LED: Lightsavers

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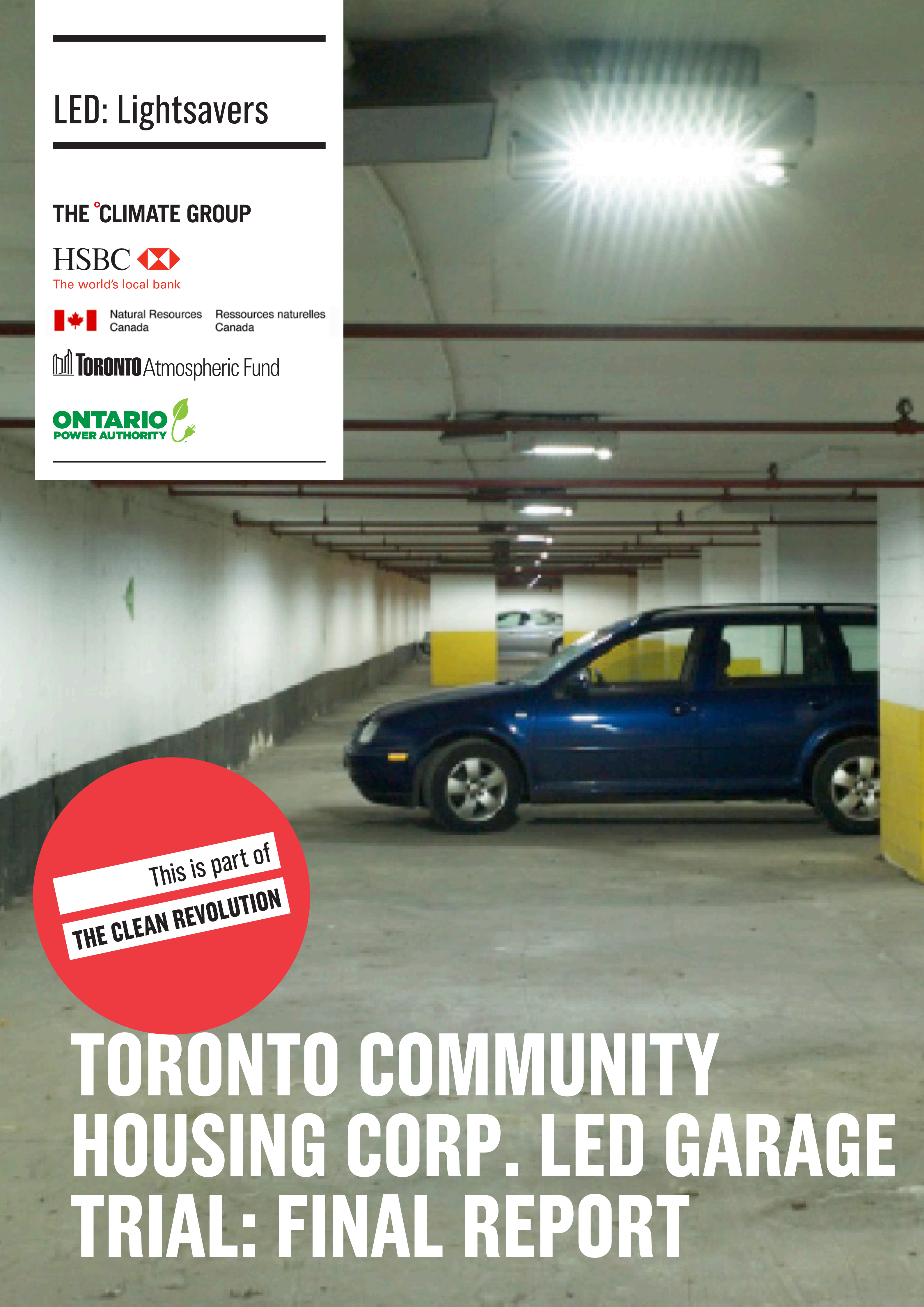

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# TORONTO COMMUNITY HOUSING CORP. LED GARAGE TRIAL: FINAL REPORT

**Background:**
LightSavers is a project of the Toronto Atmospheric Fund (TAF), in affiliation with The Climate Group, and is supported by the Ontario Power Authority and Natural Resources Canada. The LightSavers project aims to accelerate deployment of advanced lighting technologies — Light Emitting Diodes (LEDs) and smart controls — in order to reduce energy use and greenhouse gas emissions.

The first phase of the LightSavers project focuses on pilot testing advanced lighting technologies in real world applications. Pilot projects are hosted by municipalities and public sector organizations across the Greater Toronto Area. TAF coordinates ongoing monitoring and evaluation of pilot projects.

For more information on the LightSavers project, see www.lightsavers.ca.

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**Disclaimer:**
Mention of any commercial product, device, measurement instrument or specific lighting engineers/consultants in this document does not represent an endorsement by TAF or Toronto Community Housing. The report summarizes data collected on site at this specific pilot site and is not intended to predict the performance of the same or other products on other sites.

# Table of Contents

# 1.0 Executive Summary

This is a final report on the City of Toronto Community Housing Corporation (TCHC) LightSavers Pilot Project. The project involved replacement of 140 High Pressure Sodium (HPS) parking garage lights with new Light Emitting Diode (LED) parking garage lights, with new fluorescent parking garage lights, and with occupancy sensor controls. The purposes of the project were as follows:

1. To evaluate whether the LED parking garage lights could be a viable and energy efficient alternative to the conventional HPS lights commonly deployed for parking garage illumination across North America,
2. To evaluate whether the LED parking lights can compete with more conventional replacement technology such as T8 fluorescent lights, and;
3. To evaluate the costs, savings and installation issues with occupancy sensors in parking garages.

Specific factors considered in this report include illuminance, uniformity, average illuminance over time, temperature sensitivity, energy consumption, user reaction and economic performance. The pilot locations are two underground residential building parking garages owned and operated by Toronto Community Housing.

Data was collected over a nine-month period beginning in February 2010. The key findings are summarized below:

- Energy consumption was reduced by over 70%.
- The LED fixtures exceeded the illuminance levels required by the Toronto Municipal Code and recommended by the Illumination Engineering Society of North America (IESNA)[1], without any changes to the number of fixtures or the fixture spacing.
- Both the LED and fluorescent fixtures were perceived by building residents as providing higher light levels and improved visibility compared to the baseline HPS lighting system, despite a designed reduction in illuminance levels of 20-30%.
- Illuminance uniformity was slightly better than the baseline design and much better than IESNA design guidelines.
- There was no depreciation in average illuminance in the LED test areas over the nine-month (~6500 hour) monitoring period.
- Temperature sensitivity (correlation between light output and ambient temperature) was present but within expected parameters.
- The adaptive controls functioned as intended and were well received by building residents.
- The LED fixtures complete with adaptive controls are expected to pay for themselves within 10 years, while payback with the motion sensor equipped fluorescent system was even shorter.

# 2.0 Site Description

The pilot sites are two underground residential parking garages located at 2743 Victoria Park Avenue and 2180 Ellesmere Avenue in the City of Toronto. The buildings are owned by Toronto Community Housing (TCH), Canada's largest social housing provider. The parking garages are used exclusively by the building residents as well as TCH staff.

The Parking garage at 2180 Ellesmere is non-symmetrical and separated into four isolated zones: north, south, east, and west. The north zone was retrofitted with dimmable LED fixtures; the south zone was retrofitted with dimmable T8 fluorescent fixtures; and the east and west zones remained as HPS fixtures. Refer to Appendix B for a map of the garage and the location of the test fixtures.

[1] Recommended Practice 20-98, Lighting for Parking Facilities, IESNA

The parking garage at 2743 Victoria Park is rectangular in shape, with seven rows of lighting fixtures. Two rows on the east side of the garage were retrofitted with dimmable LED fixtures, half of the three middle rows on the north side were retrofitted with dimmable T8 fixtures, and the rest of the fixtures remained as HPS fixtures. Refer to Appendix C for a map of the garage including zone locations.

## 2.1 Baseline Lighting System

The original lighting system featured McGraw Edison fixtures using 100 Watt High Pressure Sodium (HPS) lamps, and 120 Volt electromagnetic ballasts. This fixture type is commonly found in parking garages in Toronto and elsewhere. The input wattage is 129 watts per luminaire. There were 107 HPS fixtures at 2180 Ellesmere and 142 fixtures at 2743 Victoria Park. The fixtures are operated 24 hours per day, seven days per week. The luminaires in both parking garages are spaced approximately 20ft apart.

## 2.2 Fluorescent Lighting System

The T8 fluorescent fixtures installed in this project are Peerless vapour-proof fiberglass fixtures (DC/DP), equipped with two General Electric 4 ft T8 fluorescent lamps with a 4100K colour temperature. The ballasts installed are Osram Sylvania Quicktronic PROStart T8 Quickstep Bi-Level Dimming Electronic ballasts. The rated input wattage of the fixtures is 54W at the high level and 27W at the low level. Twenty-seven T8 fixtures were installed at the Victoria Park site and forty-two were installed at the Ellesmere site. Fixture spacing remained identical to the baseline HPS lighting system. A Leviton PIR fixture-mounted occupancy sensor was added to one side of each fixture. The detection range for an 8ft mounting height is 20ft. See Appendix D for full fixture and sensor specifications. The fixtures were set to reduce light output and energy consumption by 50% when no motion was detected for 15 minutes within the sensor range.

## 2.3 LED Lighting System

The LED fixtures used in the pilot project were EDGE LED Parking Structure Lights (X-PS) manufactured by Ruud Lighting. The rated input wattage of the fixtures is 55W for two LED light-bars, with 3400 initial delivered lumens and 6000K colour temperature.[2] The luminaire efficacy is 62 lumens per watt. Each fixture has a built-in occupancy sensor for bi-level dimming, with a specified detection range of 25ft at an 8ft mounting height. Note that a special order was placed with Ruud Lighting to supply fixtures with bi-level switching between 350mA (55W) and 175mA (27.5W); the regular factory settings for bi-level dimming for the fixture is 525mA and 175mA (in this case the factory setting would have resulted in over-lighting the facility when the fixtures were in the high-power state). See Appendix E for full fixture and sensor specifications. The fixtures were set to reduce drive current by 50% when no motion was detected for 15 minutes within the sensor range.

# 3.0 Performance Assessment Methodology

This pilot project was evaluated using the LightSavers Monitoring and Evaluation Protocol, developed by TAF in collaboration with the Ontario Centre for Environmental Technology Assessment (OCETA). The full protocol is available at www.lightsavers.ca.

## 3.1 Illuminance

Prior to any illuminance measurements, the existing HPS parking garage lights were re-lamped with new lamps, and these were operated for approximately 100 hours to allow the lamps to achieve rated output.

In addition to normal photopic measurements, scotopic data were also collected for comparison purposes at these sites. Ambient temperature was also recorded at the time of each measurement.

Note that all illuminances were recorded at full fixture output, since the occupancy sensor made it impossible to collect values when the space was unoccupied.

[2] +/- 500K

Each garage was divided into three zones: (1) a baseline zone illuminated by the original (re-lamped) HPS fixtures; (2) a test zone illuminated by the bi-level Ruud LED fixtures controlled by Passive Infra-Red sensors (PIR); and (3), a test zone illuminated by bi-level T8 Fluorescent fixtures controlled by PIR sensors. A grid of between 8 and 13 measurement points were marked on the floor of each zone in each garage. Each grid contains an equal number of measurement points in the centre of one driving lane and one parking row. Locations were selected to minimize shadowing and interference from parked vehicles. During the data collection cycle, some measurements were skipped when site conditions made accurate measurement impossible (e.g. due to parked vehicles).

It is to be noted that the measurement grid used does not follow IES recommended practice, which would require more data points and vertical illuminance measurements. However, the values are real and the purpose of the measurements, to compare the relative illuminance in different areas and to validate the performance claims for LED luminaires, has been served.

Illuminance data was collected on site for a 9 month period commencing in February, 2010. Since the quantity of raw data at this site is extensive, the summary data charts are appended to this document (See Appendix F).

For reference, the Illuminating Engineering Society of North America Lighting Handbook, Ninth Edition, *Recommended Maintained Illuminance for Parking Garages*, was used (see Appendix A). Minimum maintained horizontal illuminance is 10 lx. Recommended Maximum/Minimum value is 10:1. Also referenced are the Property Standards of the Toronto Municipal Code, which require a minimum illuminance of 50 lx for parking garages.

### 3.2 Power

Optimum Energy Products Ltd. (OPEL) EML-2000 Energy Loggers were installed on each lighting circuit in the parking garages to monitor the power demand of each fixture type. The power demands were logged every hour for seven months from November 26, 2009 to June 26, 2010, and cumulative energy consumption was also logged for each circuit.

## 4.0 Results

### 4.1 Illuminance

Figures 1 and 2 below illustrate the average photopic illuminance after nine months for each pilot zone.

