Developments in Federal and State Law

# ENVIRONMENTAL LAW IN NEW YORK

ARNOLD & PORTER

MATTHEW BENDER

Volume 9, No. 4 April 1998

# Light Pollution

by Michael J. Brown

## I. INTRODUCTION

Light pollution is the presence of excessive illumination in locations where it is not desired. Light pollution reduces safety, diminishes public welfare in several ways, promotes other forms of pollution, and may even have adverse ecological consequences. But unlike the more familiar forms of pollution, light pollution is easy to clean up. There are no significant technical or economic barriers to correcting excessive or misdirected lighting. In fact, light pollution remedies actually save money. As a result, legislation, regulations, or government policies to control the adverse effects of lighting are being implemented at the federal, state, and especially the local levels.

## II. PROBLEMS ASSOCIATED WITH LIGHT POLLUTION

Light pollution includes a range of problems that result from poorly designed lighting fixtures. The major types of problems associated with light pollution are glare, light trespass, sky glow, and energy waste.[1]

### A. Glare

Glare occurs when an observer directly views the source of the light. Visibility is actually reduced, because of the excessive contrast and non-uniformity of illumination. We all experience this phenomenon when driving toward a setting sun or an oncoming car with high beams. Such severe or "disabling" glare may also result from unshielded roadway lights or flood lights from nearby properties.

The reduction in visibility is explained by an effect called "veiling luminance." Direct light entering the eye from sources such as street lights is superimposed on images of the illuminated objects (e.g., the roadway), thus "impairing the ability of the driver to perform visual tasks."[2] Glare is a clear safety hazard on roads, because the reduced visibility makes it more likely that a driver will not see a pedestrian or obstruction. Glare has particularly severe effects on the elderly and persons with cataracts. Even where a safety hazard is not present, glare

(continued on page 58)

IN THIS ISSUE

Water/Clean Air Bond Act Authorizes Risk Assessment to Clean Up Brownfields," 63 *Brooklyn L. Rev.* 469 (1997).

Joseph J. Mastriano, Jeanne C. Powers, & Michael J. Lannon, "Onondaga County Cultivates a Good Thing: Agricultural Use of Biosolids," *Clearwaters,* Vol. 27, No. 3 (1997), at 14.

Elizabeth M. Morss, "Changes to State Water Quality Standards Proposed," *Clearwaters,* Vol. 27, No. 3 (1997), at 34.

Jim Northrup, "The Adirondack Condition: Economic, Environmental & Social Well-Being," *Environmental Advocates* (1997).

Stewart E. Sterk, "Avoiding EIS Preparation: Court Approves a Strategy." *N.Y. Real Estate Law Rep.,* Dec. 1997, at 10.

"Waste Remediation: Pervasive Stench" [Fresh Kills Landfill], *Empire State Report,* Feb. 1998, at 17.

# Light Pollution

(continued from page 49)

is a common annoyance and detracts from the aesthetic appearance of an area.

### B. Light Trespass

Light trespass occurs when light from one property illuminates another property. The light may enter residences through windows or illuminate outdoor portions of the property. This may be perceived as an annoyance and an invasion of privacy by the neighboring property owner.

### C. Sky Glow

Sky glow involves a brightening of the night sky due to scattering of upward-directed light from particles in the air. This severely impedes the visibility of the night sky. The majority of the world population lives in or near urban centers, where only a small number of stars are visible. The disappearing night sky is yet another side effect of urban sprawl and the development of "greenfields."[3]

In a famous satellite photograph of North America at night, the eastern United States coast from northern Virginia to southern Maine is covered by a continuous blanket of light. Any city with a population exceeding 10,000 can be identified on the photograph. Only in the desert west are there large areas without any apparent concentrations of upwardly directed light.

