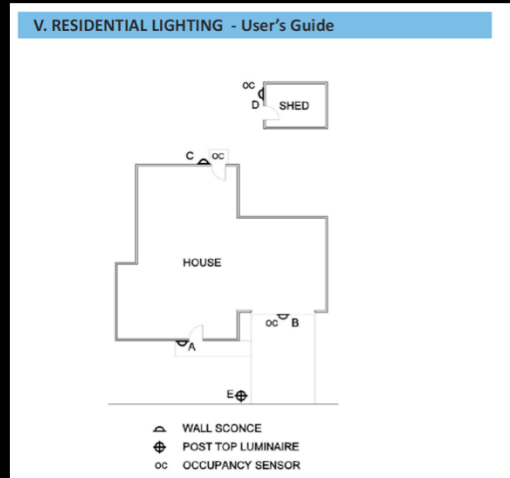


RAB Electric MFG., Inc. Obtained from <http://www.elights.com/tresspass.html>

Image. RAB Electric MFG., Inc. Obtained from <http://www.elights.com/tresspass.html>

Additional Slides and Background

MLO assumes just one fixture at entries and exits.



Model Lighting Ordinance Residential Guidance, p. 20

...there is the implicit assumption that there will be just ONE of each of these kinds of fixtures at the various entries and exits of a house....

MLO assumes just one fixture at entries and exits,
and clearly specifies an upper lumen
limit and a prohibition on trespass.

1. One partly shielded or unshielded luminaire at the main entry, not exceeding the allowed lumen output in Table G row 1.
2. Any other partly shielded or unshielded luminaires not exceeding the allowed lumen output in Table G row 3.
3. Low voltage landscape lighting aimed away from adjacent properties and not exceeding the allowed lumen output in Table G row 4.
4. Shielded directional flood lighting aimed so that direct glare is not visible from adjacent properties and not exceeding the allowed lumen output in Table G row 5.

Model Lighting Ordinance Residential Guidance, p. 19

...and has additional language ensuring the principle of no light trespass on neighboring properties.

But the larger problem, is that the Model Lighting Ordinance - and most other municipal lighting ordinances I've looked at - make a distinction between residential and commercial properties in their prescriptive standards.

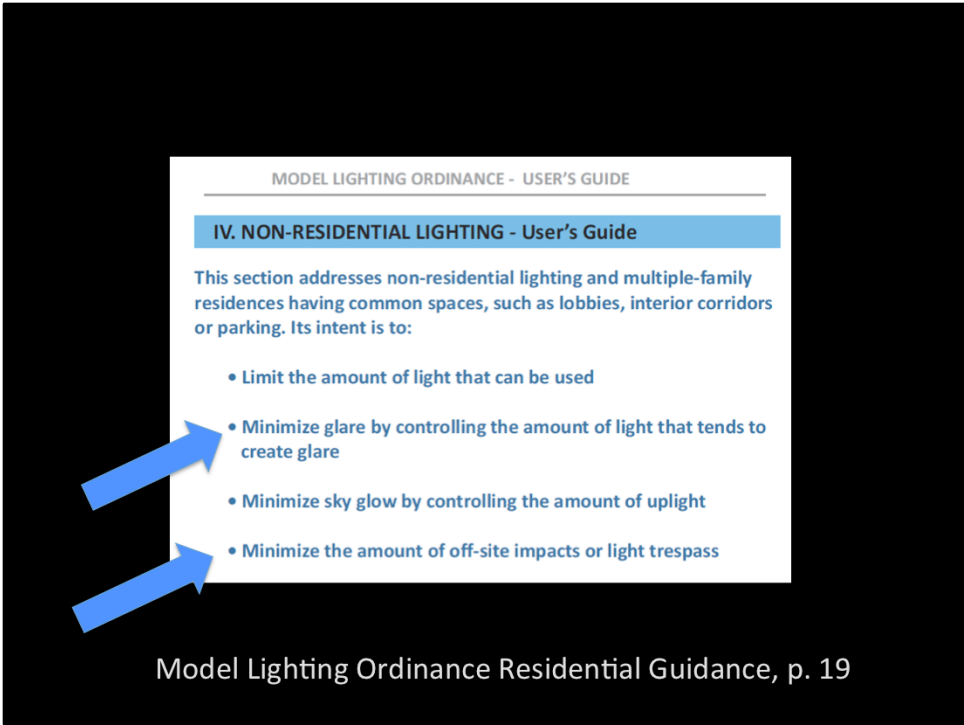
IV. NON-RESIDENTIAL LIGHTING - User's Guide

This section addresses non-residential lighting and multiple-family residences having common spaces, such as lobbies, interior corridors or parking. Its intent is to:

- Limit the amount of light that can be used
- Minimize glare by controlling the amount of light that tends to create glare
- Minimize sky glow by controlling the amount of uplight
- Minimize the amount of off-site impacts or light trespass

Model Lighting Ordinance Residential Guidance, p. 19

They require commercial properties to first limit the total amount of flux - or illumination – that can be used on the entire property - using a formula like total lumens per square foot.



but they also limit glare and light trespass by limiting lumen emitted at the upper side angles -

The three components of BUG ratings are based on IES TM-15-07 (revised):

Backlight, which creates light trespass onto adjacent sites. The B rating takes into account the amount of light in the BL, BM, BH and BVH zones, which are in the direction of the luminaire OPPOSITE from the area intended to be lighted.

