

IV. NON-RESIDENTIAL LIGHTING - Ordinance Text

For all non-residential properties, and for multiple residential properties **of seven or more domiciles and** having common outdoor areas, all outdoor lighting shall comply either with Part A or Part B of this section.

43 - Page No. 11 - Ordinance Text - Revise IV as follows:

“For all non-residential properties, and for multiple residential properties of seven or more domiciles and having common outdoor areas,”

See comment IALD#19 for the associated revision to the definition of *Common Outdoor Areas*
BASIS: As written, the inclusion of “multiple residential properties having common areas” under the “Non-Residential” lighting requirements is a potentially huge problem. The current definition of “outdoor common areas” would mean that many properties that should be considered residential (small, often owner-occupied, multi-family buildings with more than two units) might fall into this a category. In metropolitan areas such as Boston there are thousands of three family houses (“triple deckers”), converted single family homes with multiple apartments or condominium units, and small four or six unit buildings. Some have common entrances and possibly “open space primarily intended to be used by the occupants...”, and maybe shared garages. We understand what you are trying to do (treat apartment buildings as commercial properties) but we doubt if many cities would adopt the MLO this way, or if they did, would not really intend for such properties that they consider to be residential, to comply with the non-residential section – it would either be ignored or unenforced, or there would be an uproar.

ACCEPT - Revised Text

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

A. Prescriptive Method

An outdoor lighting installation complies with this section if it meets the requirements of subsections 1 and 2, below.

1. Total Site Lumen Limit

The total installed initial lamp luminaire lumens of all outdoor lighting systems on the site shall not exceed the total site lumen limit. The total site lumen limit shall be determined using either the Parking Space Method (Table A) or the Hardscape Area Method (Table B). Only one method shall be used per permit application, and for sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial lamp luminaire lumens is calculated as the sum of the initial lamp luminaire lumens for all luminaires. ~~tested with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.~~

55. The total installed initial lamp luminaire lumens is calculated as the sum of the products of luminaire efficiency, ballast factor, and initial lamp lumens for all luminaires tested with relative photometry and 140% 100% of initial lamp luminaire lumens for all luminaires tested with absolute photometry.

SUPPORT: 1.The term "lamp lumens" is not applicable to solid-state luminaires tested with absolute photometry. When referring to lumens for luminaires tested with absolute photometry, indicate luminaire lumens – not lamp lumens. 2.It is understood that if a Prescriptive Method project is not designed by a lighting professional, it is probably unrealistic to expect photometry to be compiled for review. What is not clear is why under the Performance Method, where a lighting professional is most likely involved, it is deemed that evaluation of efficiency and ballast factor is overly complicated and unnecessary. Propose revising the tables for luminaire (not lamp) lumens, and then applying a 70% multiplier to lamp lumens for non-LED products in the Prescriptive Method.

Either of these changes would need to cascade through other sections, as described above (but not detailed here). Please contact me if interested in the latter revision and you require clarification or assistance. Reference Standards IES LM 79-08

#27 - Non-Residential Lighting, Section A. Prescriptive Method

Based on working directly with town officials, the language of the user's guide [and certainly, the main text] is beyond the vocabulary and comprehension of many who would be actually employing the ordinance or regulation for lighting [see examples below

REJECTED - Language is consistent with building codes

#29 - Request: Make it clearer, both in the ordinance text and in the user guide, that most outdoor lighting installations can be regulated using only the prescriptive method.

Rationale: It's true that some installations will require a lighting designer or engineer to comply, but in order for the MLO to become widely adopted we must make the case that existing governing boards, with their existing levels of expertise, are adequate to adopt and enforce the MLO. **REJECTED - - Information on which method is used the most is not available at this time. This data can be collected in the future when the MLO is in use.**

#29 Request: reverse the order in A-1, so that the Hardscape Method is listed first.

Rationale: Won't hardscape calculations be more common for a site plan than simply parking lots?

REJECTED - doesn't make a real difference to the usefulness of the MLO.

30 - Absolute photometry, by definition is the actual representative measurement of delivered lumens, used similarly with fixture efficiency of relative photometry. Our comment is 3 part:

2) The 1.4 multiplier is of concern as we cannot directly interpret a 70% efficiency assumption into a 1.4 or 140% multiplier. Did you derive the 1.4 adjustment factor by dividing 1(100% measured efficiency of absolute photometry) by .7 (70 % efficiency assumption)? (ordinance text)

3) By considering only initial lumens for HID products, should we rather consider the relationship between initial lumens and fixture efficiency in our calculations? The use of initial lumens does not allow adopting agencies who utilize higher performance optics which deliver more lumens to the task area as a promotion of greater energy efficiency. (ref. Section I, Article e., page 5 of the Preamble: "Conserve energy and resources to the greatest extent possible")

#35 - Section A

How does a specifier know whether a luminaire is tested with absolute photometry or relative photometry? What should a specifier look for to know what system is used?

30, 35 and 55 - ACCEPTED IN PART - MLO will change "initial lamp lumens" to "initial luminaire lumens".

43 - Subsection No. A.1. Page No. 12 Ordinance Text

The total installed initial lamp lumens of all lighting systems on the site Outdoor Lighting shall not exceed the total site lumen limit

REASON: Outdoor lighting is a defined term and should be used. The term "site" is not defined, and could be misinterpreted to not include the buildings

See comment IALD#22 for the revised definition of Outdoor Lighting.

ACCEPTED

A. Prescriptive Method

An outdoor lighting installation complies with this section if it meets the requirements of subsections 1 and 2, below.

1. Total Site Lumen Limit

The total installed initial lamp luminaire lumens of all outdoor lighting systems on the site shall not exceed the total site lumen limit. The total site lumen limit shall be determined using either the Parking Space Method (Table A) or the Hardscape Area Method (Table B). Only one method shall be used per permit application, and for sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial lamp luminaire lumens is calculated as the sum of the initial lamp luminaire lumens for all luminaires tested with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.

#57 – An outdoor lighting installation complies with this section if it meets the requirements of subsections 1 and 2, below.

1. Total Site Lumen Limit

The total installed initial lamp lumens of all lighting systems on the site shall not exceed the total site lumen limit. The total site lumen limit shall be determined using either the Parking Space Method (Table A) or the Hardscape Area Method (Table B A). Only one method shall be used per permit application, and for sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

Table A -- Allowed Total Initial Lumens per Site for Nonresidential Outdoor Lighting, Per Parking Space Method May only be applied to properties up to 10 parking spaces (including handicapped accessible spaces):

LZ0	LZ1	LZ2	LZ3	LZ4
500	700	900	1,200	1,500
lms/space	lms/space	lms/space	lms/space	lms/space

REASONS:

Delete Table A and revise Existing Table B to be new Table A

In section IV. NON-RESIDENTIAL LIGHTING (Cont.) on page 12, the Prescriptive method – total site lumen limit there is the option to use either table the Parking Space Method (Table A) or the Hardscape Area Method (Table B). Unfortunately the lumen per parking spot limit doesn't allow enough light to meet IES recommended light levels. As an example, Zone 3 the current Table A method provides 1/5 the recommended minimum light level. Additionally, the designer will just use the Hardscape Area Method (Table B). Comparing the lumens allowed in Table A they do not equate to Table B allowances. A typical parking spot is 9 x 18 feet, but the driveway access must also be included. The typical driveway area per parking spot is 9x24 for a single row of parking for a total square footage of 378. Using Table B the allowed lumens per space should be 567 lumens for Zone 0, 945 lumens for Zone 1, 1512 lumens for Zone 2, 3024 lumens for Zone 3 and 4536 lumens for Zone 4.

Simplify the document by deleting existing Table A.

Rejected - The per parking space method is applicable in small rural towns and is a simple method for small retail "mom & pop's) without drive lane access and the parking lot is immediately adjacent to the road. This reasoning will be emphasized in the user's guide.

57 - Total Site Lumen wattage Limit

Complies with ANSI/ASHRAE/IES 90.1-2010 TABLE 9.4.6 Individual Lighting Power Allowances for Building Exteriors (these were published and approved as addendum "I" and addendum "BR" to 90.1-2007).

The total installed initial lamp lumens of all lighting systems on the site shall not exceed the allowed total initial site lumens. The allowed total initial site lumens shall be determined using Tables D and E. For sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens:

The total installed initial lamp lumens of all is calculated as the sum of the initial lamp lumens for all luminaires tested with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.