Sky glow is a particular problem for astronomical observatories. Astronomers might thus be regarded as a "sensitive population" for light pollution in the same way that children are a sensitive population for environmental lead. Society at large also suffers a loss when the majority of the population cannot see the Milky Way or a significant number of stars in a dark sky. Two of the brightest comets of this century were visible during the past two years, yet most people would have had to travel a significant distance from their homes to obtain a clear view.

### D. Energy Waste

A side effect of excessive and poorly designed lighting is that an enormous quantity of energy is wasted. The International Dark Sky Association (IDA) of Tucson, Arizona estimates that 30 percent of all the light emanating from roadway fixtures is wasted, because it goes sideways or up. This translates into $1 billion annually in wasted energy costs in the United States.[4] Wasted energy also results in additional air pollution and greenhouse gas emissions.

By the same logic, individual property owners are wasting significant energy and their own money by using inefficient lighting devices. Many common lights have two forms of inefficiency. More power is needed to achieve a given level of illumination where it is desired because of the significant fraction of the light that is misdirected. Many lights also use inefficient types of bulbs. For example, municipal street lights and inexpensive residential "yard lights" frequently use mercury vapor bulbs, which require more power for a given light output (i.e. more watts per lumen) than high-or low-pressure sodium vapor.[5]

Because of these two factors, a homeowner could achieve similar levels of illumination with an unshielded 175-watt mercury vapor yard light and a shielded 50-watt high pressure sodium vapor light. Assuming the lights are on all night, a switch to the more efficient type could reduce annual electricity costs from $85 to $27 (assuming $0.10/kilowatt-hour in power costs). Even if the efficient and shielded light is more expensive, the incremental cost will rapidly be repaid, and the savings in operating costs will continue for years to come.

## III. CAUSES AND REMEDIES FOR LIGHT POLLUTION

### A. Excessive Lighting

The problems of glare, light trespass, sky glow, and energy waste are partly attributable to excessive lighting. The number and density of lights on public and private property have increased rapidly and are frequently much greater than needed. Municipalities often install numerous street lights without clear criteria for how much lighting is warranted. A major goal of increased street lighting is typically enhanced traffic safety, but safety can actually be compromised by glare as previously discussed.

More illumination is also commonly sought to deter crime, but there is actually little or no data indicating that lighting reduces crime. In recent years, lights have even been turned off in some locations (e.g. schools), in recognition that lights may attract loiterers and vandals. A United States Department of Justice study on the effects of street lighting on crime found:

> "While there is no statistically significant evidence that street lighting impacts the level of crime, especially if crime displacement is taken into account, there is a strong indication that increased lighting – perhaps lighting uniformity – decreases the fear of crime."[6]

Richard Moran, a criminologist at Mount Holyoke College in Massachusetts, stated that "I'm not aware of any research that indicates that lighting has a positive effect on crime."[7]

A related problem is the use of lights at times when they are not needed. Lights designed to illuminate parking lots, industrial buildings, and residential yards may be left on all night even when the lighting is only required for a portion of the night.

A transition to energy efficient lighting ironically can exacerbate the problem of excessive lighting. If a 100-watt mercury vapor street light is replaced with a more efficient, 100-watt sodium vapor street light, the new light may be twice as bright (because sodium vapor provides more light per watt). Instead, energy savings can be achieved by using a lower power model (e.g., 50 watts) that delivers the same illumination as before.

An obvious solution to excessive lighting is to use only as much lighting as necessary. The Illuminating Engineering Society of North America has developed standards and guidelines for appropriate levels of lighting. For example, brightness levels for roadway lighting are specified for different road classes (freeway, expressway, major, collector, and local).[8] In many locations, such as residential streets in suburban and rural areas, there may be no need for any roadway lighting. In such areas, signs and reflectors can provide ample hazard warning and guidance for drivers.

On the other hand, the perception among the general public that light and safety are synonymous is a formidable barrier to the reduced use of lighting. Many people simply feel better with more light, and municipal officials commonly receive requests from constituents for more street lighting.

