Outdoor Lighting

ULSTER COUNTY
PLANNING BOARD

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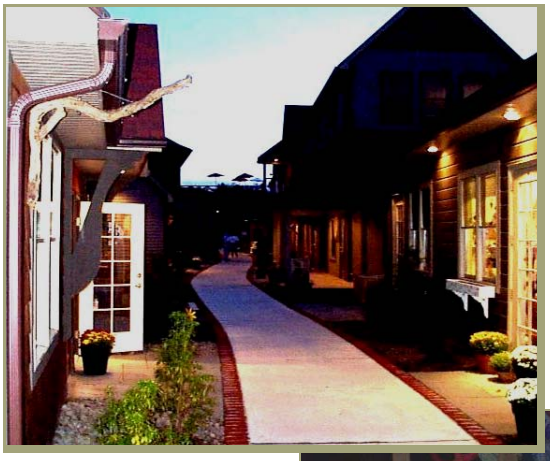
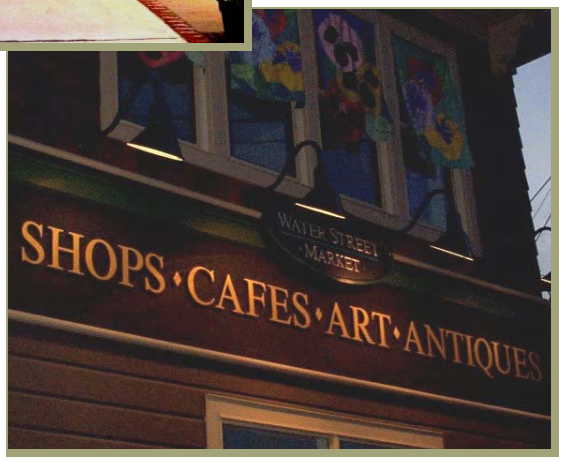
Planners Memorandum





Outdoor Lighting

Community plans place great emphasis on safety and appearance. They are common elements routinely expressed in many areas of zoning statutes and design guidelines. Outdoor lighting a critical component of these elements, is rarely mentioned. Even though today's outdoor lighting may be much brighter, the lack of standards and its treatment as an afterthought in the review process hampers its effectiveness. Yet, done properly outdoor lighting makes communities safer, more comfortable and attractive.

This memorandum addresses issues surrounding effective outdoor lighting including: technical background, design/review objectives, and regulatory measures. Sample ordinance provisions are included. These can be incorporated into land use statutes or guidelines for the review of outdoor lighting designs.

OBJECTIVES OF OUTDOOR LIGHTING

Technological changes have reduced lighting costs while bringing increased light levels. As a result without proper design glare and unwanted light can become normal occurrences despite the availability of specialized optics that control them. Color shifts from mixing lamp types can add to distraction. In short, without proper design outdoor lighting may have the ability to move light meters but address few of objectives for which it was installed.

Lighting design and its review should begin with the consideration of its objectives:

Safety: All lighting should minimize the potential for personal harm and damage to property as well as facilitate the movement of vehicles and pedestrians. Dark areas and hiding places should be illuminated, as should obstacles such as curb edges, drainage structures, and other hazards such as fallen limbs or patches of

ice. Area lighting should enhance the ability of drivers to see pedestrians and site features such as access points, crosswalks, and signs.

Identification: Lighting should improve the legibility of critical site features, people, landmarks, and active areas. Building entrances and directional signs should be highlighted. Color perception should not be distorted or harsh.

Aesthetics: Where appropriate site features may be highlighted in a manner that adds to their appearance and recognition. Unique applications make it is possible to create more elegant settings than those found during the day. Techniques used may highlight portions of the built environment while leaving darkened the less attractive site features or infusing color on the site. The total effect adds to site recognition, communicating a message that the site is a safe and attractive place to visit. This "advertising" is an important element in the success of many projects.

Usability: Lighting can encourage the nighttime use of areas beyond commercial spaces. Communities can extend the use of

walkways, lawns, and recreation areas by providing the proper intensity of light.

LAMPS AND LUMINAIRES

Outdoor lighting components are divided into two main areas lamp type and the luminaire. The lamp is the light source. The luminaire connects the lamp to the power supply, distributes the light, and protects the lamp. By using different characteristics and combinations designers can illuminate a building in a soft glow that welcomes all, or a harsh glare of bright light that allows the security guard to see out, but confuses those who approach the protected location.