**Figure 1:** Average Photopic Illuminance After 9 Months – Victoria Park

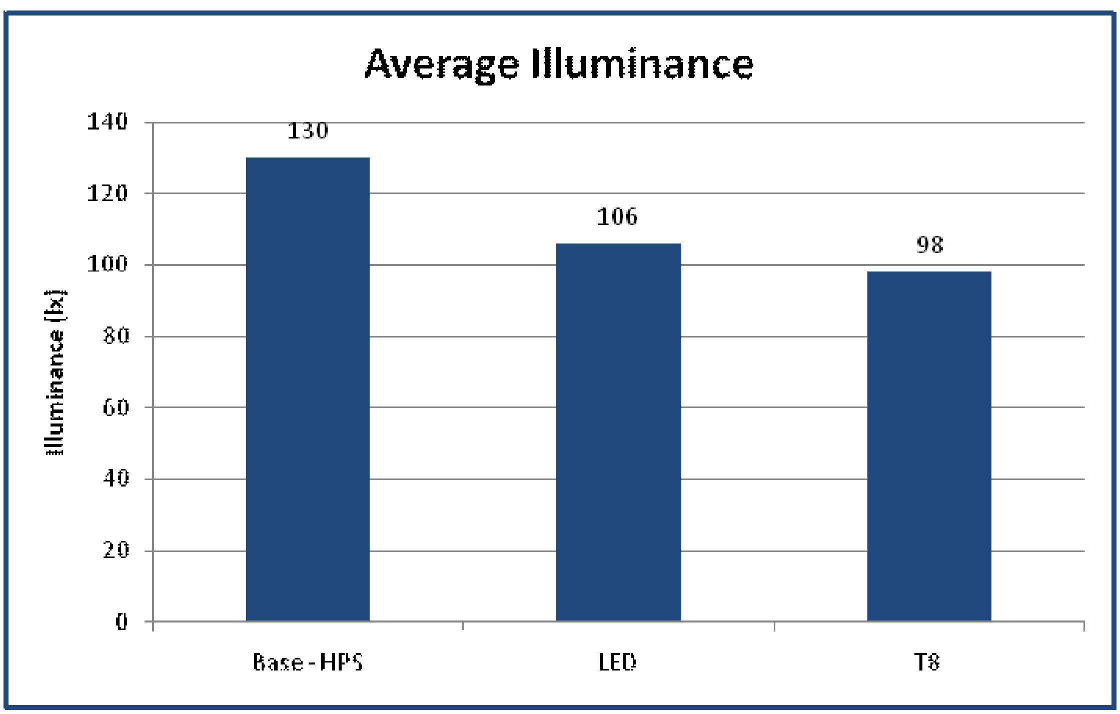
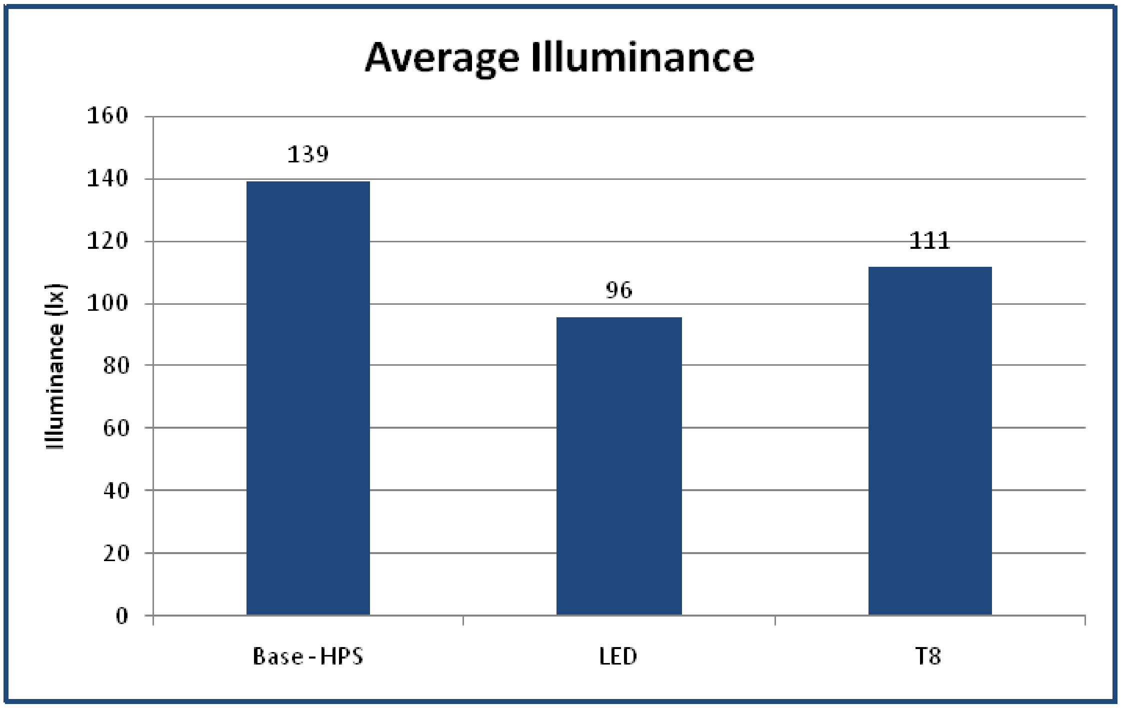


**Figure 2:** Average Photopic Illuminance After 9 Months – Ellesmere




The average photopic illuminance measured on site after nine months with the baseline (re-lamped) HPS fixtures was 130 lux at Victoria Park and 139 lux at Ellesmere.

Average photopic illuminance under the LED fixtures was 106 at Victoria Park and 96 at the Ellesmere site.

Average photopic illuminance under the T8 fluorescent fixtures was 98 lux at Victoria Park and 111 lux at the Ellesmere site.

Interestingly, although the spacing between fixtures was the same, the LEDs provided higher illuminance levels at Victoria Park while the T8 fluorescent fixtures provided higher illuminance levels at the Ellesmere site. However the differences are fairly minor.

Figure 3 illustrates the minimum illuminance values after nine months, with reference to the IES recommended value for parking garages (RP-20) as well as the City of Toronto's Property Standards Code requirements.

While the minimum illuminance provided by both the T8 and LED fixtures was 25-50% lower than under the baseline HPS fixtures, in all cases it was still well in excess of the IES recommended value.

The T8 fixtures at Victoria Park did not meet the Toronto Property Standard of a minimum of 50 lux. The T8 fixtures at Ellesmere just met the Toronto Property Standard. Both LED fixtures exceeded the Toronto Property Standard.

Photopic illuminance is the standard metric for measuring light levels, however it excludes significant portions of the visible light spectrum which can contribute to visibility under certain conditions. LED and fluorescent light sources have a significant proportion of their light output in these excluded wavelengths. Figure 4 and 5 below illustrate and compare the average photopic illuminance values with the average scotopic illuminance measured on site.

**Figure 3:** Minimum Photopic Illuminance After nine Months — Both Sites

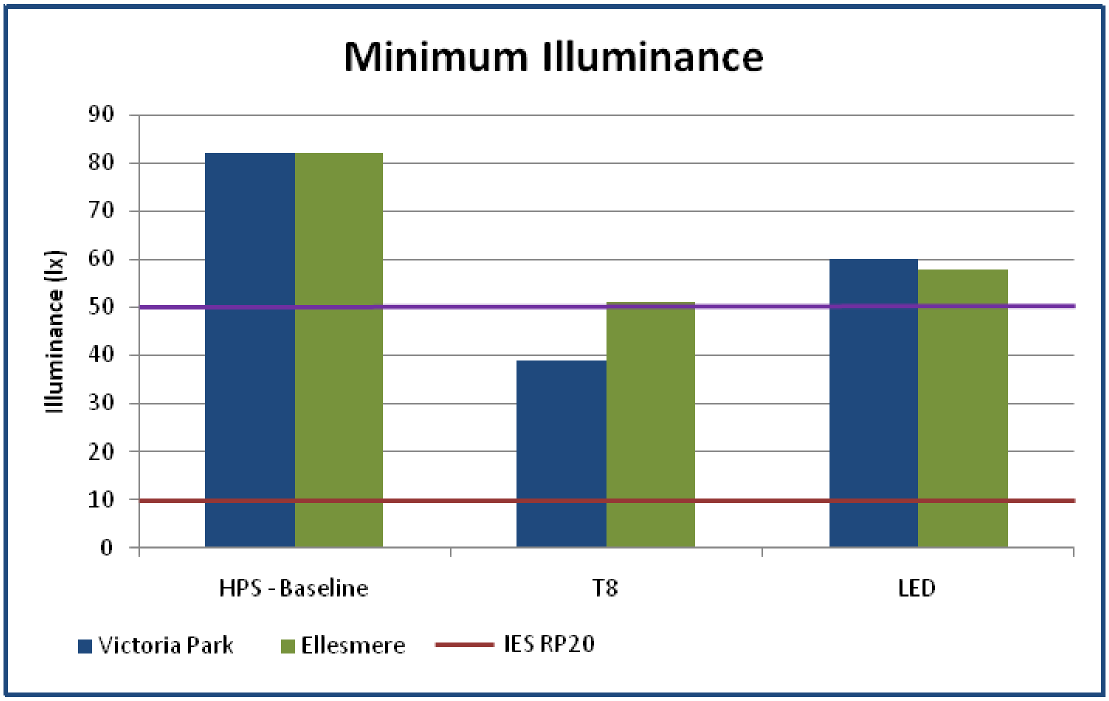



**Figure 4:** Average Scotopic and Photopic Illuminance After 6 Months – Ellesmere

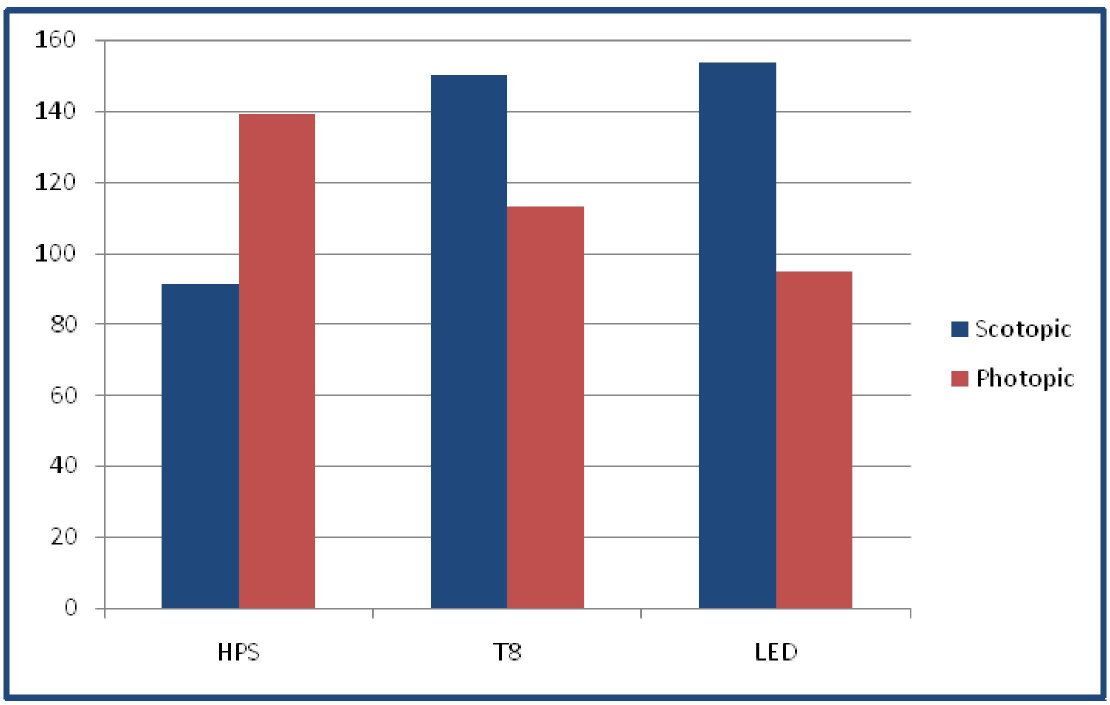
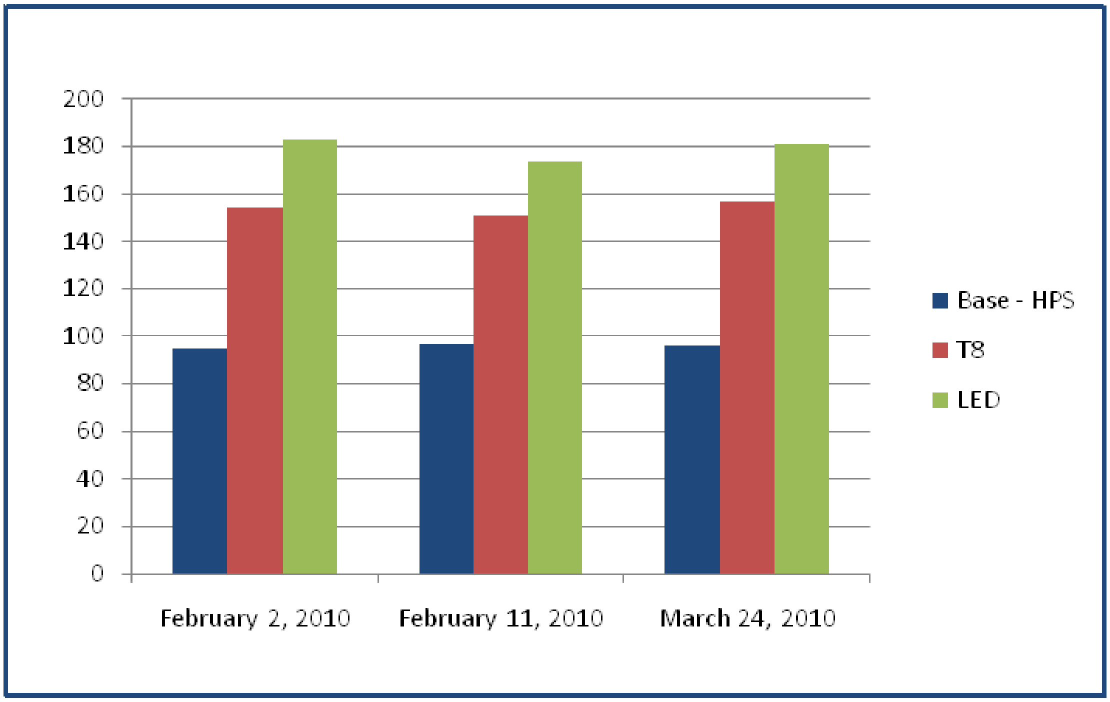


**Figure 5:** Average Scotopic Illuminance – Victoria Park




The scotopic data is included here although there is no current metric to interpret these data. As expected, the white light sources, T8 fluorescent and LED, have considerably better scotopic values than the HPS light source. However, these illuminance levels are well outside the range of scotopic vision. Note that only one set of scotopic readings were taken at Ellesmere, while three dates were collected at Victoria Park. There is no significant difference in the data collected on the three dates at Victoria Park.

## 4.2 Uniformity

Uniformity of illuminance levels is critical for human vision since the eye is so sensitive to contrast. The IESNA recommendation for parking garages is a maximum to minimum ratio of 10:1 or lower. The uniformity of the lighting products tested was excellent, and well within the IES recommended value. From these values it may be extrapolated that the uniformity at 50% light level will most likely be within the recommended value.

**Table 1:** Max:Min Values After 9 Months - Ellesmere

| | **Max:Min After 9 Months** |
|---|---|
| Base HPS fixtures | 2.3:1 |
| T8 fixtures | 3.4:1 |
| LED fixtures | 2.2:1 |

**Table 2:** Max:Min Values After 9 Months – Victoria Park

| | Max:Min After 9 Months |
|---|---|
| Base HPS fixtures | 2.3:1 |
| T8 fixtures | 2.5:1 |
| LED fixtures | 2.1:1 |

## 4.3 Colour Temperature

Colour temperature readings were taken during the first and last illuminance measurement sessions in order to verify the product specifications and assess whether there was any shift in colour temperature over the course of the monitoring period. The data is illustrated below in Table 3.

**Table 3:** Colour Temperature

| | Ellesmere | | Victoria Park | | Manufacturer Specifications |
|---|---|---|---|---|---|
| | *Feb 2010* | *Oct 2010* | *Feb 2010* | *Oct 2010* | |
| **T8** | 3900K | 3845K | 3740K | 3750K | 4100K (+/- 500K) |
| **LED** | 6090K | 6095K | 5780K | 5760K | 6000K (+/- 500K) |

The colour temperature of both the LEDs and the fluorescent fixtures was within manufacturer specifications. As the data above illustrate, there was no significant colour shift over the course of the pilot monitoring period for either of the tested products.

## 4.4 Average Illuminance Over Time

Uncertainty over the useful lifetime of LED luminaires is one of the key barriers to widespread adoption of the technology. Therefore one of the objectives of the LightSavers pilots is to monitor average illuminance over time for LED's in real site conditions. Unlike conventional lighting technologies, LED light sources generally do not burn out but rather gradually decline in lumen output. End-of-life for LED luminaires can vary based on site specific requirements, but is generally considered to be the point when lumen output has declined to 70% of the original value (referred to as L70).