### B. Fixture Design

The second major root cause of light pollution is poor lighting fixture design. Given the widespread desire for outdoor lighting and the probable continued increase in the total number of lights, efforts to control light pollution are likely to focus on lighting fixture design.

Until recently, most outdoor lighting was not designed to provide precise control of the direction and area of illumination. Because of the lack of shielding, the illuminated area extends to neighboring properties or roadways, resulting in glare and light trespass. Such problems commonly occur with unshielded street lights, flood lights, and even internally illuminated signs.

This phenomenon is related to the "cutoff angle" of the light, which is the angle between a vertical line extending down from the light and the outer edge of the light beam emanating from the fixture. For example, a light which projects a beam down and sideways in all directions, but not up, has a cutoff angle of 90 degrees. In most situations, any light emitted at an angle exceeding 70 degrees from the vertical is wasted. The light at angles between 70 and 90 degrees typically hits the ground at such a great distance from the source and at such an oblique angle that the illumination is minimal. Light at angles exceeding 90 degrees goes up into the sky and is completely wasted.

### C. Full Cutoff Lighting

The centerpiece of the strategy for addressing light pollution is full cutoff lighting.[9] A full cutoff light is sufficiently shielded so that light is not emitted above a horizontal plane through the fixture. That is, the cutoff angle is no more than 90 degrees (the most effective versions limit the cutoff angle to 80 degrees or less). Full cutoff lights actually provide significantly better visibility than unshielded lights, because one sees the illuminated area without interference from glare. The level of illumination desired and distribution of light are not compromised, and full cutoff lights also prevent sky glow and save money.

These lights are widely available for roadway and commercial applications, although they are not yet common for residential use. For example, General Electric and several other manufacturers produce full cutoff roadway lights similar in style (but superior) to the traditional cobra-head "drop light." Traditional lights use a lens or refractor to distribute the light. By contrast, full cutoff lights have the bulb recessed inside the housing, and the light is distributed in a more controlled manner by reflectors.

Early in the history of street lighting, the invention of refractors to spread the light over the roadway was advertised as a great innovation. The Holophane Glass Company touted the advantages of its "Holophane Refractor."[10] The refractor was said to provide uniform illumination of the road, in contrast to the then-prevalent globes which placed a spot of bright light directly under the lamp and promoted waste by emitting significant light above the horizontal.

With modern luminaires, reflectors can be used instead of refractors to eliminate nearly all light above the horizontal yet provide effective light distribution. The use of full cutoff lighting is increasing as its advantages become better known. This is particularly apparent in recent commercial development where, for example, many shopping center parking lots are equipped with full cutoff lights.

The fact that remedies for light pollution actually save money means that progress in this area should encounter fewer obstacles than solutions to the more familiar forms of pollution. Because of the effects of poorly designed lighting on the night sky, amateur and professional astronomers clamored for improved lighting practices. Over the past decade, the IDA and local counterparts such as the New England Light Pollution Advisory Group (NELPAG) have been instrumental in educating the public on the safety, aesthetic, and financial losses resulting from light pollution and on the potential solutions.

## IV. Municipal Zoning Bylaws

### A. Many Outdoor Lighting Bylaws are not Enforced

Most towns have zoning bylaws with some provisions related to lighting, intended to avoid nuisance conditions such as bright light from commercial properties spilling onto residential properties. Such bylaws, however, have traditionally been too vague and imprecise to enforce. The traditional bylaw typically either

requires that lights not be visible beyond the property line or prohibits excessive glare. A prohibition against light crossing a property line effectively makes almost all lights nonconforming, because even full cutoff luminaires have some near-horizontal light that is likely to reach a neighboring property. On the other hand, a strategy to prohibit glare is ineffective in the absence of a precise definition of glare. Because of the imprecision and unintended stringency of such bylaws, they are rarely enforced.