REJECTED - Lumens versus watts - commenter wants to use ASHRAE/IES 90.1 - rejected long ago because ordinances may not be updated and increased LPW of sources may lead to overlighting, especially with Solid State Lighting.

25 - IV.A, Prescriptive method PAGE 12 - (Also Section IX)

We believe that the total site lumen limits in Tables A and B are excessive. We have seen calculations suggesting that, outside of LZ 0, these are well above even "enhanced security" IES recommendations. Even in LZ 4, we see no reason for assigning "enhanced security" light levels to every site.

We have also reviewed data from the 2002 Pier report suggesting that, in a substantial proportion of cases, existing parking lots are lighted to levels below RP-20-98. This suggests that IES is already recommending more light than many users actually find necessary, so MLO allowances should certainly not exceed RP levels

ACCEPTED - Lumen allowances for both Table A and Table B have been lowered.

Page 12, continued

A. Prescriptive Method

An outdoor lighting installation complies with this section if it meets the requirements of subsections 1 and 2, below.

1. Total Site Lumen Limit

The total installed initial **lamp luminaire** lumens of all **outdoor** lighting ~~systems on the site~~ shall not exceed the total site lumen limit. The total site lumen limit shall be determined using either the Parking Space Method (Table A) or the Hardscape Area Method (Table B). Only one method shall be used per permit application, and for sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial **lamp luminaire** lumens is calculated as the sum of the initial **lamp luminaire** lumens for all luminaires. ~~tested with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.~~

19 - Section IV.A.1, Page 12- The use of initial Lamp Lumens is not applicable with SSL luminaires. In addition, it doesn't make sense to apply an arbitrary 'efficiency' factor to SSLs (where did this come from?!). Please use Luminaire Lumens (just like BUG!). This simplifies things and puts everything on an even playing field. Note: The Prescriptive Method Example will have to be redone to reflect this change.

My suggested wording changes follow:

1. Total Site Lumen Limit

The total installed initial luminaire lamp lumens of all lighting systems on the site shall not exceed the total site lumen limit. The total site lumen limit shall be determined using either the Parking Space Method (Table A) or the Hardscape Area Method (Table B). Only one method shall be used per permit application, and for sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial luminaire lamp lumens is calculated as the sum of the initial luminaire lamp lumens for all luminaires. ~~tested with relative photometry and 140% of initial luminaire lamp for all luminaires tested with absolute photometry.~~ For relative photometry, initial luminaire lumens = total lamp lumens x the luminaire efficiency (or total calculated zonal lumens). For absolute photometry, initial luminaire lumens is the total calculated zonal lumens.

ACCEPTED IN PART - MLO to use initial LUMINAIRE lumens instead of initial LAMP lumens

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PRESCRIPTIVE METHOD

2. Limits to Off Site Impacts

All luminaires shall be rated and installed according to Table C.

#27 - IV. Non-Residential Lighting, Section 2, limits to off-site impacts. There is an assumption here that the designer of the proposed lighting plan will ultimately have access to plotting software to determine the distribution/impact of the lighting plan. One would hope that this has become a standard practice, but in the real world, there are many who design – and who review building plans that still have no comprehension of this! The idea of the “BUG” rating system is a good idea for those involved in the engineering aspect of lighting design, however, asking government officials to learn this and be able to reference it is unrealistic.

REJECT - Document consistent with engineering practice and building code language BUG ratings will be increasingly easier to obtain either from the manufacturer, distributor, lighting representative, or obtained with lighting software with IES photometric files.

25 - IV.A, TABLE C) PAGE 14 - (Also Section IX) - In Table C, change Uplight ratings in LZ 2-4 to U0. REASON: We understand the purpose of MLO to be reducing light pollution. Allowing direct uplight for no reason subverts that purpose.

COMMENT ACKNOWLEDGED - The U values are significantly reduced to minimize uplight. A new Section3 has been added to require fully shielded luminaires for all parking lot applications (allowing an exception only for Ornamental lu7minaires).

#5 Comment: This is setting the location of the top of the box. If you don't set a limit above the tallest luminaire, then the top of the box could be set extremely high so that much of the uplight is dissipated. The way it was written the top could be any height 10 feet or greater above the tallest luminaire.

REJECTED - Hard to understand comment. Box only applies to performance method

25 - IV.A, Prescriptive method A(2) PAGE 14

Add a sentence to the existing text, as follows:

All luminaires shall be rated and installed according to Table C. Any luminaire for which BUG ratings are not available shall be fully shielded.

REASON: It is not reasonable to assume that all non-residential luminaires will be BUG rated anytime in the near future. As noted previously, requiring use of the Performance Method when BUG ratings are not available is unsatisfactory because of the many problems with the Performance Method.

ACCEPTED IN PART - Luminaires must be BUG rated and installed according to Table C.

#10 - General Comment

In the audio podcast, Ms. Clanton asked something to the effect of whether the MLO should be including reflected light in its off-site impact calculations, and that commenter's opinions on this question would be of interest.

I would say “Yes” – reflected light should certainly be included in a site's lighting limitation calculation. There are several reasons:

1.Light reflecting off of vertical surfaces, such as walls, reflects in such a way that its luminance is maximum in the horizontal direction, regardless of the shielding characteristics of its original source luminaire. Since light entering the atmosphere at angles near horizontal is disproportionately responsible for sky glow over great distances from its source, such reflections should definitely be included in site lighting limitation calculation.

2.Light reflecting up from horizontal surfaces into the sky is a significant contributor to sky glow in urban areas, and is likely to be exacerbated by the increasing prevalence of high-albedo/white concrete. Site lighting limitations should account for this effect.

In my opinion, aggregate luminance reflected from a surface is, from the point of view of light trespass, just as undesirable as that same luminance emitted directly from a luminaire.

REJECT - This is a prescriptive method and does not require calculations. Reflectances can only be inputted into a calculation model.

2. Limits to Off Site Impacts

All luminaires shall be rated and installed according to Table C.

3. Light Shielding for Parking Lot Illumination

All luminaires used for parking lot illumination shall emit no light above 90 degrees, and shall have a U0 rating.

Exceptions:

- a) Ornamental parking lot lighting shall be permitted by special permit only, and shall meet the requirements of Table C-1 for Backlight, Table C-3 for Glare and Table H for uplight control without the need for external field-added modifications.**

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

B. Performance Method

1. Total Site Lumen Limit

The total installed initial **lamp luminaire** lumens of all lighting systems on the site shall not exceed the allowed total initial site lumens. The allowed total initial site lumens shall be determined using Tables D and E. For sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial **lamp luminaire** lumens of all is calculated as the sum of the initial **lamp luminaire** lumens for all luminaires tested. ~~with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.~~

32 - First, we question the need to apply a 140% multiplier to the LED Fixture absolute photometry lumen values. The LED fixture's initial lumen values are calculated and recorded via the absolute photometry report and we believe these are the values that should be used in the calculations to determine allowable site LED fixture lumens.

This unfairly penalizes LED products that have been designed to deliver lumens in the most efficient manner possible. If this ordinance were to pass in its present form, it will allow areas to be ineffectively lighted which in turn will lead to the use of additional unneeded or less efficient fixtures, not to mention increased energy use over what would be required for the site. This appears to be directly contradictory to the DOE, Energy Star and Green initiative to reduce outdoor lighting energy usage.

ACCEPTED IN PART - MLO will use initial luminaire lumens versus initial lamp lumens.

#36 - Section B Page 16 Same comments as on previous page (for the Prescriptive Method), plus: For the Performance Method, there is another method of reporting luminaire lumens: They can be included in a luminaire schedule on the point-by-point printout that shows compliance with the lighting. Easy to review!

ACCEPTED IN PART -Initial lamp lumens being changed to initial luminaire lumens.

#35 - Since no one has published an explanation of how MLO was developed, it's not clear why many of the requirements exist.

For example, why are LAMP lumens limited? Why not limit lumens leaving the fixture? Isn't the true menace lumens escaping into the environment, rather than lumens trapped in the fixture? If you use lumens emitted by the fixture, you don't have to counter-intuitively INCREASE the allowed lumens emitted by LED products. That 1.4 LED lumen multiplier seems senseless, at least without some argument for why lamp lumens are used instead of luminaire lumens. Maybe the answer has something to do with evaluating existing lighting installations, in which no technical data record exist about the fixtures?

