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TO:	CHAIR AND MEMBERS CIVIC WORKS COMMITTEE MEETING ON APRIL 28, 20143
FROM:	EDWARD SOLDI, P. ENG. DIRECTOR, ROADS & TRANSPORTATION
SUBJECT	TRANSPORTATION ENERGY OPTIMIZATION PLAN (TEOP)

RECOMMENDATION

That on the recommendation of the Director, Roads & Transportation, the following actions **BE TAKEN** with respect to Light Emitting Diode (LED) street lights:

- a) The implementation of a LED Street Light Upgrade Program **IN PRINCIPLE**, subject to a business case being provided outlining capital and operating financial considerations;
 - i. Approval hereby **BE GIVEN** to enter into a contract with RealTerm Energy at a cost of \$90,000.00 excluding HST for the purchase of the street light mapping, data collection, photometric design and technical review related to the LED street light conversion project in accordance with the 'Procurement of Goods and Services Policy' Section 14.4 Single Source, Clauses e and g, noting that this data will be used to populate the City of London's Corporate Asset Management Database and provide the data necessary to develop a comprehensive business case;
 - ii. The Civic Administration **BE AUTHORIZED** to undertake all the administrative acts that are necessary in connection with this contract;
 - iii. Approval hereby given **BE CONDITIONAL** upon the Corporation entering into a formal contract or having a purchase order relating to the subject matter of this approval; and,
 - iv. The financing for this project as identified in the Sources of Financing Report attached hereto as Appendix "A" **BE ACCEPTED**.

- b) The proposed street light design criteria (Appendix "B") **BE CIRCULATED** to interested stakeholder for comments;
 - i. Civic Administration **BE DIRECTED** to report back at a future meeting summarizing the stakeholders comments and formalizing new street light design criteria adopting LED street lights as the only approved fixture for new construction and new developments.

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PREVIOUS REPORTS PERTINENT TO THIS MATTER

For additional information, please refer to the following committee reports:

1. October 19th, 2009: Environment and Transportation Committee “Alternative Street Lighting Technology Review”
2. October 18th, 2010: Environment and Transportation Committee “Alternative Street Lighting Technology Review – Update -

BACKGROUND

In October 2010, the Environment and Transportation Committee was provided with an update on the alternative street light technology which included a couple of pilot Light Emitting Diode (LED) street light locations. This report will provide an update to those pilot studies and where LED street lights are being currently being used or considered.

In April of 2014, the Civic Works Committee was provided an overview of major Environmental and Engineering initiatives for 2014. The Transportation Energy Optimization Plan (TEOP) was one four the four major initiatives for Roads and Transportation.

At the end of 2013, there were nearly 35,000 street lights in the City with wattages ranging from 70W to 400W. These lights can be broken down into three major categories:

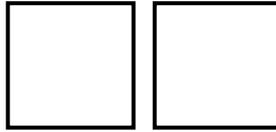
Style	Quantity	Wattage
Cobra (fixtures is on an arm extending over the road)	21,000	70W to 400W
Post-top (used on most residential streets)	13,650	70W to 150W
Other (pedestrian globes, wall mounted, etc)	350	70W to 250W

Manufactures have spent a significant amount of effort in developing cobra style LED fixtures; however, there are very few options available for post-top style fixtures. To date all of the pilot studies have included only cobra style fixtures.