The manufacturer estimate for the useful life (L70) of the LED fixtures in this trial was 150K hours, corresponding to approximately 17 years in this application. However, many independent experts recommend a more conservative estimate of LED lifetimes of 50K hours, given the lack of long-term performance data. The monitoring period for this pilot corresponds to approximately 6500 hours of operation. If the manufacturer estimated lifespan is accurate, source lumen depreciation should be less than 1.5% over the trial period.

Note that the data collected is illuminance on the pavement, not source lumens. Other factors than lumen depreciation can contribute to changes in horizontal illuminance such as ambient temperatures, stray light from other sources, and dirt depreciation on the luminaires. Additionally, portable light meters such as those used in this study are only accurate to plus or minus 5%.

The data can be graphed as shown here (see *Average illuminance over 6500 hours of operation* below).

**Figure 6:** Average illuminance over 6500 hours of operation – Ellesmere

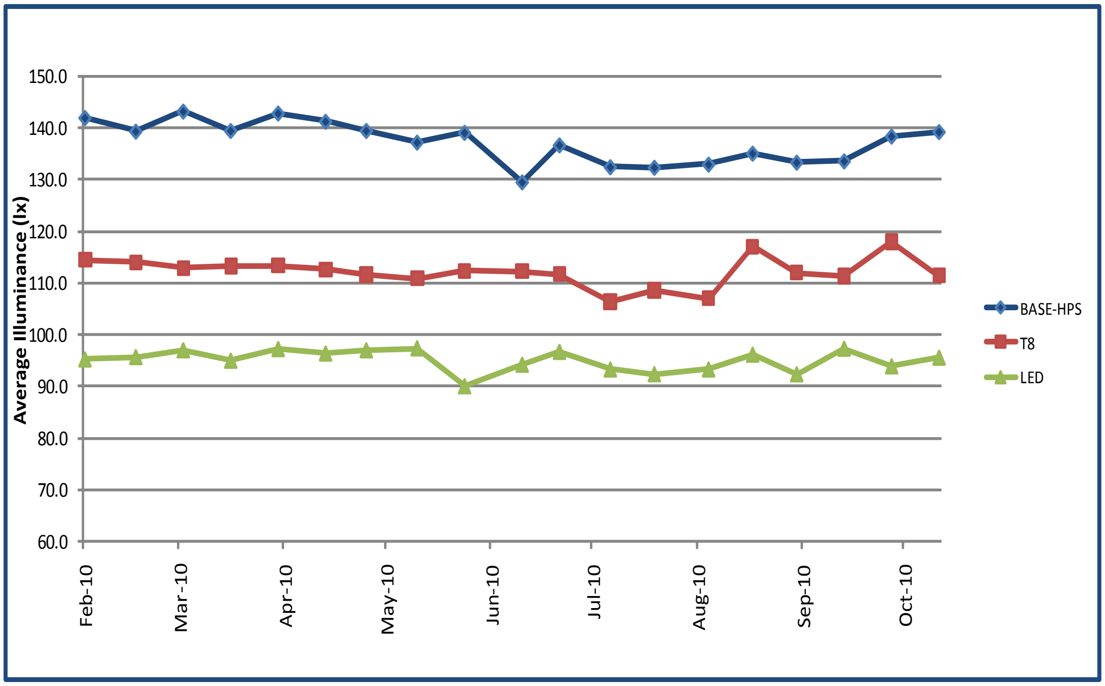



**Figure 7:** Average illuminance over 6500 hours of operation – Victoria Park

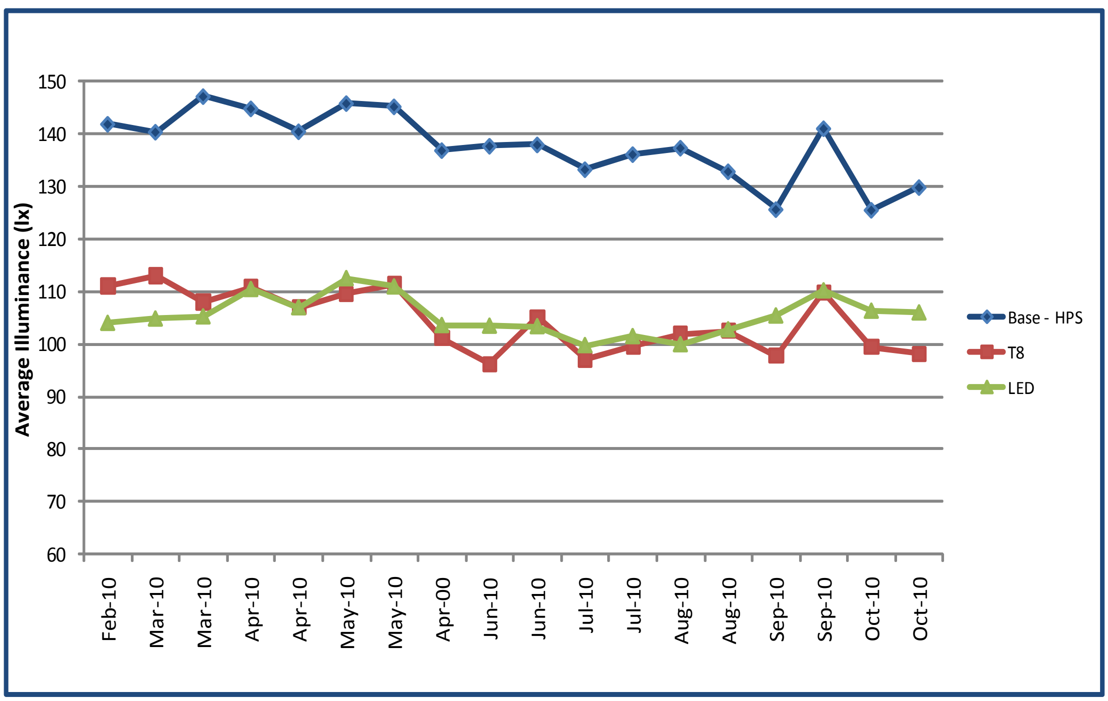


Table 4, below, illustrates the percentage change in average illuminance from the first measurement session to the last measurement session.

**Table 4:** Average Illuminance: % Change, first measurement vs. last measurement

| | % Change Ellesmere | % Change Victoria Park |
|---|---|---|
| Base HPS fixtures | -1.9% | -18.1% |
| T8 fixtures | -2.7% | -2.6% |
| LED fixtures | +0.4% | +5.6% |

The 18% reduction in illuminance for the baseline HPS fixtures at Victoria Park is very high for an HPS source after 9 months. This may indicate an underlying problem with one or more of the HPS luminaires.

The T8 fluorescent values are approximately what is expected. These sources have excellent lamp lumen depreciation values, typically 0.9 or better.

In the LED test areas, average illuminance actually increased, indicating the measured values after 9 months are higher than the starting point. This is not entirely unexpected, as some studies have shown a slight appreciation in LED light output during the first few thousand hours of operation. Although this data cannot be extrapolated to predict the useful life of the fixtures, the stability of the average illuminance levels over 6500 hours of operation adds credibility to the manufacturer estimated lifespan of 150K hours.

## 4.5 Temperature Sensitivity

Another goal of on-site measurement is to track any sensitivity of LED fixtures to climate, in particular temperature. LEDs are known to be sensitive to ambient temperature, with higher temperatures leading to lower light output and vice versa. Temperature data is collected at LightSavers sites using digital thermometers (Omega HH308).

Although fluorescent technology is also known to be sensitive to temperature, this relationship is relatively well understood and was not of interest in this study.

Figure 8 and Figure 9 (see next page) illustrate the average illuminance and ambient temperature for the LED fixtures for each measurement session, organized from coldest to warmest. The readings are organized from coldest to warmest in order to illustrate any observed correlation.

Figure 8 shows the Illuminance and Temperature data for the Ellesmere site. As expected, there is a statistically significant, inverse correlation between temperature and illuminance[3]. There is approximately 7% variation in light levels across a range of 23 degrees celsius. It is notable that the five lowest average illuminance readings were all recorded at times when the ambient temperature was above 20 degrees celsius. However, it should be noted that the differences are within the error margin of the illuminance meter.

Figure 9 shows the Illuminance and Temperature data for the Victoria Part site. On this site there is a very slight, inverse correlation between average illuminance and abmient temperatures, however the relationship is not statistically significant[4]. The differences are within the error margin of the illuminance meter.

3 $R^2$= -.504, significant at the .05 level.
4 $R^2$ = -.087, significance is .362.

**Figure 8: Illuminance and Temperature – Ellesmere**

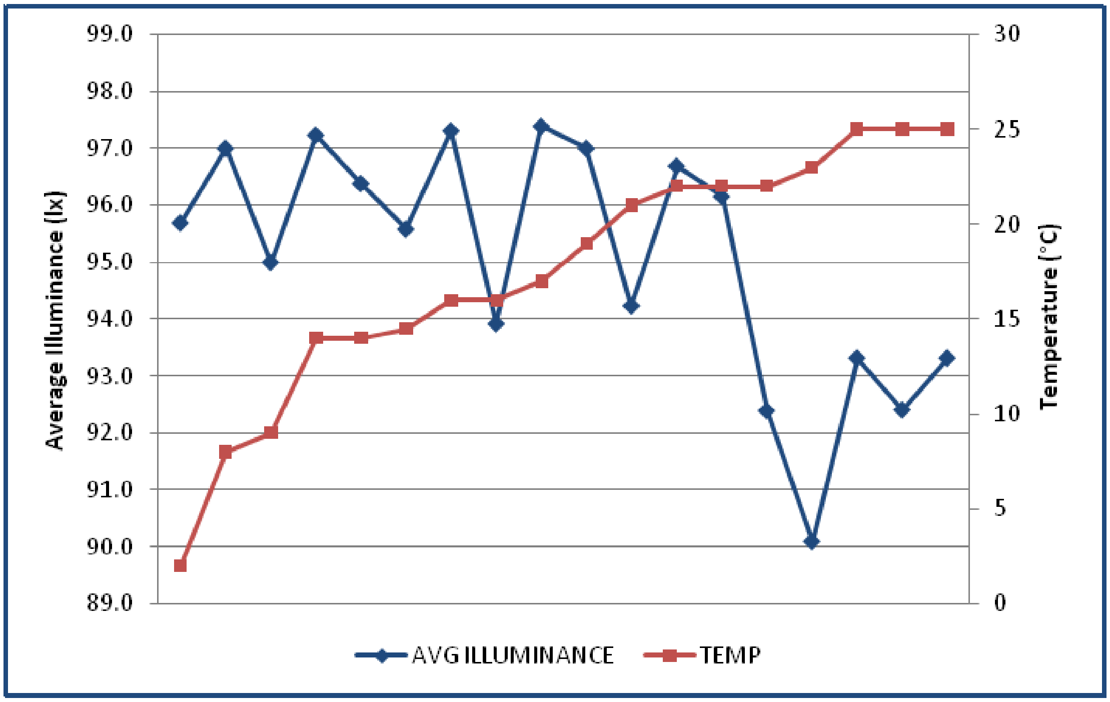
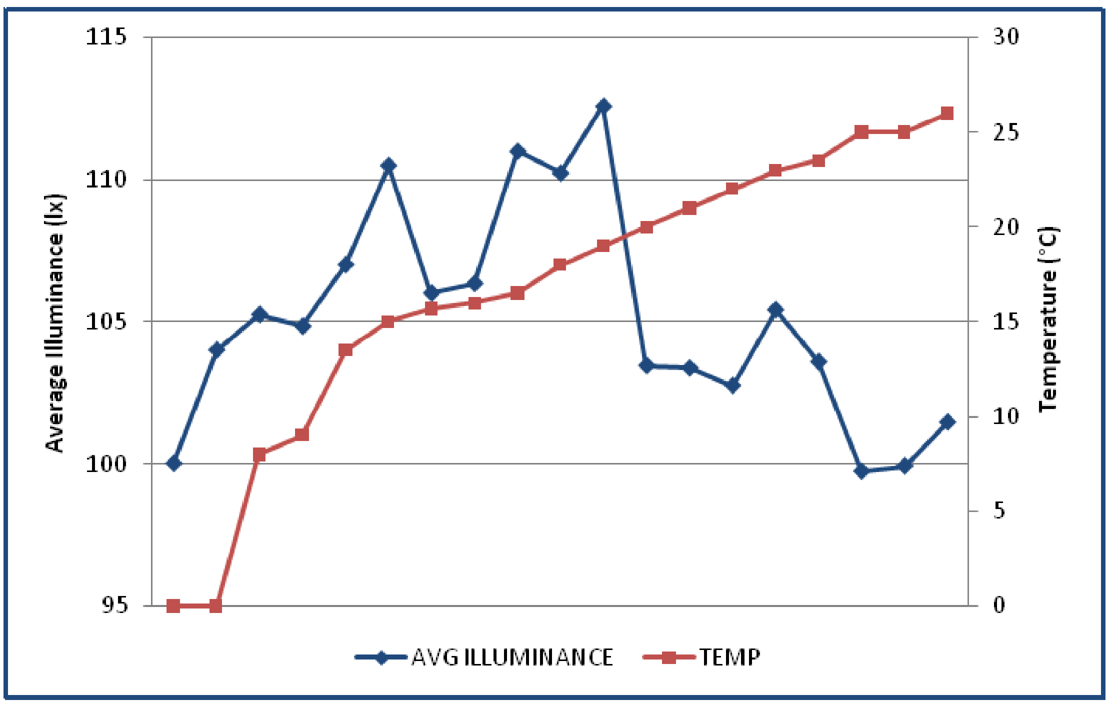



**Figure 9: Illuminance and Temperature – Victoria Park**



## 4.6 Power & Energy

Power use and energy consumption were tracked over a seven month period using data loggers connected to each of the lighting circuits. Figures 10 and 11 below illustrate the power consumption of each fixture-type on full power as well as the average power consumption over seven months for the T8 and LED fixtures.