## B. Tucson Protects Nearby Observatories

A small number of municipalities developed more focused outdoor lighting regulations as early as the 1970s, primarily to reduce adverse effects on astronomical research. The Tucson, Arizona area is home to two major observatories, Kitt Peak National Observatory and Mount Hopkins Observatory. The locations for these mountaintop observatories were selected for the extraordinary clarity of the atmosphere and favorable desert climate. Yet their proximity to a major city exposes the observatories to light pollution.

In 1972, Tucson and surrounding Pima County enacted an outdoor lighting code designed to protect the dark skies over the observatories.[11] The first stated purpose of the ordinance is "to provide standards for outdoor lighting so that its use does not unreasonably interfere with astronomical observations." Additional goals identified in the ordinance are enhancement of nighttime enjoyment of property within the city and energy conservation. Tucson is reputed to be the only city in the United States with a population exceeding 500,000 where the Milky Way is visible from the city center, a distinction at least partly attributable to good lighting practices.

In its current version, the Tucson ordinance defines "Area A" to include critical areas within specified distances of the observatories (35 miles for Kitt Peak and 25 miles for Mount Hopkins), while other areas are defined as "Area B." The code imposes shielding requirements for each area, which depend on the type of lamp. Mercury vapor lamps are prohibited throughout the county, while certain lamp types are prohibited only in Area A, including high pressure sodium (except on major streets), metal halide, and quartz.

Lamp types which are not banned are required to be fully or partially shielded. The ordinance defines full shielding as ensuring that "no light rays are emitted by the installed fixture at angles above the horizontal plane as certified by a photometric test report" (full cutoff). Partially shielded fixtures may emit up to 10% of the light above the horizontal plane (semi-cutoff).

The code imposes the least stringent restrictions (partial shielding throughout the county) on low pressure sodium (LPS) lamps, which are stated to be the preferred type of lamp. This distinction among different lamp types derives from their varying effects on astronomical observations. LPS lamps have the virtue of emitting all the light at one frequency (monochromatic), resulting in less interference with telescopes making observations at a broad range of frequencies. An additional advantage of LPS lamps is superb energy efficiency, where a 35-watt LPS lamp provides more light than a 100-watt mercury vapor lamp (typical street light). The monochromatic nature of LPS lamps explains their strong yellow color and inability to render color (i.e. the true colors of illuminated objects are not apparent). In many applications, however, color rendering is not critical.

## C. Dark Skies for a Massachusetts Observatory

Oak Ridge Observatory in Harvard, Massachusetts, a research facility owned by the Harvard-Smithsonian Center for Astrophysics, houses the largest telescope east of the Mississippi River. Yet the observatory is only 30 miles west of Boston and close to the densely populated suburbs. In a small-scale analog to the Tucson ordinance, twin zoning bylaws were enacted in 1974 by the neighboring towns of Boxborough[12] and Harvard[13] to protect the Oak Ridge Observatory from light pollution. The bylaws require outdoor lights to be "shielded from above in such a manner that the edge of the shield is below the light source, all outdoor lighting fixtures shall be full cutoff fixtures, and except for street lights, direct rays from the light source are confined to the property boundaries." As previously discussed, the latter requirement is generally unachievable, but this goal is approximated by the full cutoff mandate. Exceptions are provided for single family residences, "customary holiday lighting," low intensity lights used to mark entrances and exits, and emergency lighting. The bylaw banned sodium vapor and metal halide lamps, but Harvard lifted the ban on sodium vapor in 1997 because of the perceived limited availability of alternatives for street lighting.

## D. Lighting as an Environmental Issue

While the Tucson ordinance and the Harvard/Boxborough bylaws represent early efforts designed especially to protect astronomical observatories, light pollution control has emerged more recently as an issue in various communities not specifically concerned with astronomy. A 1990 dispute in Mamaroneck, New York framed outdoor lighting as an environmental issue.[14]

A citizens' group (Friends of Harbor Island Park) challenged the approval by the Village of Mamaroneck of a proposed outdoor lighting system for a softball field (Lanza Field). Lanza Field is located in Harbor Island Park, a 39-acre facility adjacent to Long Island Sound. The Village Board of Trustees authorized an outdoor lighting contract to allow nighttime use of the field. The Friends petitioned to halt the project on the grounds that the Village had not followed the procedural requirements of the State Environmental Quality Review Act (SEQRA), which mandates an environmental impact statement (EIS) for any project with significant environmental effects.

