Engineering Design Criteria Manual

Last Updated January 2025

Revision Information Sheet

The current and future revisions are numbered consecutively. If you are maintaining a hardcopy version of this electronic document, you are required to remove and replace the applicable pages in your manual to ensure that your manual is up to date.

All future updates and revisions to this manual will be posted to this page. It is the user's responsibility to visit this page periodically to check for changes to the manual.

Individual notifications will **not** be sent to consultants advising them of new updates or revisions.

Engineering Design Standards and Criteria

November 2024 Updates

Section	Comments
3.12	Added acceptable geometrics for driveway widening's
3.20	Revised emergency access material depth
3.9	Removed reference to matching sidewalk widths for existing and infill developments
8.3.3	Added reference to referee testing
8.5.4	Added reference to base asphalt left longer than 42 months.
10.6	Added Pre and Post Construction Surveys

Engineering Standard Drawings

November 2024 Updates

Standard	Comments
OS-201	Made reference to OS-211
OS-202	Made reference to OS-211
OS-203	Made reference to OS-211
OS-211	NEW Setbacks from City regulated structures and trees
OS-320	Added driveway flare and widening for residential driveways
OS-602	Revised asphalt width from 80mm to 300mm

Appendices

Appendix	Comments
Appendix 1	Updated the runoff coefficients

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Appendices

1. Introduction

1.1 Guiding Principles

The following standards, criteria, and policies shall be used as a guideline for the preparation and processing of all engineering submissions presented to the City's Engineering Services Department for approval. This guide will also touch on some of the concurrent Planning Services processes and engineering submission requirements that are required to finalize and approve Engineering Submissions for Capital Projects, Subdivisions and Site Plans in the City of Oshawa (City).

These requirements are not all encompassing and do not relieve the Applicant of the responsibility of submitting a finished product of competent engineering design and construction.

While innovations by the Applicant at the design stage will be considered by the City, any proposal to deviate from City standards and requirements shall be discussed with and approved by the Engineering Services Department prior to making a formal engineering submission. If requested by Engineering Services, the Applicant shall submit such proposals in writing, detailing the rationale and provide a life-cycle cost-benefit analysis.

While it is understood that the engineering standards are guidelines, sound engineering, judgement, and experience should be exercised.

The following sections will identify the design requirements for municipal infrastructure within the City of Oshawa.

1.1.1 Personnel Qualifications

A Professional Engineer licensed to practice in the Province of Ontario and registered in the relevant design specialties must seal and sign all engineering products, including contract drawings, engineering reports and specifications. In the case of structural and foundation work, two stamps are required. The drawings and reports shall also bear the signature or stamp of the independent checker of the work.

The Applicant shall furnish individuals qualified in specialty fields such as geotechnical, electrical, environmental, structural, specification / special provision writing, transportation and landscape design to lead those activities.

1.1.2 Project Standards

The Applicant shall prepare the design in accordance with accepted technical standards, specifications, guidelines, and state-of-the-art practices. Where appropriate, the Applicant will be responsible for ensuring compliance with the most recent technical references. The City Project Manager or designate will resolve any conflicts in design criteria.

1.2 Other Approving Agencies

1.2.1 The Regional Municipality of Durham

The City of Oshawa is a lower tier municipality located within the Regional Municipality of Durham (Region). The Region is responsible for all sanitary sewers and watermains plus appurtenances that are to be installed on all road allowances and registered easements within the Region. The Region manages a number of Regional Roads within the City and is also responsible for most storm sewers and appurtenances located within their roads. . Maps illustrating Regional Roads within the City can be found in the City's latest copy of the Official Plan and Transportation Master Plan.

Applicants and their engineering consultant shall contact the Region of Durham Works Department to obtain copies of the Region's design criteria and standards for sewers, watermains, and Regional roads.

While the Region and City both function as separate entities, there are areas within the development process that are jointly managed by both, such as the construction inspection process.

1.2.2 Central Ontario Lake Conservation Authority

The Central Ontario Lake Conservation Authority (CLOCA) is a local, community-based, environmental organization that is responsible for managing watershed resources within the City of Oshawa. They offer information and analysis by reviewing land use plans, applications under the Planning Act, and supporting technical reports and drawings to provide formal comments that address environmental considerations.

