City of Kawartha Lakes Infrastructure Guidelines – 2024 Roads

The design portion of these guidelines should be considered as minimum criteria. This document provides the City's design preferences under normal circumstances. The Engineer must use their best judgment to find innovative solutions when abnormal design conditions are encountered. Deviation from these design guidelines requires written approval of the Director of Engineering & Corporate Assets or designate. All proposed works within the City of Kawartha Lakes Right-of-Way (ROW) shall comply with all applicable current industry standards and specifications for design, installation, modification, quality management and quality control, such as:

- Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads
- Ontario Provincial Standards (OPS), their most recent editions or revisions thereof
- American National Standards Institute (ANSI) and Illuminating Engineering Society of North America (IESNA) ANSI / IESNA RP-8-00
- Canadian Standards Association (CSA)
- Ontario Electrical Safety Code
- Electrical Safety Authority (ESA)
- O. Reg. 413/12: Integrated Accessibility Standards
- The Corporation of the City of Kawartha Lakes By-Law 2017-151 "A By-law to Regulate Access to Municipal Right of Ways in the City of Kawartha Lakes"
- The Corporation of the City of Kawartha Lakes By-Law 2018-017 "City Lands Encroachment By-Law"
- The Corporation of the City of Kawartha Lakes By-Law 2017-216 "A By-law to Regulate Fences in the City of Kawartha Lakes"

CKL Road Standard Drawings

Standard Drawing No.	Description
CKL-401	Standard Turning Basins for Terminated Roadways
CKL-403	20.0 m Urban Local ROW Sidewalk on One Side
CKL-404	20.0 m Urban Local ROW Sidewalk on Both Sides
CKL-405	26.0 m Urban Collector ROW
CKL-406	26.0 m Urban Collector ROW Pathway on One Side

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Standard Drawing No.	Description
CKL-407	20.0 m Rural Local ROW
CKL-411	Emergency Access
CKL-413	3 Metre Multi-Use Walkway
CKL-413 ‘B’	3 Metre Multi-Use Walkway with Bollards
CKL-LID	Draft Low Impact Development (LID) for information only
CKL-201	Deciduous Tree Planting
CKL-501 ‘B’	Typical Street Name Sign Detail
CKL-609	Typical Chain Link Fence Detail
CKL-609 ‘B’	Typical Privacy Fence Detail

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1.0 Road Classification

All roadways shall be classified and designed in accordance with the City of Kawartha Lakes Transportation Master Plan. The proposed classification shall be confirmed with the City of Kawartha Lakes before the design begins.

2.0 Geometric Design Elements

Table 1 Geometric Design Criteria

Geometric Detail	Local	Collector	Arterial
Minimum Right-of-Way (m)	20.0	26.0	26.0-36.0
Posted Speed (km/h)	40	50 Industrial: 50	70
Minimum Design Speed (km/h)	50	60	80-100
Minimum Safe Stopping Sight Distance (m)	65	85	110-140 (Follow TAC guidelines)
Minimum Crest Curve (K Value)	7	13	23-36
Minimum Sag Curve – Comfort Control (K Value)	6	9	12-16
Minimum Sag Curve – Headlight Control (K Value)	12	18	25-32
Pavement Width (Face of Curb to Face of Curb) (m)	8.5	9.4	Min. 3.5 m per lane
Minimum Crossfall (%)	2.0	2.0	2.0
Minimum Crossfall Through Intersection (%)	1.0	1.0	1.0
Minimum Grade (%)	0.5	0.5	0.5
Maximum Grade (%)	6.0	6.0	6.0
Intersection Angle (degrees)	80°-90°	80°-90°	80°-90°
Minimum Tangent Length at Intersections (m)	45	60	75

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Geometric Detail	Local	Collector	Arterial
Minimum Tangent Length between Reverse Curves (m)	30	50	120
Typical Annual Average Daily Traffic (AADT)	<1500	1500-6000	6000+

3.0 Intersecting Road and Right-of-way Characteristics

Table 2 Minimum Sight Triangle Requirements

Road Classification	Intersecting Road	Sight Triangle (m)
Local	Local, Minor and Major collector	5x5
Minor and Major Collectors	Minor and Major collectors	10x10
Major Collector	Major collectors	15x15

4.0 Minimum Curb Radius Requirements

Table 3 Minimum Curb Radius Requirements

Intersecting Road Types	Residential (m)	Industrial (m)
Public Laneway Local/Collector	7.5	15*
Local - Local	7.5	15*
Local - Collector	10	15*
Collector - Arterial	10	15*
Collector - Collector	10	15*
Collector - Arterial	10	15*
Arterial - Arterial	13	15*

- Based on the assumption that WB-20 turning vehicles will not encroach onto opposing traffic on collector and arterial roads.

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5.0 Intersections

Table 4 Minimum Intersection spacing Requirements

Intersection Spacing	Minimum Spacing
Arterial roads	400m between signalized intersection
Collector roads	60 m
Local roads (Four-legged intersection)	60 m
Local roads (Three-legged intersection)	40m

Minimum curb radius requirements for various intersecting roadways shall be confirmed with Table 3 – Minimum Curb Radius Requirements. On routes with high volumes of truck traffic compound radii shall be used. Intersection curb radii may need to be increased on truck and bus routes where higher volumes of large traffic are expected. In determining curb radii for truck routes in areas with heavily pedestrian movement consideration should be given to maintaining minimum curb radii to reduce pedestrian crossing distance.

At the intersection of two roads, the transition of the minor road classification shall not interfere with the normal cross-fall of the major road, unless otherwise required by the overland flow route design. A 1.0% to 2.0% backfall shall be provided on all road profiles. Intersections shall be designed according to TAC Section 2.3.2.3, Vertical Alignment and Cross-Slope.

Traffic Calming

Any proposed traffic calming devices or methodology are to meet the requirements of the City's Traffic Calming Policy

Functional Internal Traffic (F.I.T) Study

A functional internal traffic study is required for all draft plan submissions. The F.I.T study should be accompanied by a transportation impact study (TIS), where required.

The following items help to determine the roadway network types and classifications and ensures that the critical design elements of the road network are confirmed. The list is further complemented by items which deal with the provision of adequate parking, proper access for major attractors and generators, and the formation of a satisfactory traffic control plan. Where applicable, additional items should be added that include traffic calming measures and active transportation measures.