Lamp Type: Each lamp type has properties that make it suitable for particular applications. These include color rendition, light output (lumens), efficacy (lumens/watt), lamp life, strike time, and economy.

Today nearly all non-residential outdoor area lighting is provided by high intensity discharge (HID) lamps, replacing the familiar incandescent bulb. All HID lamps operate by firing a gas. High-pressure sodium (HPS) and metal halide (MH) are the main types. Low-pressure sodium (LPS) is often categorized as a HID source although technically it does not fit the category. Fluorescent sources are also used, as is tubular halogen, an incandescent source.

Metal Halide lamps produce a warm white light similar to incandescent, offering the best color rendition of any of the HID lamps. Lamp life and efficacy are less than HPS, particularly at higher wattage, making it more expensive to operate. Light output diminishes by 25 percent during the first

DEFINITIONS

Avoidance Glare: unwanted direct light that is sufficiently powerful enough to cause viewers to avert their eyes.

Cutoff Angle: the angle formed by a line drawn from the direction of the light rays at the light source and a line perpendicular to the ground from the light source above which no direct light is emitted.

Direct Light: light emitted directly from the lamp, off the reflector or diffuser and through the lens of the luminaire.

Efficacy: the total light output of a light source divided by the total input power. Efficacy is expressed in lumens per watt.

Footcandle: a unit of illumination produced on a surface, equal to 1 lumen per square foot. One footcandle equals 10.76 lux.

IESNA: Illuminating Engineering Society of North America. IESNA is a technical society whose membership is interested in the art, science and practice of illumination.

Light Trespass: extraneous light on adjacent property, typically produced by stray light from outdoor lighting. Light trespass includes glare from direct light as well as unwanted spill light.

Lumen: the rate of flow of light used to express the overall light output of a lamp.

Luminaire: a complete lighting unit consisting of light source and all necessary mechanical, electrical and decorative parts.

Parabolic aluminized reflector lamps (PAR's): any lamp type with a hard glass bulb, an interior reflection surface and a lens to control beam spread.

Private Outdoor Lighting: All outdoor lighting designed to illuminate sites held in private ownership. Private outdoor lighting does not include street lighting but shall include public utility lighting, provided for a fee that is designed to primarily light private property.

Source Lumens: total initial lamp lumens of the light source.

Uniformity Ratio: the ratio of the average numerical illuminance to the minimum value found within a lighted area.

Wall-Pack Luminaire: a lighting unit designed for direct mounting on building walls whose primary function is to light building exteriors.

10,000 hours of operation and continues to decrease throughout lamp life.

High-pressure sodium lamps are the most efficient HID lamps available (unless you include low-pressure sodium). Color rendition for HPS lamps is fair. Light produced appears golden yellow next to other lamps. A 10 percent reduction in light output can be expected over the life of the lamp that lasts about 24,000 hours.

TYPE OF LAMP	WATTAGE RANGE	INITIAL LUMENS PER WATT	AVERAGE RATED LIFE HOURS
Sodium			
Low-pressure	18 - 180	62 - 150	12,000 - 18,000
High-pressure	35 - 1,000	51 - 130	7,500 - 24,000
Metal Halide	70 - 2,000	69 - 115	5,000 - 20,000
Fluorescent	4 - 215	14 - 95	6,000 - 20,000
Incandescent	15 - 1,500	8 - 24	750 - 3,500

Fluorescent lamps are cheap, start quickly and have excellent color rendition. These lamp types are limited to small area applications such as walkways, building entrances, and signs due to their total light output. Fluorescent lamp light output drops dramatically during cold weather.

Luminaires : A wide variety of luminaire types are available. Generally, their names describe mounting location as well as distinctive features such as shielding, light distribution or ornamentation. Nearly all HID luminaires are available in metal halide or high-pressure sodium of varying wattage.

Manufacturers produce illumination data for all their luminaires in the form of charts. These represent actual light patterns and intensity levels on horizontal and vertical planes. The iso-lines are points of equal light levels usually measured in footcandles. Typical light distribution patterns vary from circular and symmetrical around the center of a luminaire to highly asymmetrical patterns. The latter used to avoid light trespass.