ACCEPTED IN PART - Lamp lumens -relates to absolute photometry issues

2. Limits to Off Site Impacts

All luminaires shall be rated and installed according to Table C.

B. Performance Method

1. Total Site Lumen Wattage Limit

Complies with ANSI/ASHRAE/IES 90.1-2010 TABLE 9.4.6 Individual Lighting Power Allowances for Building Exteriors (these were published and approved as addendum "I" and addendum "BR" to 90.1-2007).

The total installed initial lamp lumens of all lighting systems on the site shall not exceed the allowed total initial site lumens. The allowed total initial site lumens shall be determined using Tables D and E. For sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial lamp lumens of all is calculated as the sum of the initial lamp lumens for all luminaires tested with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.

REJECTED - Lumens versus watts - commenter wants to use ASHRAE/IES 90.1 - rejected long ago because ordinances may not be updated and increased LPW of sources may lead to overlighting

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

B. Performance Method

1. Total Site Lumen Limit

The total installed initial **lamp luminaire** lumens of all lighting systems on the site shall not exceed the allowed total initial site lumens. The allowed total initial site lumens shall be determined using Tables D and E. For sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial **lamp luminaire** lumens of all is calculated as the sum of the initial **lamp luminaire** lumens for all luminaires. ~~tested: with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.~~

57 - B. Performance Method

1. Total Site ~~Lumen~~ Wattage Limit

Complies with ANSI/ASHRAE/IES 90.1-2010 TABLE 9.4.6 Individual Lighting Power Allowances for Building Exteriors (these were published and approved as addendum "I" and addendum "BR" to 90.1-2007).

~~The total installed initial lamp lumens of all lighting systems on the site shall not exceed the allowed total initial site lumens. The allowed total initial site lumens shall be determined using Tables D and E. For sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.~~

~~The total installed initial lamp lumens of all is calculated as the sum of the initial lamp lumens for all luminaires tested with relative photometry and 140% of initial lamp lumens for all luminaires tested with absolute photometry.~~

REJECTED - Lumens versus watts - commenter wants to use ASHRAE/IES 90.1 - rejected long ago because ordinances may not be updated and increased LPW of sources may lead to overlighting, especially with SSL luminaires.

36 - General - Uplight: Basically, the user is asked to compare some kind of calculation or summary showing the lumens on the inside top and sides of the box with the total lamp lumens researched from lamp catalogs and summed. This is awkward, and not a rational comparison. The Aussies have something called Upward Waste Light Ratio (UWLR). (The Europeans call it simply ULR.) It's the percentage of a site's total luminaire lumens that are emitted in an upward direction, based on the luminaires' installed positions. This is what you're looking for, not the upward luminaire lumens as a percentage of initial lamp lumens. And it's easy to calculate! For consideration: Do you really need this if you use the BUG Rating to restrict the uplight? Uplight: Basically, the user is asked to compare some kind of calculation or summary showing the lumens on the inside top and sides of the box with the total lamp lumens researched from lamp catalogs and summed. This is awkward, and not a rational comparison. The Aussies have something called Upward Waste Light Ratio (UWLR). (The Europeans call it simply ULR.) It's the percentage of a site's total luminaire lumens that are emitted in an upward direction, based on the luminaires' installed positions. This is what you're looking for, not the upward luminaire lumens as a percentage of initial lamp lumens. And it's easy to calculate! For consideration: Do you really need this if you use the BUG Rating to restrict the uplight? Finally, light trespass is totally missed here, even though it's mentioned in the User Guide on this page (first paragraph, first sentence). Why not simply a maximum horizontal and vertical illuminance at the property line and off the property, as LEED now requires? Easy to calculate and demonstrate with a point-by-point, and easy to understand.

REJECTED - Many issues:

(1) The box method is not awkward and can be calculated with lighting software programs. It allows for calculation analysis that accounts for buildings, reflectances and other site specific items.

(2) It takes into account ULR/UWLR, which are luminaire specific only for site specific. BUG system accounts for glare and backlight in addition to uplight, but permits effective shielding by canopies and buildings;

(3) BUG Option A and Box Calculations both account for light trespass in effect as commentor suggests.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PERFORMANCE METHOD

2. Limits to Off Site Impacts

All luminaires shall be rated and installed using either Option A or Option B. Only one option may be used per permit application.

Option A: All luminaires shall be rated and installed according to Table C.

Option B: The entire outdoor lighting design shall be analyzed using industry standard lighting software including inter-reflections in the following manner:

1) Input data shall describe the lighting system including luminaire locations, mounting heights, aiming directions, and employing photometric data tested in accordance with IES guidelines. Buildings or other physical objects on the site within three object heights of the property line must be included in the calculations.

2) Analysis shall utilize an enclosure **comprised of calculation planes with zero reflectance values** around the perimeter of the site. The top of the enclosure shall be no less than ~~10-~~ **33 feet (3 10 meters)** above the tallest luminaire. Calculations shall include total lumens upon the inside surfaces of the box top and vertical sides and maximum ~~line of sight~~ **or "TV" vertical** illuminance (footcandles and/or lux) on the sides of the enclosure.

The design complies if:

- a) The total lumens on the inside surfaces of the ~~box~~ **virtual enclosure** are less than ~~10%~~ **15%** of the total site lumen limit; and
- b) The maximum ~~line of sight~~ **or "TV" vertical** illuminance on any vertical surface is less than the allowed maximum illuminance per Table F.

35 - All luminaires shall be rated and installed using option A or option B. It might be a good idea to state the Performance method must only be used for the entire site, rather than a portion of the site.

REJECTED - Already states that only one option may be used per permit application.

35. Define "object heights." **ACCEPTED - Objects and object heights to be defined**

#35 - For the vertical point spacing on the walls of the calculation box, what calculation point spacing is required? Grid spacing has a huge impact on results if it is too large. How does MLO handle sloped sites? The world is not flat. Are sloped sites at an advantage or disadvantage or neither. Can you prove that the difference is negligible?

ACCEPTED IN PART - Option B calculation rules needed

35 - Does MLO use an "enclosure" or a "box" around the site? Terminology is not consistent. More importantly, it is not clear that this is a virtual box formed by calculation grids, using calculation software! Diagrams are needed.

Proposed code language wording is correct.

#36 - For TV illuminance, which way is the observer looking? Upward toward the source, or horizontal but in the direction of the source. It would seem to be the former (from the definition: "when looking at the brightest source in the field of view"), but this is very unrealistic and therefore irrelevant as a metric. Only lighting professionals look upward toward a light source. What is the point spacing for the grid (Observer positions)? At what height above the ground? A separate grid would be needed for each luminaire that the Observer in each position could see. Barring obstructions, the number of grids would be the product of the number of Observer positions all around the perimeter times the number of luminaires—a lot of data—just to find the maximum value on any side of the enclosure for any Observer position. TV illuminance is not intuitive and not easily calculated. This reviewer understands that there is one software program that will make this calculation, but it is proprietary to a specific luminaire manufacturer, and as such some employers will not allow its use, leaving them the very tedious calculation process described in the previous paragraph. A more appropriate glare metric is the CIE's Glare Rating (not UGR, which is for interior applications). See CIE 112 – 1994. It was developed in 1994 specifically for outdoor sports and site applications.

ACCEPTED IN PART - Deleted "TV illuminance". Glare rating systems considered and decided at this time not to use it.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PERFORMANCE METHOD

IV. NON-RESIDENTIAL LIGHTING (cont.) – Ordinance Text
PERFORMANCE METHOD, page 17 - 2. Limits to Off Site Impacts, Option B, 2)

Analysis shall utilize an enclosure around the perimeter of the site. The top of the enclosure shall be no less than ~~10 feet (3 meters)~~ **33 feet (10 meters)** above the tallest luminaire building or other physical objects included in the calculation.