The court found that the proposed project was located in a critical environmental area under Westchester County law, because of its proximity to Long Island Sound. The court also determined, however, that the project conformed to the definition of a "Type II action" (i.e. an action never requiring an EIS), which includes "construction or placement of minor structures

accessory or appurtenant to existing facilities . . . not changing land use or density."[15] Furthermore, the project had already started before the effective date of the critical environmental area designation. Therefore, the petition by the Friends was dismissed, and the project was allowed to proceed without an EIS.

While the circumstances of the Mamaroneck case did not result in substantive advances in light pollution control (except that the Village agreed to limit the hours of usage of the lights), the case represents an example of increased awareness among the general public that more light is not automatically better. This awareness has accelerated during the 1990s and has spurred the enactment of outdoor lighting legislation or regulations by a number of municipalities and states.

## E. Outdoor Lighting Bylaw in Townsend, Massachusetts

Municipal outdoor lighting bylaws aimed specifically at controlling light pollution are now becoming more common. This trend is apparent in Massachusetts, where two towns, Townsend[16] and Plymouth,[17] enacted stringent bylaws in 1997. A third town, Lexington, is actively developing a similar bylaw.[18] After enactment of the Plymouth bylaw, the Boston Globe editorialized:

> "Every community should reach for the stars. The solution to light pollution is simple and inexpensive, while the benefits are great."[19]

Townsend, a semi-rural town in north central Massachusetts (population 9,000), provides a typical example of recent efforts to regulate lighting at the local level. The pre-existing zoning bylaw includes the following unenforced requirement pertaining to outdoor lighting:

> "In all zoning districts, for safety reasons, any private outdoor lighting fixture, whether temporary or permanent, other than gaseous tube letters in signs, shall be so placed or hooded that the light source itself shall not be directly visible at any point beyond the lot lines of the premises illuminated."[20]

Because of a budget crisis, Townsend removed the majority of its 230 street lights in 1990,[21] reducing the inventory to only 80 lights. Improved fiscal conditions by 1996 prompted proposals to restore some of the lost lights and install lights in new locations. Because of the potential large increase in the number of street lights, some citizens asserted that any new lights should have a full cutoff design.

The Townsend Planning Board appointed a Study Committee to evaluate lighting and other zoning issues in advance of the 1997 Annual Town Meeting. The Planning Board decided to develop an outdoor lighting bylaw applicable not only to street lights, but to private property as well. On the advice of the town counsel, the Board later modified the proposed bylaw to apply only to private property because of potential conflicts with state law thought to result from regulation of roadway lighting in a zoning bylaw. The proposal would thus apply to such locations as shopping centers, industrial buildings, and residences (with exceptions) but not to public roadway lights or government buildings.

Debate on the proposal proceeded at a public hearing. The viewpoints expressed ranged from strong support by amateur astronomers to one resident who feared a loss of individual freedom to the "light police." Notwithstanding such concerns, the bylaw was approved by unanimous voice vote at the Annual Town Meeting on May 6, 1997.

The essence of the Townsend bylaw,[22] partly based on a 1992 ordinance in Kennebunkport, Maine,[23] is contained in the following section:

9.19.3

REGULATIONS: All luminaires for private outdoor lighting installed in the Town of Townsend shall be in conformance with the requirements established by this Bylaw.

9.19.3.1

The luminaire shall emit no direct light above a horizontal plane through the lowest direct light emitting part of the luminaire.

