

Memo

To: Charley Goheen, Township of Chapleau
From: Tijo Joseph **Reviewer:** Ayman Nicola
cc: Ayman Nicola **Wood File No.:** Client P.O. # 0435
Date: 9 September 2020
Re: **Streetlight LED Upgrade – Business Case Study (rev 2)**

1.0 Introduction

The Township of Chapleau contracted Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited (Wood), to conduct a business case study on the Township’s proposed plan to upgrade the Township’s public street-lighting network to light-emitting diode (LED) technology. This technical memo submission by Wood presents the business case study findings for the proposed upgrade project and covers the following aspects:

- Baselining of energy use attributed to the Township’s streetlighting network;
- Benefits of LED technology for streetlighting;
- Savings and financial analysis from upgrading to LED fixtures; and
- Key luminaire specifications to consider for vendor product evaluation.

2.0 Project Background

Currently, the Township’s streetlights are high pressure sodium (HPS) luminaires. Table 1 presents the Township’s existing streetlight inventory.

Table 1: Township’s Streetlight Inventory

Fixture type	Quantity	Fixture wattage (W)
HPS 100W	144	130
HPS 150W	96	190
HPS 250W	88	310

Note(s)

1. Inventory information was provided by the Township via Addendum #1 as part of the Township’s Request for Proposal package



Chapleau Hydro, the local electric distribution company (LDC) in Chapleau, maintains and operates the Township’s street-lighting network. Table 2 summarises the annual electricity use and cost associated with the Township’s street-lighting network based on Chapleau Hydro invoice records for 2019 (reference customer account no. 055164000 which covers streetlights) shared by the Township.

Table 2: Township’s Streetlights Electricity Use & Cost in 2019

Annual electricity use associated with streetlight operation	274,259 kWh
Electricity demand associated with streetlight operation	64 kW
Annual electricity cost associated with streetlight operation	\$70,137
Blended average electricity rate for streetlight operation	\$0.26/kWh
Estimated streetlight operating hours per annum	~4,270 hours

Note(s)

- Electricity use, electricity demand, cost, blended average utility rate, and estimated lamp operating hours are based on 2019 invoice records provided by the Township pertaining to customer account no. 055164000.

The Township plans to replace the existing streetlight HPS fixtures to LED fixtures in two stages. Table 3 presents the roll-out of fixture replacements planned between the two stages.

Table 3: Township’s Streetlight LED Upgrade – Roll-out Stages

Stages	Fixtures to be replaced
Stage 1	HPS 100W – 11 fixtures HPS 150W – 18 fixtures HPS 250W – 57 fixtures
Stage 2	HPS 100W – 133 fixtures HPS 150W – 78 fixtures HPS 250W – 31 fixtures

Note(s)

- Roll-out of fixture replacements planned under the two stages is per information provided by the Township via email dated 17th August 2020.

3.0 Benefits of LED Technology for Streetlighting

Adopting LED technology for streetlighting, versus conventional HPS technology, generally offers the following benefits:

- Improvement in nighttime visibility abetted by better colour rendering index;
- Reduction in light pollution as a result of directional lighting quality which can mitigate light pollution components such as artificial skyglow;
- Ability to dim lamps;
- Longer lamp life span;
- Reduction in electricity consumption; and
- Reduction in maintenance costs.



4.0 Energy Savings and Financial Analysis

This section presents the estimated annual electricity savings and return on investment from implementing the proposed streetlighting upgrade project.

4.1 Energy Savings

Table 4 summarises the estimated annual electricity savings assuming replacement of the existing HPS fixtures with LED fixtures.

Table 4: Estimated Energy Savings - Upgrade to LED Fixtures Scenario

Stage	Existing fixture type	Existing energy baseline (kWh)	Replacement fixture type	New energy baseline (kWh)	Estimated annual energy savings (kWh)
Stage 1	HPS 100W – 11 fixtures	96,145	LED 58W – 11 fixtures	27,136	69,009 (~70% ↓)
	HPS 150W – 18 fixtures		LED 58W – 18 fixtures		
	HPS 250W – 57 fixtures		LED 82W – 57 fixtures		
Stage 2	HPS 100W – 133 fixtures	178,115	LED 58W – 133 fixtures	63,100	115,015 (~65% ↓)
	HPS 150W – 78 fixtures		LED 58W – 78 fixtures		
	HPS 250W – 31 fixtures		LED 82W – 31 fixtures		

Note(s)

- The year 2019, the most recent for which electricity use records are available, is assigned as the baseline year.
- The LED luminaire replacement scenario is assumed as 58W, 58W, and 82W fixture wattages to replace HPS 100W, HPS 150W, and HPS 250W respectively. The assigned lamp wattages for the replacement scenario are based on inputs provided by the Town on final product selection via email dated August 31, 2020.
- Savings analysis assumes ~4,270 hours of annual operation per fixture.
- Savings are preliminary estimates.