**Figure 10: Ellesmere Power Usage (watts per fixture)**

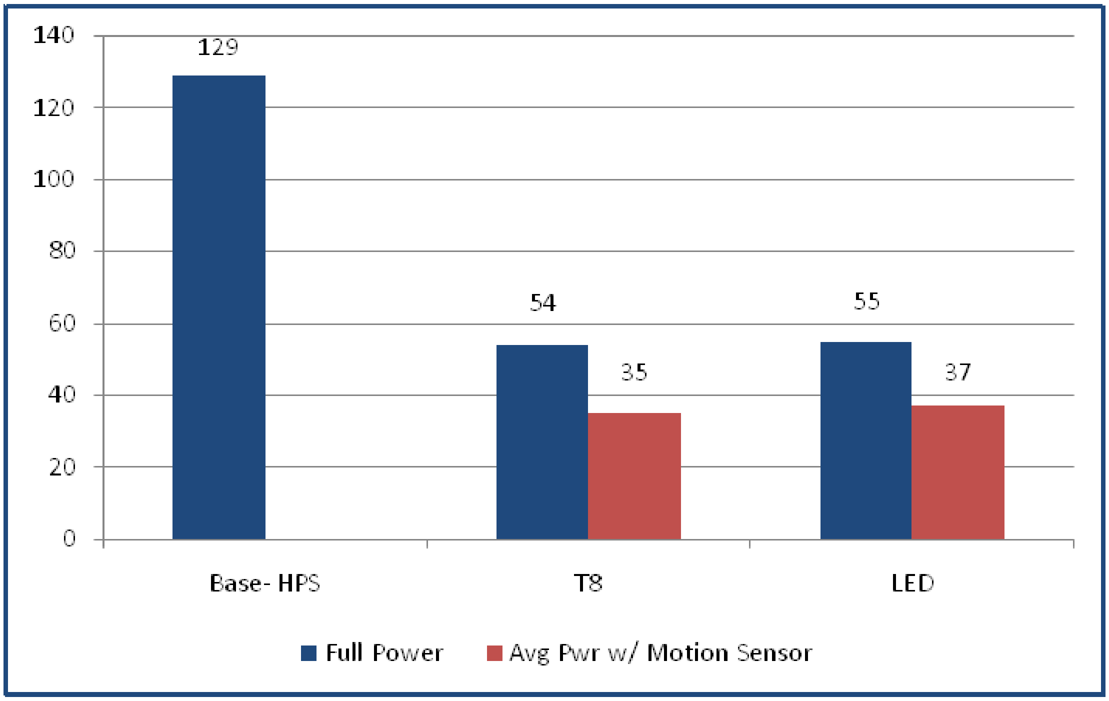
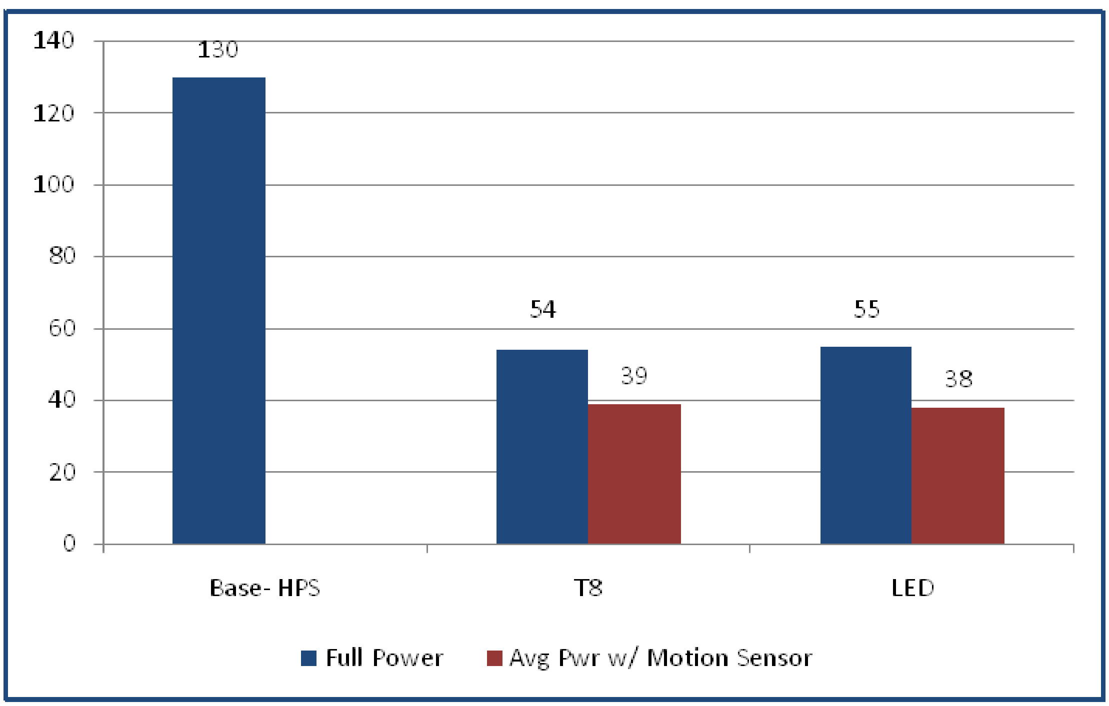



**Figure 11: Victoria Park Power Usage (watts per fixture)**



Actual energy savings compared to the baseline design were nearly identical for both the fluorescent and LED fixtures, ranging from 70-73% (see Tables 5 and 6 below). The majority of the savings were due to the reduced wattage of the new LED and T8 fixtures. The adaptive control systems accounted for approximately 20% of the total energy savings.

**Table 5: Ellesmere Calculated Savings**

| | Power Savings | Percent Savings |
|---|---|---|
| T8 fixtures | 129 W – 35 W = 94 W | 73% |
| LED fixtures | 129 W -37 W = 92 W | 71% |

**Table 6: Victoria Park Calculated Savings**

| | Power Savings | Percent Savings |
|---|---|---|
| T8 fixtures | 130 W – 39 W = 91W | 70% |
| LED fixtures | 130 W – 38 W = 92 W | 71% |

## 4.7 Economic Performance

The economic performance of the LED and fluorescent luminaires was assessed under two scenarios. The first is an early replacement scenario, where the costs and benefits of installing the LED fixtures are compared against leaving the existing HPS fixtures installed, over a fifteen year period. This scenario assumes that the HPS fixtures would last for an additional fifteen years with only replacement of minor components (in this case that would be unlikely).

The second scenario is an end of life or new construction scenario, where the costs/benefits of the LED fixtures are compared against the costs of purchasing new HPS fixtures assumed to be equivalent to those already installed at the site. This scenario assumes that the lights need to be replaced within the near term future, and could also be extrapolated to new construction situations where project managers are faced with a choice between HPS and LED fixtures.

The installed cost of the LED fixtures was $1,066 per fixture. The installed cost of the T8 fixtures was $307 per fixture. The assumed installed cost of a new HPS luminaire is $260. Average annual maintenance savings are based on information provided by TCH staff.

The results of each scenario are illustrated below (on a per-fixture basis).

**Table 7: Economic Performance for Early Replacement Scenario**

| Fixture | Cost | Annual Energy Savings* | Avg. Annual Maintenance Savings | Simple Payback** | 15 Year Return on Investment |
|---|---|---|---|---|---|
| LED | $1,066 | $81 | $17.50 | 10 years | 71% |
| T8 | $307 | $81 | $0 | 4 years | 443% |

* At $0.10/kWh

** Assuming 3.5% annual inflation in energy prices

**Table 8:** Economic Performance for End of Life or New Construction Scenario

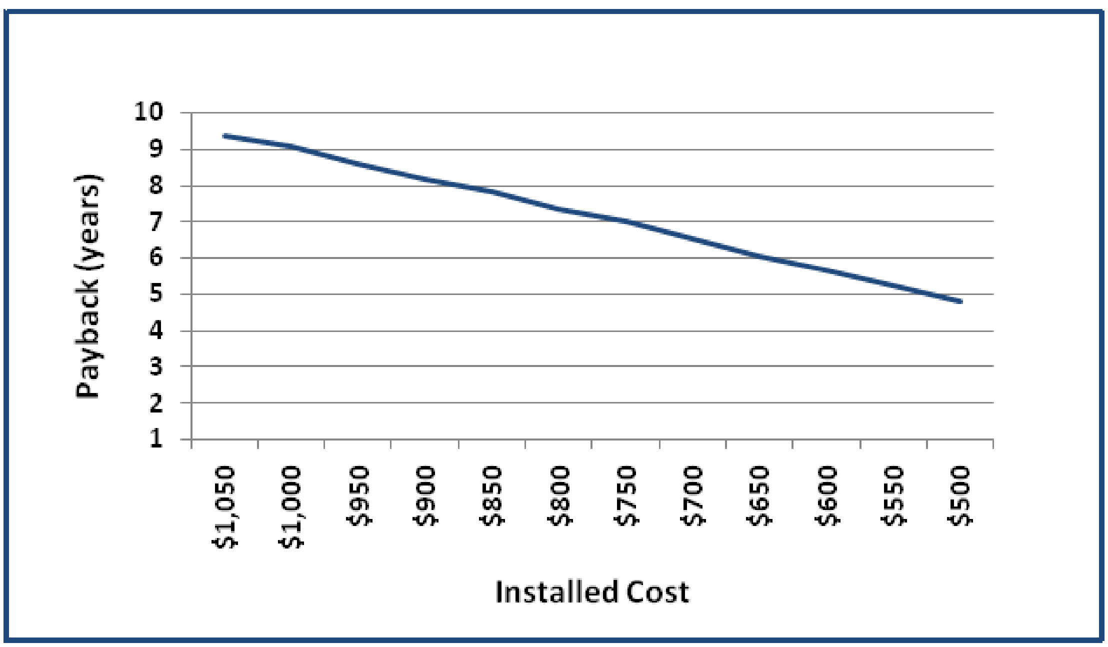
| Fixture | Incremental Cost | Annual Energy Savings* | Avg. Annual Maintenance Savings | Simple Payback** | Total Cost of Ownership (15 years)** |
|---|---|---|---|---|---|
| LED | $806 | $81 | $17.50 | 8 years | $1,706 |
| T8 | $47 | $81 | $0 | 1 year | $974 |
| HPS | N/A | N/A | N/A | N/A | $2,470 |

* At $0.10/kWh
** Assuming 3.5% annual inflation in energy prices

The payback for the LED fixtures under the early replacement scenario is relatively long, although still well within the expected lifetime of the fixtures. Under the end of life or new construction scenario, the LED fixtures offer a considerably lower Total Cost of Ownership compared to the HPS lighting system. However, realizing this benefit depends on the products meeting the manufacturer claimed lifetimes of over 15 years.

It should be noted that the actual costs incurred in this pilot project are probably not representative of what the costs would be on future installations. First, the price of LED luminaires is falling relatively rapidly. Second, a larger purchase order would result in a lower price point. Figure 12 below illustrates the estimated payback of the LED fixtures in an end of life scenario at a variety of installed costs which might be achievable in the near-term future for larger scale projects. To achieve a five year payback, the installed cost of the LED fixtures would need to fall to below $600 per fixture.

**Figure 12:** Installed Costs vs. Payback (scenario one)



## 4.8 Public Perception Summary

LightSavers contracted EKOS Research Associates to test resident reaction to the new lighting in these two buildings. Four focus group sessions were held in the buildings across two nights. Each participant was also asked to complete a short questionnaire in order to better allow results to be compared across groups.

Residents in both buildings had strongly positive reactions to the new lighting and saw the new lighting as a vast improvement over the old lighting.

Safety was, by far, the top concern for a large majority of residents.
Most felt that the new lighting had positively impacted their sense of personal safety; several also mentioned that incidences of vandalism had been reduced following the installation of the new lights.

All residents perceived the new lights to be brighter than the old lighting. This was notable given that average illuminance levels were actually decreased. Though most felt the new lights were the right level of brightness some felt that the LEDs were too bright and others felt the Fluorescents were not bright enough.

The motion sensors were viewed very favourably by most residents. Many noted that their sense of personal safety was positively impacted by fact that motion sensors were being used and no one expressed concern at the lower levels of light when motion had not been detected.

While there were some differences in opinion on which of the new lights was preferred, there was a slight lean towards the LED lighting (which was perceived to be brighter).

Residents clearly would not support a return to the old lighting and the new lights have raised their expectations for garage lighting in their buildings.

The full survey report can be accessed at www.lightsavers.ca/public.php

# 5.0 Conclusions

The project has successfully proven that LED parking garage lighting, equipped with adaptive control technology, can be used to replace conventional High Pressure Sodium technology with excellent energy savings.

Average illuminance in the LED test area was very stable over 6500 hours of operation, indicating excellent lumen maintenance. This adds credibility to the manufacturer estimated lifespan of 150,000 hours for this application. Temperature sensitivity was present but within expected parameters.

The LED system was able to greatly exceed the minimum illuminance levels recommended by the IES (RP-20), and also exceeded the much stricter requirements of the Toronto Municipal Code, without requiring any changes to fixture spacing or the number of fixtures. Uniformity was excellent.

The LED lighting system, complete with adaptive controls, is expected to pay for itself within 10 years, which is well within the manufacturer estimated lifespan. However, the T8 fluorescent lighting system tested in parallel at these sites has a payback of under 4 years. This indicates that LEDs require further performance improvements, and/or price reductions, in order to be competitive with high-efficiency fluorescent technology from an economic perspective.

Residents strongly preferred both the LED and fluorescent lighting over the baseline HPS lighting. The new lighting is perceived to be brighter and makes the residents feel safer while in the garages — despite the fact that illuminance levels were reduced. This effect is presumed to result from the superior colour rendering of both the LED and fluorescent system. The adaptive control system was also well received by residents, with several noting that the system enhanced their feeling of safety by alerting them to the presence of other individuals in other parts of the garage.

While the majority of the energy savings were accounted for by the luminaires themselves, the adaptive control system accounted for approximately 20% of the total energy savings. The additional savings were more than adequate to justify the small incremental cost of the adaptive controls. However, the most significant benefit of the adaptive controls may be their expected impact on the LED luminaire lifetimes. The LED luminaires operate at a lower drive current in the low-power state, which reduces the temperature inside the luminaire. Heat is the primary cause of lumen depreciation in LEDs. This effect should extend the lifespan of the LED fixtures by up to 50%.