SUPPORTING INFORMATION: Numerous IESNA documents recommend the use of far-field photometry and the “five-times rule” for outdoor luminaires to permit higher computational accuracy regardless of the luminous opening size and to maintain the integrity of the point source “inverse squared rule”. The ninth edition of the *Lighting Handbook* discusses these topics under the Far-Field Photometry heading on page 9-12. Likewise, the following IESNA documents discuss far-field photometry and even define specific photometric distances:

LM-10-96 IESNA Approved Method for Photometric Testing of Outdoor Fluorescent Luminaires = See page 5, 6.0 TEST PROCEDURE FOR FAR FIELD PHOTOMETRY. This section also states the following: “If a reduced [less than five times the maximum dimension of the source] test distance is used, some of the reported candlepower values will be altered and the coefficient of utilization (as for roadways) affected...” It would be preferred not to introduce these inaccuracies in lighting measurements.

LM-31-95 IESNA Approved Method for Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge Lamps = See page 1, 3.2.4 Test Distance. In particular, this section states “A distance of eight to ten meters (26 to 33 feet) should be sufficient for any beam forming luminaire.”

LM-35-02 IESNA Approved Method for Photometric Testing of Floodlights Using High Intensity Discharge or Incandescent Filament Lamps = See pages 1-2, 3.5 Test Distance. In particular, this section states “A distance of 7.5 to 10 meters (25 to 33 feet) should be the minimum test distance...”

Without quantification of the various outdoor applications, luminaires and lamp sources, the recommended 33 feet (10 meters) is arguably a reasonable compromise. It is recommended that a study be conducted to quantify these variables and validate this recommendation.

This study is also recommended to enable lighting manufacturers to work in conjunction with the IDA and the IESNA to evaluate the criteria set forth in page 17, Option B in the paragraph that starts “The design complies if...” With this data, we can subject these guidelines to a more rigorous analysis.

Considering that this is a site option and that the buildings and other physical objects within the calculation enclosure could reflect light – and, thus, would effectively become sources of illumination – the recommendation is made to include them in the determination of the distance to the top of the enclosure.

Further support for a 10 meter height and inclusion of buildings and other physical objects is contained within Lighting Research Center (LRC) documentation regarding their Outdoor Site-Lighting Performance or OSP Methodology. References to avoiding near-field photometry issues and the 10 meter height is located as follows: “OSP Methodology – Glow and Trespass” = See page 2, *Location of Top* where it states “Default should be set to 10m above highest object (pole, roof, peak, etc.)”

“Outdoor site-lighting performance” article = See page 204 (PDF page 4), second full paragraph in the left hand column where it states “For purposes of standardization, the top of every calculation box was set to 10m above the highest luminous architectural element on the property, such as the tallest luminaire on the property or the highest point on a building that might be illuminated with flood lighting. To avoid problems associated with near-field photometry, the 10m incremental height was adopted as the standard for the calculation box.”

Referenced Standards : *IESNA Lighting Handbook, ninth edition.*

LM-10-96 IESNA Approved Method for Photometric Testing of Outdoor Fluorescent Luminaires.

LM-31-95 IESNA Approved Method for Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge Lamps.

LM-35-02 IESNA Approved Method for Photometric Testing of Floodlights Using High Intensity Discharge or Incandescent Filament Lamps.

LRC “OSP Methodology – Glow and Trespass” located at <http://www.lrc.rpi.edu/researchAreas/outdoor.asp> under Publications.

LRC “Outdoor site-lighting performance: A comprehensive and quantitative framework for assessing light pollution” located at <http://www.lrc.rpi.edu/researchAreas/outdoor.asp> under Publications.

ACCEPTED - Credible Argument

2. Limits to Off Site Impacts

All luminaires shall be rated and installed using either Option A or Option B. Only one option may be used per permit application.

Option A: All luminaires shall be rated and installed according to Table C.

Option B: The entire outdoor lighting design shall be analyzed using industry standard lighting software including inter-reflections in the following manner:

- 1) Input data shall describe the lighting system including luminaire locations, mounting heights, aiming directions, and employing photometric data tested in accordance with IES guidelines. Buildings or other physical objects on the site within three object heights of the property line must be included in the calculations.
- 2) Analysis shall utilize an enclosure **comprised of calculation planes with zero reflectance values** around the perimeter of the site. The top of the enclosure shall be no less than ~~10–33 feet (3 10 meters)~~ **33 feet (3 10 meters)** above the tallest luminaire. Calculations shall include total lumens upon the inside surfaces of the box top and vertical sides and maximum ~~line of sight~~ **or “TV” vertical** illuminance (footcandles and/or lux) on the sides of the enclosure.

The design complies if:

- a) The total lumens on the inside surfaces of the ~~box~~ **virtual enclosure** are less than ~~10%~~ **15%** of the total site lumen limit; and
- b) The maximum ~~line of sight or “TV”~~ **vertical** illuminance on any vertical surface is less than the allowed maximum illuminance per Table F.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PERFORMANCE METHOD

2. Limits to Off Site Impacts

All luminaires shall be rated and installed using either Option A or Option B. Only one option may be used per permit application.

Option A: All luminaires shall be rated and installed according to Table C.

Option B: The entire outdoor lighting design shall be analyzed using industry standard lighting software including inter-reflections in the following manner:

1) Input data shall describe the lighting system including luminaire locations, mounting heights, aiming directions, and employing photometric data tested in accordance with IES guidelines. Buildings or other physical objects on the site within three object heights of the property line must be included in the calculations.

2) Analysis shall utilize an enclosure **comprised of calculation planes with zero reflectance values** around the perimeter of the site. The top of the enclosure shall be no less than ~~10-~~ **33 feet (3 10 meters)** above the tallest luminaire. Calculations shall include total lumens upon the inside surfaces of the box top and vertical sides and maximum ~~line of sight~~ **or "TV" vertical** illuminance (footcandles and/or lux) on the sides of the enclosure.

The design complies if:

- The total lumens on the inside surfaces of the ~~box~~ **virtual enclosure** are less than ~~10%~~ **15%** of the total site lumen limit; and
- The maximum ~~line of sight or "TV"~~ **vertical** illuminance on any vertical surface is less than the allowed maximum illuminance per Table F.

43 - Subsection No. B. 2. Option B: 2) Page No. 17 Ordinance Text

Analysis shall include a calculation enclosure around the perimeter Property Line of the site
Add this text:

For property lines that abut public walkways, bikeways, plazas, and parking lots, the vertical planes of the calculation enclosure may be placed 5 feet (1.5 meters) beyond the property line.
For property lines that abut public streets, roadways, highways, and public transit corridors, the vertical planes of the calculation enclosure may be located at the centerline of the public street, roadway, highway, or public transit corridor.

BASIS: Property Line is the defined term that should be used.

Without the provision to adjust the effective property line for calculations, these limits may be impossible to meet in conditions where the property line is very close to the building, or at the building façade or hardscape areas such as parking lots, even with the most sensitive lighting. In urban locations the property line is often at the face of the building on the sidewalk. It may also be impossible to meet these limits and properly light the intersection of a driveway and street, where the property line is along the street. The provision is already in Table C and should be included in Performance Option B for the same reasons.

ACCEPTED IN PART - coordinate with the software and calculate a few sites and see what happens if we adjust the calculation grid.

43 - Subsection No. B.2 Option B: 2) Page No. 17

The top of the calculation enclosure shall be no less more than 10 feet (3 meters) above the tallest highest luminaire.

REASON: If you can be "no less than", that means you could put the enclosure top at infinity and have zeros everywhere.

It is irrelevant how tall a luminaire is, it is the height above the ground that matters.

ACCEPTED IN PART - coordinate with the software and calculate a few sites .

43 - Subsection No. 2. Option B: 2) Page No. 17 - Revise third sentence of 2) as follows:

Calculations shall include total lumens upon the inside surfaces of the enclosure ~~box~~ top and vertical sides, and the maximum ~~line of sight or "TV" illuminance~~ Off-Site Illuminance on the sides of the enclosure.

Revise b) as follows: The ~~maximum line of sight or TV illuminance~~ Off-Site Illuminance on any vertical surface ~~side of the calculation enclosure~~ is ~~less not more~~ than the allowed maximum illuminance per Table F.

BASIS See comment IALD#24 for new term and definition to replace "TV Illuminance"

ACCEPTED IN PART - Deleted TV Illuminance

#25 Pages 16-18 and 27-31 - General comments about Performance Method

1. We believe that the LRC "shoebox" on which Performance Method is based is fatally flawed because it fails to account for angular emissions. We recommend that this approach be abandoned.