Associated with each item are specific criteria which require measurement, calculation and/or demonstration of adherence to standards and operating parameters. It is recognized that not all items may be applicable to all applications.

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Items identified with an asterisk (*) indicate that this item must be completed at the initial stages of any Draft Plan submissions. Other items may be deferred, subject to the City's concurrence, but it must be emphasized that a proper geometric and standards fit must occur. Otherwise, many conditions and red lining of plans may occur.

Components of the Functional Internal Traffic Study

1. Road Network Layout and Design Volumes * - The built-out traffic flows are to be determined on each internal road for the typical weekday and/or weekend peak hours. In addition, if the development application contains a collector road which forms an intersection with another collector road or any type of road bounding an arterial road, the typical peak hour turning volumes must be identified. It is imperative that any associated exclusive turning lanes, particularly left turns, are provided with their ultimate storage and taper length dimensions. It is understood that collector roads at intersections with other collector roads and arterial roads may require a right-of-way widening to permit the introduction of necessary vehicle turning lanes. All projected traffic volumes are to be consistent with projections in a T.I.S., where a T.I.S. is required.
2. Internal Road Classification and Right-of-Way * - Standards are available from accredited associations identifying the acceptable range of traffic flows that a type of road can satisfactorily accommodate, either in a 24-hour period or during the roadway peak hours. The road type and classification being considered must be capable of serving the traffic flow demand within the identified level and comply with the City's Official Plan and Transportation Master Plan.
3. Horizontal and Vertical Geometry * - Acceptable standards pertaining to horizontal curves, vertical curves, intersection angles and Safe Vehicle Stopping and turning decision criteria are contained in Manuals available from the Ontario Ministry of Transportation, the Transportation Association of Canada and Institute of Transportation Engineers. All road elements are to be evaluated and made to conform to the applicable criteria.
4. Intersection Spacing * - Standards are available from accredited associations i.e. TAC that identify the minimum spacing of intersections from each other. The development application must meet these minimum standards.
5. Intersection Warrants – Turning Lanes, Traffic Signals, Roundabouts * - The forecast demand volumes and the forecast intersection turning movements will dictate the appropriate traffic control device as well as the intersection lane configuration. The forecast demand volumes will be used to calculate required storage lengths for any turning lanes. If a traffic signal is to be considered, then a signal warrant analysis must be conducted that follows the O.T.M. A roundabout can be considered as an alternative to an intersection controlled by a traffic signal or all-way stop. A functional plan is to be provided.
6. Street Elbows * - Certain internal local roads may have center line radii greater than 90 degrees to continue the lot fabric. At these locations, pavement width analysis must be conducted to ensure that opposing design vehicles (design vehicles to be determined by the city) can negotiate the maneuver with no impacts. In addition, individual driveways must be located such that the road maneuvering area and sidewalk is not compromised. Formation of land use patterns incorporating such street elbows are not encouraged.
7. Rear Laneways * - The laneway layout and operation must be thoroughly addressed.

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This includes pavement widths, shoulder treatments, garage (building) setbacks (including ability to maneuver an automobile into and out of the garage), automobile, emergency vehicle and garbage truck circulation and turning movement capability. The assessment must be done along a typical cross-section of the laneway and at each intersection or bend formed by a laneway. Bends in laneways are discouraged.

8. Temporary Turnarounds and Cul-de-Sacs * - Any proposed temporary turnaround or cul-de-sac must be capable of satisfactorily accommodating service and emergency vehicle turning capability.
9. On Street Parking * - The location of on-street parking must be done in a consultative manner with all disciplines involved in the preparation of the development application. The location of on-street parking will be guided by many factors including adjacent land uses, roadway geometrics and traffic demand flows. There is expected to be no parking on laneways. It is expected that parking will only be permitted on one side of local roads. It is expected that parking will be introduced sensitively on collector roads. Additional pavement on collector roads must not encourage speeding or diminish the operation of future transit. Consideration of parking bays (indent parking) with protected intersection conditions minimizing pedestrian walking distances are considered appropriate.

   The development application must demonstrate through scaled plans that the required parking supply for residents and visitors can be achieved. On street parking must respect vehicle sight line requirements, parking space width and length, emergency vehicle needs, snow storage and intersection setbacks. No portion of a vehicle parked in a driveway can protrude onto the curb.
10. Traffic Calming - All roadway cross-sections must consider pavement widths that are conducive to reducing vehicle speeds. On-street parking should be strategically placed such that the additional pavement does not encourage greater vehicle speeds. If necessary, traffic calming devices can be considered excluding speed humps or other devices that are not acceptable to transit or emergency service vehicles. Should further traffic calming features be desired the traffic tables, medians and boulevard treatments can be considered. All proposed traffic calming is to be consistent with the Canadian Guide to Neighborhood Traffic Calming.
11. Headlight Screening - “Window Streets” or other internal roads may parallel a bounding arterial road. Vehicle headlight movements must be examined on the local road and preventative measures must be brought forth which prevent headlight glare from reaching the eye level of drivers on the bounding arterial road.
12. Service and Emergency Vehicle Circulation - All internal roads including laneways must demonstrate that the available driving surface can efficiently accommodate the free flow movement of emergency and service vehicles.
13. Emergency Vehicle Access - Where a subdivision proposes only one vehicular access, secondary emergency vehicle access is to be considered in consultation with City staff.
14. Curb Radii - Curb radii can be introduced which reduce vehicle speeds and benefit pedestrians. The curb radii must demonstrate to scale that sufficient capacity is provided for vehicle turning demands and that all service and emergency vehicles can efficiently negotiate turns.
15. Corner Daylighting - The ability to minimize the required space providing the necessary clear sight line distances for vehicle turning and stopping can be accomplished through corner daylighting. Each intersection must be examined to verify that clear vehicle sight lines are available. Any special circumstances must be

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justified.