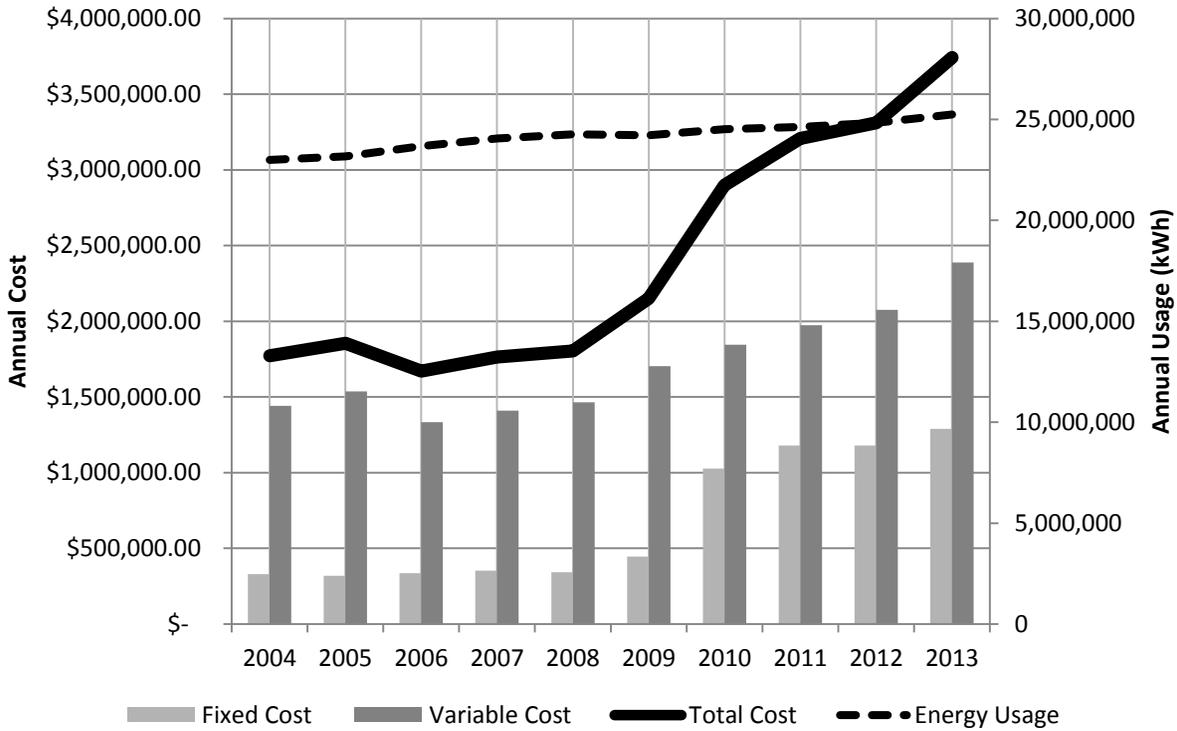
DISCUSSION

Street Light Energy

The annual street light energy costs have grown significantly over the last 10 years largely due to the cost of the electricity. Only a small portion of the increase can be attributed to growth in the street light network.



Street Light Energy



The cost of street light energy can be broken into two types of charges. There are fixed costs or delivery charges for the infrastructure needed to get electricity to the street lights. These charges do not vary based on the amount of electricity consumed. There are also variable charges that are based on the amount of electricity used.

As the above graph shows, the fixed energy costs increased significantly in 2010 and have continued to increase. The variable energy costs have steadily increased. The variable costs represent approximately 2/3rds of the energy bill and can be reduced if energy consumption is reduced. The fixed costs will not reduce if energy usage decreases. The energy efficiency of LED street lights compared to High Pressure Sodium (HPS) varies depending on the wattage. Based on current experience LED street lights consume 35% less energy than the equivalent HPS street lights. This translates into an approximate energy cost savings of 25%. LED street light technology is improving; therefore, energy savings may be higher once photometric designs are completed.

LED Street Light Use in Ontario

LEDs have been around a long time and are used in many different types of displays such as traffic signals. LEDs in street lights are a relatively new use and as with all new technologies, some of the early projects did not produce the expected results. The challenge for LED street light manufactures is to produce a fixture that uniformly distributes light onto the pavement and sidewalk and that meets the necessary lighting levels. Some LED fixture manufactures have developed their product to meet the road end user's needs. The following are some Ontario municipalities that have started converting their street light network from HPS fixtures to LED:

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Kingston	10,000 street lights at an estimated cost of \$4 million
Markham	12,300 cobra-style street lights in 2012
Mississauga	49,000 street lights started in 2012 at a cost of \$26 million. Implemented a street light monitoring system.
Sarnia	Starting process to replace mercury vapour street lights with LEDs.
Sudbury	1,300 street lights in 2012 at a cost of \$1.2 million
Windsor	23,000 street lights starting in mid-2014 at an estimate cost of \$14.3 million

Other municipalities have undertaken large LED street light upgrade projects, most notably Los Angeles; however, climate, energy rates and funding vary dramatically which makes comparisons to these cities difficult.