Luminaire designs also include many ways to control glare. The most common being cutoff or shoebox design. Cutoff luminaires use lamp location and optics to effectively restrict light intensities above 75 degrees and eliminate light above the horizontal plane.

EFFECTIVE OUTDOOR LIGHTING DESIGN

Many of us know first hand the impact of poor lighting design having driven down a road or into a parking lot only to be blinded by lighting installed to improve safety and visibility. Other familiar examples are accent lights that cause glare, or brilliant pools of light followed by dark areas that disorient to drivers and pedestrians alike. To address these problems zoning regulations or design guidelines can articulate criteria in the design of outdoor lighting. The following sections identify these criteria and provide sample language for inclusion in a zoning statute.

Several communities in Ulster County have already included standards for outdoor lighting that are part of special permit and site plan review procedures. While not comprehensive, inclusion insures that outdoor lighting receives attention in the review process. These general standards used in conjunction with the criteria contained in this memorandum are one approach to insure adequate review of outdoor lighting.

Town of Woodstock

Any outdoor lighting fixture, with the exception of incandescent fixtures up to one hundred fifty (150) watt intensity per light source, shall be shielded from above in such a manner that:

a. *The edge of the shield is below the light source*
b. *Direct rays of the light source are confined to the property boundaries*
c. *Direct rays are prevented from escaping toward the sky*

For the purpose of these provisions, light source includes any refractor, reflector or globe. Outdoor lighting shall be of substantially minimum intensity needed for the particular purpose. Mercury vapor lighting is prohibited. Any outdoor lighting fixture already installed on the effective date of this Local Law shall be brought into compliance with these provisions within one (1) year of said effective date.

Town of Hurley

Site Plan Review Standards for the A-4 and Hurley Historic District:

Exterior lighting fixtures shall be no higher than 15 feet above the average finished grade within a 20 foot radius. The light source shall be shielded from direct view above a line drawn from the lowest point on the light source to the ground at an angle of 45 degrees.

Town of Lloyd

Exterior lighting: All exterior lighting shall be of such type and location and shall have such shading as will prevent the light source from being seen beyond the boundaries of the lot upon which is located.

The following standards follow the format normally included within a zoning statute. They can just as easily be thought of an adopted to design guidelines or review checklists.

Purpose and Applicability

Safety issues are a primary purpose of lighting design. Parking areas, walkways, and entrances all need to be properly illuminated. In addition the manner in which people perceive an area or building plays an important role in its success. Decision-makers should be aware of this and consider building feature and landscaping lighting to enhance site aesthetics and recognition. Such lighting should keep in mind the concern regarding unnecessary skyward illumination. In this manner, the primary purpose of safety is addressed as well as the issue of site aesthetics. Low intensity or shielded lighting need not be subject to review whereas certain types of lighting, such as mercury vapor may be banned.

- **Sample Language:**

LEGISLATIVE FINDINGS AND PURPOSE

This Town Board of finds that proper outdoor lighting is necessary for the safety of motorists and pedestrians as well as aiding in police functions and reducing crime. The Board also finds that the proper design and use of outdoor lighting will insure a nighttime appearance consistent with overall community goals of enhancing the attractiveness of businesses, streets and other portions of the environment.
The purpose of the Section is to provide the regulatory framework to insure the installation of safe and attractive outdoor lighting needed to protect the health,

safety and welfare of the citizens and visitors to the community. The Section will control unwanted glare and light trespass onto neighboring properties, roadways, and night sky.

APPLICABILITY

All outdoor lighting for non-government uses shall be in conformance with the requirements of this Section.

EXCEPTIONS

Holiday lights for a maximum of 60 days per calendar year. Any spot or flood luminaire having initial source lumens of 1500 or less provided that no direct light is focused so as to cause avoidance glare on adjoining property or roadways. Such luminaire may be redirected or its light output controlled so as to eliminate this glare and be eligible for exemption under this section.

PROHIBITED LIGHTING

All moving, revolving and flashing lights are prohibited. Mercury vapor lights are prohibited.

Submittal Requirements

The design of outdoor lighting considers numerous factors. A meaningful review requires information on luminaire type, mounting height, light output, etc. Incorporating the necessary submittals as part of the application to obtain a special permit or site plan approval is an effective approach.

- **Sample Language:**

SUBMITTAL REQUIREMENTS

Uses requiring site plan and special permit approval:

Lighting plan showing conformity with standards contained in this Section. Such plan shall indicate the location, type of lamp, luminaire, mounting height, source lumens, illuminance and glare control options if any for each light source and area.