16. Pedestrian and A.O.D.A. Accommodation - Sidewalks must be available to serve primary pedestrian flows. At curb locations grading must be provided to accommodate wheelchair movements and meet the A.O.D.A. requirements.
17. Surface Treatments - As part of traffic calming at intersections and to accommodate major pedestrian flows, consideration can be given to providing alternative surface treatments. These surface treatments are meant to give textural and noise signals to drivers that increased awareness is necessary.
18. Roundabouts - Any proposed roundabout must be designed to meet forecast traffic demands as well as the turning paths required for all municipal services including transit and emergency vehicles. Larger vehicles such as moving trucks should also be examined. Pedestrian crosswalks must be properly located to provide maximum visibility to all users and comply with the O.T.M.
19. Driveway Locations - Driveways to individual uses must respect the adjacent traffic flow demands and resultant intersection lane configuration requirements. The driveway location must minimize impacts on the role and function of adjacent boundary lanes, particularly turning lanes. At internal collector to collector road or arterial road intersections, consideration should be given to a land use form served by rear laneways, thereby reducing the impact on intersection lane functions.
20. Sidewalks - The placement of sidewalks must conform to Municipal guidelines and the A.O.D.A. requirements. Sidewalks should not be across residential lot frontages less than 11 m in width to increase driveway parking capacity on smaller lots. Continuity and connectivity are imperative to providing an environment which encourages walking. Special pedestrian crossings outside of intersection locations must be examined in detail and the justification for pedestrian actuated controls brought forward that comply with the O.T.M.
21. Bicycle Paths, Bicycle Lanes and Multiuse Paths - Bicycle paths and lanes must be in conformity with Municipal goals and objectives. Those bicycle routes, whether lanes, paths or multiuse paths must be clearly identified, and the appropriate geometric standards incorporated into the roadway cross-sections or where bicycles cross a roadway.
22. Transit Route Pattern - Where so directed by the City, the primary route pattern to serve the development application will be identified and the following related items are to be addressed.
23. Bus Stop and Pedestrian Pad - Major bus stop locations along each route will be identified. At these locations the necessary concrete pad to serve boarding and de-boarding passengers will be identified and included in the development application.
24. Development Integration - Opportunities should be examined at significant locations where adjacent land uses can provide an integration opportunity with transit. This could range from integrated shelter/building conditions to a minor pick-up and drop-off area near the bus stop.
25. Major Public Generators & Attractors * – Driveway and Entrance Locations - Within the development application there could be uses such as public schools, high schools and community centers, parks, etc. These land uses generate unique vehicle circulation and parking demands. The vehicle flow demands should be examined in the context of planning driveway and entrance locations which minimize impacts on bounding intersections and major pedestrian flows.
26. Major Public Generators & Attractors * – On Street Parking Assessment - Many of these generators are also located next to parks. The bounding road network should

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be examined to determine if on-street parking can serve multiple parking demands. How the on-street parking is incorporated with the roadway cross-section should be examined in detail. The intent is not to increase the asphalt surface area continuously, leading to increased vehicle speeds.

27. Major Public Generators & Attractors * – Traffic Control Plan for Entrances Providing Direct Access - The appropriate traffic control device plan which directly serves these uses must be brought forth. The accommodation of pedestrian flows must also be identified.
28. Traffic Control and Pavement Marking Plan - The development application must provide the definition and location of all traffic control, pavement marking and parking control signage to be installed in accordance with the Ontario Traffic Manual and related specifications.

6.0 Standard Turning Basins for Terminated Roadways

6.1 Permanent Standard Turning Basins

Permanent standard turning basins shall be constructed in accordance with CKL-401 “Standard Turning Basins for Terminated Roadways”. All standard turning basins and intersections shall be detailed at a scale larger than the road plan. The minimum gutter grade of 1.0% shall be maintained.

6.2 Temporary Turning Circles

Temporary turning circles are required where a road currently dead ends but will be continued for future development. Temporary turning circles are to be constructed to the same standards as 6.1 Permanent Standard Turning Basins.

7.0 Pavement Design

Pavement design for all roads will be considered individually. Minimum pavement design thickness according to the different road classifications are shown in Table 4. The Developer shall retain a qualified soils consultant, the qualified soils consultant shall be responsible for sampling, testing and designing a suitable pavement design.

- Asphalt mix designs are to be supplied to the City and to the retained qualified geotechnical consultant for review prior to commencing construction. Asphalt placed before the approval of the asphalt mix design will be removed and disposed of offsite at the Owner’s expense.
- Reclaimed Asphalt Product (RAP): The use of RAP is not permitted in surface asphalt. The maximum percentage of reclaimed asphalt material shall be 20% of the volume of aggregate used for the base course (HL8 only). Reclaimed material shall conform to OPSS 1154.
- Performance Graded Asphalt Cement (PGAC): The PGAC specified shall be PGAC 58-34 unless otherwise approved by the Director of Engineering and shall be in accordance with OPSS 1101.

The composition and construction thickness of the road pavement shall be design based upon the following factors:

a) Mechanical analysis of the sub-grade soil
b) Frost susceptibility
c) Drainage
d) Future volume and class of traffic expected to use the pavement

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e) Construction loading considerations.

Sub-grade samples for mechanical analysis laboratory testing shall be taken at a maximum of 50.0 m intervals along all road alignments and at any locations judged to be lower in bearing capacity. California Bearing ratio (C.B.R.) tests shall be performed for each representative soils type. All tests must be conducted by a qualified soils consultant. Copies of all tests and the road design proposed by the soils consultant shall be submitted for the approval of the Engineering Department.

Where the construction will involve trenching for installation of sewers and watermains, the soils report shall comment on trenching, pipe bedding, cover, backfill, and compaction requirements. It shall provide recommendations with respect to construction methods to be employed to reduce the risk of settlement occurring.
Before placing concrete and asphalt pavement, the Consulting Engineer must submit the concrete and asphalt mix designs to Engineering for approval.

Table 5 Minimum Pavement Design Thickness

Road Class	Topcoat Asphalt (HL4)	Base Coat Asphalt (HL8)	Granular 'A' (mm)	Granular 'B' (mm)
Local	40 mm	50 mm	150	300
Collector	40 mm	90 mm	150	450
Arterial	40 mm	100 mm	150	450

Notes:
1. The Granular 'B' thickness may require adjustment depending upon subgrade soil condition, weather conditions during construction and use by heavy construction traffic.
2. The pavement design thickness assumes adequate positive drainage of the sub-base.
3. These are minimum requirements only and may require additional depths subject to specific design considerations.
4. Minimum 10:1 taper at transitions in road make up.