London’s LED Street Light Pilot Studies

The first LED street light pilot was installed at the intersection of Dundas Street and Creamery Road in March 2010 (using 110W LED fixtures instead of the standard 150W High Pressure Sodium (HPS) fixtures). There were some initial problems with the LED fixtures; however, these were resolved and the fixtures have been performing satisfactory.

A second pilot location was created in 2011 as part of the construction of Innovation Park Phase III (Oetker Gate, Discovery Drive and Nova Court). The traditional HPS design would use 150W fixtures. The LED design used 110W, 130W and 150W fixtures from three different suppliers. All three LED street light brands have performed well since their installation.

A third smaller pilot location was created in 2012 on Lorraine Avenue to test a fourth LED fixture that was not available when the Innovation Park Phase III was designed. To date this fixture has performed well.

The above three pilot locations have provided the City with areas to test four LED street light fixtures that meet our design criteria. All four fixtures have performed satisfactory and have been accepted for use on City street light projects.

Current Status of LED Street Lights

The development of Roadway Lighting Fixture Design Criteria and monitoring of the three pilot LED street light locations has provided staff with sufficient data to evaluate and recommend the use of the following LED street light fixtures for use on City streets:

Cree – LEDway



Holophane – LEDgend

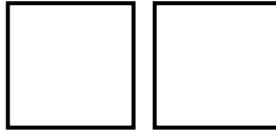


LED Roadway – Satellite



Phillips/Lumec – RoadStar





LED street lights have now been installed at the following locations:

Dundas Road at Creamery Road (Pilot #1)	3
Innovation Parking Phase III (Pilot #2)	35
King Edward Avenue	34
Lorraine Avenue (Pilot #3)	4
Meadowlilly Bridge	9
Oxford Street (Sanatorium Rd to Hyde Park Rd)	61
Royal York Road	16
Sarnia Road (Aldersbrook Rd to Wonderland Rd)	50
Southdale Road (Wonderland Rd to Wharncliffe Rd)	82
West Brough's Bridge	6
Total to Date	300

LED street lights will be installed in 2014 at:

Dundas Street at Ontario Street	6
Dufferin Avenue (Wellington Street to Waterloo Street)	9
Emery Street at Wharncliffe Road	6
Glanworth Drive (urban section)	27
Hyde Park Road (Oxford Street W to Sarnia Road)	127
Queens Avenue at Richmond Street	6
Sunningdale Road E (east of South Wenige Drive)	37
Wellington Road S at Manning Drive	6
Wellington Street (Dufferin Avenue to Central Avenue)	19
Total for 2014	243

By the end of 2014, London should have 543 LED street lights installed.

The City is currently considering nine new LED street light fixtures for testing and four of these are post-top fixtures.

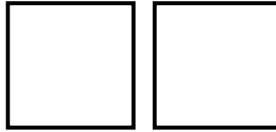
Association of Municipalities of Ontario's (AMO) LED Street Light Initiative

AMO through its subsidiary, Local Authority Services (LAS) has partnered with RealTerm Energy (RTE) and Cree Canada to provide LED Street Light upgrades. The partnership offers a complete package of data collection, street light photometric design, construction and operation. Municipalities can use part or all of the services provided by the partnership.

The estimated cost to convert London's street lights and anticipated savings is summarized below:

	<u>Cobra-Style Street Lights</u>	<u>All Street Lights</u>
Total Project Cost	\$9,350,000	\$24,350,000
Annual KWh Savings	7,500,000 - 10,000,000	12,000,000 - 16,000,000
Annual Energy Cost Savings	\$950,000 - \$1,250,000	\$1,500,000 - \$2,000,000

There are two available financing options with the above LED upgrade project. The City could finance the work and the expected return on the investment would be just over five years for both of the above scenarios. RTE also offers an Energy Performance Contract option to finance the project. The projects costs are financed by an Energy Services Company (ESC) with a



portion of the energy and maintenance savings being paid to the ESC for 10 years. The net savings to the City is estimated to be \$100,000 to \$300,000 per year during the 10 year period.

It should be noted that there are many factors impacting the cost of the project and the energy/maintenance savings and the above values may change. The first step in preparing a business case for a major LED street light upgrade is to review the street light inventory, prepare LED photometric designs using the street light inventory, a review of historical energy billings and a review of subsidies that may be available to off-set some of the LED conversion costs.

