

DELTA Portfolio

Demonstration and Evaluation of Lighting Technologies and Applications ▲ Lighting Case Studies

CLIFTON PARK REST AREA Clifton Park, New York



Site Sponsor:
New York State
Energy Research and
Development Authority

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Project Profile



Clifton Park Rest Area, looking south

An interstate highway rest area is a welcome sight to weary drivers, promising relaxation and respite. In 1997, the New York State Department of Transportation expanded its rest area north of exit 9 on the I-87 Adirondack Northway. The exterior of the new Clifton Park Rest Area contains separate parking lots for cars and trucks, picnic areas, and a dog walking park; the pavilion houses a tourist information counter, restrooms, vending machines, and a State Police station. The Clifton Park Rest Area is only accessible from the northbound lanes of I-87. The site has wooded embankments on both sides, and some commercial development behind. The facility is open 24 hours a day, year-round. DELTA evaluated the exterior and interior lighting areas open to the public at the Clifton Park Rest Area.

Lighting Objectives

- Provide good visibility for drivers and pedestrians after dark
- Make the rest area look safe and welcoming after dark
- Enhance the aesthetics of the picnic area and the interior of the pavilion
- Limit light trespass

Lighting and Control Features

- **Nighttime Visibility.** The parking lot is lighted by full cutoff luminaires that minimize glare to drivers and pedestrians. They are arranged to provide more light in the driving lanes and less in the parking area. Because vehicles and pedestrians are most likely to be in conflict in the driving lanes, more light in the driving lanes creates a safer environment.
- **Perception of Safety.** Illuminances at the rest area are high enough to promote a perception of safety. The lighting of the pavilion is designed to make the windows and doorways look bright at night, which gives approaching drivers a welcoming impression.
- **Aesthetics.** The lighting of the pavilion is well matched to the architecture, reinforcing the building's role as a "gateway to the Adirondacks." The lighting emphasizes the dramatic and interesting ceiling structure, which makes the interior look attractive.
- **Light Trespass.** Full cutoff luminaires in the parking lot and roadways limit light trespass onto neighboring properties and adjacent roadways, including the interstate highway.

Exterior Lighting

*"It's much nicer than the lighting that used to be here ...
we've been coming here for 30 years..."*

– A visitor

*"I don't particularly care for the
pinkish-yellow color of the lights."*

– A visitor

On entering the rest area, a driver must select the appropriate parking area. Trucks and other large vehicles go to a parking area on the south side of the pavilion, while cars go to a parking area on the north side. DELTA evaluated the exterior lighting for the car parking area because more of the exterior facilities are located on the north side. The 34,500 ft² (3200 m²) parking area has two aisles of parking spaces. After parking their vehicle, visitors usually proceed

across one or two of the driving lanes to the pavilion walkway, although some people go directly to the adjacent picnic area or the dog walking park.

The picnic area (see plan on page 4) contains numerous islands of vegetation and picnic tables. Measured reflectances of the concrete surfaces on the walkway and the picnic area were between 10% and 20%; the reflectance of the parking area asphalt was 10%.

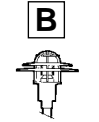


Exterior Lighting (continued)

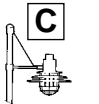
Specifications:



A Pole-mounted high pressure sodium (HPS) cutoff luminaire, 24" square x 9" deep (610 mm x 230 mm), with type III optics. Mounted on 7" (180 mm) square pole with varying heights of 25', 30', and 40' (7.6 m, 9.1 m, 12.2 m).
 Lamp: 400 W clear HPS, ED18, mogul base
 Ballast: Core and coil, high power factor (HPF), -40°F minimum starting temperature
 Wattage: 457 W per ballast