7.1 Tack Coat

Tack Coat shall be applied in accordance with OPSS 308 – Construction Specification for Tack Coating and Joint Painting and OPSS 310 – Construction Specification for Hot Mix Asphalt or as amended.
Tack coat shall be applied to the following but not limited to:

- Protection board
- Existing pavement surfaces including, but not limited to, hot mix and Portland cement concrete
- Milled pavement surfaces
- Expanded asphalt surface
- Cold-in-place recycled surfaces
- Vertical surfaces include all edges of concrete curbs, catch basins and other appurtenances, longitudinal joints, and transverse joints for application of tack coat.

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7.2 Pavement Construction

Paving construction shall be in accordance with OPSS.MUNI 310 – Construction Specification for Hot Mix Asphalt or as amended.

Where segregation or other asphalt deficiencies are identified within the maintenance period, the defective areas shall be removed and replaced from edge of pavement to edge of pavement and for an unspecified length depending on the severity of the defect. Defective areas shall be replaced with acceptable hot mix of the same type and compacted to the satisfaction of the City.

All maintenance holes, catch basins, valves and hand wells that have a deviation more than 10mm from surface asphalt elevation shall be milled, re-adjusted, and re-paved to suit final grades.

7.3 Pavement Markings

Plastic pavement markings shall be provided in accordance with the latest standards of the "Ontario Traffic Manual – Book 11" and "Ontario Traffic Manual – Book 15". Pavement markings are required for lane separation, road centerline, turning lanes, stop bars, cross walks, turning arrows and island markings.

Pavement markings are to be shown on the applicable plan drawings and shall be in accordance with the latest OPSS requirements.

7.4 Subdrains

All subdrains shall be 100mm diameter perforated corrugated plastic pipe with filter cloth shall be C.S.A. approved or approved equivalent and shall be installed in accordance with OPSS.MUNI 405 and OPSD 216.021

Subdrain shall be installed in a separate 300mm x 300mm trench below subgrade with a minimum 50mm Granular 'A' bedding and Granular 'A' backfill.

8.0 Concrete Curb and Gutter

For all urban roads, curb and gutter as per OPSD 600.040 - Concrete Barrier Curb with Standard Gutter is required and may be of two-stage construction as per OPSD 600.070 – Concrete Barrier Curb with Standard Gutter, Two Stage Construction.

Before concrete is placed, the Consulting Engineer must submit the concrete mix designs to Engineering for approval. Concrete to be a minimum of 32 MPa compressive strength at 28 days and conform to OPSS.MUNI 1350.

Contraction joints are to be placed at intervals not exceeding 3.0 meters.

If OPSD 600.070 is the method of construction for the curb and gutter, there are additional requirements prior to a base curb inspection and placement of the top curb. Prior to the City's inspection of the base curb, a minimum width of 300 mm of HL-8 base asphalt requires to be cut and removed from face of curb.

9.0 Sidewalks

The location and width requirements for sidewalks in new developments shall be designed in accordance with CKL typical road cross-sections. Sidewalks are generally required on both sides of collector and arterial roadways. On local roads, sidewalks are required on at least one side and on both sides if significant pedestrian volumes are anticipated or located near schools, parks, churches, hospitals and so forth.

All sidewalks are to be designed in accordance with OPSD 310.010. There is to be a minimum of 150mm thickness of Granular 'A' material below sidewalk compacted to 100%

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Standard Proctor Maximum Dry Density (SPMDD). If the typical cross-section design incorporates a 3.0 m multi-use pathway, the pathway shall be designed in accordance with CKL-413. Sidewalks shall meet the requirements of O.Reg. 413/12: Integrated Accessibility Standards.
The sidewalks shall be increased in thickness at all commercial, industrial and apartment entranceways to 200 mm and welded wire mesh reinforcement shall be installed. Concrete sidewalks at entranceways shall be designed according to OPSD 310.050. If the sidewalk has been constructed prior to the establishment of an entrance, the existing sidewalk shall be removed and shall be replaced with the appropriate sidewalk thickness.
Dummy joints and contraction joints shall be achieved by saw cuts the day after placement. Tooled joints will not be permitted. Contraction joints shall be placed at every third dummy joint and shall be saw cut that is 0.25 of the sidewalk thickness. Contraction joints should be placed to produce panels that are as square as possible and never exceeding a length to width ratio of 1.5 to 1.

10.0 Boulevards

The grade of the boulevard shall be constant from the back of curb to the ROW limit or sidewalk. Terracing or embankments within the ROW shall not be permitted. All debris and construction materials shall be removed from the boulevard area upon completion of the initial stage of road construction and the boulevards shall be maintained in a clear state.

For all boulevard areas, prior to sodding, 150 mm in depth of clean, screened topsoil shall be placed. Number 1 nursery sod shall be used for all boulevard areas.

11.0 Entrances and Driveways

Driveways in new subdivisions are to be designed at the maximum width of 6.0m. Refer to CKL-112 and CKL-112B for service connection locations. The designs of all new commercial, industrial and multi-residential site plan entrances shall conform to OPSD 350.010 and City of Kawartha Lakes By-Law 2017-151.

11.1 Operational Considerations

- Two-way driveways should be at or near 90 degrees to the road.
- Minimum use driveway (<25 vehicles/day) serving single family residential land uses the two-way movements may consist of a single lane, drive in and back out maneuver.
- For high volume two-way driveways, the driveway will consist of two one-way driveways divided by a centerline for traffic exceeding 100 peak hours of 750 vehicles per day.
- Where pedestrians routinely cross the one-way driveway, it is desirable to provide a driveway intersection angle of 70 degrees with the sidewalk rather than something less to encourage vehicular deceleration and provide the driver and pedestrian with a better opportunity to observe a possible conflict.
- Avoid positioning driveways on the inside of horizontal curves or on the far side of crest vertical curves

11.2 Sight Distances

The provision of adequate sight distance for the exit maneuver from the driveway is one of the most critical elements. The sight distance is determined considering the design speed on the intersecting roadway.