2. If the "shoebox" is not abandoned, we believe the following limitations should be placed on Performance Method:

a. Performance Method may not be used without a special use permit.

b. Performance Method may be used only in Lighting Zones 3 and 4.

Section IV.B covering Performance Method should be moved to an Appendix.

REASON If the concept is not abandoned, its use should be severely restricted.

REJECT - Need verification from software company

#25 - Allowing 10% of lumens to leave the site appears to be arbitrary and excessive. The allowance should be reduced to a more realistic level.

REJECT - 10% of total site lumens was determined by the LRC for fully shielded lighting systems.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PERFORMANCE METHOD

2. Limits to Off Site Impacts

All luminaires shall be rated and installed using either Option A or Option B. Only one option may be used per permit application.

Option A: All luminaires shall be rated and installed according to Table C.

Option B: The entire outdoor lighting design shall be analyzed using industry standard lighting software including inter-reflections in the following manner:

- 1) Input data shall describe the lighting system including luminaire locations, mounting heights, aiming directions, and employing photometric data tested in accordance with IES guidelines. Buildings or other physical objects on the site within three object heights of the property line must be included in the calculations.
- 2) Analysis shall utilize an enclosure **comprised of calculation planes with zero reflectance values** around the perimeter of the site. The top of the enclosure shall be no less than ~~10~~ **33** feet (**3 10** meters) above the tallest luminaire. Calculations shall include total lumens upon the inside surfaces of the box top and vertical sides and maximum ~~line of sight~~ **or "TV" vertical** illuminance (footcandles and/or lux) on the sides of the enclosure.

The design complies if:

- a) The total lumens on the inside surfaces of the ~~box~~ **virtual enclosure** are less than ~~10%~~ **15%** of the total site lumen limit; and
- b) The maximum ~~line of sight~~ **or "TV" vertical** illuminance on any vertical surface is less than the allowed maximum illuminance per Table F.

Limits to Off Site Impacts

All luminaires shall be rated and installed using either Option A or Option B. Only one option may be used per permit application.

Option A: All luminaires shall be rated and installed according to Table C.

Option B: The entire outdoor lighting design shall be analyzed using industry standard lighting software including inter-reflections in the following manner:....

delete the following tables in there entirety

Table A - Allowed Total Initial Lumens....

Table B - Allowed Total Initial Lumens....

Table D Performance Method Allowed Total....

Table E Performance Method Additional....

REASONS:

Delete "Total Site Lumen Limit" method prescriptive and performance methods from the MLO and reference the approved 90.1-2010 language in Table 9.4.6.

These "Lumen" calculations are an alternate energy code calculation and create significant duplication of work for the design team. It is not the lumens that are put on the site that should matter but the lumens that leave the site in the form of light trespass and sky glow that should matter in the MLO. ASHRAE/IES 90.1 with addendum "i" & addendum "br" and the IECC and numerous state energy codes already include either a 4-zone or 5-zone lighting power density requirements. The 90.1 5-zone was developed primarily using Metal Halide lamps which have approximately 85 lumens per watt. When applying and comparing the 90.1 allowance and the MLO allowance the 90.1 allowance closely matches or is more stringent than the proposed lumen limits in the MLO.

Let the energy codes limit the lumens introduced to the site through the Watts/sf and the MLO limit the lighting that leaves the site through the "Limits to Off Site Impacts".

Also - Will a municipality be able to modify this document? Say, not adopt the Performance method? If the answer is "yes" then this change is even more important to allow the design team to light the outdoor environment and not being limited to a basic hardscape calculation.

REJECTED - Lumens versus watts - commenter wants to use ASHRAE/IES 90.1 - rejected long ago because ordinances may not be updated and increased LPW of sources may lead to overlighting

#25 - Allowing 10% of lumens to leave the site appears to be arbitrary and excessive. The allowance should be reduced to a more realistic level.

REJECTED - 10% of total site lumens was determined by the LRC for sully shielded lighting systems. 15% is required if the MLO uses initial lumen

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

This MLO provides two methods for determining compliance. The *prescriptive method* contains precise and easily verifiable requirements for luminaire light output and fixture design that limit glare, uplight, light trespass and the amount of light that can be used. The *performance method* allows greater flexibility and creativity in meeting the intent of the ordinance. It should be noted that both the prescriptive or performance method limit the *amount* of light that can be used, but do not control *how* the lighting is to be used.

36 - The last User Guide paragraph on page 11 refers to "...easily verifiable requirements for luminaire light output and fixture design..." (Emphasis added) Yet the Ordinance Text on page 12 refers to "initial lamp lumens." It should be luminaire light output that is the basis of the ordinance, not lamp lumens.

Accepted: Initial lamp lumens has been replaced with initial luminaire lumens.

New



30 Please provide an explanation regarding the 70% fixture efficiency for luminaires utilizing LED lamp sources. Since this efficiency or true delivered lumens is already calculated (measured) during the absolute photometric data collection, an additional lumen multiplier may not be warranted. (user's guide)

Accepted: Initial lamp lumens has been replaced with initial luminaire lumens.

PRESCRIPTIVE METHOD - User's Guide

Most outdoor lighting projects that do not involve a lighting professional will use the prescriptive method, because it is simple and does not require engineering expertise.

For the prescriptive method, the initial **luminaire** lumen allowances defined in Table A or B will provide basic lighting (parking lot and lighting at doors and/or sensitive security areas) that is consistent with the selected lighting zone. ~~It will~~ **The prescriptive method is intended to provide a safe lighting environment without while reducing sky glow or and adverse offsite impacts.** A jurisdiction may also allow a prescriptive method for classes of sites, such as car dealerships, gas stations, or other common use areas.

Note that the values are for initial ~~lamp~~ **luminaire** lumens, not foot-candles on the target (parking lot, sidewalk, etc). Variables such as the efficiency of the luminaire, dispersion, and **lamp wear** can affect the actual amount of light so the lumens per square foot allowance is not equal to footcandles on the site. **By specifying initial luminaire lumen values, it is easier for officials to verify that the requirement is being met.** **Initial luminaire lumens are available from photometric data. Each initial luminaire lumens should be supplied on the submittal forms.**

~~Also, since solid state luminaires (such as LEDs) do not have initial lamp lumens, their lumen rating is stated in initial luminaire lumens or absolute photometry. As a result, the MLO requires an adjustment factor to normalize initial lumen ratings for absolute photometry. It is assumed that luminaires are 70% efficient, so the adjustment factor is 1.4 for luminaires tested with absolute photometry methods.~~ **Listed below is**

an example format for compliance workbook for the Prescriptive Method. If the reports are all generated by the same software, format, and compliance workbook, it would be much easier for an official than perusing lamp manufacturers' catalogs for the various lamps to find the initial lamp lumens.

These same programs also calculate a luminaire's BUG Rating, which is also required and not likely to be included in older printed photometric reports.

Finally, basing the ordinance on luminaire lumens would enable luminaires measured with absolute photometry to compete on a fair basis, without wild assumptions regarding their efficiency. (Where in the world did 70% come from? It may apply to some SSL luminaires, but it is certainly not the norm.) **Accepted in Part: Initial lamp lumens has been revised to initial luminaire lumens which is available in photometric files.**

#29 Request: Make it clearer, both in the ordinance text and in the user guide, that most outdoor lighting installations can be regulated using only the prescriptive method.

Rationale: It's true that some installations will require a lighting designer or engineer to comply, but in order for the MLO to become widely adopted we must make the case that existing governing boards, with their existing levels of expertise, are adequate to adopt and enforce the MLO.

31- "It will provide a safe lighting environment without skyglow or adverse offsite impacts."

This important assessment implies that the safety of an undefined lighting system for a site plan yet to be conceived can be determined by planners who desire certain lighting levels in certain geographical areas. It is a very strong assertion, and it does not appear to be supported by any facts.

We cannot say that a certain quantity of lumens is all you need to determine in advance the safety of an otherwise unknown system in an unknown facility. Perhaps the writers meant "It will **The prescriptive method is intended to provide a safe desirable lighting environment ...**" **ACCEPTED**

The inclusion of "skyglow" in this unqualified statement ("unqualified" meaning "unmodified by any adjectives or conditional phrases") also damages the credibility of the statement, causing a designer to wonder why meeting the criteria of the LZ4 would not cause skyglow in the LZ4 – but those same values would cause skyglow in the LZ2. Better to say "unanticipated" or "unwanted" or "unacceptable" skyglow.