9.19.3.2

The luminaire shall be mounted at a height in feet equal to or less than the value 3 + (D/3) where D is the distance in feet to the nearest property boundary. The maximum height of the luminaire may not exceed twenty-five (25) feet.

The standard in 9.19.3.1 is simply a technical description of a full cutoff luminaire and guarantees that no light is directed upwards. The height limitation in 9.19.3.2 is designed to ensure that lights on tall poles are not close to the property line and thus minimizes light trespass. The bylaw further requires lighting at outdoor recreational facilities to be turned off by 11:00 P.M.

The bylaw exempts luminaires with lamps below 1,800 lumens (e.g., 100-watt or less incandescent bulb) and flood lights below 900 lumens (75-watt or less incandescent bulb). This eliminates most residential pole-mounted driveway lamps and porch lights but does regulate bright flood lights and "yard lights." The bylaw provides additional exceptions for emergency temporary lighting, hazard warning lights required by government regulation, and nonconforming lighting for periods up to seven days (with a permit from the Building Inspector). Existing luminaires lawfully in place before enactment of the bylaw are "grandfathered" until they are moved or replaced.

Because the new regulations applied only to private property, the Planning Board developed a supplemental proposal for the Special Town Meeting on September 9, 1997, this time in the form of a general, rather than a zoning, bylaw.[24] The general bylaw was designed to close the regulatory gap by including street lights and municipal and other government-owned facilities. As with the zoning bylaw, any newly installed luminaire is required to have a full cutoff design. While concerns were expressed about the availability and cost of full cutoff street lights, the bylaw proponents demonstrated that these lights are readily available with an incremental unit cost no more than $10

above the cost of traditional lights. The proposal was approved unanimously at the Special Town Meeting.

The Townsend outdoor lighting bylaws should be effective in preventing a significant increase in light pollution, assuming adequate enforcement. Although not required by the new regulations, replacement of existing unshielded lights with full cutoff lights could result in even more rapid progress. A Street Light Review Committee appointed by the Board of Selectmen is currently evaluating options for installing new street lighting and replacing existing lights.

Replacement of existing street lights can easily be justified on economic grounds alone, even without reference to the benefit of the new full cutoff luminaires. In discussions with the local electric utility (Fitchburg Gas & Electric Company), Townsend officials found that the cost to remove existing unshielded street lights would be approximately $75-$100 per light (mostly utility crew labor). The utility does not charge the town for the installation of new lights, except for any incremental cost associated with the full cutoff specification (less than $10). The new lights would have high pressure sodium lamps, which are significantly more energy efficient than the existing mercury vapor lamps. For example, the most common type of roadway luminaire currently in place (100-watt mercury vapor) would generally be replaced with an equally bright 50-watt HPS luminaire, resulting in annual energy savings of approximately $30 per light. The initial replacement cost is thus repaid within 3 years, and the annual lighting budget could then either be reduced or utilized to support maintenance of a greater number of street lights.

### F. Other Approaches used by Municipalities

An alternative approach to regulating light pollution is to specify the quantity of light permitted to stray across property lines. For example, San Diego County, California controls light trespass by limiting the illuminance (amount of light per unit area) to 0.21 lux (equivalent to bright moonlight) near the property line.[25] A Skokie, Illinois ordinance seeks to limit light trespass from street lights in residential areas to 3 lux. Eatontown, New Jersey limits light trespass to 0.1 footcandles (1.08 lux) in residential areas and 0.5 footcandles (5.38 lux) in business areas and also includes shielding requirements for non-residential lighting.[26] The local utility responded to the ordinance by using only full cutoff street lights for new installations in Eatontown.[27]

Some bylaws focus on specific types of lighting perceived to pose a particular problem. For example, Atlanta requires billboards to be illuminated from above rather than below, thus reducing sky glow.