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The placement of road hardware, such as utility cabinets and mailboxes, and landscaping in the right of way shall be placed to prevent obstructions to the required sight lines.

Table 6 Sight Distances

Posted Speed	Required Visibility
80 km/h	140 meters
60 km/h	85 meters
40 km/h	65 meters

11.3 Turning Characteristics

The two styles of driveway entrances commonly used to accommodate vehicle turning paths are:

1. The straight flared design
2. The curb return design.

The straight flared style is recommended for driveways with volumes less than 750 vehicles/day along roadways with low to moderate volume.

11.4 Angle of Driveway

- Two-way driveways normally intersect the roadway curb at or near 90 degrees. However, a minimum acute angle of 70 degrees, as measured from the roadway curb line, normally operates acceptably.
- For one-way driveways, where a skewed intersection assists in the efficient traffic operation, skews in the range of 45 to 60 degrees are appropriate in industrial areas where pedestrians are infrequent.
- For residential and commercial land uses, where pedestrian volumes are normally moderate to high, minimum skew angles in the range of 60 to 70 degrees are preferred to improve the drivers' visibility of pedestrians and encourage lower turning speeds.

11.5 Spacing of Adjacent Driveways

Driveways are normally located considering their physical relationship to existing or possible future driveways. The following criteria shall be taken into consideration:

- Minimum spacing between driveways
- Minimum offset to property line
- Maximum number of driveways based on property frontage.

The application of these design criteria assists in meeting the following objectives:

- To clearly identify to the user which property each driveway serves
- To ensure that sufficient space is available between driveways for the positioning of traffic signs, lighting poles and other surface utility fixtures, and road hardware
- To separate the conflict areas for each driveway
- To provide appropriate space between driveways for on street parallel parking, where permitted and in consideration of sight line requirements
- To increase the length of potentially collision free pedestrian areas by minimizing the number and width of driveways.

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The minimum spacing between driveways is measured between the end and start of the curb returns on the adjacent driveways. A 1.0-meter minimum spacing is recommended between adjacent low volume driveways for residential properties along local and collector roadways. A 3.0-meter minimum is suggested for both industrial and commercial land uses. Where the speed limit is 80 km/hr the required spacing is 120 m.

11.6 Setback Requirements

- Entrances shall be a minimum of 15 meters from the limits of a right of way at a street intersection.

11.7 Culverts

- Minimum 450 mm diameter culvert for driveways at a minimum length of 7 meters.
- Minimum 600 mm diameter culvert for roadways at a minimum length of 7 meters.

11.8 Number of Driveways

Residential properties are restricted to one driveway, irrespective of frontage. For large site plan developments, the location and design elements of driveways are determined by a detailed traffic impact study.

11.9 Grades

A minimum 2.0% grade change at the edge of road is required, up to a maximum of 8.0% on low volume local roads.

12.0 Roadside Ditching

Rural roads shall confirm to standard drawing CKL-407 unless otherwise approved by the Director of Engineering. Rural roadside ditches shall be designed as follows:

- 3:1 front and back slope
- Minimum 4.5 m in width
- Minimum 0.25 m wide flat bottom
- Ditch inverts shall be a minimum 0.3 m below the granular/subgrade interface where its daylights into the ditch unless an invert subdrain is designed to pick up subgrade drainage
- Desirable minimum longitudinal ditch grade shall be 1.0% with minimum being 0.3%
- Ditch grades greater than 3.0% shall have staked sod protection and ditches greater than 5.0% shall have hand laid rip rap protection.

13.0 Signage

13.1 Street Name Signs

Street name signs shall be installed at all intersections and shall identify each street at the intersection.

As per CKL-501 ‘B’ “Typical Street Name Sign Detail” the street name sign shall be 100 mm white reflective uppercase lettering on a reflective green background 150 mm in height and 610 to 915 mm in length. Signs shall be anodized aluminum and at least 2.3 mm thick.

All street name signs shall be fastened to either of the following:

- Steel U-Flange posts in accordance with OPSS.MUNI 703 and OPSD 990.110
- Telspar sign support system hardware, including signpost, two-piece breakaway anchor and hardware as supplied by UCC Industries International Inc.

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All street name signs (temporary or permanent) are required to be installed upon the completion of the base course asphalt and must be maintained by the Owner as identified in the subdivision agreement until final assumption by the City.

13.2 Traffic Control and Advisory Signs

All traffic control and advisory signs shall be installed facing and at right angles to the flow of traffic that they are intended to serve. All signs shall be fastened either of the following:

- Steel U-Flange posts in accordance with OPSS.MUNI 703 and OPSD 990.110
- Telspar sign support system hardware, including signpost, two-piece breakaway anchor and hardware as supplied by UCC Industries International Inc.

Signs are to be installed on street light posts where practical to minimize clutter in boulevards. All traffic control and advisory signs (temporary or permanent) are required to be installed upon the completion of the base course asphalt and must be maintained by the Owner as identified in the subdivision agreement until final assumption by the City.

In rural developments all stop signs shall be a minimum Ra-101 (75 cm x 75 cm).
All traffic control and advisory signs shall conform to the latest “Ontario Traffic Manuals – Book 5, 6 and 7” and the latest “Manual of Uniform Traffic Control Devices for Ontario” as applicable. All proposed location and type of traffic control and advisory signs shall be indicated on the applicable plan drawings.

14.0 Fencing

The proposed location and type of fence or sign shall be shown on the plan drawings. All lands are to be fenced where residential lots abut City of Kawartha Lakes lands.

Fencing which is to be installed as part of a subdivision or development agreement shall be located as outlined in the agreement and shall be designed and constructed in accordance with the following criteria:

a) All acoustic fencing is to be constructed as per OPSS.MUNI 760 “Construction Specification for Noise Barrier Systems” and manufacturer’s specifications. The acoustic fencing shall be certified by a qualified Engineer prior to assumption of the subdivision. The certification shall include the section of fence being certified, materials used, construction method, structural integrity (including wind loading), and certification that the required noise abatement levels for the acoustic fencing have been met.
b) All chain link fencing to be black vinyl and shall be constructed in accordance with CKL-609 “Typical Chain Link Fence Detail” unless otherwise approved by the City. Gates, when required shall be constructed in accordance with OPSD 972.102.
c) All privacy fencing shall be constructed in accordance with CKL-609 ‘B’ “Typical Privacy Fence Detail” unless otherwise approved by the City.