CLOCA provides comments on the impact to natural hazards and natural heritage features and systems including:

- Flood plain management
- Impact to identified watersheds
- SWM Outfall locations
- LID Infrastructure
- SWM pond hydraulic calculations to meet watershed targets
- Erosion and slope stability
- Wetlands, shorelines of lakes, rivers, and streams
- Ravines, valleys, and stream corridors
- Natural Heritage Features and Systems
- Groundwater, Source Water Protection, Hydrologic Features and Areas
- Fish and fish habitat protection

Applicants and their engineering consultant shall contact CLOCA for any project within their jurisdictional area.

1.2.3 Others

There are also a number of other agencies, which may require the submission of engineering documents for approvals and permits or for general coordination. The following list is a sample of such agencies, however the responsibility for obtaining all appropriate external agency approvals ultimately shall be the Applicant's and their consultants.

- Ministry of Natural Resources and Forestry (MNRF)
- Ministry of the Environment, Conservation and Parks (MECP)
- Ministry of Transportation (MTO)
- Ministry of Municipal Affairs and Housing (MMAH)
- Department of Fisheries and Oceans (DFO)
- Canada Post
- Environment Canada
- Oshawa Power
- Enbridge Gas Distribution Inc.
- Bell Canada
- Rogers Cable
- Railways
- Trans-Northern Pipelines
- Trans-Canada Pipelines

1.3 Alternate Product Usage

If the Engineering Services Department receives product approval requests from suppliers interested in having the products evaluated for purchase by Engineering Services, the supplier should contact The Road Authority (TRA).

The City supports the efforts of the Ontario Good Roads Association (OGRA) and the Ontario Provincial Standards (OPS) organization. TRA is a service provided by the OGRA and is "an Internet-based information resource that provides a mechanism for infrastructure owners, consultants, contractors, and product suppliers to collaborate and share information. TRA provides users with information on products, services, and technical solutions available for use in the public works sector."

If a product is listed on the TRA-approved supplier list, it means the product is approved for its intended use, however, it is at the Engineering Services Department's discretion whether to use the product.

Consultation with Engineering Services is required for consideration of any alternative products for which Engineering Services does not already have a design guideline or standard. Alternate products and materials will not be permitted without written consent of

the Engineering Services Department. Proposals for the use of alternative products or technologies in the design and construction of the City's infrastructure must adhere to the following process:

- Submit a written request to the Engineering Services Department for the applicable project.
- Apply a pilot initiative approach to the implementation of the proposed alternative.

Once the product or technology has been deemed acceptable by Engineering Services and relevant stakeholders, then it may be considered by the Engineering Services Department for addition to the City's standards.

1.4 Applicable Legislation and Guidelines

The City's Site Plan Control By-Law 137-1989 has been created under the authority of the Planning Act, Section 41. Accordingly, no site development may be completed within the City unless plans for the proposed works have been submitted to and approved by staff of the Engineering Services Department.

In addition to applicable provincial statutes related to development, various by-laws and guidelines govern the engineering review process in Oshawa, such as:

- By-Law 137-1989 Site Plan Control
- By-Law 85-2006 Site Alteration
- By-Law 33-2009 Building Code
- By-Law 09-1990 Storm Sewer Connection
- By-Law 13-2003 Development Services Fees Schedule
- By-Law 60-2019 Development Charges By-Law
- By-Law 46-2013 Storm Sewer
- By-Law 37-2007 Road Occupancy
- By-Law 112-1982 Noise
- By-Law 72-1996 Sign
- By-Law 78-2008 City Trees
- By-Law 63-2022 Parkland Dedication
- By-Law 136-2006 Boulevard
- By-Law 60-94 Land Use / Property Zoning
- Region of Durham By-Law 55-2013 Sewer Use
- Policy & Procedure No. 2.3.2-028 Roadway Damage Deposit
- Region of Durham Transportation Master Plan

- City of Oshawa Transportation Master Plan
- City of Oshawa Urban Design Guidelines for Sites with Vehicle Drive-through
- City of Oshawa Parks Development Design Standards
- City of Oshawa Accessibility Design Standards
- City of Oshawa Engineering Design Criteria Manual

It is the Applicant's responsibility to ensure that the most recent version of the by-law is used. In addition to the documents listed above, the proposed development may be subject to additional statutes, by-laws, resolutions, specifications, or site-specific guidelines as applicable.