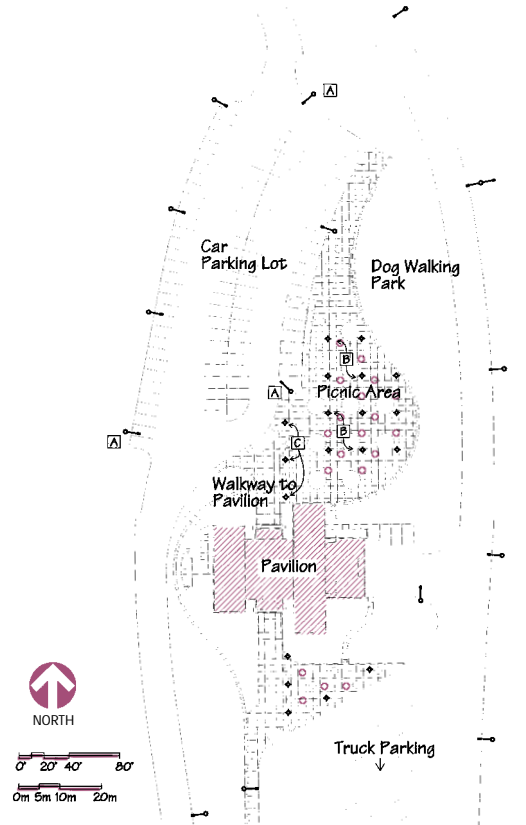
B Pole-mounted HPS luminaire head, 2'-6" H x 2'-4" diam. (0.8 m x 0.8 m), with 12' (3.7 m) steel pole painted black.
 Lamp: 100 W, ED23¹/₂, clear HPS
 Ballast: Core and coil, HPF, -40°F minimum starting temperature
 Wattage: 130 W per ballast



C Same as B, but radius arm mounting with inverted head.

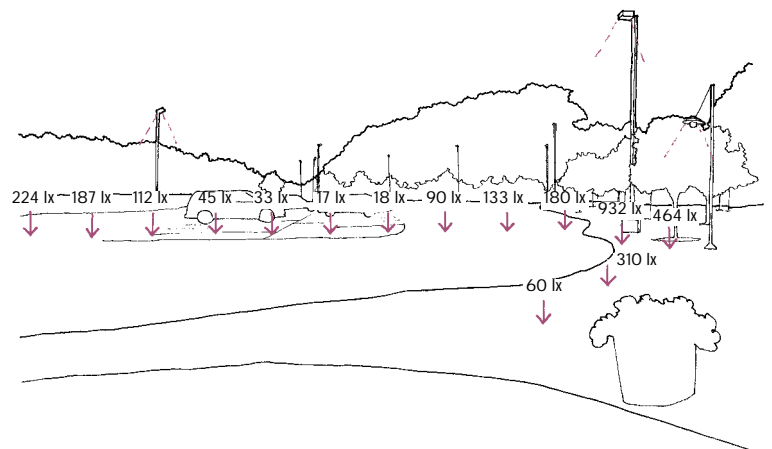


D Recessed HPS downlight, 10" square x 5" deep (250 mm x 130 mm), with prismatic lens and regressed black baffle.
 Lamp: 70 W clear HPS, B17, medium base
 Ballast: Magnetic HPF
 Wattage: 90 W per ballast
 (See page 7 for location on architectural plan.)



Car parking lot

- The parking lot is lighted with pole-mounted high pressure sodium full cutoff luminaires (type A) that limit light trespass onto neighboring properties and roadways.



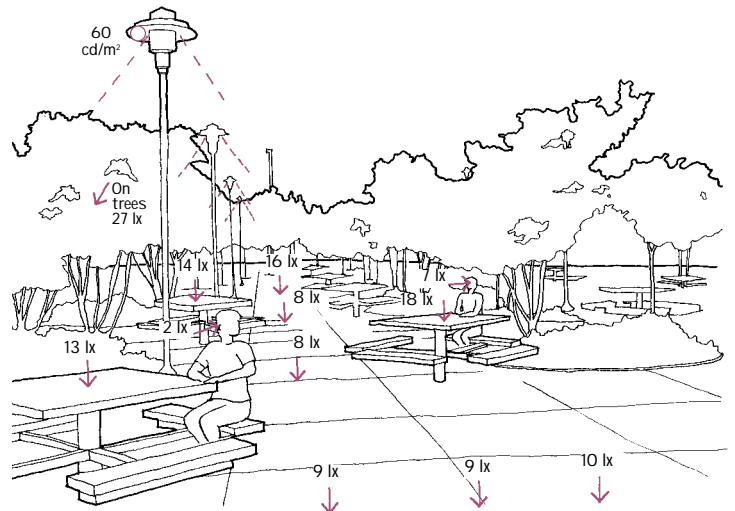
Perspective of car parking lot, looking north

The Illuminating Engineering Society of North America (IESNA) recommends an average illuminance of 11 lux (lx) [1.0 footcandle (fc)] in parking areas and 5 lx (0.5 fc) in minor activity areas of roadside rest areas. Illuminance uniformity recommendations range from 3:1 to 6:1 (average to minimum).