4.2 Financial Analysis

Table 5 summarises the estimated annual cost savings assuming replacement of the existing HPS fixtures with LED fixtures.

Table 5: Estimated Cost Savings - Upgrade to LED Fixtures Scenario

Stage	Existing fixture type	Estimated existing energy cost (\$)	Replacement fixture type	Estimated new energy cost (\$)	Estimated annual cost savings (\$)
Stage 1	HPS 100W – 11 fixtures	24,584	LED 58W – 11 fixtures	7,055	17,529 (~70% ↓)
	HPS 150W – 18 fixtures		LED 58W – 18 fixtures		
	HPS 250W – 57 fixtures		LED 82W – 57 fixtures		
Stage 2	HPS 100W – 133 fixtures	45,544	LED 58W – 133 fixtures	16,406	29,138 (~65% ↓)
	HPS 150W – 78 fixtures		LED 58W – 78 fixtures		
	HPS 250W – 31 fixtures		LED 82W – 31 fixtures		

Table 6 presents the financial metric values associated with the proposed LED upgrade project.



Table 6: Financial Metrics - Upgrade to LED Fixtures Scenario

Stage 1	
Total annual cost savings	\$17,529
Payback period	~3 years
Net present value (NPV)	\$132,500
Stage 2	
Total annual cost savings	\$29,138
Payback period	~5 years
Net present value (NPV)	\$165,247

Note(s)

8. The calculated financial metrics is based on a lamp life span of 15 years, discount rate of 5%, and a capital outlay based on installed fixture cost estimates of \$565 and \$580, for LED 58W, and LED 82W luminaires respectively.
9. The capital outlay estimate only covers the LED luminaires and excludes items such as engineering fee, project management fee, rebate program discounting, disposal of the HPS fixtures, permits as applicable, rewiring, contingency, and post install measurements.
10. The calculated financial metrics do not account for maintenance savings, utility rate escalation, or annual inflation.
11. Costs are estimates and subject to potential change as cost components such as the fixture cost could vary depending on vendor selection and quote.

5.0 Key Luminaire Specifications for Product Evaluation

As guidance to the Township on luminaire lighting performance attributes to consider during product evaluation, Table 7 list some key luminaire specifications along with corresponding brief explanatory notes.

Table 7: LED Luminaire Specifications

Product attribute	Comments
Fixture wattage	Rated power draw of fixture measured in watts (W)
Power factor	>0.9 at a minimum
Light output	Performance result for emitted visible light output measured in lumens (lm)
Efficacy	Performance result for luminaire efficacy (higher the better); Efficacy represents the ratio of luminaire light output (in lm) to luminaire input power (in W)
Light intensity	Performance result for illuminance level per square foot of surface area (unit of foot candle or lm/ft ² ; as guidance, lighting levels and uniformity requirements as per Illuminating Engineering Societies (IES) RP-8 Recommended Practice for Roadway Lighting Standard)
Colour Rendering Index (CRI)	Quantitative measure of light source's ability to show the colours of an object as it would show under natural light; ≥70 at a minimum
Correlated Colour Temperature (CCT)	Colour of emitted light expressed in degree Kelvin (K); Neutral white light colour is around the 4000K level
Zero light above 90°	No production of light at or above 90° (eliminating uplight)
Qualified Products Listing	Product listing with organizations like DLC® which qualify commercial LED luminaires based on product testing results from accredited laboratories
Safety label	Certification label/s attesting to product safety (e.g. CSA product certification)
Warranty	A minimum five-year warranty (any higher, the better) covering the entire luminaire



Note(s)

12. Other luminaire features to consider include photocell integration, dimming capability, and adaptive controls monitoring system/integrated lighting controls.
13. The attributes listed in Table 7 are specifically related to lighting performance and hence exclude aspects such as wind load rating, wet location rating, or vibration testing.

6.0 Conclusions

The Township's proposed conversion plan of the existing streetlighting network of HPS fixtures to LED technology-based fixtures is assessed can result in substantial energy and cost savings estimated as 184,024 kWh and \$46,667 respectively per annum. The required investment for implementing the proposed upgrade could be repaid through the generated savings with the payback period estimated as 3 years and 5 years corresponding to Stage 1 and Stage 2 phases respectively. Additionally, LED fixtures offer the benefit of relatively lower maintenance cost (case studies suggest >50% cost savings versus HPS lamps) over the luminaire life which has not been factored in the estimated cost savings and financial payback in this memo.

Other suggestions for the Township's consideration with regards to project implementation include:

- Ascertaining current lighting condition (to establish if streets are over-lit or under-lit) through a photometric analysis – this will help inform the evaluation process should reference be made to IES's RP-8 Standard for target lighting levels
- Testing lighting performance post Stage 1 implementation including measuring average illuminance as well as obtaining community feedback on perceived light quality

Sincerely,

Wood Environment & Infrastructure Solutions
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