ACCEPTED

31 - The comment is about the term "Lamp wear." Did the writers mean "Lumen Depreciation?"

REASON Considering the near-admonishments in Sections IX TABLES and X DEFINITIONS of the handbook (left side) about using conflicting or obsolete technical terminology, we should refrain from introducing new terms without defining them in Section X. My apologies if "lamp wear" is a common lighting Industry term outside of Florida – but I've never heard it used here.

The third User Guide paragraph on p. 12 states, "By specifying initial lumen values, it is easier for officials to verify that the requirement is being met." How? By looking up the lamp lumens in the lamp manufacturers' catalogs? If they aren't familiar with the catalogs, this could be time consuming, and perhaps even unlikely to happen. And how does one look up LED luminaire lumens? This information isn't typically included in most SSL luminaire cut sheets. **Accepted in Part: Initial lamp lumens has been replaced by initial luminaire lumens. This information is available on photometric reports.**

Luminaire lumens are directly relevant to the purpose of the MLO: controlling delivered light in nighttime exterior environments. Lamp lumens don't come close to addressing this concern, as luminaire efficiency can vary widely between luminaire types and even between manufacturers of similar looking types.

There are many lighting software programs and photometry tools that will calculate and display luminaire lumens. These are calculated directly from the reported candela values in the photometric report (whether absolute or relative). These programs are free or low cost. It would be easy to include in the project materials a printed photometric report on each luminaire type used in a project that showed the luminaire lumens.

Page 12, Continued

PRESCRIPTIVE METHOD - User's Guide

Most outdoor lighting projects that do not involve a lighting professional will use the prescriptive method, because it is simple and does not require engineering expertise.

For the prescriptive method, the initial **luminaire** lumen allowances defined in Table A or B will provide basic lighting (parking lot and lighting at doors and/or sensitive security areas) that is consistent with the selected lighting zone. ~~It will~~ **The prescriptive method is intended to provide a safe lighting environment without while reducing sky glow or and** adverse offsite impacts. A jurisdiction may also allow a prescriptive method for classes of sites, such as car dealerships, gas stations, or other common use areas.

Note that the values are for initial ~~lamp~~ **luminaire** lumens, not foot-candles on the target (parking lot, sidewalk, etc). Variables such as the efficiency of the luminaire, dispersion, and lamp wear can affect the actual amount of light so the lumens per square foot allowance is not equal to footcandles on the site. By specifying initial **luminaire** lumen values, it is easier for officials to verify that the requirement is being met. **Initial luminaire lumens are available from photometric data. Each initial luminaire lumens should be supplied on the submittal forms.**

~~Also, since solid state luminaires (such as LEDs) do not have initial lamp lumens, their lumen rating is stated in initial luminaire lumens or absolute photometry. As a result, the MLO requires an adjustment factor to normalize initial lumen ratings for absolute photometry. It is assumed that luminaires are 70% efficient, so the adjustment factor is 1.4 for luminaires tested with absolute photometry methods.~~ Listed below is an example on a typical compliance worksheet for the Prescriptive Method.

MLO only focuses on “reducing obtrusive light” instead of looking at possible ways to reduce the carbon footprint as well.

The idea of “Most outdoor lighting projects that do not involve a lighting professional will use prescriptive method, because it is simple and does not require engineering expertise.” (MLO User's Guide, page 12) is misguided and dangerous. The example below explains the concerns.

Figure 2 shows two options of lighting a typical parking lot (sized at 29,730 square feet) The first option (on the left) uses two 30-foot poles with single 400-watt luminaires .The second example on the right uses, two 30-foot poles with three 150-watt luminaires per pole.

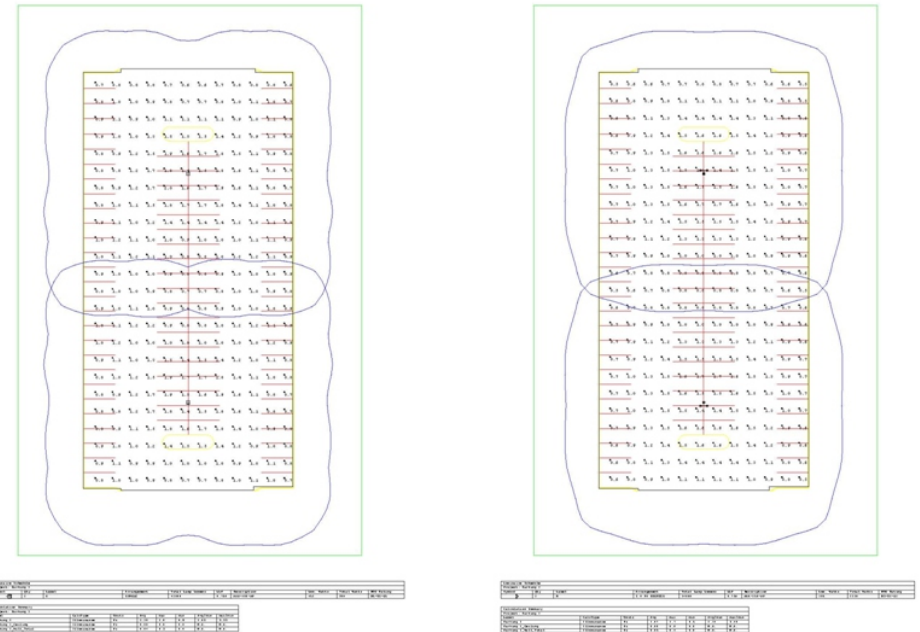


Fig.2 Typical parking lot

Both lighting designs meet requirements on Enhanced security light for parking lots and MLO requirements on lumens per site LZ- 2 (<4 lm/sf). They also meet the required total spill light outside the boundary line (< 10% of total lumens). If the proposed prescriptive method and BUG rating are followed, the only possible solution for LZ-2 is the use of 150-watt or lower wattage luminaires. However, Table 2 shows that 400-watt luminaires provide less light spill than the 150-watt luminaires. Another advantage of the 400-watt luminaire design is a lower carbon footprint based on conservation of energy and resources.

Table 2. Comparison design of a 400w luminaries vs. a 150w luminaries

	400 w	150 w
Luminaires	2	6
Initial lumens per site	84000	84000
Illum Avg	1.1	1.07
Illum min	0.6	0.5
Lumens per site	2.83 lm/sf	2.83 lm/sf
Total watt	904	1110
Avg illum on "box" surrounding the site	0.04 fc	0.05fc
Spill light outside boundary line	5.90%	7.40%
BUG rating	B5-U3-G5	B3-U2-G2

As shown in Table 2, choosing the luminaries with lowest BUG rating without the proper professional expertise would not prevent an increased light spill, but could essentially increase the carbon footprint. The formal positive result is that the 150-watt luminaries have a rating of G2 and could be approved for this project. However this would create several negative results:

1. The total light trespass value would increase from 5.9% (two 400-watt luminaries) to 7.4% (six 150-watt luminaries).
2. Energy consumption would increase from 904 watts (two 400-watt luminaries) to 1110 watts (six 150-watt luminaries).
3. The carbon footprint from mining, manufacturing and disposal would increase approximately three times if the 150-watt luminaries are used instead of the 400-watt luminaries.

It would appear that the incorrect luminaire (150 instead of 400-watt) would be used because the MLO does not have a consistent approach to the problem: On one hand it uses the Lumen Density (MLO, IX Tables, Table B) method that apply in all areas. On the other hand, it uses the BUG rating system, which applies to the performance of individual luminaries. This combined method does not make sense since it contradicts itself. The combined system puts an emphasis on minimizing light spill while largely ignoring considering the carbon footprint of a selected lighting design. Realistically, the combined MLO-BUG system is neither environmentally friendly nor does it minimize light spill.

This problem could be solved if the consistency of Lumen Density could be extended to the Uplight and Glare represented in Table C (MLO, IX Tables). This would allow the ability to effectively replace the BUG rating system on allowed density of UH, UL, FVH, BVH, FH, BH measured in lumen per square foot (see example Table 3).