Picnic area

- The close spacing and wide light distribution of these post-top luminaires (type B) ensure a uniform illuminance on the tables and pavement of the picnic area as well as limited variation in the illuminance on visitors' faces.
- Glass refractors in type B luminaires reduce luminance from most viewing positions, resulting in reduced glare.

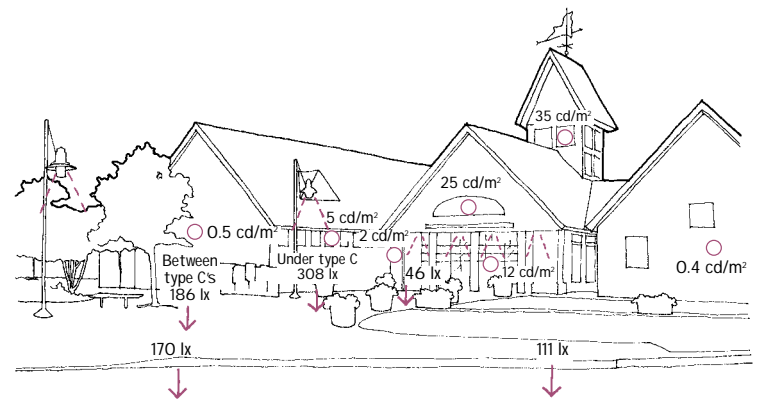


Perspective of picnic area, looking north



Walkway to pavilion

- A line of shorter, pole-mounted luminaires (type C) visually leads a visitor to the entrance. Glass refractors in these luminaires reduce luminance from most viewing positions, resulting in reduced glare.
- Recessed downlights mounted in the eaves (type D) further emphasize entrance location and produce an inviting appearance.



Perspective of walkway to pavilion, looking south



Exterior Lighting (continued)

Visitors' Response

Questionnaires were completed by 80 people using the pavilion walkway after dark. For an overall assessment, the users were asked how the lighting compared to other rest areas they had visited. The results indicate that the majority of the visitors considered the exterior lighting of the rest area better than that of other rest areas. (See table below right.)

For an assessment of individual features of the rest area, the visitors were asked whether they agreed or disagreed with a series of statements. The table below gives the percentage of visitors who agreed with each statement, in decreasing order. Most visitors agreed that there is plenty of light to see vehicles and other people, that the lighting is attractive and comfortable, and that the lighting in the picnic area and walkway produces a feeling of safety. The only negative comments indicated concern about leaving vehicles and possessions unattended in the parking area and the presence of some dark areas. DELTA noted that the illuminance of the center part of the parking lot was only one-tenth that of the surrounding parking lot areas (see perspective drawing on page 4), making it seem dark in comparison.

Most visitors must park in this dark central area, since handicapped parking and police vehicles occupy the east and west edges of the lot (see aerial photo on page 2). While the illuminance in this area is above IESNA recommended illuminances, its non-uniformity helps explain visitors' concerns. Additional luminaires could have been placed in the center of the parking lot to increase uniformity.

The visitors were also asked to pick any words from a list of matched positive and negative words that they thought best described the lighting of the area. Words used by more than 50% of visitors were "Attractive," "Well-maintained," "Safe," "Comfortable," and "Clean."

Compared to other interstate rest areas, the lighting at this rest area is:

Better	About the same	Worse
61%	35%	4%

Statements about the exterior lighting (n = 80 visitors)

	Percentage agreeing
I can easily see people approaching me.	91%
The lighting in the picnic area and walkway makes me feel safe.	91%
Overall, the lighting in this rest area is attractive.	91%
Overall, the lighting in this rest area is comfortable.	90%
There is plenty of light in the parking area to see pedestrians and other vehicles.	84%
I do not feel safe leaving my car and possessions in the parking area.	25%
There are dark areas that make me nervous.	23%
The light fixtures in the picnic area and walkway are too bright.	9%

Space Type	Area (ft ²) [†]	LPD* (W/ft ²) [†]	ASHRAE/IESNA* Allowed LPD (W/ft ²) [†]
Car Parking Lot	34,500	0.09	0.18**
Picnic Area	19,000	0.10	0.10**

* See *Abbreviations* on page 11

** Although the 1999 version of the ASHRAE/IESNA 90.1 Standard does not apply to exterior parking lots or picnic areas, the previous 1989 Standard does provide a basis for comparison.