# Appendix A: IESNA Parking Garage Illuminance Recommendations

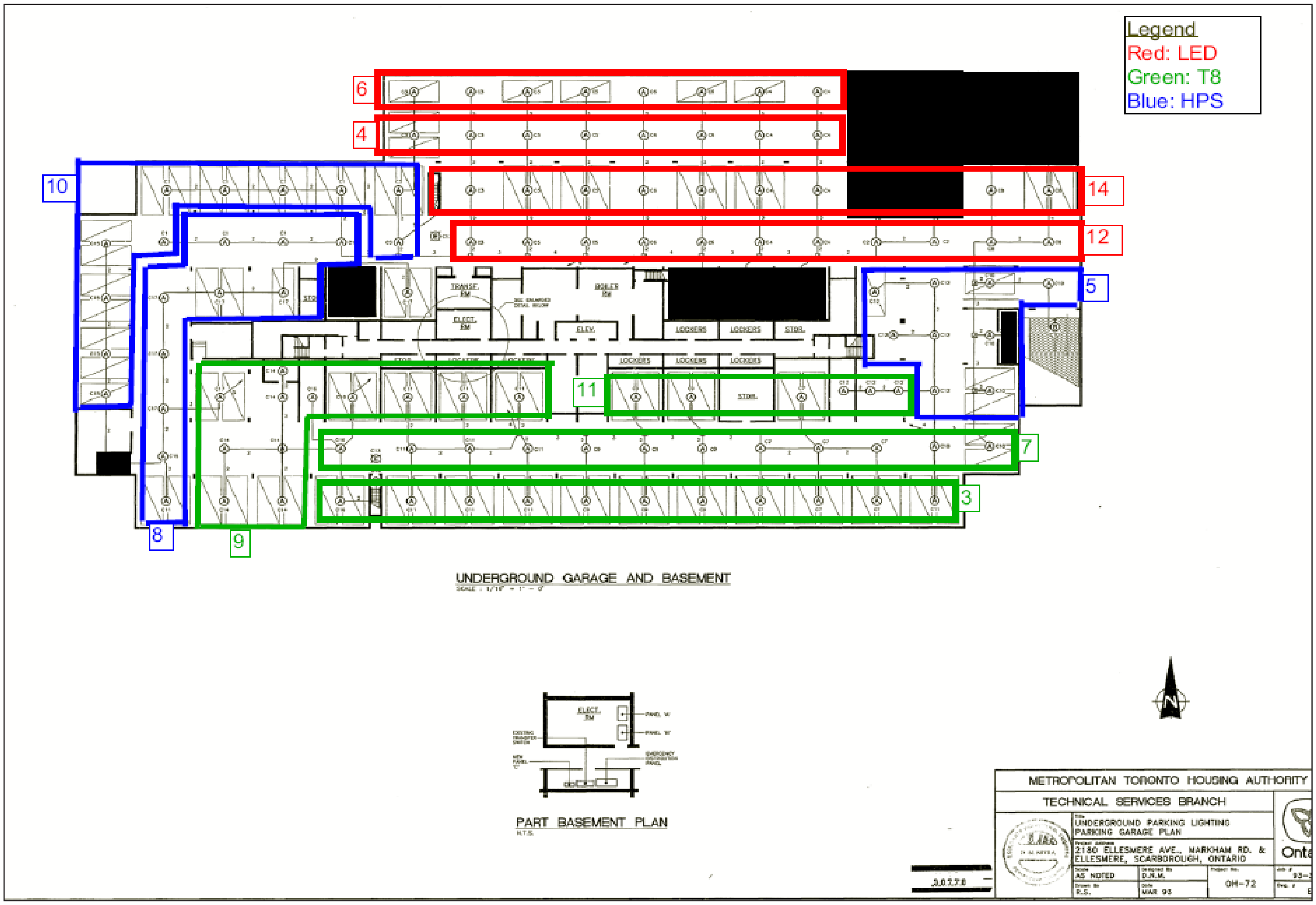
| | Basic | Enhanced Security |
|---|---|---|
| Min Horizontal Illuminance | 2 lx, 0.2 fc | 5 lx, 0.5 fc |
| Uniformity ratio (max-min) | 20:1 | 15:1 |
| Min Vertical Illuminance | 1 lx, 0.1 fc | 2.5 lx, 0.25 fc |

PARKING LOT LIGHTING

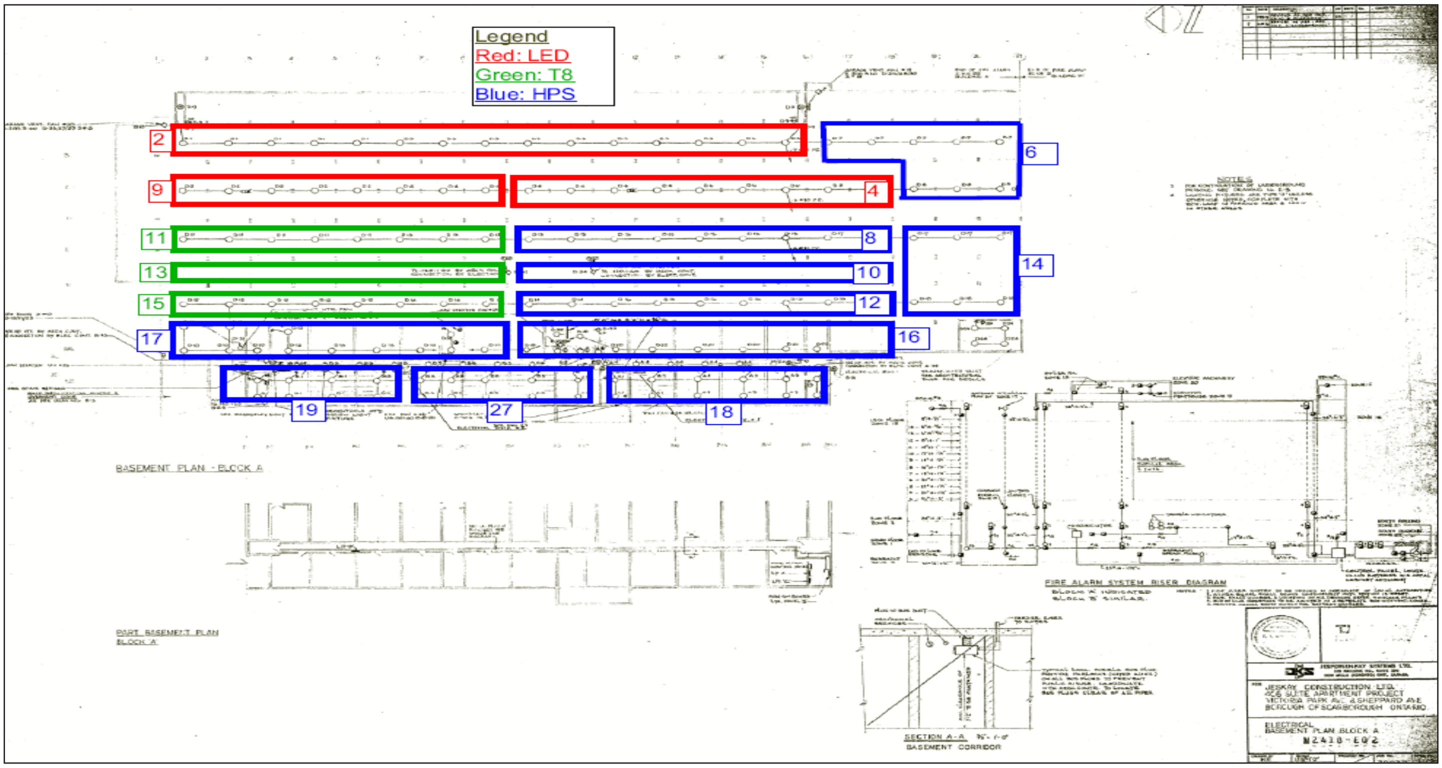
| | Basic | Ramps: Day | Ramps: Night | Entrance: Day | Entrance: Night | Stairs |
|---|---|---|---|---|---|---|
| Min. Horiz'l | 10 lx<br>1.0 fc | 20 lx<br>2.0 fc | 10 lx<br>1.0 fc | 500 lx<br>50 fc | 10 lx<br>1.0 fc | 20 lx<br>2.0 fc |
| Max:Min | 10:1 | 10:1 | 10:1 | | 10:1 | |
| Min. Vertical | 5 lx<br>0.5 fc | 10 lx<br>1.0 fc | 5 lx<br>0.5 fc | 250 lx<br>25 fc | 5 lx<br>0.5 fc | 10 lx<br>1.0 fc |

PARKING GARAGE LIGHTING

# Appendix B: Fixture locations at 2180 Ellesmere



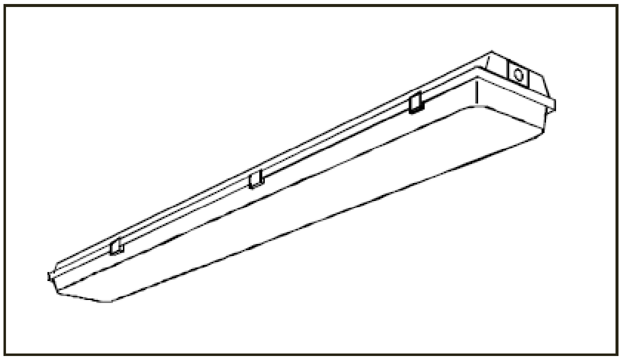
## Appendix C:  Fixture locations at 2743 Victoria Park



# FIBERGLASS FLUORESCENT LUMINAIRES for WET or DAMP LOCATIONS

# DC/DP

FLUORESCENT LAMPS 32 W/T8



*Date:*___________

*Project Name:*

*Fixture type:*

*Cat. No:*

*Volts:*

*Ballast type:*

*Variants:*

## Specifications:

**GENERAL:** A fluorescent lighting strip totally enclosed within a sealed fiberglass body. Continuous neoprene gasket around perimeter of acrylic diffuser. The diffuser is supported with tension latches that hinge on either side.
Weather, moisture, corrosion and dust resistant. Suitable for commercial and industrial applications such as packing houses, food processing, kitchens, etc.. Available for surface or stem mounting.

**SHIELDING:** DCC and DPC series, supplied with a crepe pattern clear acrylic diffuser.
**DCO and **DPO series, supplied with a white opal acrylic diffuser.

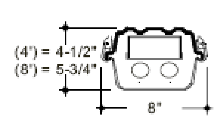
**HOUSING:** Interior housing die-formed from code gauge steel. Finish white polyester powder coating. Steel parts are chemically cleaned and phosphatized ensuring maximum paint adhesion. Exterior enclosure is moulded fiberglass. Note: all perforations made and installation hardware must be sealed by installer.

**ELECTRICAL:** Units are equipped with certified electronic instant start ballasts 120 vac. 60Hz. Other ballasts and voltages are available upon request. Lampholders medium bi-pin.

**CERTIFIED:** CSA and/or UL.

| LENGTH | LAMPS | CAT. NO. SURFACE | CAT. NO. PENDANT | WEIGHT |
|---|---|---|---|---|
| 52" | 2-32 W/T8 | **DCO-4-232- | **DPO-4-232- | 6 Kg (13) |
| | 2-32 W/T8 | DCC-4-232- | DPC-4-232- | |
| 102" | 4-32 W/T8* | DCC-8-432- | DPC-8-432- | 12 Kg (26 lbs) |

* LAMPS IN TANDEM
** WHITE OPAL DIFFUSER supplied




**ORDERING GUIDE:**
**CAT. NO. + VOLTS + BALLAST**

120
277
347

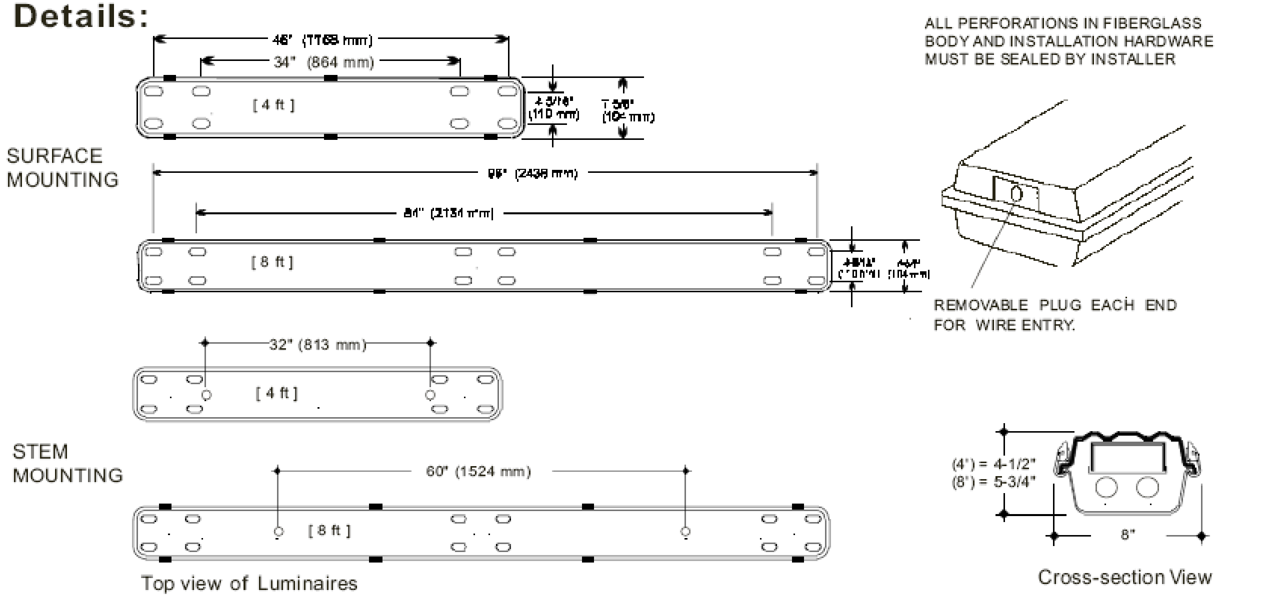
EL = Electronic

*Example:* **DCC-4-232-120-EL**

**PEERLESS ELECTRIC CO. LTD** ISSUED JAN. 4, 2003 REV...............

SPEC SHEET No **DC-02E**

## Details:



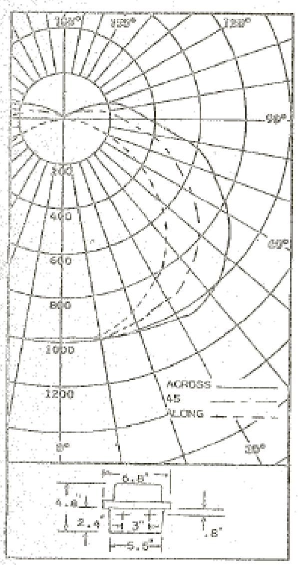

## Photometric Data:

ENVIRONMENTAL RESEARCH LABORATORIES

7410 E. HELM DRIVE, THUNDERBIRD INDUSTRIAL AIRPARK, SCOTTSDALE, ARIZONA 85260 TELEPHONE: (602) 948-3471

CERTIFIED TEST REPORT NO. ERL 4067
COMPUTED BY ERL PROGRAM **INDOOR**

PEERLESS SEALED WRAPAROUND LUMINAIRE, CAT. NO. FCC248 OR FPC248
CLEAR STIPPLED ACRYLIC LENS, FIBERGLASS HOUSING, CANADA G.E. BALLAST #17A240E
TWO SYLVANIA F40T12CW FLUORESCENT LAMPS, RATED 3150 LUMENS EACH




CANDLEPOWER SUMMARY

| ANGLE | ACROSS | 67.5 | 45 | 22.5 | ALONG | OUTPUT LUMENS |
|---|---|---|---|---|---|---|
| 0 | 985 | 985 | 985 | 985 | 985 | |
| 5 | 982 | 981 | 978 | 975 | 973 | 94 |
| 10 | 1016 | 1013 | 1004 | 992 | 987 | |
| 15 | 997 | 992 | 975 | 955 | 944 | 278 |
| 20 | 1024 | 1011 | 980 | 950 | 931 | |
| 25 | 994 | 975 | 927 | 882 | 857 | 434 |
| 30 | 1009 | 983 | 916 | 849 | 815 | |
| 35 | 1039 | 1007 | 921 | 828 | 786 | 568 |
| 40 | 1013 | 979 | 879 | 762 | 709 | |
| 45 | 994 | 956 | 847 | 705 | 638 | 641 |
| 50 | 954 | 915 | 798 | 641 | 561 | |
| 55 | 901 | 859 | 735 | 567 | 474 | 638 |
| 60 | 844 | 798 | 666 | 489 | 384 | |
| 65 | 774 | 728 | 590 | 405 | 294 | 559 |
| 70 | 689 | 646 | 509 | 320 | 209 | |
| 75 | 635 | 592 | 456 | 256 | 142 | 447 |
| 80 | 565 | 527 | 401 | 198 | 84 | |
| 85 | 453 | 419 | 316 | 140 | 35 | 315 |
| 90 | 384 | 350 | 252 | 104 | 13 | |