Table 3. Maximum allowed Uplight and Glare density lm/sf

	LZ-0	LZ-1	LZ-2	LZ-3	LZ-4
Allowed Uplight Rating	U0				
Allowed Glare Rating	G0				
UH density lm/sf		0.005	0.01	0.02	0.03
UL density lm/sf		0.005	0.01	0.02	0.03
FVH/BVH density lm/sf		0.015	0.02	0.04	0.06
FH/BH density lm/sf		0.45	0.75	1.5	2.3

Another concern is the possible acceptance of equipment and lighting layouts by non-professionals using misleading information. In Figure 3 below, photometric data is stated on a Per 1000 amp lumen basis. The stated BUG rating in the report (based on 1000 lamp lumens) is shown as 0-0-0. The BUG rating when using a 40,000 lumen MH lamp is actually 4-3-4, a dramatic difference in the way the luminaire's application would be interpreted. Based on the MLO's statement that "no engineering expertise required", this luminaire could mistakenly be welcomed on many municipal projects.

Comment noted: The Author of this comment addresses a common problem of a per 1000 lumen photometric files that are common amongst a few manufacturers. There many existing photometric files that exist that will not give accurate BUG ratings. Cooperation with manufacturers to revise or cleanse their data bases of these erroneous files is important. The other example of using 400 watt luminaires in lieu of 150 watt luminaires is a design issue. The 400 watt luminaire does create more glare and that is what the BUG system is designed to address. The Author's suggestion of using an extended version of Lumen Density to replace the BUG system is rejected. BUG is complicated enough, and a more in-depth analysis would add hard to understand complication. The Author's comment that "the MLO-BUG system is neither environmentally friendly no does it minimize light spill" is rejected. The author has one example that shows higher wattage used and higher off site lumens, with one proposed design. Another equally viable design alternative would give opposite results. The author has not taken into account the increase in glare from this 400 watt luminaire compared to the 150 watt luminaire.

Page 12, Continued

PRESCRIPTIVE METHOD - User's Guide

Most outdoor lighting projects that do not involve a lighting professional will use the prescriptive method, because it is simple and does not require engineering expertise.

For the prescriptive method, the initial **luminaire** lumen allowances defined in Table A or B will provide basic lighting (parking lot and lighting at doors and/or sensitive security areas) that is consistent with the selected lighting zone. **It will provide a safe lighting environment without while reducing sky glow or and adverse offsite impacts.** A jurisdiction may also allow a prescriptive method for classes of sites, such as car dealerships, gas stations, or other common use areas.

Note that the values are for initial **lamp luminaire** lumens, not foot-candles on the target (parking lot, sidewalk, etc). Variables such as the efficiency of the luminaire, dispersion, and lamp wear can affect the actual amount of light so the lumens per square foot allowance is not equal to footcandles on the site. By specifying initial **luminaire** lumen values, it is easier for officials to verify that the requirement is being met. **Initial luminaire lumens are available from photometric data. Each initial luminaire lumens should be supplied on the submittal forms.**

~~Also, since solid state luminaires (such as LEDs) do not have initial lamp lumens, their lumen rating is stated in initial luminaire lumens or absolute photometry. As a result, the MLO requires an adjustment factor to normalize initial lumen ratings for absolute photometry. It is assumed that luminaires are 70% efficient, so the adjustment factor is 1.4 for luminaires tested with absolute photometry methods:~~

Solid state luminaires do not have initial lamp lumens, only initial luminaire lumens (absolute photometry). Other luminaires tested with relative photometry will have initial luminaire lumens which can be calculated by multiplying initial lamp lumens by the luminaire efficiency.

Listed below is an example on a typical compliance worksheet for the Prescriptive Method.

25. - On page 12, delete the 2nd sentence of 2nd paragraph. There is no evidence to support the claim that the Prescriptive Method in general, or Tables A and B in particular, "will provide a safe lighting environment without sky glow or adverse offsite impacts."

ACCEPTED IN PART - Sentence Modified in Response to Comment 31

In this example, three types of luminaires are used to light a parking area and building entry in a light commercial area. Two of these three luminaires use metal halide lamps: 70 watt wall mounted area lights and 150 watt pole mounted area lights. For these, the Initial Luminaire Lumens is equal to the initial lamp lumens multiplied by the luminaire efficiency. These values are entered into the compliance chart. The lumen value for the building mounted LED luminaires is equal to the lumens exiting the luminaire. Therefore, the value already represents the Initial Luminaire Lumens and no luminaire efficiency is needed. The total Luminaire Lumens for the site is equal to 247,840. The allowable lumens are based on the lighting zone and the total hardscape area. Referencing Table B, the allowed lumens are 2.5/SF for LZ2. Multiplying this by the total hardscape square footage gives a value of 250,000 lumens allowed. Because this value is greater than the value calculated for the site, the project complies.

PRESCRIPTIVE METHOD EXAMPLE - COMPLIANCE CHART			
<i>Lamp Descriptions</i>	<i>QTY</i>	<i>Initial Luminaire Lumens</i>	<i>Total</i>
70 W Metal Halide	8	3,920	31,360
150 W Metal Halide	20	9,600	192,000
18 W LED	24	1,020	24,480
TOTAL INITIAL LUMINAIRE LUMENS			247,840
SITE ALLOWED TOTAL INITIAL LUMENS*			250,000
PROJECT IS COMPLIANT?			YES

* Listed below is the method of determining the allowed total initial lumen for non-residential outdoor lighting using the hardscape areamethod. (Table B).

SITE ALLOWED TOTAL INITIAL LUMENS	
<i>Site Description</i>	Light Commercial
<i>Lighting Zone</i>	LZ-2
<i>Hardscape Area (SF)</i>	100,000
<i>Allowed Lumens per SF of Hardscape (Table B)</i>	2.5
<i>Site Allowed Total Initial Lumens (lumens per SF X hardscape area)</i>	250,000

LIMITS TO OFFSITE IMPACTS

The prescriptive method of the MLO restricts uplighting, including upward light emitted by decorative luminaires. A jurisdiction may choose to preserve some types of lighting, including lighting of monuments or historic structures. In this case, the adopting jurisdiction should exempt or otherwise regulate these types of lighting carefully so that it does not inadvertently allow glaring or offensive lighting systems.

25. On page 14, 2nd paragraph, the 1st sentence is again using the old definition of "light pollution." Revise first two sentences as follows:
Offsite ~~impacts include both effects of light pollution and include glare, light trespass, sky glow, and impacts on the nocturnal environment.~~ **Both** All of these are a functions of the fixture or luminaire design and installation. **ACCEPTED**

Offsite ~~impacts include both effects of light pollution and include glare, light trespass, sky glow and impacts on the nocturnal environment.~~ **Both** All of these are a functions of the fixture or luminaire design and installation. This document replaces the previous luminaire classification terminology of full cut-off, semi cut-off, **and** cut-off because those classifications were not as effective in controlling offsite impacts as **with** the new IESNA luminaire classification system as described in TM-15-07.

25. On page 14, 3rd sentence of 2nd paragraph: It's a matter of opinion whether BUG is more effective than the old cutoff classifications since BUG's fixed lumen limits may result in more fixtures being used. Revise sentence as follows:
This document replaces the previous luminaire classification terminology of full cut-off, semi cut-off, and cut-off because those classifications were not as effective in controlling offsite impacts as with the new IESNA luminaire classification system as described in TM-15-07.
ACCEPTED

A traditional method of defining light trespass is to identify a maximum light level at or near the property line. However, this method does not address offensive light that is not directed toward the ground, or the intensity of glaring light shining into adjacent windows. The requirements defined in Table C limit the amount of light in all quadrants that is directed toward or above the property line. The Backlight/Uplight/Glare (BUG) rating will ~~better help~~ limit both light trespass and glare. (A detailed explanation of the BUG system is provided in the section on Table C.)

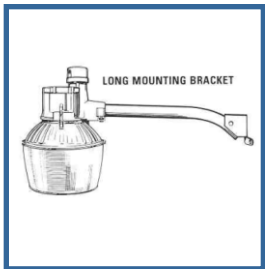
25. On page 14, 4th sentence of 3rd paragraph, delete the word "better." Again, this is a matter of opinion.
ACCEPTED IN PART - Deleted "better", replaced with "help"

The limits for light distribution established in Table C (for the BUG rating system) prevent or severely limit all direct upward light. A small amount of uplight reflected by snow, light-colored pavement or a luminaire's supporting arms is inevitable and is not limited by the prescriptive method of this ordinance.