## V. State and Federal Legislation and Policies

Several states have enacted or are considering laws mandating a full cutoff design for state-funded lighting, such as highways and buildings. Maine enacted such a law in 1991, and good lighting practices rapidly spread beyond state-funded projects to the local level. In response to the state law, most of the utilities in the state opted to stock only full cutoff roadway lights, so that even municipalities not covered by the law have been installing them.[28] Connecticut has mandated full cutoff lighting on state highways since 1995. In Massachusetts, a proposed law requiring full cutoff lighting for all state-funded lighting (with limited exceptions) cleared several legislative committees in 1997. Other states have taken at least symbolic steps; New Mexico declared itself a "dark sky state" to encourage development of local ordinances.

The New Jersey Legislature enacted a law in 1993 creating the New Jersey Light Pollution Study Commission (NJLPSC). The Commission's report offers 12 recommendations for controlling light pollution.[29] The recommendations include use of full cutoff roadway and area lights by state agencies and private lighting installers, use of timers or motion sensors to eliminate building exterior lighting when it is not needed, training for municipal engineers and planners, and use of reflectors instead of lights where feasible on roadways. The report further proposes designation of "dark areas" suitable for astronomical observations, in which lighting would be regulated to preserve starry skies.

The NJLPSC report includes a compendium of local light pollution control ordinances throughout the United States. This non-comprehensive list identifies 25 ordinances in 9 states. Eleven of the identified municipalities are located in Arizona and California, while one (Pittsford) is in New York. The Town of Pittsford's building code requires shielded lighting for illuminated awnings, signs, recreational facilities, churches and agriculture. Sports facilities must turn their lights off by 10:00 P.M., while illuminated signs must be off by 11:00 P.M.

Even in some states without such legislation, agencies have adopted policies to reduce light pollution. The Illinois Department of Transportation's full cutoff lighting policy is obvious to any visitor to the Chicago area.

Even in Vermont, the nation's most rural state, sky glow is recognized as a problem. Most electric utilities that supply roadway lights are now using full cutoff luminaires. Because of the cold climate in Vermont and the high reflectivity of snow (75% of the incident light is reflected), even full cutoff lighting contributes to sky glow.[30] Therefore, the Chittenden County Regional Planning Commission recommends using only the amount of illumination needed for the specified task to minimize reflected light.

On the national level, the United States Environmental Protection Agency has a Green Lights Program to promote voluntary energy conservation. Participating companies agree to survey their facilities and invest in efficient lighting to reduce long-term costs. The Green Lights Program focuses less on outdoor lighting than on indoor lighting, which accounts for a greater proportion of overall energy use. Nevertheless, advocates of dark sky preservation see the program as beneficial to their cause.[31]

## VI. Conclusion

Excessive and poorly designed lighting brings glare, light

trespass, sky glow, and energy waste. These problems have become ubiquitous with an increasing population and urban sprawl. Full cutoff lighting effectively reduces light pollution by directing all the light downward where it is needed.

The use of full cutoff lighting has been mandated by zoning ordinances in many cities and towns. Such ordinances were initially limited to municipalities near astronomical observatories but are now becoming more common nationwide. Several states have enacted or are considering legislation to require full cutoff lighting in state-funded projects including highways. These local ordinances and state laws can garner widespread support, because they result in cost savings along with the benefits of reduced light pollution.

With bright lights proliferating even faster than the human population, light pollution would appear to be as intractable an environmental problem as greenhouse gas emissions or disappearing rain forests. But if the benefits (including energy and cost savings) of full cutoff lights become more widely known and improved lighting practices are implemented, light pollution could be substantially controlled within a few decades as the current stock of lights is replaced. The resulting energy efficiencies would also make a small contribution towards abating greenhouse gas emissions, acid rain, and other genuinely difficult environmental problems.

---

Michael J. Brown is Senior Project Director with Environmental Strategies Corporation in Boxborough, Massachusetts. A resident of Townsend, Massachusetts, he is a principal author of that town's outdoor lighting bylaws and a member of the Planning Board Study Committee and Street Light Review Committee.