Illuminance may be plotted using manufacturer's photometric charts or the planning board may require iso-footcandle drawings to examine the interaction of all lighting on the site.

Any additional documentation necessary to show conformance to the standards set forth in this Section.

Additions or changes to an approved lighting plan shall be considered amendments to the site plan and subject to the review provisions of this Statute. A public hearing may be held at the option of the planning board.

All other uses:

Documentation as required and determined by the zoning enforcement officer to show conformance with the standards set forth in this section.

Illuminance and Uniformity

Illuminance is the measure of the amount of light in a given area. It is measured in footcandles or lux, the metric equivalent. One footcandle is equal to one lumen uniformly

distributed over an area of one square foot. Illuminance can be evaluated using footcandle charts that manufacturers produce for their luminaires or computer programs. The programs plot footcandles on a grid (usually 10 foot squares). The grid shows the interaction between all lighting on the site and is helpful in determining light uniformity. The computer programs also take into account the loss of light output that occurs over time. For large facilities and sensitive areas the grid plot is recommended. To answer the question of how much light is enough the Illuminating Engineers Society of North America (IESNA) publishes a handbook with recommended levels of illumination by activity area.

Area/Activity	Average Maintained Footcandles (fc)
Building Exterior	
Entry	
Active use	5
Infrequent use	1
Building Surrounds	1
Parking areas, Commercial	
traffic, medium activity	1
traffic, high activity	2
pedestrian areas	
medium activity	2.4
high activity	3.6
Parking areas, Residential	
traffic area	0.5
pedestrian areas	0.8
Loading Docks	20
Major Roads	
Commercial area	2
Intermediate area	1.4
Residential area	1

In general, average illuminance measured in footcandles should be less than 5 and greater than 1 for parking areas whereas walkways should be less than 10 and greater than 2. The activity is the main determinate for lighting levels between these ranges.

Uniformity is a measure of the differences in lighting levels on the site. A gradual transition between the brightest areas of the site and those with more subdued lighting is needed to avoid disorientation as well as eliminate shadows that may compromise safety and security. Uniform modest light levels in appropriate hierarchy are more important than increased intensity. Differences in adjacent light levels are known as the uniformity ratio. This ratio should not exceed 3 to 1 (average to minimum) for roadways and other traffic areas and 4 to 1 for paths and walks.

- **Sample Language:**

ILLUMINANCE AND UNIFORMITY

Lighting in conformance with this Section is required for all parking lots having 5 or more cars.

Light levels shall be designed to meet but not exceed the latest recommended levels from IESNA for the type of activity/area being lighting except light levels for ATM machines shall be in accordance with the New York State ATM Safety Act. Where no standard is available from IESNA, the applicable standard shall be determined taking into account the levels for the most similar IESNA activity.

Uniform light levels shall be achieved on the site. The uniformity ration (average to minimum) shall not exceed 3:1 for parking and traffic areas nor 4:1 for pedestrian areas. Design should establish a hierarchy of lighting to insure a smooth transition from bright areas to those with subdued lighting.

Maximum to average light levels should be kept within a 6 to 1 ratio.

Light levels shall be maintained at design levels with lamp or luminaire replacement as needed.

Light Source Visibility—Glare

Glare is produced by a bright light source but can become a problem for even low wattage fixtures. Glare becomes more apparent when viewed against a dark background. Nuisance glare causes discomfort or mild distraction. Avoidance glare is powerful enough to cause viewers to avert their eyes.

Typically, glare is associated with the amount of light or exposure of the lamp in the luminaire.

Elimination of glare is a paramount concern in most lighting designs. Luminaire viewing angles, mounting height, and shielding should all be carefully scrutinized to reduce glare. The use of unshielded wall pack units and floodlights to light parking areas or walkways should be avoided.