ZONAL LUMENS AND PERCENTAGES

| ZONE | LUMENS | % LAMP | % FIXTURE |
|---|---|---|---|
| 0-30 | 806 | 12.80 | 18.12 |
| 0-40 | 1374 | 21.82 | 30.89 |
| 0-60 | 2653 | 42.12 | 59.62 |
| 0-90 | 3973 | 63.07 | 89.28 |
| 40-90 | 2598 | 41.25 | 58.39 |
| 60-90 | 1319 | 20.95 | 29.66 |
| 90-180 | 476 | 7.57 | 10.72 |
| 0-180 | 4450 | 70.64 | 100.00 |

** EFFICIENCY = 70.64% **

PREPARED FOR:
PEERLESS LIGHTING
MONTREAL, QUEBEC

LUMINANCE SUMMARY - FOOTLAMBERTS

| ANGLE | ACROSS AVG | ACROSS MAX | ACROSS M/A | ALONG AVG | ALONG MAX | ALONG M/A |
|---|---|---|---|---|---|---|
| 45 | 1411 | 2551 | 1.8 | 1180 | 2017 | 1.7 |
| 55 | 1413 | 2448 | 1.7 | 1059 | 1745 | 1.6 |
| 65 | 1404 | 2266 | 1.6 | 864 | 1354 | 1.6 |
| 75 | 1416 | 2330 | 1.6 | 639 | 959 | 1.5 |
| 85 | 1366 | 2319 | 1.7 | 360 | 368 | 1.0 |

REFLECTANCE OF PAINT: 88%
SC(ALONG)=1.3, SC(ACROSS)=1.6
S/MH = 1.6
CERTIFIED BY: L.M. Ayers

DATE: MAR 26, 1980
TESTED IN ACCORDANCE WITH IES PROCEDURES. TEST DISTANCE EXCEEDS 25 FEET.

### COEFFICIENTS OF UTILIZATION

ZONAL CAVITY METHOD

EFFECTIVE FLOOR CAVITY REFLECTANCE = 20%

| CC | 80 | | | | 70 | | | | 50 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WALL | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 |
| RCR | | | | | | | | | | | |
| 1 | .74 | .70 | .66 | .63 | .71 | .67 | .64 | .61 | .63 | .60 | .58 |
| 2 | .66 | .60 | .55 | .50 | .64 | .58 | .53 | .49 | .54 | .50 | .46 |
| 3 | .60 | .52 | .46 | .41 | .58 | .50 | .45 | .40 | .47 | .42 | .39 |
| 4 | .55 | .46 | .39 | .34 | .53 | .44 | .38 | .34 | .42 | .36 | .32 |
| 5 | .50 | .40 | .34 | .28 | .48 | .39 | .33 | .28 | .37 | .31 | .27 |
| 6 | .46 | .36 | .29 | .24 | .44 | .35 | .28 | .24 | .33 | .27 | .23 |
| 7 | .42 | .32 | .25 | .21 | .40 | .31 | .25 | .21 | .29 | .24 | .20 |
| 8 | .39 | .29 | .22 | .18 | .37 | .28 | .22 | .18 | .26 | .21 | .17 |
| 9 | .36 | .26 | .20 | .15 | .34 | .25 | .19 | .15 | .23 | .18 | .15 |
| 10 | .33 | .23 | .17 | .13 | .32 | .23 | .17 | .13 | .21 | .16 | .13 |

SPEC SHEET No. **DC-02E**

**PEERLESS ELECTRIC CO. LTD**
9145 BOIVIN, LASALLE, QUE. H8R 2E5 TEL. (514) 595-1671
161 BARTLEY DRIVE, TORONTO, ONT. M4A 1E6 TEL. (416) 751-5644

# QUICKTRONIC® PROStart® T8 QUICKSTEP® Bi-Level Dimming

*High Efficiency Series*

Normal Ballast Factor

## Lamp/Ballast Guide

Primary Systems
32W T8 - OCTRON®
2-lamp QHES2x32T8/UNV PSN-SC

Also operates:
FBO32, FBO31, FO25, FBO24, FO17 & FBO16

NOTE: NOT FOR USE WITH ENERGY SAVING T8 LAMPS, (operation in bi-level mode will cause lamp instability and lamps may not start)

## Key System Features

- QUICKSTEP Stepped Switching, bi-level dimming (0.87 BF to 0.34BF)
- High Efficiency Systems – over 90% efficient
- NEMA Premium Ballast compliant
- California Title 24 compliant
- PROStart Programmed Rapid Start
  - Extends lamp life
- Universal input voltage (120 – 277v)


## Application Information

**SYLVANIA QUICKTRONIC PROStart T8 QUICKSTEP** is ideally suited for:

- Office
- Schools
- Commercial
- Retail
- Occupancy sensor usage
- Building control systems
- Institutional

**SYLVANIA QUICKTRONIC High Efficiency PROStart QUICKSTEP** is a programmed rapid start electronic T8 ballasts that will operate the family of linear and U-bend equivalent T8 lamps at high efficiency. QUICKSTEP bi-level step dim ballasts are specifically designed to meet California's Energy Efficiency Standards (Title 24) for multi-level lighting controls, (Section 131). The combined lamp and ballast system offers a high efficiency system for T8 luminaires along with high performance features that are standard on **SYLVANIA HIGH EFFICIENCY** Series ballasts.

QUICKTRONIC QHE PROStart delivers an optimized programmed rapid start technology which extends T8 lamp life and allows over 50,000 switching cycles for occupancy sensor and building control systems applications.

Setting the standard for quality, QUICKTRONIC PROStart QUICKSTEP systems are covered by our QUICK 60+® warranty, the first and most comprehensive system warranty in the industry.


The QUICKTRONIC PROStart QUICKSTEP ballasts also meets the requirements for the **NEMA Premium Ballast, (NPB) program.** The NPB program promotes the use of high efficiency T8 electronic ballasts by meeting or exceeding the Ballast Efficiency Factors, (BEF) established by the CEE, (Consortium for Energy Efficiency). For additional information on this program go to: ***www.cee1.org*** or ***www.nema.org***

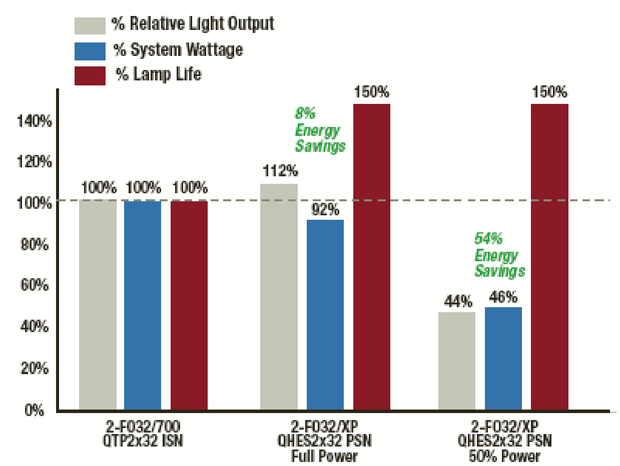
## System Information

**SYLVANIA QUICKTRONIC PROStart QUICKSTEP High Efficiency (QHES)** ballasts operate from 120V through 277V, eliminating "wrong voltage" wiring errors and reducing the number of models in inventory by 50%.

**QUICKSTEP QHES PROStart** system has two AC line inputs in addition to the neutral wire. These AC line inputs must be connected to the same phase of the line voltage. The two line inputs can be configured to provide a bi-level light output system by wiring with two switches. When both switches are on, the lamps operate at full light output. When either switch is off, the lamps operate in a dimmed mode and the ballast wattage is reduced by 50%.

Alternatively, QUICKSTEP ballasts can be controlled by occupancy sensors allowing for customized zone controls and various energy saving configurations.

| Lamp & Ballast Type | BF | Input Watts | Initial LPW | Mean System Lumens @ 8000 Hours | Relative Light Output @ 8000 Hours | % System Watts | % Energy Savings | % Lamp Life @3hrs/ Start |
|---|---|---|---|---|---|---|---|---|
| 2-FO32/700 QTP2x32 ISN | 0.88 | 59 | 84 | 4,435 | 100% | 100% | 0% | 100% |
| 2-FO32/XP QHES2x32 PSN Full Power | 0.87 | 54 | 97 | 4,959 | 112% | 92% | 8% | 150% |
| 2-FO32/XP QHES2x32 PSN 50% Power | 0.34 | 27 | 76 | 1,938 | 44% | 46% | 54% | 150% |




ECS089 - 3/2008

SEE THE WORLD IN A NEW LIGHT SYLVANIA

Normal Ballast Factor

# PROStart® T8 PSN

## QUICKSTEP Bi-level Dimming

## High Efficiency Systems

NEMA Premium

## High Efficiency QUICKSTEP® (Bi-Level) T8 DIMMING SYSTEMS (120-277V)

| Item Number | OSRAM SYLVANIA Description | | Input Current (AMPS) | Lamp Type | Rated Lumens (lm) | No. of Lamps | Ballast Factor (BF) | System Lumens | Mean Lumens | Input Wattage (W) | System Efficacy (lm/W) | BEF[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QHES2x32T8/UNV PSN-SC | (@100%) | 0.46/0.20 | FO32/700 | 2800 | 2 | 0.87 | 4870 | 4385 | 55/54 | 89/90 | 1.61 |
| 49157 | Banded Pack | (@50%) | 0.23/0.10 | FO32/700 | 2800 | 2 | 0.34 | 1905 | 1810 | 27 | 71 | 1.26 |
| 49156 | Pallet Pack | (@100%) | 0.46/0.20 | FO32XP | 3000 | 2 | 0.87 | 5220 | 4960 | 55/54 | 95/97 | 1.61 |
| | | (@50%) | 0.23/0.10 | FO32XP | 3000 | 2 | 0.34 | 2040 | 1940 | 27 | 76 | 1.26 |
| | | (@100%) | 0.34/0.16 | FO25XP | 2175 | 2 | 0.88 | 3830 | 3635 | 42/41 | 91/93 | 2.15 |
| | | (@50%) | 0.18/0.09 | FO25XP | 2175 | 2 | 0.34 | 1480 | 1405 | 22 | 67 | 1.55 |
| | | (@100%) | 0.23/0.11 | FO17XP | 1375 | 2 | 0.88 | 2420 | 2300 | 28 | 86 | 3.14 |
| | | (@50%) | 0.15/0.07 | FO17XP | 1375 | 2 | 0.34 | 935 | 890 | 18 | 52 | 1.89 |

*Banded Pack contains 10 pieces, (add "-B" to Description). Pallet Pack contains 840 pieces, (add "-PAL" to Description).*

*1: Ballast Efficiency Factor (BEF) shown = (Ballast Factor x 100) divided by Input Wattage (Note: calculation based on lowest input wattage).*

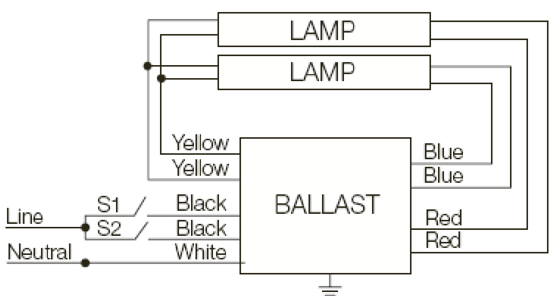
### Performance Guide

Data based upon SYLVANIA OCTRON® lamps shown. QUICKTRONIC QHE QUICKSTEP PROStart ballasts are also compatible with other lamp manufacturers equivalent lamp types that meet ANSI specifications. NOTE: NOT FOR USE WITH ENERGY SAVING T8 LAMPS, (operation in bi-level mode will cause lamp instability and lamps may not start).

QUICKSTEP PROStart ballasts will also operate F32, F25, F17 & U-bend equivalent T8 lamps. Complete performance data is available in the QUICKSYSTEMS section of the SYLVANIA Ballast Technology & Specification Guide.

### Installation Notes

- Install in accordance with National & Local Electric Code
- Ground Ballast Case
- The AC line inputs must be connected to the same phase of the line voltage
- <u>DO NOT CONNECT</u> two separate phases of line voltage to the input of QUICKSTEP ballasts, the ballast will be damaged and not covered by warranty




**2-Lamp QHES (QUICKSTEP)**

| | |
|---|---|
| Full light output (full power) | S1 & S2 closed (on) |
| Bi-level mode (50% power) | S1 or S2 open (off) |

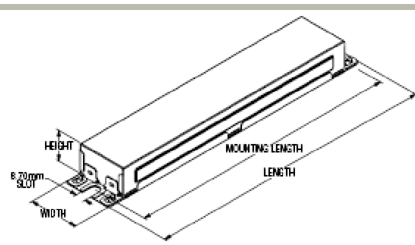
### Specifications
Data based on F32T8

**Starting Method:** Programmed Rapid-Start
**Ballast Factor:** 0.87/0.34
**Circuit Type:** Series
**Lamp Frequency:** >40 kHz
**Lamp CCF:** Less than 1.7
**Starting Temp:**[2]
0°F/-18°C for OCTRON T8 lamps; 32°F/0°C in dimmed mode
**Input Frequency:** 50/60 Hz
**THD:** <10% (full power)
<20% (@50% power)
**Power Factor:** >97% (full power)
**Voltage Range:** +/–10%

UL Listed Class P, Type 1 Outdoor
CSA Certified
70°C Max. Case Temp. (5 yr. warranty)
FCC 47CFR Part 18 Non-Consumer
Class A Sound Rating
ANSI C62.41 Cat A Transient Protection
Remote Mounting up to 7 feet (keep blue wires short, ie. lamp(s) attached to the blue leads to remain in the fixture that houses the ballast).

[2] Operation below 50°F/10°C may affect light output or lamp operation – see "Low Temp. Starting" definition.

**Dimensions Small Can Enclosure:**
Overall: 9.5" L x 1.68" W x 1.18" H
Mounting: 8.90"
Weight: 1.6 lbs ea. (approx.)




### System Life / Warranty

QUICKTRONIC products are covered by our QUICK 60+® warranty, a comprehensive lamp and ballast system warranty. For additional details, refer to our QUICK 60+ warranty bulletin.