Implementation of a LED street light upgrade project will be done in a multi-phase approach. The multi-phase approach would allow for a staged implementation and subsequent stages would benefit from lessons learned in the previous phase. The first phase of street lights to be upgraded to LEDs could be the cobra-style fixtures on major roads (~9,300 fixtures). As mentioned previously the development of cobra-style fixtures has moved along further than post-top style fixtures that are found on most local streets. Street lights on major roads tend to have higher wattage compared to minor roads; therefore, there is a greater opportunity for energy savings. The higher volume of traffic on the major roads would also benefit from the improved light quality offered by LED street lights. The second phase could be the minor roads with cobra-style fixtures (~11,700 fixtures). The third and last phase could be the upgrade of post-top fixtures and other styles (~14,000 fixtures).

The cost to compile the City's street light inventory, conduct photometric designs, review historical energy billings and available subsidies for the Phase 1 & 2 (cobra-style fixtures) RTE has provided a quote of \$90,000 plus HST. This work would provide the necessary information to calculate the actual cost of the LED upgrade, the energy savings and the subsidy available to help offset the cost of the upgrade. If the project proceeds to construction then Phase 1 could proceed with the Phase 2 design ready to proceed when appropriate.

New Subdivisions & Developments

LED street lights are included in all major reconstruction projects or new street light initiatives undertaken by the City. Some cities have passed regulations requiring all new subdivisions and developments that will be owned and maintained by the city to utilize LED street lights.

Developers in London have not embraced LED street light fixtures for their new developments. This can be partially attributed to the lack of post-top style fixtures; however, London's current street light design requirements do not encourage the use of new products.

In order to ensure LED street lights are used on all future development it is recommended that the City's design and construction specifications be revised (Appendix "B") to permit only LED street lights, that all street light fixtures are Dark Sky Compliant (i.e. minimizes light shining upwards) and to require photometric design calculations for local and secondary collector roads. Currently photometric design calculations are only required on arterial and primary collector roads or if a new street light product is requested by the developer. The above recommended changes are consistent with the development requirements in other municipalities and it will ensure adequate lighting levels are achieved on all city streets. The estimated cost of providing photometric calculations is minimal (a few thousand dollars) when compared to the cost of developing the subdivision.

Four LED post-top have been accepted for in-field testing and interested developers could help in the testing phase. Decorative cobra-style fixtures and poles are also an option for developers to consider.

CONCLUSION

LED street light technology has improved significantly in the last few years and LED street lights are now standard equipment for new City street light project or major road reconstructions. Four LED street light fixtures are approved for use and seven products have been accepted for trial areas.

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The LED street light marketplace has matured to the point that it is appropriate to develop a business case for a major upgrade project. In order to develop the business case the following activities should be completed:

- i. Compile and review the City's street light infrastructure inventory;
- ii. Lighting designs using the LED street lights to calculate the installation cost and energy consumption;
- iii. Technical review of energy costs, maintenance costs and available subsidies to calculate a reliable rate of return for a LED upgrade project. This review will include working with London Hydro to confirm the energy billing (fixed and variable costs) of the project.
- iv. Review of financing options for the project.

The City will require expert 3rd party resources to complete the above tasks; therefore, it is recommended that the City use the services of the AMO/LAS and RTE partnership at an estimated cost of \$90,000 excluding HST for the Phase 1 and 2 (cobra-style fixtures) in accordance with the 'Procurement of Goods and Services Policy' Section 14.4 Single Source, Clauses e and g.

Once the business case is finalized it will be presented to Municipal Council later in 2014. If the business case is approved then the actual Phase 1 upgrading of the street lights from HPS to LED can commence once funding for the project is finalized. The length of time to complete the upgrade will vary depending on the extent of the project. The other upgrade phases would follow completion of the first phase.

The upgrading of HPS street lights to LED and the use of LED street lights on City projects should be accompanied with the adoption of LED street lights for use in new developments. To accomplish this goal it is recommended that photometric design calculations be required for all roadways and that only approved cobra-style fixtures be used. This new standard (Appendix "B") should be circulated to stakeholders for their comments. The formal adoption of the new street light design standard will be subject to a future report to the Civic Works Committee which can proceed independently of the LED upgrade business case.