2. Engineering Drawing and Submission Requirements

This section provides guidelines for Engineering Design Drawing and Submission requirements to the City. All applicable drawing requirements as referenced in Oshawa Standard OS-1001 and 1002 shall be adhered to. The drawings must include, but not limited to, the information as follows:

2.1 Capital Projects Submission Requirements

An engineering submission for Capital Projects will normally include the following drawings in PDF format:

- Cover Sheet with Key Plan, Index of Drawings and Project Description
- General Notes and Legend
- Horizontal Control Plan
- Plan and Profile Drawings of all proposed roads and sewers
- Typical Cross-Sections and Details
- Design Cross Sections and Entrance Profiles
- Erosion and Sedimentation Control Plans
- Line Marking
- Other Drawings as Required (Traffic Management Plans, Staging Plans and Landscaping Drawings)
- Regional Drawings (Sanitary, Watermain and Traffic Signals)
- Street Lighting and Photometric Plan(s) of new lighting levels for the Rights of Way

The City withholds the right to request additional information, drawings, and reports.

2.2 Subdivision Submission Requirements

The engineering submission package shall consist at a minimum of the following typical drawings, fees, and reports in PDF format:

- A Preliminary Engineering Fee (base fee) according to the General Fees and Charges Bylaw
- Draft Plan Condition response matrix identifying how each of the issued Draft Plan Conditions has been addressed
- Cover Page
- Index
- General Notes

- General Plan(s)
- Master Lot Grading Plan(s)
- Intersection Grading Detail Plan(s). It can be incorporated in the Master Lot Grading Plan (s)
- Storm Sewer and Foundation Drainage Collector Drainage Plan(s)
- Plan and Profile Plan(s)
- Stormwater Management Facility Plan(s)
- Utility Coordination Plan(s) [for new roads]
- Traffic Signage and Pavement Marking Plan(s)
- Erosion and Sedimentation Control Plan(s)
- Details Plan(s)
- Landscape Plan(s)
- Street Lighting and Photometric Plan(s)
- Geotechnical Report
- Hydrogeological Report
- Stormwater Management Report
- Erosion and Sediment Control Report
- Noise Assessment Report
- Transportation Impact Study
- Environmental Assessment Report
- Arborist Report

The City withholds the right to request additional information, drawings, and reports.

2.2.1 General Requirements

The following are general minimum requirements for all engineering drawings:

- Engineering drawings are to be prepared on 594mm X 841mm (A1) size paper
- Scale Bar:
    - For Subdivisions the scale shall generally be 1:500. A scale of 1:250 may in some instances be required for multi-family areas to fully explain the necessary details.
    - For Site Plans scales shall generally be 1:250, 1:300 or 1:400 depending on the size of the lot area.
- North arrow

- Title block
- Key plan
- Legend
- City of Oshawa benchmark as published by Cosine
- Revision table
- All lot numbers, street names, blocks and proposed easements shown and numbered in accordance with the proposed plan for registration
- Proposed roads, curbs, and sidewalks
- Existing roads, curbs, and sidewalks
- Professional Engineering Stamp
- Oshawa Project File Number
- Draft Plan of Subdivision Number
- Registered Plan Number
- Driveway aprons
- Existing municipal addresses of adjacent properties
- Match lines where drawings overlap
- Other information that may be deemed necessary by the City in a specific situation in order to process the application

2.2.2 General Plan(s)

All applicable drawing requirements as referenced in Section 2.2.1 shall be adhered to with the additional following information:

- Proposed maintenance holes and catch basins, including maintenance hole system ID and catch basin leads
- Proposed rear yard catch basins, leads and easements, including RLCB system ID, size, slopes, lengths, flow arrows and easement dimensions
- Proposed sewers including size, lengths, material, slopes, flow arrows, system ID (i.e., STM, SAN, FDC)
- Proposed watermain, valves, hydrants, and bends
- Label proposed and existing sidewalk widths
- Proposed headwalls or outlets
- Existing sewers, structures, utilities, roads, etc.
- Regulatory floodplain information

2.2.3 Master Lot Grading Plan(s)

All applicable drawing requirements as referenced in OS-1001 and 1002 shall be adhered to with the additional following information but not be limited to:

- Existing contours shown at maximum 0.50 m intervals extending a sufficient distance outside the limits of the proposed plan (minimum 15 m or as required to indicate all significant features). Contours shall be based on up-to-date survey information.
- Topographic information including the location of existing natural and/or artificial features and applicable spot elevations of on-site and surrounding lands (trees, hydrants, above ground utilities, driveways, curbs, fences, buildings, culverts, easements, railway lines, pipelines, etc.).
- Proposed road grades, lengths, and elevations at 20.0 m or 25.0 m intervals on all streets with symbols at grade changes indicating direction of slope.
- Existing and proposed elevations at all lot corners and intermediate points of grade change, including 3H:1V slope ticks, required to illustrate the lot grading concept and drainage pattern and existing spot elevations extending to a minimum of 15 m beyond the proposed plan.
- Lot Drainage Type ID.
- All proposed rear lot catch basins and catch basin leads (preferable) with rim and pipe invert elevations.
- Elevations and grades along proposed swales at regular intervals.
- All proposed maintenance holes, and catch basins with system ID.
- Any watercourse running through or abutting the proposed development including their respective Regulatory Floodplain Limits.
- Location and cross section of the overland outlet for the “Major” storm.
- Direction of surface water run-off by means of an arrow pointing in the direction of flow on lands both within and, as required, off the site.
- Minimum basement elevations (if applicable).
- Terracing, including the use of retaining wall, shown with intermediate grades and cross- sections. Where required, further details may be added on the plot plan (site grading plan).
- All proposed sidewalks. Detailed sidewalk design adjacent to all corner lots must be provided. All sidewalk ramp grades must also be illustrated.
- Cross-sectional details of storm sewers on easement, if any, (including rear lot catch basin lead) including footing elevations for the proposed building.
- Elevation and extent of ponding limits at major sag points and/or overland flow spill areas.

- Location and height of any acoustic fence or berm.
- Proposed type of lot grading for each residential lot.
- Road length, grade and elevations at critical points is to be shown on the grading plans. (This facilitates checking of property line elevations without having to flip back and forth to the plan and profile drawings).

2.2.4 Intersection Grading Plan(s)

Intersection grading detail drawing(s) for all intersections shall be prepared with two decimal precision and shall include but are not limited to:

- All sidewalk ramp grades and elevations
- Curb grades and elevations (top and bottom)
- Centerline road grades and elevations
- Catch basin locations and rim elevations

2.2.5 Storm Sewer and Foundation Drainage Collector Drainage Plan(s)

Storm sewer drainage plans shall include but are not limited to:

- Drainage area and runoff co-efficient
- Major overland flow route arrows
- Maintenance hole information with system ID
- Sewer flow arrows, grade, size, and material
- Regulatory floodplain limits and FDC outlet information
- Existing downstream storm sewer information

Foundation Drainage Collector Drainage plans shall include but are not limited to:

- Cumulative flow, tributary flow, and number of units per catchment area
- Maintenance hole information with system ID
- Sewer flow arrows, grade, size, and material
- Regulatory floodplain limits and FDC outlet information
- Existing downstream FDC sewer information

2.2.6 Plan and Profile Drawing(s)

Plan and profile drawing(s) shall include but are not limited to:

In Plan View

- All alignments shall start with a station that is a multiple of 1000 (i.e., 1+000, 2+000,

etc.) or if it is a continuation of a previous design use the alignment chainage from that design. Chainage is to be west to east and south to north. Chainages shall not start at 0+000.

- The pavement portion of the road shall be hatched. All proposed sidewalks shall be hatched.
- The Centerline of Construction information in the appropriate right-of-way (i.e., VPI's, BVC, EVC, High Points, Low Points, Length, and grade from VPI to VPI).
- Gutter Data Table information as per the template below:

	GUTTER DATA					UNDERDRAIN
NO.	DESC.	STATION.	GUTTER ELEV.	LENGTH (m)	GRADE %	DEPTH BELOW SUBGRADE

- Proposed maintenance holes and catch basins, including maintenance hole system ID and catch basin leads.
- Proposed rear yard catch basins, leads and easements, including RLCB system ID, size, slopes, lengths, flow arrows and easement dimensions.
- Proposed sewers including size, flow arrows, and system ID (i.e., STM, SAN, FDC)
- Proposed watermain, valves, hydrants, and bends.
- Proposed service connections.
- Proposed headwalls or outlets.
- Culvert pipe lengths, sizes, materials, and inlet/outlet invert elevations.
- Existing sewers, structures, utilities, roads, etc.
- Catch basin Data Table information as per the template below:

	CATCH BASIN DATA				C.B. CONNECTION DATA				
NO.	STATION	FINAL RIM ELEV.	PROP. RIM ELEV.	PROP. INVERT ELEV.	LEN. (m)	DIA. (mm)	CLASS OF PIPE	GRADE % ELEV.	CLASS OF BED'G