[†] 1 ft² = 0.093 m²; 1 W/ft² = 10.76 W/m²

Interior Lighting

“We go out of our way to come to this rest area... the exterior is nice too.”

– A visitor

“My compliments to the designers.”

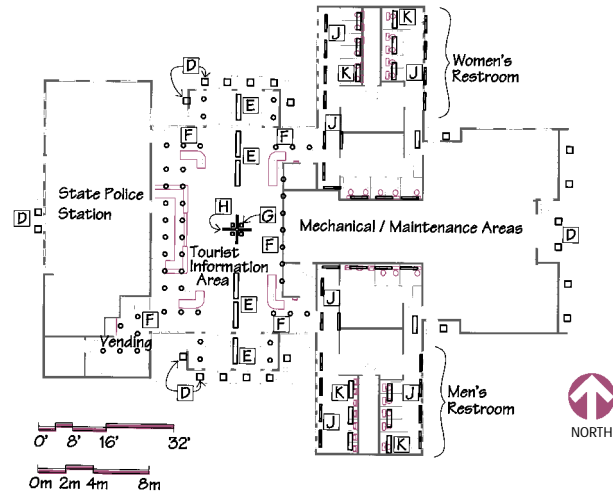
– A visitor

Upon entering the pavilion through the double doors, visitors find themselves in a spacious tiled area with the entrances to the restrooms on one side and a tourist information counter and vending machines on the other. The dominant feature of this space is the elaborate wood-paneled ceiling leading up into the central tower, through which some daylight is admitted. These surfaces are illuminated with type E and H uplights (see specifications). Reflectances range from 10% to 70% for the floors, ceilings, and walls. DELTA evaluated this central tourist information area, and the stall areas of the restrooms.

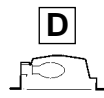
Lighting glows from the tower, windows, and entrances making the exterior of the pavilion look inviting and safe for approaching drivers. This impression continues on the interior, with gentle uplighting drawing attention to the wood-paneled ceiling. Visitors are comfortable browsing tourist brochures and sipping vending machine coffee while taking a break from driving. In general, the lighting of the pavilion provides enough light where needed, without glare.

A discordant note in the lighting of this space is the strong scallops of light produced by the type F downlights on the wall displaying a large map of New York State. Given the nature of the display, DELTA believes a more uniform – and probably more energy-efficient – solution would have been continuous linear fluorescent wall-wash luminaires.

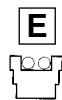
Additionally, the use of a cluster of four metal halide downlights (type G) in the cruciform chandelier produces a “punch” of light on the floor below that is harsher than necessary, given the relatively short distance of 11 feet (3.4 m) from the floor and the lack of anything to accent with the light. One visitor commented that standing underneath these luminaires felt uncomfortably glaring. DELTA suggests reducing intensity by using lower wattage metal halide lamps, using more diffuse light sources, or relying entirely on the uplighting on the ceiling. In addition, the clear metal halide lamps used by this luminaire create a color of light that does not complement the warmth of the wooden surroundings and the predominant earth tones of the tile floor.



Specifications:



D Recessed high pressure sodium (HPS) downlight, 10" square x 5" deep (250 mm x 130 mm), with prismatic lens and regressed black baffle.
Lamp: 70 W clear HPS, B17, medium base
Ballast: Magnetic high power factor (HPF)
Wattage: 90 W per ballast



E Pendant-mounted linear fluorescent uplight, mounted in custom 6' L (1.8 m) wooden housing, with 3' pendant length (0.9 m).
Lamps: (2) F40T12/CW/HO
Ballast: Magnetic, Rapid Start, HPF
Wattage: 107 W per 2-lamp ballast