### Ordering Guide

Item Number — **49157 QHES 2 x 32T8 / UNV PSN SC** — Enclosure Size: Small Can
QUICKTRONIC High Efficiency — Starting Type, PROStart, Normal Ballast Factor
Step Dim, QUICKSTEP (bi-level) — Line Voltage (120-277v)
Number of Lamps (2) — Primary Lamp Wattage & Type

Specifications subject to change without notice.



**OSRAM SYLVANIA National Customer Service and Sales Center**
1-800-LIGHTBULB (1-800-544-4828)
www.sylvania.com

the system solution®

**PRODUCT DATA**

LEVITON

# OSFHU Fixture-Mounted Infrared High-Bay Occupancy Sensor

The OSFHU self-contained sensor mounts directly to a luminaire or electrical box to provide local occupancy control for either general area or aisle way pattern detection using PIR technology with a microprocessor based digital architecture that minimizes false triggering. The OSFHU provides a trouble-free "install and forget" solution for high-bay lighting control.

- Passive Infrared Technology (PIR)
- Interchangeable lenses for 360° high-bay, 360° low-bay, and aisle way patterns
- Use in warehouses, manufacturing, and other high ceilings
- Cold storage application model available
- Simple, fast installation
- Mounts directly to industrial style fluorescent luminaires
- 8 ft.–40 ft. mounting heights
- 120/277/347 VAC
- 480 VAC

OSFHU

OSFHU-IxW • OSFHU-CxW • OSFOA-00W

### DESCRIPTION

The OSFHU high-bay occupancy sensor is specifically designed for high mounted areas such as warehouses, manufacturing and other high ceiling applications. The OSFHU installs directly to an industrial fluorescent luminaire or an electrical junction box. It is a self-contained sensor and relay that turns individual light fixtures on or off based on occupancy in the detection zone. It comes with three interchangeable lenses for use in either a 360° high-bay or 360° low-bay general area or an aisle way. The OSFHU provides reliable coverage up to 40 ft. mounting heights. The OSFHU is also available in a model for cold storage applications with temperatures as low as -40° F.

To improve the field-of-view for deep body fixtures, a separate offset adapter accessory (OSFOA-00W) can be used to position the sensor below the fixture body. The adapter simply snaps into a 1/2" knockout on the end of the industrial fixture to attach the sensor.

### OPERATION

Passive Infrared Technology (PIR) is used to sense occupancy by comparing the infrared energy from an object in motion and the background space. PIR sensors minimize false ON from background environmental conditions such as air movement to provide reliable detection of line-of-sight motion.

### INSTALLATION

The OSFHU installs directly to an industrial fluorescent fixture or an electrical junction box through a standard 1/2" knockout using provided lock-nut. Wiring is connected inside the fixture body. For deep body fixtures, the accessory OSFOA is a two piece plastic offset that installs into the fixture 1/2" knockout using the provided lock-nut. Then the OSFHU sensor is installed in one of three, 1/2" punch-outs positioning the OSFHU at the correct field-of-view position flush or below the fixture reflector assembly. Wiring is routed through the OSFOA to the fixture body for wiring.

### FEATURES

**Fast, Simple Installation:** The OSFHU sensor is a self-contained, line voltage sensor that easily installs on individual fixtures using standard 1/2" knockouts. Simply make the electrical connections inside the ballast compartment, install the appropriate, adjustable lens assembly included and the sensor is ready. For deep body fixtures, the OSFOA positions the OSFHU sensor flush or below the bottom of the reflector giving the sensor full field-of-view.

**Zero Crossing Circuitry:** Relay uses a zero crossing circuitry to provide reliable, long-life operation.

**Range and Coverage:** The 360° high-bay PIR lens provides a 2:1 spacing to mounting height coverage under 25 ft. mounting and a 1.5:1 for heights up to 40 ft. mounting. The 360° low-bay lens provides 2:1 spacing to mounting height coverage for 8 ft. to 20 ft. mounting. The aisle lens is designed to provide detection of 60 ft. long by 20 ft. wide for heights up to 40 ft. mounting.

**LED:** Green LED indicates occupancy detection.

**Leviton Mfg. Co., Inc. Lighting Management Systems**

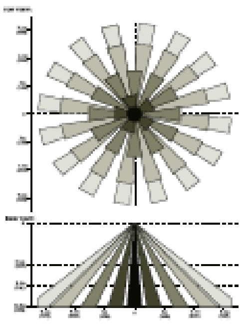
20497 SW Teton Avenue, Portland, OR 97062 1-800-736-6682 Tech Line: 1-800-959-6004 Fax: 503-404-5594 www.leviton.com/lms

**OSFHU-IxW • OSFHU-CxW • OSFOA-00W**

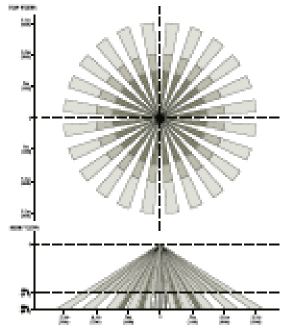
## PRODUCT DATA

LEVITON

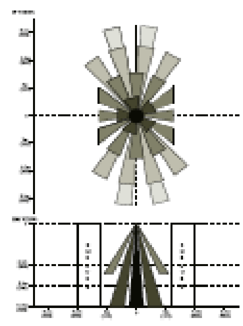
High-Bay 360° FOV

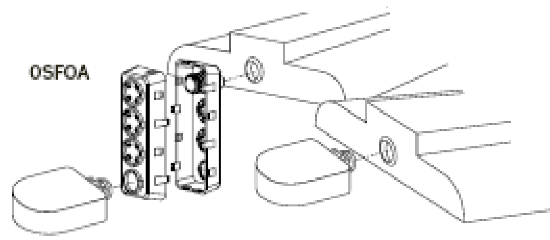


Low-Bay 360° FOV



Aisle FOV






### SPECIFICATIONS

**Electrical**

Input Voltage: 120/277/347 VAC
Input Voltage: 480 VAC
Operational Frequencies: 50/60Hz
Wire Designation: Line-Black, Load-Red, Neutral-White
Load Rating:
Fluorescent Ballasts: 800VA @ 120 VAC
1200VA @ 277 VAC
1500VA @ 347 VAC
2000VA @ 480 VAC
Motor: 1/4 HP Load @ 120V

**Environmental**

Operating Temperature Range:
OSFHU-IxW: 14°F to 160°F
OSFHU-CxW: -40°F to +40°F
Storage Temperature Range: -14°F to 160°F
Relative Humidity: 20% to 90% non-condensing

**Physical**

***OSFHU-IxW/OSFHU-CxW***

Size: 3.50" H x 3.50" W x 1.25" D
Color: White
Construction: High-impact, injection molded plastic housing.
Color coded wire leads are 42" long
Listings: UL and cUL Listed

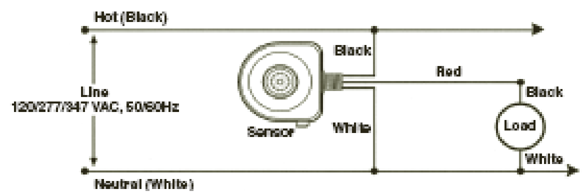
***OSFOA-00W***

Size: 5.50" H x 2.00" W x 2.00" D
Color: White
Construction: High-impact, injection molded plastic housing.

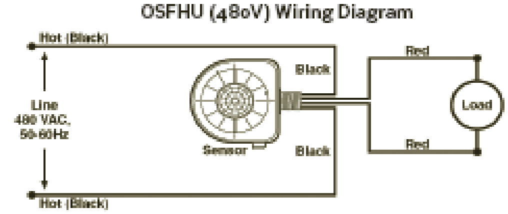
**Warranty**

Limited 5-Year Warranty

OSFHU Wiring Diagram




OSFHU (480V) Wiring Diagram




### CONTROLS

Timer Setting: 30 seconds–20 minutes

### ORDERING INFORMATION

| CAT. NO. | DESCRIPTION |
|---|---|
| OSFHU-ITW | Fixture-Mounted PIR High-Bay Sensor with 3 Interchangeable Lenses, White |
| OSFHU-CTW | Fixture-Mounted PIR High-Bay Sensor with 3 Interchangeable Lenses for Cold Storage, White |
| OSFHU-I4W | Fixture-Mounted PIR High-Bay Sensor with 3 Interchangeable Lenses, 480V, No Neutral, White |
| OSFHU-C4W | Fixture-Mounted PIR High-Bay Sensor with 3 Interchangeable Lenses for Cold Storage, 480V, No Neutral, White |
| OSFOA-00W | Fixture-Mounted Offset Adapter Accessory for OSFHU, 3 Position, White |

**Leviton Manufacturing Co., Inc. Lighting Management Systems**
20497 SW Teton Avenue, Portland, OR 97062
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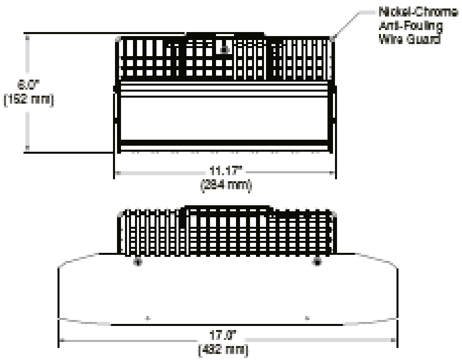
G-7366C/D8-cds

THE EDGE™

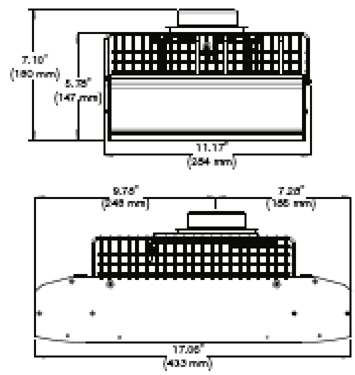
# LED PARKING STRUCTURE LIGHT

**X-PS SERIES**

**Direct Mount**




**Pendant Mount**




**Notes:**

| X=SSL/LED | PRODUCT | MOUNTINGS | OPTICAL SYSTEMS | NOMINAL DELIVERED LUMENS IN (00'S) | LED GENERATION | VOLTAGE | OPTIONS | COLOUR |
|---|---|---|---|---|---|---|---|---|
| X | PS = Parking Structure | 0 = Surface<br>9 = Pendant | 5 = Type V<br>A = Flood (Nema 6x6) | 034 (2 light bars)<br>051 (3 light bars)<br>068 (4 light bars)<br>085 (5 light bars) | B = 110 to 118 Lm/W | 1 = 120V<br>2 = 277V<br>*347V consult factory | E = Emergency<br>F = Fuse (120-277V)<br>P = Photocell | S = Silver<br>T = Black<br>W = White<br>Z = Bronze<br>B = Platinum Bronze |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| X | PS | | | | B | | | |

## GENERAL DESCRIPTION

Slim, low profile design. Fixture is constructed from rugged extruded aluminum and stamped metal components. LED driver is mounted in extruded aluminum fixture ends and sealed for weather-tight operation. High performance aluminum heatsinks specifically designed for LED parking structure application. Nickel-chrome plated wire guard provides anti-fouling protection from leaf/debris and animal nesting to assure cool LED operation. Mount bracket designed to mount directly over existing junction boxes. Optional pendant mount. 5 year limited warranty on fixture. Optional internal battery emergency backup available.

## LABELS

UL and cUL listed for wet locations.

## PATENT

Pending

## ELECTRICAL

Modular design accommodates varied lighting output from high brightness, white, 6000K, 75 CRI, long life LED sources operated at 350mA. 120-277V 50/60 Hz, Class 1 LED drivers are standard. 347V input is optional. LED drivers have power factor >90% and THD <20% at full load. Integral weather-tight electrical box with terminal strip for easy power hook-up.

## FINISH

Exclusive Colorfast DeltaGuard™ finish features an E-Coat epoxy primer with an ultra-durable silver powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Bronze, black, white and platinum bronze powder topcoats are also available. The finish is covered by our 10 year limited warranty.

## LED CLASS SPECIFICATIONS: GENERATION B

| Light Bars | Initial Delivered Lumens | | System Watts | | Dim. "A"/in. |
|---|---|---|---|---|---|
| | Type V | NEMA 6x6 | 120-277V | 347-480V | |
| 2 | 3,400 | 3,840 | 55 | 59 | 11.75 |
| 3 | 5,100 | 5,760 | 79 | 84 | 13.75 |
| 4 | 6,800 | 7,680 | 104 | 109 | 15.75 |
| 5 | 8,500 | 9,600 | 128 | 133 | 17.75 |

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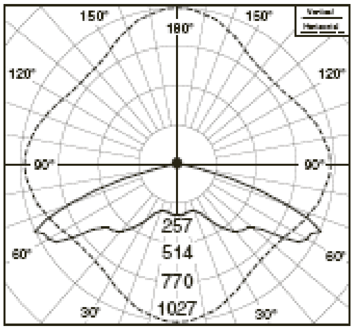
X-PS SERIES

THE EDGE™

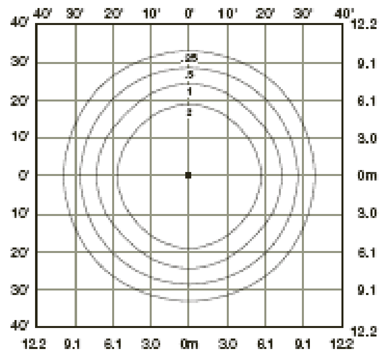
# LED PARKING STRUCTURE LIGHT

Isofootcandle plots show initial footcandles at grade. (Footcandles ÷ 0.0929 = Lux)

## Type V

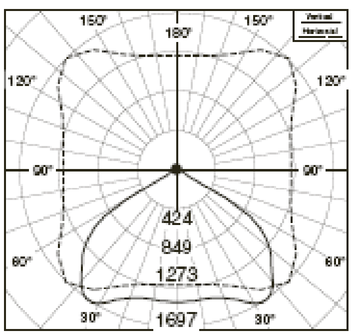


Independent Testing Laboratories certified test.
Report No. ITL 59237.
Candlepower distribution curve of 2 light bar Luminaire with 3138 initial delivered lumens.

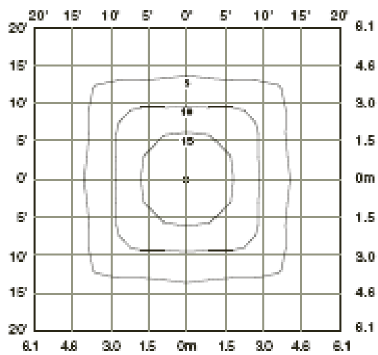


Isofootcandle plot of 4 light bars Type V LED luminaire at 10' A.F.G. Initial delivered lumens at 6276. Initial FC at grade.

## NEMA 6x6



Independent Testing Laboratories certified test.
Report No. ITL 59235
Candlepower distribution curve of 2 light bar luminaire with 3584 initial delivered lumens.



Isofootcandle plot of 6 light bar Type PS fixture at 15' A.F.G. Initial delivered lumens at 10752. Initial FC at grade.