- In the Gutter Data Table provide the grade portion only where it differs from being 2% grade from the Centerline of Construction.
- Maintenance hole chainage (Location as per City of Oshawa template).
- Maintenance hole offset from Centerline of Construction where it differs from the typical offset.
- note indicating the distance between the final and interim pavement elevation.
- Common gutter point descriptions as follows:
    - PC – Point of curvature
    - PCC – Point of common curvature

- PRC – Point of reverse curvature
- BHC – Beginning of horizontal curve
- EHC – End of horizontal curve
- VPI – Vertical PI (in the gutter)
- HPI – Horizontal PI (in the gutter)
- Low Points, High Points, E, N, W, S, Limits

In Profile View

- Scale: Generally, 1:500 horizontal and 1:50 vertical.
- Where the profile is along a horizontal curve, design the road grade such that the associated curb grade is a minimum of 0.5%. Avoid stacked minimums (e.g., minimum horizontal radius with a minimum “k” value).
- Profile grid is to be spaced 0.5m vertically.
- Safety grates information and elevations.
- Service connection risers information and elevations.
- Underground pipes with a different hatching.
- Size of pipe and use. i.e., 250mm dia. FDC sewer.
- Pipe bedding, dimension ratio, material, and class.
- Hydraulic grade line for Type II system.
- Maintenance hole size and corresponding OPSD #.
- All critical points in the profile. (i.e., VPI’s, BVC, EVC, High Points, Low Points) Length and grade from VPI to VPI.
- Maintenance hole rim elevations.
- Subgrade transitions required clearly indicated in the profile.

2.2.7 Stormwater Management Facility Plan(s)

Stormwater management facility plan(s) shall include but are not limited to:

In Plan View

- Existing contours shown at maximum 0.50m intervals extending a sufficient distance outside the limits of the proposed plan (minimum 15m or as required to indicate all significant features). Contours shall be based on up-to-date survey information.
- Topographic information including the location of existing natural and/or artificial features and applicable spot elevations of on-site and surrounding lands (trees, hydrants, above ground utilities, driveways, curbs, fences, buildings, culverts, easements, railway lines, pipelines, etc.).

- Any watercourse or tributary running abutting the proposed SWM facility including their respective Regulatory Floodplain Limits.
- Existing and proposed elevations at regularly spaced intervals and intermediate points of grade change, including 3H:1V slope ticks, required to illustrate the SWM facility grading concept and existing spot elevations extending to a minimum of 15m beyond the proposed plan.
- Pipe and structures, including size, material, class, slope, inverts, and rim elevations. Non-standard structures (i.e., quality and quantity control structures) shall have construction details and sections provided.
- Proposed SWM pond contours and gradients, including pond sump, bottom of pond, permanent pool, active storage, freeboard, etc.
- Limit of proposed grading disturbance.
- Maintenance access detail, including slope, material, and construction specifications.
- Outfall channel details, including inverts, gradient, length, lining, cross section, restoration, etc.
- Pond surface treatment and lining details.
- Sediment storage area.
- Fencing.

In Section View

- Pond water elevations (i.e., sump, permanent pool, active storage, etc.) and storage volumes.
- Existing and proposed ground profiles.
- Seasonally high ground water profile.
- Pond gradients.
- Any watercourse or tributary running abutting the proposed SWM facility including their respective Regulatory Floodplain Limits.
- Watercourse setback distance.
- Pipes and structures.
- Pond lining and surface treatment details.

2.2.8 Utility Coordination Plan(s)

The following are general requirements for this drawing:

- Engineering drawings are to be prepared on 594mm X 841mm (A1) size paper.

- Scale: For Subdivisions the scale shall generally be 1:500. A scale of 1:250 may in some instances be required for multi-family areas to fully explain the necessary details.
- North arrow.
- Title block.
- Key Plan.
- City of Oshawa benchmark as published by Cosine.
- Legend.
- All lot numbers, street names, blocks and proposed easements shown and numbered in accordance with the proposed plan for registration.