- **Sample Language:**

LIGHT SOURCE VISIBILITY

The visibility of the light source from a luminaire is restricted to the following:

a. *Non-residential zones – direct light shall not be visible above 5 feet at the adjoining public roadway pavement edge, or 25 feet beyond the property line, except no restriction for lighting site entrances*
b. *Residential zones and where adjacent property is in a residential zone – direct light shall not be visible above ground level at the adjoining public roadway pavement edge, or 25 feet beyond the property line or at the dwelling unit whichever is less except no restriction for lighting site entrances.*

LUMINAIRES

All luminaires whose initial source lumens are greater than 1,500 must meet the following requirements:

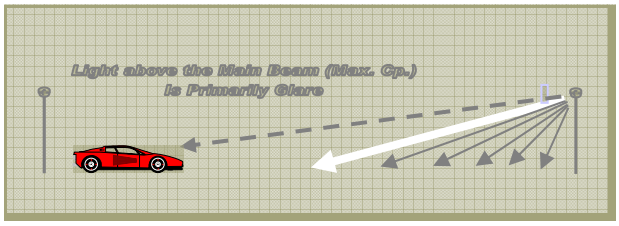
a. *Have a cutoff angle of 90 degrees of less.*
b. *Wall-pack units are required to be opaque shielded or have optics that provide a cutoff angle of 70 degrees or less.*
c. *Canopy lights whose source lumens are greater than 20,000 lumens must be fully recessed or have side shields.*

MOUNTING HEIGHTS

Roof mounted area lighting is prohibited
Pole mounting heights shall be no higher than 35 feet

Light Trespass

Light trespass develops whenever unwanted light spills onto neighboring property or the street. In many instances the amount of light striking the property is not disruptive but the visibility of the light source causes the problem. Light trespass may be deliberate to integrate adjoining



compatible land uses or to provide uniformity and focus at site entrances. Where trespass

presents a problem, luminaires with special optics to control beam spread and eliminate glare should be employed to eliminate unwanted light.

- **Sample Language:**

LIGHT TRESPASS

Light trespass shall be limited to the following:

a. In all zoning districts, at the pavement edge of adjoining public roads – A maximum of 0.5 footcandles, except for site access points where a maximum of 1 footcandle at the pavement edge is permitted.

b. Residential Districts and where an adjacent property is in a residential district – a maximum of 0.2 footcandles 25 feet beyond the property line or at the dwelling unit whichever is less.

c. Non-residential Districts – no maximum limit however, light trespass shall be consistent with adjoining uses and light levels to insure that IESNA standards are not exceeded.

Color Rendition

Color rendition refers to the shift in the color of objects when illuminated with various sources of light. Manufacturers use correlated color temperature (CCT) measured in Kelvin as an indication of the general warmth or coolness of a light source. Color rendition is important for identification and appearance of objects in environment. At lower light levels (below 3 footcandles), the eye shifts to peripheral vision. Studies have shown that color rendition is critical for identification at these levels. The importance continues up to 10 footcandles. Most outdoor lighting falls within these levels. Metal Halide lamps offer the best color rendition making them the lamp of choice for installations where identification is important. Another consideration concerning color rendition is the appearance of site elements. High-pressure sodium lamps enhance the color of brick but detract from that of grass. Mixing lamp types at installations will exacerbate their color differences and may have a negative effect on site appearance.

- **Sample Language:**

COLOR RENDITION

Color rendition will be considered in approving lighting designs. For larger area applications the following lamps are listed in order of preference:

- *Metal halide*
- *High-pressure sodium*
- *Low-pressure sodium*

A preference will also be shown for the use of similar lamp types on a site. The use of different lamps with wide separations in color rendition will require appropriate documentation.

Nonconforming Lighting

Some existing outdoor lighting may cause safety or nuisance problems for a community. Remedies to these situations are usually not costly and can be more than adequately justified under the protection of public health, safety and welfare. The goal is to target those lights that create these problems as well as achieve gradual compliance with outdoor lighting standards over time as luminaires are replaced.

- **Sample Language:**

NONCONFORMING LIGHTING

All outdoor lighting lawfully existing prior to the effective date of this Statute shall be deemed conforming to this Section except that:

a. No replacement or installation of new luminaires shall be permitted unless in conformance to this Section.

b. All outdoor lighting that, in the opinion of the building inspector, is causing avoidance glare on adjoining roadways or properties shall be required to submit lighting details to the building inspector showing that the existing lighting meets the requirements of this Section or how such lighting will be brought into conformance.

Costs

Although not part of the regulatory framework, equipment, annual energy, and maintenance costs are part of lighting design decisions. Decision-makers should bear in mind the impact lighting can have not only on safety and appearance, but also the bottom line issues of sales, rent levels, and insurance costs.