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# LED MULTI-LEVEL OPTION

ACC-LED

| SPEC # | OPTION | DESCRIPTION |
|---|---|---|
| | G | 175/350/525mA Hi/Low Drive Current, Dual Circuit Input |
| | K | 175/525mA 2-Level w/ Integrated Sensor Control |
| | DK | 350/700mA 2-Level w/ Integrated Sensor Control |

| SPEC # | OPTION | DESCRIPTION |
|---|---|---|
| | L | 0/350mA 2-Level w/ Integrated Sensor Control |
| | CL | 0/525mA 2-Level w/ Integrated Sensor Control |
| | DL | 0/700mA 2-Level w/ Integrated Sensor Control |

## Products

| | | | Area | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Option | Voltage | Canopy | DA, DL, AA Mounts | R3, R4, R5 Mounts | SA Mounts | Round Area[1,2] | Security | Parking | Pathway[1] | LEDway |
| G[3] | 120 – 277 | 2 – 6 Light Bars | 1 – 6 Light Bars | 2 – 6 Light Bars | N/A | 2 – 6 Light Bars | 1 – 2[4] Light Bars | 2 – 5 Light Bars | Yes | 20 – 120 Leds |
| | 347 – 480 | 2 – 6 Light Bars | 2 – 6 Light Bars | 2 – 6 Light Bars | N/A | N/A | N/A | N/A | Yes | N/A |
| K | 120 – 277 | 2 – 5 Light Bars | 1 – 6 Light Bars | 2 – 5 Light Bars | 1 – 3 Light Bars | 2 – 6 Light Bars | N/A | 2 – 5 Light Bars | Yes, N/A on PO mount | 20 – 120 Leds |
| | 347 – 480 | N/A | 2 – 6 Light Bars | N/A | N/A | N/A | N/A | N/A | Yes, N/A on PO mount | N/A |
| DK | 120 – 277 | 2 – 3 Light Bars | 1 – 6 Light Bars | 2 – 3 Light Bars | 1 – 3 Light Bars | N/A | N/A | 2 – 3 Light Bars | N/A | 20 – 100 Leds |
| | 347 – 480 | N/A | 2 – 6 Light Bars | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| L | 120 – 277 | 2 – 6 Light Bars | 1 – 12 Light Bars | 2 – 6 Light Bars | 1 – 3 Light Bars | 2 – 6 Light Bars | 1 – 5 Light Bars | 2 – 5 Light Bars | Yes | 20 – 120 Leds |
| | 347 – 480 | 2 – 6 Light Bars | 1 – 12 Light Bars | 2 – 6 Light Bars | N/A | 2 – 6 Light Bars | N/A | N/A | Yes, N/A on PO mount | N/A |
| CL | 120 – 277 | 2 – 5 Light Bars | 1 – 6 Light Bars | 2 – 5 Light Bars | 1 – 3 Light Bars | 2 – 6 Light Bars | N/A | 2 – 5 Light Bars | Yes, N/A on PO mount | 20 – 120 Leds |
| | 347 – 480 | N/A | 2 – 6 Light Bars | N/A | N/A | N/A | N/A | N/A | Yes, N/A on PO mount | N/A |
| DL | 120 – 277 | 2 – 3 Light Bars | 1 – 6 Light Bars | 2 – 3 Light Bars | 1 – 3 Light Bars | N/A | N/A | 2 – 3 Light Bars | N/A | 20 – 100 Leds |
| | 347 – 480 | N/A | 2 – 6 Light Bars | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

*1 Round area spider mount maximum pole height is 10'.*
*2 All round area and pathway fixtures equipped with microwave sensor are 120/277VAC.*
*3 See G option drive current chart.*
*4 120 – 240V is required only for two light bars.*

## Additional Options Available with Multi-Level

| | | | Area | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Option | Voltage | Canopy | DA, DL, AA Mounts | R3, R4, R5 Mounts | SA Mounts | Round Area | Security | Parking | Pathway | LEDway |
| G | 120 – 277 | N/A | N/A | N/A | N/A | F | N/A | N/A | F | F, P, R |
| | 347 – 480 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | F | N/A |
| K | 120 – 277 | F, P | F, P, R[5] | F, P | N/A | F | N/A | F, P | F | F, P, R |
| | 347 – 480 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | F | N/A |
| DK | 120 – 277 | F, P | F, P, R | F, P | N/A | N/A | N/A | F, P | N/A | F, P, R |
| | 347 – 480 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| L | 120 – 277 | F | F | F | N/A | F | F | F | F | F, P, R |
| | 347 – 480 | N/A | N/A | N/A | N/A | F | N/A | N/A | F | N/A |
| CL | 120 – 277 | F | F | F | N/A | F | N/A | F | F | F, P, R |
| | 347 – 480 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | F | N/A |
| DL | 120 – 277 | F | F | F | N/A | N/A | N/A | F | N/A | F, P, R |
| | 347 – 480 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

*5 Five light bar maximum. Sensor moves to side casting.*
*NOTES: F–Fuse; P–Photocell; R–NEMA Photocell Receptacle. If fixture is equipped with photocell, fixture is wired as off, low mode and high mode.*

### Multi-Level Options

| Option | Drive Current (mA) | Sensor Included |
|---|---|---|
| G | 175/350/525 | No |
| K | 175/525 | Yes |
| DK | 350/700 | Yes |
| L | 0/350 | Yes |
| CL | 0/525 | Yes |
| DL | 0/700 | Yes |

### LEDway™ Output Multipliers

| Drive Current (mA) | Lumen Multiplier | Power Multiplier | $L_{70}$ Life (hours)* |
|---|---|---|---|
| 175 | | | |
| 350 | | | |
| 525 | | | |
| 700 | | | |

** Based on Ruud LEDway™ Series at 15ºC (59ºF) ambient temperature. Output multipliers are not to be used in conjunction with LD map.*

### THE EDGE™ Output Multipliers

| Drive Current (mA) | Lumen Multiplier | Power Multiplier | $L_{70}$ Life (hours)* |
|---|---|---|---|
| 175 | 0.60 | 0.5 | > 150,000 |
| 350 | 1.00 | 1.0 | > 150,000 |
| 525 | 1.34 | 1.5 | 70,000 |
| 700 | 1.60 | 2.1 | 50,000 |

** Based on Ruud EDGE™ Series at 15ºC (59ºF) ambient temperature. Output multipliers are not to be used in conjunction with LD map.*

### G Option Drive Current Configurations

| Leads | | Drive Current Output |
|---|---|---|
| 175mA | 350mA | |
| ON | OFF | 175 |
| OFF | ON | 350 |
| ON | ON | 525 |

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ACC-LED

# LED MULTI-LEVEL OPTION

| Sensor Details | |
|---|---|
| **Application** | **Lens** |
| Canopy | 20' maximum mounting height, 40' coverage area, 360º<br>Lens with 40' maximum diameter coverage area at 20' maximum height. Coverage distribution has a cone of 90º aperture.<br>Detecting lens tiers are uniformly distributed thru coverage area.<br>See figure 1. Consult factory for special configurations. |
| Area / LEDway | 40' maximum mounting height, 68' coverage area, 360º<br>Lens with 68' maximum diameter coverage area at 40' maximum height. Coverage distribution has a cone of 80º aperture.<br>Detecting lens tiers are more dense in the inner 24' diameter area with absent tiers from 26 – 50'.<br>See figure 2. Consult factory for special configurations. |
| Parking / Security | 8' maximum mounting height, 50' coverage area, 360º<br>Lens with 50' maximum diameter coverage area at 8' maximum height. Coverage distribution has a cone of 145º aperture.<br>Detecting lens tiers are more dense in the inner 22' diameter area with absent tiers from 24 – 46'.<br>See figure 3. Consult factory for special configurations. |
| Pathway / Round Area | 12' maximum mounting height, 360º pattern<br>No lens required. 12' maximum height at the bottom of the sensor. Half sphere coverage pattern with 11' radius.<br>See figure 4. Consult factory for mounting heights greater than 12' or special mounting configurations above 12'. |

**Figure 1 Canopy Light**


**Figure 2 Area Light**

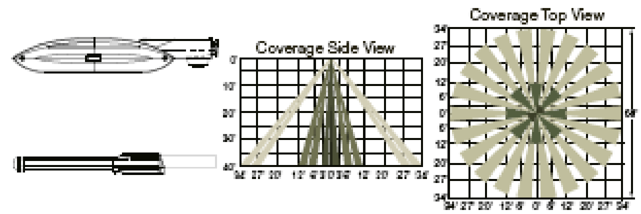



**Figure 3 Security/Parking Light**

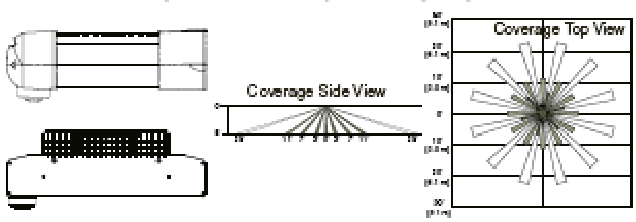
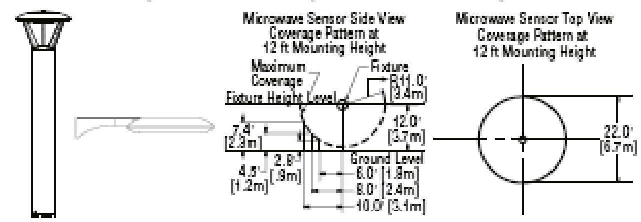



**Figure 4 Pathway/Round Area Light**




## GENERAL DESCRIPTION

The EDGE™ series multi-level options allow multiple operating drive currents for high and low modes. These drive currents are conveniently selected to balance LED life, lumen output and energy savings. Multi-level options are designed to have integrated and remotely located sensors. Multi-level function is designed with all LEDs operating at the same current for maximum and uniform LED life.

The recommended combination (175/525mA drive currents) provides approximately 45% of the delivered lumens while consuming only 33% of the energy in low (175mA) versus high (525mA) mode. Assuming an 80% vacancy rate in a space it also has a similar life expectancy to that of our standard 350mA product. The result is a system that provides energy savings and/or a lower initial cost without compromising quality or performance.

The G option will be wired such that four power leads will exit the fixture: two hots (line 1 and line 2), one common and one ground. The two hot leads will be labeled identifying the drive current, 175mA (line 1) and 350mA (line 2). See chart for G option drive currents for high low configurations. All other options will have three power leads: hot, common and ground.

## GENERAL DESCRIPTION CONT'D

The occupancy sensor used in Area, Canopy, LEDway, Parking and Security fixtures use passive infrared technology that reacts to changes in infrared energy (moving heat) within the coverage area. During operation if motion is detected within the sensor's coverage area, the relay in the sensor closes and lighting loads are automatically turned on. When motion is no longer detected for the duration of the time setting, the relay opens and the lighting load is turned off, or set to low level depending on the two level option. The occupancy sensor has customer adjustable light level and time delay features. Light levels can be adjusted from <10FC to >120FC. This feature is factory set at 20FC. The light level feature will only prevent the lights from turning on or going to high mode (depending on the two level option selected) when ambient light exceeds selected level. The light level feature does not switch the fixture.

Time delay can be adjusted from 30 seconds to 30 minutes and is factory set at 15 minutes. Once motion is detected the light level will remain unchanged until the set time cycle is completed.

The microwave sensor used in Pathway and Round Area fixtures utilizes SHF (Super High Frequency) technology to control lighting based on occupancy. It sends out electromagnetic waves that bounce off nearby surfaces, and uses the Doppler principle to analyze changes in the return waves to detect motion in the coverage area. This sensor is factory set to 10 minutes. This sensor operates at 120 or 277 VAC.

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## Appendix F: Summary Data Chart

| | LIGHTSAVERS TCHC SUMMARY DATA | | | |
|---|---|---|---|---|
| | ELLESMERE | | | |
| | | | | |
| | BASE-HPS | T8 | LED | Temperature |
| | | | | |
| February 9, 2010 | 142.0 | 114.5 | 95.2 | |
| February 24, 2010 | 139.4 | 114.0 | 95.7 | 2 |
| March 10, 2010 | 143.3 | 112.9 | 97.0 | 8 |
| March 24, 2010 | 139.5 | 113.3 | 95.0 | 9 |
| April 7, 2010 | 142.9 | 113.4 | 97.2 | 14 |
| April 21, 2010 | 141.3 | 112.6 | 96.4 | 14 |
| May 3, 2010 | 139.5 | 111.6 | 97.0 | 19 |
| May 18, 2010 | 137.3 | 110.9 | 97.4 | 17 |
| June 1, 2010 | 139.1 | 112.4 | 90.1 | 23 |
| June 18, 2010 | 129.6 | 112.3 | 94.2 | 21 |
| June 29, 2010 | 136.7 | 111.8 | 96.7 | 22 |
| July 14, 2010 | 132.5 | 106.4 | 93.3 | 25 |
| July 27, 2010 | 132.4 | 108.6 | 92.4 | 25 |
| August 12, 2010 | 133.0 | 107.0 | 93.3 | 25 |
| August 25, 2010 | 135.1 | 117.0 | 96.2 | 22 |
| September 7, 2010 | 133.4 | 112.0 | 92.4 | 22 |
| September 21, 2010 | 133.6 | 111.4 | 97.3 | 16 |
| October 5, 2010 | 138.4 | 118.0 | 93.9 | 16 |
| October 19, 2010 | 139.3 | 111.4 | 95.6 | 14.5 |

| LIGHTSAVERS TCHC SUMMARY DATA | | | | |
|---|---|---|---|---|
| VICTORIA PARK | | | | |
| | | | | |
| | | **Average Photopic** | | |
| **Measured Date** | **Base - HPS** | **T8** | **LED** | **Temperature** |
| February 11, 2010 | 159 | 101 | 100 | 0 |
| February 24, 2010 | 142 | 111 | 104 | 0 |
| March 10, 2010 | 140 | 113 | 105 | 9 |
| March 24, 2010 | 147 | 108 | 105 | 8 |
| April 7, 2010 | 145 | 111 | 111 | 15 |
| April 21, 2010 | 141 | 107 | 107 | 13.5 |
| May 3, 2010 | 146 | 110 | 113 | 19 |
| May 18, 2010 | 145 | 111 | 111 | 16.5 |
| April 1, 1900 | 137 | 101 | 104 | 23.5 |
| June 18, 2010 | 138 | 96 | 103 | 20 |
| June 29, 2010 | 138 | 105 | 103 | 21 |
| July 14, 2010 | 133 | 97 | 100 | 25 |
| July 27, 2010 | 136 | 100 | 101 | 26 |
| August 12, 2010 | 137 | 102 | 100 | 25 |
| August 25, 2010 | 133 | 103 | 103 | 22 |
| September 7, 2010 | 126 | 98 | 105 | 23 |
| September 21, 2010 | 141 | 110 | 110 | 18 |
| October 5, 2010 | 126 | 99 | 106 | 16 |
| October 19, 2010 | 130 | 98 | 106 | 15.7 |

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