In addition to the General Requirements, include the following information:

- Provide location of all proposed underground and aboveground utility infrastructure, all which are to include dimensioning from lot lines and street lines as appropriate to accurately assess the proposed location in accordance with the appropriate City Design Standards. Care should be taken to ensure that all utility designs are extended to accommodate any future phasing and to eliminate any future Municipal Consents.
- Provide location of all utility road crossings, depth, duct quantity and dimensional location. Reference to Oshawa Standard OS-221 – Utility Duct Road Crossing Detail) and OS-226 Common Utility Trench.
- Provide all proposed tree locations (including dripline).
- Road allowance property lines with all lot and block property line fabric of the subdivision with their corresponding street names, lot, and block identification numbering.
- Street curb lines and sidewalks.
- Proposed driveway location illustrating actual width to match the housing form.
- Street lighting and wiring schematics, connection to transformer with locations of disconnect switches.
- Maintenance holes, catch basins, hydrants shown with all main line piping together with corresponding service connections, and any specific traffic controls.
- Sign-off from all Utility Providers involved.

2.2.9 Traffic Signage and Pavement Marking Plan(s)

Traffic signage and pavement marking plan(s) shall include but are not limited to:

- All traffic signage in accordance with OTM design criteria (stop signs, speed limit signs, bicycle lane signs).
- All pavement markings in accordance with OTM design criteria.

2.2.10 Traffic Management General Plan

The Traffic Management General Plan should, among other things, show on the street network where the following signs are to be located, if required:

- No Parking
- Speed Limit
- Bicycle Route Start
- Bicycle Route End
- Bicycle Route, where the solid line becomes a dashed as cycle lanes approach a corner
- Bicycle Route Markers
- Share The Road, Single File
- Vehicle Passing Prohibited
- Reserved Bicycle Lane
- Bicycles Excepted
- Directions to other cycling facilities
- Bicycle Parking if any

Refer to the latest copy of the OTM Book 18 Section 4.2 and 4.3.4.2 for cycling facilities signs and pavement marking design requirements.

2.2.11 Erosion and Sediment Control Plan(s)

Staged erosion and sediment control plan(s) to show the Erosion and Sediment Control (ESC) measures at different stages of development (i.e., earthworks, servicing, building construction and decommissioning shall include but are not limited to:

Stage 1 Plan – Earthworks Construction

- Existing contours shown at maximum 0.50 m intervals extending a sufficient distance outside the limits of the proposed plan (minimum 15 m or as required to indicate all significant features). Contours shall be based on up-to-date survey information.
- Topographic information including the location of existing natural and/or artificial features and applicable spot elevations of on-site and surrounding lands (trees, hydrants, above ground utilities, driveways, curbs, fences, buildings, culverts, easements, railway lines, pipelines, etc.).
- Construction access details.
- Internal haul routes.
- Protective fencing details.

- Limits and areas of disturbance.
- Drainage boundaries and size.
- Location of bodies of water, streams, wetlands, channels, and ditches on or within 30m of the site boundaries.
- Location of proposed and existing storm water drainage features on or within 30m of the site boundaries.
- Location, dimension and use of existing buildings or other structures on or adjacent to the site.
- The location of the predominant soil types.
- Regional Storm Flood Plain and Conservation Authority Fill Regulation lines.
- Environmental constraints and setbacks.
- Phasing boundaries and construction sequencing details.
- Sediment control pond and traps, including:
    - Stage-storage tables
    - Storm inlet / outlet details
    - Emergency overflow details
    - Turbidity curtain details
    - Decommissioning details or permanent SWM pond conversion details
- Infiltration/Low Impact Development (LID) area compaction mitigation measures (if applicable).
- Vegetation buffers and setbacks from natural features.
- Swales and check dams.
- Temporary Bulkheads.
- Topsoil or other material stockpile and berm location(s).
- Construction notes and details including:
    - Construction schedule of the anticipated starting and completion dates of each land disturbing or land developing activity including the installation of construction site control measures
    - Re-vegetation details to be indicated for stripping areas subject to long term exposure
    - Procedures for monitoring and maintaining the erosion and sediment controls, including method of removing and disposing of sediment from any sediment traps
    - Details of contingency plan for failure of control elements during extreme runoff events, when impacts from water are severe

- Emergency contact information during earthwork construction

Stage 2 ESC Plan – Servicing and Building Construction

- Draft plan of subdivision layout, showing ultimate road and lot layout
- Updated drainage boundaries
- Updated location, depth, and design of all ESC measures
- Rear lot catch basin and catch basin inlet protection details
- Bulkhead details
- Stabilization measures
- Updated ESC construction notes and details

Stage 3 ESC Plan – Decommissioning

- Permanent stabilization measures and timelines
- Depict the removal / decommissioning of ESC measures
- ESC decommissioning construction notes and details

2.2.12 Landscape Plan(s)

Please refer to latest version of the City's Parks Development Design Standards and the Oshawa Accessibility Design Standards for design guidelines on landscape plans.