All fencing shall require a certificate and survey from an Ontario Land Surveyor, confirming the as-constructed elevations (top and bottom) and location in relationship to property lines of all regulatory fencing installed.

15.0 Streetscape

As per the City of Kawartha Lakes subdivision agreement, the owner shall install trees within the right of way of all streets with an urban cross-section to be dedicated to the City in

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accordance with the approved landscape plan. All plant material must conform to the most recent version of the Canadian Nursery Trades Association "Canadian Standards and Specifications for Nursery Stock".

All trees shall:

- be undamaged and disease free
- have a reasonably straight trunk, free of any decay, sunscald, wounds or mechanical damage
- possess a straight single central leader, with no multiple competing stems
- be a minimum of 60 mm caliber
- be 3000 mm to 3500 mm height, with a minimum 1500 mm branching height clearance from grade at the time of planting
- have their root ball secured in a wire basket
- have a balanced canopy with uniform branching
- be planted in accordance with CKL Standard Detail 201, Deciduous Tree Planting.

For acceptable tree species used within the City's right of way and parkland, refer to List of Acceptable Tree Species for City of Kawartha Lakes Planting.

15.1 Streetscape Requirements

Street trees shall be located on the boulevards in accordance with the CKL Road Cross-Section Standard Drawings.

Street trees shall be spaced in accordance with the growth habits of the particular species and in accordance with the following guidelines:

- Generally, one tree per 10.0 metres shall be provided.
- Smaller species shall be spaced 5.0 to 6.0 metres.
- Larger species shall be spaced 10 metres apart.
- A minimum of one tree shall be provided for every lot frontage.
- A minimum of two trees shall be provide for every flankage yard
- Species biodiversity and the use of at least fifty percent of native species is required unless otherwise approved by the City.
- Monoculture arrangements are not acceptable for streetscape.
- No trees shall be permitted in a drainage swale.
- The City may request that trees are to be planted at closer intervals, of higher calibre and in greater quantities if desired.

Trees within subdivision developments shall be planted in accordance with the following requirements:

- after buildings on pertinent lots or blocks are completed
- after pertinent lots or blocks including boulevards are graded and sodded
- after curbs are complete
- after utility locates have been complete.

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Table 7 Minimum Clearance for Streetscape Planting

Description	Minimum Clearance Required (m)
Edge of Sidewalk	1.5
Edge of Driveway	1.5
Underground Utilities	1.0
Utility Pedestals	1.5
Concrete Base of any Cabinet	1.5
Back of Curb	2.0
Fire Hydrant	3.0
Streetlight	5.0
Stop Sign / Traffic Signal / Intersections	15.0
Hydro Transformer	1.5 (5.0 from access door)
Mailbox	1.5

16.0 Utilities

Roadway cross sections are such that the width of the boulevard allows snowbanks to accumulate. Utilities and street furniture shall be located such that space for snow storage from roadway and sidewalk maintenance is sufficient.

All utilities shall be installed in a Joint Utility Trench (J.U.T.) as per Hydro One Joint Trench – Power, Communication & Gas Distribution Lines – Typical Detail. All utility street crossings shall be installed by Hydro One Trench, Street Crossing – Typical drawing.

Utility pedestals shall be paired with streetlights if possible or with other utilities. A minimum of 1.0 m clearance is required between the edge of a driveway and any proposed above ground utility.

Community mailboxes shall be placed according to the Canada Post Corporation requirements. Community mailbox locations shall be indicated on the Utility Coordination Plans and Plan & Profile drawings. Where possible a streetlight will be placed adjacent to a community mailbox location to ensure appropriate lighting levels are met. The required width of the curb depressions shall be dimensioned on both the Utility Coordination Plans and the appropriate Plan and Profile drawings.

17.0 Street Lighting

17.1 General

All street lighting systems for new development in the City of Kawartha Lakes shall be 120-volt with LED luminaires. All components of street lighting systems for roadways in the City shall be CSA approved and shall meet the requirements of the Ontario Electrical Safety Code

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and the Electrical Safety Authority (ESA).

In an effort to reduce light pollution, the City of Kawartha Lakes requires that all street lighting and facility lighting be designed and constructed such that the lighting design is dark sky compliant/friendly. As such, standard luminaires are full cut-off except for decorative which are semi-cut-off.

An ESA certificate will be required prior to the street lighting systems being energized. The Developer's Engineer shall make the necessary arrangements to obtain an ESA certificate. Streetlights shall be energized prior to the first occupancy of any development.

The Electrical Consultant shall perform inspections of the streetlight system during installation and provide inspection reports documenting the inspections. The Electrical Consultant shall provide a letter to the City certifying that the street light system has been installed per their design and inspected and passed by Electrical Safety Authority. A copy of the ESA inspection report shall be included with this letter.

When the system installation is complete and has been certified by the Consultant the developer shall submit a written request to the City to energize the lights. Streetlights shall not be energized without written approval of the City of Kawartha Lakes.

The Developer shall arrange with the Local Distribution Company (Hydro One) for the connection of all lighting systems. The Developer shall provide easements wherever they are required.

The location of street lighting poles and transformers shall be shown on the Utility Coordination Plan. For urban cross-sections, poles shall be located not greater than 40 meters apart. For roadways with 60 km/h or less design speed and barrier curb, poles shall be located 2.0 meters behind the face of the curb.

For rural cross-sections, poles shall be located behind the ditch on the same side of the street, preferably at common lot lines. Due to the variability that may occur in rural subdivision design, the location of the poles may vary between developments. However, the guiding principles for the location shall be;

- no closer than 1.0 m to the property line (frontage)
- in a consistent offset from the property line for each street
- a minimum of 1.0 m behind the top of the ditch
- at a location where the luminaire height is within the manufacturer's guidelines.

For rural roadways with a design speed of 60km/h or less the minimum pole setback shall be 3.0 m minimum subject to the guiding principles outlined above.

For all roadways with design speeds greater than 60 km/h pole offset shall be in accordance with TAC guidelines for clear zone requirements based on roadway design speed.