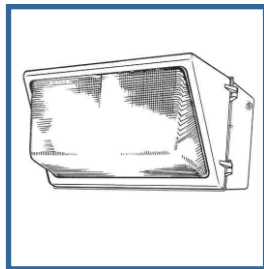
25. On page 14, last paragraph, delete the last sentence. Snow and light-colored pavements have nothing to do with the photometry on which the BUG ratings are based.
REJECTED - The sentence adds clarity to the intent and limitations of the MLO

LIMITS TO OFFSITE IMPACTS

A seemingly non-compliant fixture, such as a post-top translucent acorn luminaire, may in certain cases meet the BUG ratings, as long as it has proper interior baffling within the acorn globe. However, the BUG ratings in Table C will limit the use of the following types of luminaires in ~~some~~ all lighting zones:



Barn Lights



Non-Shielded Wall Packs



Floodlights or lights not aimed downward

45 - Limits to off site Impacts - Use of LP fixture images is confusing with respect to the intent of the accompanying text. I.e., use images of fixtures with interior baffles.
REJECTED - The sentence that precedes the images states that the images shown are examples of luminaires that will be limited in their use in some zones.

#29 - Page 15 By the pictures of the 3 lights
Request: in the User's Guide, indicate that the three types of area lighting illustrated are not acceptable in any lighting zone.

Rationale: since the MLO is intended to be a model — an ideal — we should not give the impression that poorly designed luminaires are acceptable under any circumstances.

ACCEPTED IN PART - Delete “some” and replace with “all”, to convey that the use of these types of luminaires will be limited in all lighting zones

PERFORMANCE METHOD - User's Guide

The performance method is best for projects with complex lighting requirements or when the applicant wants or needs more flexibility in lighting design. The performance method is also used when any lighting designer ~~fixtures are required to be~~ plans to aimed or directed any light fixture upward (above 90 degrees). An engineer or lighting professional generally will be required to design within the performance method. An adopting jurisdiction may also wish to hire an engineer or lighting professional to review and approve projects using this method and/or incorporate review of the performance method into special review procedures.

← #25 - Aiming light fixtures upward is an option, not a requirement. Therefore, revise 2nd sentence on page 16 as follows:
The performance method is also used when the designer wishes to aim any light fixtures are required to be aimed or directed upward.
Please note that it is not altogether clear what "upward" means in the above sentence. Above 0 degrees? Above 90 degrees? Please clarify.

ACCEPTED

The Performance Method is also best for projects where higher lighting levels are required compared to typical area lighting. An example of this is an car dealership requires more light on the new cars than a standard parking lot. Another example is a gas station canopy requiring more light than an building entrance canopy. ~~allows layers of light depending on the complexity of the site compared to the prescriptive method which only has one layer of light.~~

← #35 - Define "Layers of Light" - **REASON:** Define "Layers of Light"... this could mean sets of lights used at different times for different occasions, or this could mean different light distributions superimposed upon the same space, at the same time. The potential time and space components of "layers of light" are not clear.

ACCEPTED: Remove the reference to layers and light and revised with different examples.

The first step in the Performance Method regulates overlighting by establishing the Total Initial Site Lumens (Table D) that are allowed.

Allowances include the summation of the following (Table D):

- 1) Initial lumen allowance per site
- 2) Per area (SF) of hardscape
- 3) Per length (linear feet) of hardscape perimeter.

Table E allows additional lumens for unique site conditions.

Examples of allowances include:

- 1) Per building entrance/exit
- 2) Per length (linear feet) of Outdoor Sales Frontage Perimeter
- 3) Per area (SF) of Vehicle Service Station Canopy
- 4) Plus more ...

The Site Total Initial Site Lumens allowed are a combination of allowances from Table D and Table E.

IV. NON-RESIDENTIAL LIGHTING (cont.) - User's Guide

LIMITS TO OFFSITE IMPACTS (cont.)

The Second Step in the Performance Method is to determine if the proposed luminaires are producing off site impacts such as glare, sky glow and light trespass. One may either use Option A which are the Maximum Allowable BUG Ratings in Table C, or Option B through computer lighting calculations show compliance with Maximum Line of Sight Illuminance or "TV" Illuminance at any point in the plane of the property line in Table F. Option B will be required for all non-residential luminaires that

- A) do not have BUG ratings, or
- B) exceed the BUG ratings or
- C) are not fully shielded, or
- D) have adjustable mountings.

For the performance method, Option B (2) requires photometric calculations for the site perimeter, to a height of no less than ~~10~~ 33 feet (3 10 meters) above the tallest luminaire. ~~A horizontal plane photometric plan will give a "snapshot" view of the lighting when the site complies with this ordinance. Since it is easiest to field verify horizontal levels, it would be possible to verify compliance by comparing actual site conditions to the photometric plan submitted during review.~~

Vertical illuminances at eye height (5 feet above the grade) will give values that can be used to verify compliance by comparing actual site conditions to the photometric plan submitted during review. Note that the MLO specifies 'total initial lamp luminaire lumens' as a measurement in addition to footcandles/lux. The footcandle (lux) is equal to one lumen per square meter foot, for those more used to working with those units.

30 - Section IV, Section 2. – Option "B", 2 page 17 – a more detailed explanation of "TV" illuminance and/or line of site may be required to assist with non-lighting industry adopting agency personnel, i.e. height of plane angle. Quick check of the MLO glossary does not designate this criteria as to a driver's perspective or a pedestrian's vantage point. Should we consider vertical illuminance as outlined in other IES design guides?

3. On page 17, revise last sentence of 1st paragraph as follows: Option B will be required for all non-residential luminaires that do not have BUG ratings, exceed the BUG ratings, are not fully shielded, or have adjustable mountings. REASON Page 17 change is necessary to be consistent with our IV.A.2 recommendation that luminaires for which BUG ratings are not available must be fully shielded.

ACCEPTED

35 - Editor: the text defines footcandle, and also mentions lux but does not define lux.

ACCEPTED - "LUX" will be added to the DEFINITIONS

#36 - Section B Page 17 - User Guide 2nd paragraph:

This paragraph is unclear in many places.

1. What is a "horizontal plane photometric plan"? Is this an illuminance point-by-point of the site? If so, how does this "give a 'snapshot' view of the lighting when the site complies with this ordinance"? It doesn't give the lighting on the inside top surface of the enclosure. Nor does it show the TV illuminance, which happens in a vertical plane.

Accepted in Part: Removed the horizontal illuminance and replaced with eye height line of sight illuminance.

2. "Since it is easiest to field verify horizontal levels, it would be possible to verify compliance by comparing actual site conditions to the photometric plan submitted during review." Sure, if horizontal illuminance was part of the ordinance. But it isn't, so how can comparing calculated with measured horizontal illuminance verify compliance with upright or TV illuminance?

Accepted in Part: Removed horizontal illuminance and replaced with eye height line of sight illuminance.

3. Delete the last clause of the last sentence: "...for those more used to working with those units." It is unnecessary. Accepted

Add this for completeness, since "footcandle/lux" was mentioned in the previous sentence: One lux is equal to one lumen per square meter

Accepted: revised statement to include lux (one lumen per square meter)

DESIGN COMPLIANCE - User's Guide

The application form will require information about the number of luminaires, the ~~number of lamps in each luminaire and the initial lumen output for each lamp (based on the wattage and type of lamp selected)~~ **initial lumens per luminaire and the B-U-G rating of each luminaire.** **Lamp wattages and initial lamp lumens should also be included for equipment field verification** as well as plans showing the site area measurements. This will allow the reviewer to verify that the lumen output of all the luminaires does not exceed the allowance.

Field verification can be achieved by asking the applicant and/or owner to verify that the lamp type and wattages specified have been used. ~~Since the initial lumens are usually listed on the box in which the lamp is sold, this can be achieved by providing the box for review.~~

However, if a jurisdiction requires additional on-site verification, it may also request a point-by-point photometric plan. While this will not be a true measure of compliance with the criteria of this Ordinance, comparing the actual measured levels on site to the photometric plan can be an indication whether or not the installed lighting varies from the approved design.