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Acknowledgement:

This report was prepared by a team within the Roadway Lighting & Traffic Control Division comprised of Doug Bolton and Shane Maguire.

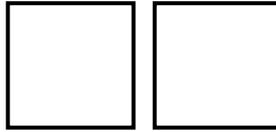
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REVIEWED & CONCURRED BY:	
JOHN BRAAM, P.ENG. MANAGING DIRECTOR ENVIRONMENTAL & ENGINEERING SERVICES AND CITY ENGINEER	

April 8, 2014

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Attach: Appendix "A" – Source of Financing
 Appendix "B" – Proposed Street Light Design Criteria



Appendix “B”

Proposed Street Light Design Criteria

2.5 STREET LIGHTING

2.5.1 Warrants

Street lighting shall be considered warranted on all roads in urban areas. At isolated rural intersections with non-continuous lighting on the intersecting roads, street lighting shall be considered warranted if the roadway meets or exceeds the requirements of the warrant provided in the Transportation Association of Canada *Illumination of Isolated Rural Intersections* guide.

Reconstruction of a substandard, isolated rural intersection should be considered before illumination. Street lighting may also be installed at isolated rural intersections at the direction of the Roadway Lighting & Traffic Control Division. Situations when this is warranted may include but are not limited to the occurrence of rare but severe collisions, an inability to maintain adequate hazard markings for raised channelizing islands, or the presence of an unusual number of long combination vehicles with reduced accelerating and braking abilities

2.5.2 Street Light Designs

The design of street lights on Primary Collector & Arterial roads must be designed, signed and sealed by a qualified Professional *Electrical* Engineer that meets the criteria identified in the Registry, Appraisal and Qualification System (RAQS) list or on the City's list of qualified consultants.

The design of street lights for Local Streets & Secondary Collector roads must be designed, signed and sealed by a *Professional Engineer*.

The design of street illumination shall conform to the requirements set out by American National Standard Practice for Roadway Lighting (ANSI/IESNA RP-8-00.)

1. Detailed photometric designs shall be submitted for all roads, intersections, sidewalks and walkways demonstrating how the RP-8-00 standards have been satisfied. Luminance criteria shall be used for tangent sections of roadways. For curved roadway sections the Illuminance criteria may be used.
2. The drawings shall show the location of the street lights (indicated by an open circle), street light conductors, the location of transformers and the location of power disconnects. The drawings shall specify the type of pole, fixture, conduit, fixture wattage, and conductor being used.
3. Street lights should be placed on one entire lot at the property line whenever possible.
4. The maximum number of lights that can be attached to a single circuit is 10 unless voltage drop calculations are provided that demonstrate the circuit can accommodate the load.
5. A disconnect is to be placed beside every transformer where a connection originates.
6. Existing street lights shall be shown as solid black circles.
7. The street light cable should be indicated by a black line with an SL imposed on the line.
8. Designers should be aware of driveway locations and living room windows when determining the location of lights.

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9. The design is to be drawn at a 1:500 scale.
10. Final designs must be accepted by the City of London's, Roadway Lighting & Traffic Control Division.

2.5.3 Walkway Lighting Design

Walkway lighting designs shall be comprised of the following:

1. 4.6m pole (black powder coated galvanized square tapered aluminium);
2. Walkway lights are to intersect street circuits at a junction box located at one end of the walkway;
3. Street light wire shall be placed in a 50mm RPVC duct;
4. The light is to be placed within 1m of the fence line in the walkway; and
5. Bollards located at either end of a lit walkway must be removable for maintenance purposes.

2.5.4 Residential Street Light Installation & Inspection Guidelines

1. The same light standard must be used from one end of a street to the other regardless of how many phases of construction are involved;
2. Poles and luminaries take a minimum of 8 weeks to be delivered. The City does not stock any residential street lights for new construction; and,
3. A power disconnect must be installed at the transformer. All installations must be inspected by the Electrical Safety Association (ESA) prior to London Hydro doing the power connection. The Contractor is responsible for arranging inspection with ESA.

2.5.5 Materials

All street light fixtures shall be Dark Sky Compliant. Materials used for street lights shall be in conformance with the City of London's Traffic Signal and Street Light Specifications.