Poles and base-mounted transformers shall have a minimum separation of 3.0 m.
Where super mailboxes are proposed within a plan of subdivision, streetlights should be located within 10 m of the super mailboxes whenever possible.

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17.2 Lighting Levels

For straight sections of roadway lighting levels shall be determined based on the luminance method. The Illumination Engineering Society (IES) defines 'luminance' as the amount of light reflected from the pavement in the direction of the driver. The average maintained luminance levels and uniformities shall comply with the values shown in the following table.

Table 8 Lighting Levels – Straight Sections

Roadway Classification	Average Luminance Lavg2 (cd/m2) (Min.)	Uniformity Ratio Lavg/Lmin (Max. Allowed)	Uniformity Ratio Lmax/Lmin (Max. Allowed)	Veiling Luminance Ratio Lvmax/ Lavg (Min.)	Pedestrian Conflict Area Classification
Local	0.3	6.0	10.0	0.4	Low[1]
Collector	0.4	4.0	8.0	0.4	Low [1]
Arterial	0.6	3.5	6.0	0.4	Low [1]

Note:
1: Pedestrian Conflict Area Classification as defined in ANSI / IESNA RP-8-00 in paragraph 2.2 on 4. The only standard exception to the low PCC used in lighting calculation in the City is in school zones, where a medium PCC shall be used.
L = Luminance

Veiling Luminance = the veiling effect produced by bright sources or areas in the visual field that result in decreased visual performance and visibility.
cd/m2 = candela per square meter
Lavg/Lmin = average luminance / minimum luminance Lmax/Lmin = maximum luminance / minimum luminance Lvmax/Lavg = maximum veiling luminance / average luminance

For curved sections of roadway or where luminance cannot be calculated accurately lighting levels shall be based on illuminance. IES defines 'illuminance' as the amount of light incident on the roadway surface from the roadway lighting system. The average maintained illuminance levels and uniformities shall not be less than the values shown in the following table.

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Table 9 Lighting Levels – Curved Sections

Roadway Classification	Average Illuminance Eavg2 (Lux)	Uniformity Ratio Eavg/Emin	Veiling Luminance Ratio Lvmax/Lavg	Pedestrian Conflict Area Classification
Local	4.0	6.0:1	0.4	Low[1]
Collector	6.0	4.0:1	0.4	Low [1]
Arterial	9.0	3.0:1	0.3	Low [1]

Note 1: Pedestrian Conflict Area Classification as defined in ANSI / IESNA RP-8-00 in paragraph 2.2 on 4. The only standard exception to the low PCC used in lighting calculation in the City is in school zones, where a medium PCC shall be used.

E = Illuminance
Veiling Luminance = the veiling effect produced by bright sources or areas in the visual field that result in decreased visual performance and visibility.

Lux = unit of illuminance (illuminance on a surface one square meter in area on which there is a uniformly distributed flux of one lumen).

Eavg/Emin = average illuminance / minimum illuminance Lvmax/Lavg = maximum veiling luminance / average luminance

Average illuminance levels at intersections should be equal to the sum of the average levels for the two intersecting roadways. The uniformity of the intersection should be equal to the criteria of the roadway with the highest level.

For LED conventional lighting calculations, a light loss factor (LLF) of 0.85 shall be utilized.

17.3 Poles

Street light poles shall be direct buried Ontario Stresscrete or equivalent (subject to the approval of the Director of Engineering & Corporate Assets), spun round concrete of Class B strength or better, and with Burndy ground lug in handhole. Street light poles shall be installed in accordance with the requirements of OPSD 2210.020. Poles on local or collector roads shall be 9.1 m overall (30 feet), and arterial roadway poles shall be 13.7 m (45 feet). All street lighting poles shall be supplied with an above grade handhole and cover, a ground lug at the handhole, and two below grade wiring apertures. For poles with disconnects, a second handhole shall be required. Poles shall be installed such that maintenance personnel are facing oncoming traffic while facing the handhole.

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Table 10 Approved Concrete Poles (Direct Buried)

Manufacturer	Local or Collector Roads – Decorative Octagonal 7.6m (Above Grade)	Local or Collector Roads Rounds 7.6 m (Above Grade)	Arterial Roadways Round 11.9m (Above Grade)
Utility Structures Inc (USI)	Madison MA-300-B-2-BE-60-F (1.8m Scroll Arm)	Hampton HA-300-B-1-PG-10 (1.8m Elliptical Bracket)	Hampton HA-450-B-1-PG-10 (3.0m Elliptical Bracket)
Stresscrete	Octagonal Class "B" E-300-BPO-G-S11 c/w FC (Blk) (1.8m Scroll Arm)	Round Class "B" E-300-BPR-G-MOO (1.8m Elliptical Bracket)	Round Class "B" E-450-BPR-G-MOO (3.0m Elliptical Bracket)
StressCrete – Telecommuni-cation Pole	Alexander KAH-25-E-11-DB (1.8m Scroll Arm)		

17.4 Brackets

Elliptical Brackets shall be 1.8 m long with 0.9 m rise tapered elliptical aluminum (or steel), single member type complete with pole plate Utility Supply Specialists TER-6-MA, or equivalent.

Brackets on arterial roads shall be 3 m with a 1.5 m rise.
Decorative scroll arms shall be 1.8 m long, USI Style 60, Stresscrete Style 170 or approved equivalent. Colour of decorative arms and bracket shall match pole and luminaire colour.

17.5 Luminaires

All new developments shall use LED type cobrahead and decorative style luminaires. Correlated Colour Temperature (CCT) shall be 4000K.