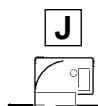
F Recessed compact fluorescent downlight, 6" diam. x 6" H (150 mm) with specular reflector.
Lamps: (2) CFQ13W/GX23-2/827
Ballast: (2) 1-lamp magnetic, HPF
Wattage: 16 W per 1-lamp ballast



G Metal halide (MH) downlight luminaire, 9" square x 15" H (230 mm x 380 mm), black finish, mounted as cluster of four in custom pendant chandelier.
Lamp: 100 W, clear MH, BD17, medium base
Ballast: Magnetic core and coil HPF
Wattage: 129 W



H Long compact fluorescent striplight, two lamps in cross section, mounted as uplight in custom pendant chandelier.
Lamps: (2) FT39W/2G11/835
Ballast: 2-lamp magnetic, Rapid Start
Wattage: 77 W per 2-lamp ballast



J Recessed linear fluorescent troffer, 9" W x 4' L (230 mm x 1.2 m), one lamp in cross section, with curved reflector and parabolic baffles mounted flush with ceiling tiles.
Lamp: F32T8/741
Ballast: Electronic, Instant Start, HPF
Wattage: 38 W when operated with one lamp



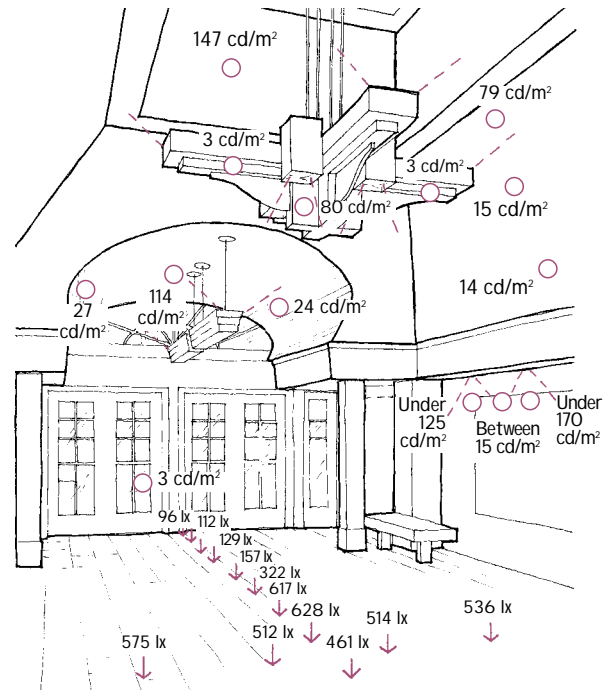
K Recessed lensed linear fluorescent troffer, 1' x 4' (0.3 m x 1.2 m), two lamps in cross section.
Lamps: (2) F32T8/741
Ballast: Electronic, Instant Start, HPF
Wattage: 58 W per 2-lamp ballast

Interior Lighting (continued)



Tourist information area

- Uplighting (types E and H) emphasizes architectural features that are visible from the exterior, such as barrel vaults and the central tower.
- Compact fluorescent recessed downlights (type F) direct light onto tourist information display areas and the map of New York State.
- Metal halide downlight luminaires in cruciform chandelier (type G) provide a "punch" of light onto the floor beneath the central tower.

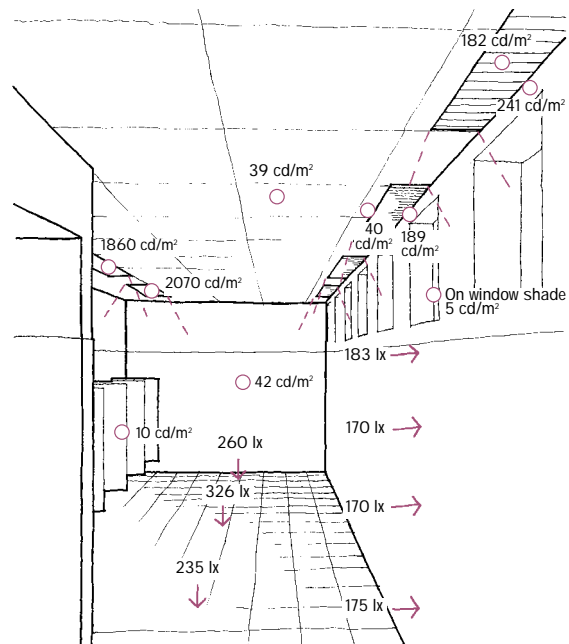


Perspective of tourist information area



Restrooms

- Recessed parabolic luminaires (type J) light the circulation area and make windows visible to drivers at night.
- Recessed lensed luminaires (type K) illuminate most stall areas.
- Daylight is admitted through windows along periphery.