Uplight, which causes artificial sky glow. Lower uplight (zone UL) causes the most sky

IV
This residential ordinance

- Minimize glare by controlling the amount of light that tends to create glare
- Minimize sky glow by controlling the amount of uplight
- Minimize the amount of off-site impacts or light trespass

Sky glow (uplight)

Trespass and Glare

Model Lighting Ordinance Residential Guidance, p. 19

- This is the colorful BUG rating system that Jeff Berg showed us -

Here's how one municipal ordinance does it:

- (A) All nonexempt outdoor lighting fixtures shall be fully shielded.
- (B) All nonexempt outdoor lighting fixtures shall be placed so as to not cause light trespass or glare beyond the property boundary.
- (C) Any lamp installed on a residential property must be shielded such that glare from the lamp is not directly visible from any other residential property.
- (D) All nonexempt outdoor lighting fixtures shall be of a type and placed so as to not allow any light above the horizontal, as measured at the luminaire.
- (E) Flood or spot lamps must be fully shielded and aimed no higher than 45 degrees above straight down (half-way between straight down and horizontal) when the source is visible from any off-site residential property or public roadway. (over....)

(Madison, Mississippi)

Maybe this is too simple for Cambridge, but this is how several municipalities did it:

- (A) All nonexempt outdoor lighting fixtures shall be fully shielded.
- (B) All nonexempt outdoor lighting fixtures shall be placed so as to not cause light trespass or glare beyond the property boundary.
- (C) Any lamp installed on a residential property must be shielded such that glare from the lamp is not directly visible from any other residential property.
- (D) All nonexempt outdoor lighting fixtures shall be of a type and placed so as to not allow any light above the horizontal, as measured at the luminaire.
- (E) Flood or spot lamps must be fully shielded and aimed no higher than 45 degrees above straight down (half-way between straight down and horizontal) when the source is visible from any off-site residential

Here's how one municipal ordinance does it:

(F) All lighting for commercial, industrial and any other non-residential activities, shall be extinguished between 11:00 p.m. (or when the business closes, whichever is later) and sunrise. Security lighting for these establishments shall conform with the other provisions of this ordinance.

(G) Commercial/industrial or business uses shall not exceed 70,000 lumens per acre.

(H) All light fixtures that are required to be shielded shall be installed and maintained in such a manner that shielding is effective as described herein for fully-shielded fixtures.

(I) Beyond the shielding requirements of this Ordinance, all light fixtures shall be located, aimed or shielded so as to minimize stray light trespassing across property boundaries.

(J) Multi-use lighting must conform to the shielding and timing restrictions, if any, that apply to most restrictive included use.

(F) All lighting for commercial, industrial and any other non-residential activities, shall be extinguished between 11:00 p.m. (or when the business closes, whichever is later) and sunrise. Security lighting for these establishments shall conform with the other provisions of this ordinance.

(G) Commercial/industrial or business uses shall not exceed 70,000 lumens per acre.

(H) All light fixtures that are required to be shielded shall be installed and maintained in such a manner that shielding is effective as described herein for fully-shielded fixtures.

(I) Beyond the shielding requirements of this Ordinance, all light fixtures shall be located, aimed or shielded so as to minimize stray light trespassing across property boundaries.

(J) Multi-use lighting must conform to the shielding and timing

Cautions on Height Limitations...
from the "Pattern Outdoor Lighting Code"

http://www.nofs.navy.mil/about_NOFS/staff/cbl/OLCHB1.14/lc-hb-v1-14.html#blulm



Pole height restrictions may cause more glare with higher angle candlepower distributions. Unfortunately, in attempts to reduce costs, some designers will avoid increasing the number of poles by using luminaires that have greater high-angle luminance, that is, luminaires that throw more light to the side. These luminaires would achieve the illuminance and uniformity specifications sought with fewer poles, but will do so at the cost of increased glare. This will lead to increased light trespass, just the opposite of what the goal may have been in restricting pole heights. Visibility is likely to be compromised as well.

Concerns about height limitations from: http://www.nofs.navy.mil/about_NOFS/staff/cbl/OLCHB1.14/lc-hb-v1-14.html#blulm

"If the intention is to limit the nighttime visual impact of lights, in particular the spread of light from high luminaires into surrounding areas (light trespass), results may be much less than hoped. Again, since most area lighting has certain target uniformity levels, shorter poles will mean that more must be used, which may increase the visual impact at night as well as in the daytime. While these poles will be shorter, a community must carefully evaluate whether the trade-off of more poles might compromise the original intent to reduce visual clutter.

Pole height restrictions may cause more glare with higher angle candlepower distributions

Unfortunately, in attempts to reduce costs, some designers will avoid increasing the number of poles by using luminaires that have greater high-angle luminance, that is, luminaires that throw more light to the side. These luminaires would achieve the illuminance and uniformity