---

[1] New England Light Pollution Advisory Group (Cambridge, Massachusetts), May 1995, "Good Neighbor Outdoor Lighting."

[2] Illuminating Engineering Society of North America (New York, New York), 1982, American National Standard Practice for Roadway Lighting, Standard #RP-8.

[3] Greenfields are relatively pristine, uncontaminated and undeveloped land typically located in exurbia.

[4] International Dark Sky Association (Tucson, Arizona), March 1990, "Economic Issues in Wasted and Inefficient Outdoor Lighting," Information Sheet 26, March 1990.

[5] International Dark Sky Association (Tucson, Arizona), April 1992, "Efficient Outdoor Lighting," Information Sheet 52.

[6] International Dark Sky Association (Tucson, Arizona), January 1998, "U.S. Department of Justice Study of Street Lighting and Crime," Information Sheet 63.

[7] Peter J. Howe, "Blinded by the Light," Boston Globe, August 26, 1996, at C1.

[8] Illuminating Engineering Society of North America (New York, New York), 1982, American National Standard Practice for Roadway Lighting, Standard #RP-8, Table 2.

[9] New England Light Pollution Advisory Group (Cambridge, Massachusetts), May 1995, "Good Neighbor Outdoor Lighting."

[10] Holophane Glass Company, 1918, "The New Era in Street Lighting," Booklet No. 150.

[11] International Dark Sky Association (Tucson, Arizona), April 1994, "Revised Tucson and Pima County Arizona Outdoor Lighting Control Ordinances," Information Sheet 91.

[12] Boxborough, Massachusetts Zoning Bylaw, Section 3340.

[13] Harvard, Massachusetts Zoning Bylaw, Section 7.5.

[14] Friends of Harbor Island Park v. Village of Mamaroneck, New York Law Journal, August 2, 1990 (Sup. Ct. Westchester County), at 20:6.

[15] 6 NYCRR 617.13(d)(8).

[16] Townsend, Massachusetts Zoning Bylaws, Section 9.19, "Outdoor Lighting."

[17] Plymouth, Massachusetts Zoning Bylaws Section 401.26, "Prevention of Light Pollution."

[18] "Turn Down the Lights, Night-Sky Gazers Say," Boston Globe (Northwest Edition), January 25, 1998, at 1.

[19] "Night Light Blight," Boston Globe editorial, April 16, 1997, at A14.

[20] Townsend, Massachusetts Zoning Bylaws, Section 9.10.7.

[21] John Pelletier, Wiring Inspector of Townsend, Massachusetts, personal communication.

[22] Townsend, Massachusetts Zoning Bylaws, Section 9.19, "Outdoor Lighting."

[23] Town of Kennebunkport Outdoor Lighting Ordinance, reprinted in "Package for Writing City and Town Lighting Ordinances," New England Light Pollution Advisory Group, Circular No. 10c, April 19, 1995.

[24] Townsend, Massachusetts, Special Town Meeting Warrant, Article 62, "Public Lighting," September 9, 1997.

[25] C. Shaflik, August 1997, "Environmental Effects of Roadway Lighting," International Dark Sky Association, Information Sheet #125.

[26] International Dark Sky Association, April 1994, Information Sheet #92, "Eatontown NJ Light Pollution Ordinance."

[27] J. Batinsey, "Light Pollution: The Neglected Problem," New Jersey Municipalities, May 1995, at 18.

[28] Dan Green, New England Light Pollution Advisory Group, Cambridge, Massachusetts, personal communication.

[29] New Jersey Light Pollution Study Commission's Report, April 1996.

[30] Chittenden County Regional Planning Commission, 1996, "Outdoor Lighting Manual for Vermont Municipalities," at 17.

[31] "Green Lights -EPA's Program to Encourage Energy Efficient Lighting," International Dark Sky Association, Information Sheet 49, July 1996.

(Matthew Bender & Co., Inc.) (PUB.004)