Perspective of restroom

Visitors' Response

Questionnaires were completed by 98 visitors to the interior pavilion of the Clifton Park Rest Area. The questionnaire was designed to ascertain the visitors' opinions of the lighting of the tourist information area and the rest rooms. The visitors' overall responses to the lighting (see table below right) were similar to those about the exterior lighting (see page 6). The results indicated that a majority of the visitors considered the lighting of the pavilion to be better than that of other rest areas.

For detailed assessments of these spaces, visitors were asked whether they agreed or disagreed with a series of statements. The tables below give the percentage of visitors who agreed with each statement, in decreasing order. In the visitor information area, most visitors agreed there is plenty of light to see other people, that the lighting is attractive and comfortable, and that the lighting produces a feeling of safety. The only negative comment indicated concern about bright reflections in the front faces of the vending machines, although observations of these machines showed that the reflections were produced by internally-illuminated

vending machines located directly opposite each other, rather than the lighting in the ceiling.

Most visitors thought that the lighting made the restrooms appear clean and safe and that the lighting was attractive and comfortable.

Finally, visitors were asked to pick any words from a list of matched positive and negative words that they thought best described the lighting of the spaces. Words used by more than 50% of visitors were "Attractive," "Well-maintained," "Comfortable," "Clean," and "Modern."

Compared to other interstate rest areas, the lighting in this rest area is:

	Better	About the same	Worse
Tourist Information Area	65%	31%	4%
Restrooms	58%	39%	3%

Statements about the tourist information area (n = 98 visitors)

	Percentage agreeing
There is enough light to see other people well.	98%
Overall, the lighting in this space is attractive.	96%
The lighting in this space makes me feel safe.	95%
Overall, the lighting in this space is comfortable.	91%
There are no dark areas in this space.	71%
The lighting causes reflections on the vending machines that keep me from seeing well.	18%

Statements about the restroom stall area (n = 95 visitors)

	Percentage agreeing
The lighting in the rest room makes it seem clean.	94%
Overall, the lighting in the rest room is attractive.	94%
The lighting in the rest room makes me feel safe.	93%
Overall, the lighting in the rest room is comfortable.	91%

Room Type	Area (ft ²) [†]	LPD* (W/ft ²) [†]	ASHRAE/IESNA* Allowed LPD (W/ft ²) [†]
Tourist Information Area	2,210	1.51	1.80
Restroom Stalls	1,350	1.44**	1.25**

* See *Abbreviations* on page 11

** It should be noted that much of the lighting in these restrooms is essentially façade lighting, with an allowance of an additional 0.25 W/ft² beyond the baseline of 1.0 W/ft². See *Project Evaluation* for discussion of savings strategies for power density and energy use.

[†] 1 ft² = 0.093 m²; 1 W/ft² = 10.76 W/m²



Project Evaluation

Maintenance

Maintenance staff had no major complaints about ballast, lamp, or controls technology. When the interior pavilion first opened, many of the initial set of fluorescent lamps failed sooner than expected, but subsequent relamping has performed normally.

Occupant Response

In general, the majority of visitors to the Clifton Park Rest Area found the lighting to be better than other rest areas they had visited.

Energy Impact

The lighting system in the tourist information area and restroom stall areas together saves almost \$350 annually when compared with spaces lighted to standards delineated in the energy standard ASHRAE/IESNA 90.1-1999. Even greater energy efficiency could have been achieved in several places in the tourist information area. Such possibilities include using T8 or long compact fluorescent lamps in the type E uplights, using linear fluorescent luminaires instead of type F recessed downlights on the map

wall, and eliminating or using lower wattage downlights in place of type G downlights. In the restrooms, other energy efficiency measures could have been adopted. Photosensor controls could have been used to turn off lights during the day in areas immediately adjacent to windows (type J). Additionally the use of lower-wattage ballasts dedicated for operation with one lamp (type J) would have helped to reduce both power density and energy use.