Table 11 Local and Collector Roadways – Cobrahead Luminaires

Manufacturer	Luminaire Type	Mount Type
Eaton Lighting Solutions (formerly Cooper Lighting)	NVN Series	Arm Mount
Cree Lighting	XSP Series	Arm Mount
General Electric	Evolve ERS Series	Arm Mount
Philips Lumec	RoadStar	Arm Mount

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Table 12 Decorative Coach Style Luminaries

Manufacturer	Luminaire Type	Mount Type
Eaton Lighting Solutions (formerly Cooper Lighting)	UTLD Traditionaire LED downlight	Post-top
Eaton Lighting Solutions (formerly Cooper Lighting)	SDL	Arm Mount
King Luminaire	Empress (K601)	Post-top / Arm Mount
Philips Lumec	L40U Series	Post-top / Arm Mount

Table 13 Arterial Roadways – Street Light Luminaires

Manufacturer	Luminaire Type	Mount Type
Eaton Lighting Solutions (formerly Cooper Lighting)	NVN Series	Arm Mount
Cree Lighting	XSP Series	Arm Mount
General Electric	Evolve ERS Series	Arm Mount
Philips Lumec	RoadStar	Arm Mount

17.6 Photocell Control

Luminaires shall be equipped with NEMA 7 prong twist lock connector sockets with dimmable drive.

The photocell port shall be 7 pin compatible. The developer can continue to use the 3-pin photocell, but the port must be configured to also accept a 7-pin photocell should CKL upgrade the photocell in the future.

Photocells shall be/have:

- omnidirectional Ambient Light Sensor type
- operating voltages between 105 and 305 volts at 50/60Hz
- a load rating of 1800VA and 1000W
- capable of a continuous load current of 16 amps maximum
- power consumption less than 0.5 Watts nominal @ 230V AC
- a 10-year manufacturer's warranty of the complete photocell unit
- an IP rating of 67
- an operating ambient temperature range of minus 35 to 70 degrees Celsius
- a life expectance of 25 years
- run maintenance free for a minimum of 20 years.

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The photocell and all subcomponents are to be free of designated hazardous substances that would otherwise prevent it from being disposed of in a normal regulated Ontario landfill site or recycled without any special type of treatment of disassembly. The photocell unit shall have visible identification which shall contain the manufacturer serial number and date of manufacture in a location which can be viewed when accessing. Photocells shall be safety certified to standards or have an equivalent listing from a recognized testing laboratory for the approved sale and use in Canada. Photocell shall contain a surge protection device (SPD) to protect all electrical and electronic components from harmful line transient voltage surges as a result of utility line switching, lightning strikes, or other electrical supply system disturbances.

17.7 Control and Supply

Street lighting systems shall be controlled by a 'Service Entrance 'rated disconnect to comply with the current Electrical Safety Authority (ESA) requirements. The disconnect shall be Square D Model CQO112M100C60 or approved equal. The branch breakers shall be 20 A Square D Model QO140HID or approved equal. Handhole breakers shall be used and placed in a separate hand hole.

Final connection to secondary supply is to be completed by local hydro authority at transformer or secondary supply pole.

The Developer shall be responsible for the payment of all fees and costs to be paid to local utility for the energizing of the street lighting system until "Formal Acceptance" of the subdivision.

17.8 Cable

Low voltage single conductor cables for roadway lighting shall be stranded copper conductors with RWU90 cross linked polyethylene insulation rated for 600-volt according to CSA C22.2 No. 38. The insulation colour of "Line" conductors shall be RED and BLACK for a120/240 V, 1-phase, 3-wire system and RED for 120 V, 1-phase, 2-wire system. The insulation colour of Neutral conductor shall be WHITE. Wire sizes allowed shall be #8, #6, #4 and #2 AWG. The wire shall be sized so as to satisfy Ontario Electrical Safety Code maximum voltage drop requirements.

Splices shall be made only in the pole handholes with CSA approved Burndy compression connectors and electrical insulating tape. Electrical insulating tape shall be rated for 600 V and -10°C to 90°C working temperature and shall be according to CSA C22.2 No. 197.
Riser wires in lighting poles shall be #12 AWG, stranded copper, type TW90 insulation. Riser wires shall be connected to the lighting circuit wiring in the pole handhole with an in-line fuse holder rated 600 V complete with protective boot and 10 A type KTK fuse.

17.9 Duct

Lighting conductors and ground wires shall be installed in 50 mm rigid duct suitable for direct bury. For under pavement crossing, install 100 mm rigid PVC duct encased in 20 MPa concrete. Cover over direct buried duct and under pavement crossing shall not be less than 0.75 m.

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17.10 Grounding

The separate system ground wire shall be #6 stranded copper, insulation colour green RWU90 cross linked polyethylene, 600-volt according to CSA C22-2 No. 38. The system ground shall be connected to the ground lug in each pole handhole and to the main ground bus at the supply disconnect.

The power supply shall be grounded with two (2) ground rods by means of 2-#6 RWU90 (green) running from the supply to approved ground rods. The disconnect shall be grounded using two (2) ground rods.

A ground rod shall also be installed at a minimum of every 5^{th} lighting pole in each circuit as well as at the last lighting pole in each circuit.

Ground rods to be steel, 19 mm diameter, 3.0 m long, copper clad for full length and shall be according to CSA. C22.2 No. 41. Ground rods shall be driven to a depth of 300 mm below finished grade.

17.11 Photometrics

17.11.a. Qualified Designers

A photometric plan for exterior lighting shall be prepared by a licensed electrical lighting specialist competent in lighting and photometrics or a licensed professional electrical engineer and submitted to the City of Kawartha Lakes for review. The plan must be legible and have sufficient information to show light levels throughout the site and in particular at all property lines

17.11.b. Design Parameters – Light Trespass

In general, the City of Kawartha Lakes policy is that the exterior lighting system shall be designed to ensure readings of 0.0 Lux at all property lines within the municipal right-of-way.

17.11.c. Drawings

In addition to the Photometric Plan an Underground Electrical/Schematic Plan and a Detail Plan shall be prepared by a licensed electrical lighting specialist or a licensed professional electrical engineer and submitted to the City of Kawartha Lakes for review.
As built drawings shall be provided to the City upon energizing the system.

17.12 Assumption of Subdivision

Prior to the assumption of a subdivision, the developer shall ensure all poles are installed correctly and in the proper location as per the approved drawings. All LED lamps are to be cleaned according to manufacturer's recommendations

18.0 References

- The Corporation of the Town of Whitby Public Works Department Design Criteria
- The Corporation of the Town of Ajax Design Criteria, Section I Streetlighting
- The Corporation of the City of Barrie Transportation Design Manual
- The Corporation of the Town of Whitby Development Control, Design and Technical Services "Landscape Plan Guidelines for Site Plan and Subdivision Development"

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