DELTA did not perform calculations of exterior lighting energy savings since no comparable lighting power density requirements for parking lots or exterior rest areas exist in the current standard, ASHRAE/IESNA 90.1-1999; however, exterior lighting power densities were lower than or equal to maximum power densities delineated in the previous 1989 standard.

Environmental Impact

Reduced energy use from the tourist information and restroom stall areas will result in lower annual power plant emissions (see table below).

Reduced Pollution Compared to System Operating at ASHRAE/IESNA Maximum Lighting Power Density

	SO ₂		NO _x		CO ₂	
	lbs	kg	lbs	kg	lbs	kg
Annual savings	33	15	13	6	4,824	2,190

Sulfur dioxide (SO₂) is associated with visible pollution (haze) and acid rain.

Nitrogen oxides (NO_x) are one of the main causes of ground level ozone (smog) and acid rain.

Carbon dioxide (CO₂) is a possible contributor to future climate changes such as global warming.

Methodology

This section gives details about methods and assumptions used in this publication.

Photometric Measurements

Both the exterior and interior illuminance and luminance measurements were made starting one hour after sunset, when the lighting of both locations had been on for at least 45 minutes.

Surveys and Interviews

Questionnaires were used to obtain the opinions of the visitors in the exterior area and in the pavilion. Exterior lighting questionnaires were completed by 80 visitors while standing outside the pavilion after dark. Interior lighting questionnaires were completed by 98 visitors while standing inside the tourist information area of the pavilion from one hour before sunset to ninety minutes after sunset. Examination of the responses collected before and after sunset showed little difference, so the difference in exterior conditions is ignored in the evaluation of the interior lighting. The exterior and interior lighting questionnaires were administered on different evenings.

To learn more about lighting design goals and use patterns, DELTA interviewed two representatives from the New York State Department of Transportation, as well as two representatives from the consulting design firm. Maintenance questions were answered by the general mechanic on-site.

Energy Analysis

To analyze annual electrical cost savings, DELTA consulted the on-site general mechanic for estimates on hours

of use. He confirmed that the interior lights are used 24 hours a day, with the exception of eight type F downlights above the tourist information counter that are off for 12 hours per night. The hours of use were multiplied by luminaire wattage to determine actual energy use.

DELTA compared these energy use estimates with the ASHRAE-IESNA 90.1-1999 standard power densities for lighting in lobbies and restroom stalls. These values were multiplied by floor area and the hours described above. Subsequent electrical cost savings were calculated using actual electrical rates charged for the facility of 7.1¢ per kWh and a monthly demand charge of \$8 per kW.

Environmental Analysis

DELTA based the environmental impact figures in the table on page 10 on the U.S. Environmental Protection Agency's September 1996 publication, "Conservation News Online." This document is available online at <http://www.epa.gov/oaintrnt/>.

Abbreviations

Abbreviations mentioned in this report include:

LPD = Lighting Power Density

ASHRAE = American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

IESNA = Illuminating Engineering Society of North America



Lessons Learned

With good design, exterior lighting based on high pressure sodium lamps can be very satisfactory.

The lighting of the exterior spaces of the Clifton Park Rest Area uses high pressure sodium lamps exclusively, yet at least 90% of visitors considered the lighting of the exterior area to be comfortable, safe, and attractive.

Lighting that is integrated with the architecture and fulfills its function will be considered attractive.

The lighting of the pavilion is designed to enhance the architecture, not to compete with it. At the same time, the lighting provides enough light where needed without glare. A very high percentage of the visitors to the pavilion considered the lighting comfortable and attractive.

When designing lighting for wall-washing, the nature of displays on the wall should be considered.

The wall displaying the large rectangular map of the New York State Thruway system is lit by individual downlights. This produces a series of light scallops across the display. A continuous linear wall-washing system would have been more appropriate.

Illuminance uniformity is important for perception of safety in parking lots.

The Illuminating Engineering Society of North America (IESNA) recommends illuminance uniformity ranging from 3:1 to 6:1 in roadway rest areas. In some areas of the Clifton Park Rest Area car parking lot, illuminance uniformity was 10:1, contributing to reasons why a few visitors felt uncomfortable leaving valuables in their vehicles.

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