2.2.13 Street Lighting and Photometric Plan(s)

Street lighting drawing submission to consist of the following:

- Photometric plan for roadway/ sidewalks/ Multi Use Paths (MUP) as per RP-8-22 requirements.
- Street lighting layout drawings including the locations of streetlights, power supplies, underground conduit for street lighting cables, street lighting handwells and ground rods.
- Street lighting wiring diagram/ schematic drawings consisting of information pertaining to underground conduit size and type, wiring size and type (i.e., copper), grounding system, power supply loading table and luminaire wattages.
- Street lighting charts and notes drawings including pole type/ height, luminaire type/ wattage, mounting bracket arm length, handwells and ground rods. Offset and stations to be included for all proposed street lighting poles and handwell locations.

2.2.14 Site Grading Plan(s)

All applicable drawing requirements as referenced in OS-1003, 1004 and 1005 shall be adhered to and, at a minimum, the following information shall be shown on each site grading plan:

- Lot number and street name.
- Proposed building location.
- Proposed elevations for all lot corners, swale inverts and intermediate points of grade change at reasonable intervals along the boundaries of the lot to illustrate drainage of the lot in relation to the surrounding lands and buildings.
- Driveway grades.
- Direction of surface water runoff using arrows to show the drainage pattern for the lot.
- Location of above ground utilities.
- All foundation control elevations.
- Finished first floor elevation.
- Locations of rain leader discharge points.
- Location of any stormwater control device.
- Location and dimensions of any LID(s).
- Location of any sump pump discharge point.
- Existing trees to be preserved.
- Proposed acoustical fencing and/or berm.
- Grate locations and elevations of all rear yard catch basins.
- Locations of any easements and underground services.
- Slopes/terracing/retaining walls.
- Outline of the useable rear yard area.

2.3 Site Plan Design Guidelines

2.3.1 General

Pre-consultation with the City's Engineering and Planning Services Departments by the Applicant and their consultants is highly recommended. This consultation helps to confirm submission requirements and obtain available engineering data. All pre-consultation meeting requests shall be arranged through Planning Services. Engineering Services may require a number of studies to adequately review the proposed site plan.

The following outline is intended to assist the applicant in preparing site plan, servicing, and grading plans for Site Plan Applications for all developments other than residential developments containing 10 dwelling units or less and any other developments exempt from site plan control. For more information regarding Site Plan Control, see the City of Oshawa web page.

The Applicant must satisfy the City, financial and otherwise; complete the applicable Development Charge Form for the site and pay all applicable development charges prior to the issuance of a building permit (development charge forms are available and applicable development charges must be paid at the City of Oshawa).

The purpose of this section is to outline the general engineering requirements for site plan submissions. These requirements are to be read in conjunction with the latest edition of other governing departments or authorities' requirements, including but not limited to:

- Oshawa Planning Service's Application for Site Plan Approval Document
- The Ontario Building Code (OBC)
- Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Sewage Works
- Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Drinking-Water Systems
- Region of Durham Design Standards
- CLOCA's Technical Guidelines for Stormwater Management Submissions
- Applicable Ontario Acts and Regulations

2.3.2 Site Servicing and Grading Plan Requirements

The site servicing and site grading plans shall be prepared to include the following information:

- Engineer's stamp required on all civil drawing(s).
- For Site Plans scales shall generally be 1:250, 1:300 or 1:400 depending on the size of the lot area.
- Existing and proposed lot grading (including parking lots, driveways, grassed areas, walkways, etc.) indicating direction of surface flow.
- Location of roof-water leader outfalls.
- Rim and invert elevations of proposed maintenance holes and catch basins.
- Size, length, location, grade, material and bedding of all proposed storm sewers and catch basin connections.
- Invert of proposed storm sewer connection at the property line.
- Invert of proposed storm sewer connection and main at the point of connection to the main.

- Location, size, length, and grade of any existing storm sewer connections if they are still to be utilized.
- Storm sewer design calculations for all proposals of 0.4 hectares or greater.
- Location and details of any erosion control works required.
- The following note is to be included on any grading plan where a site is required to have erosion control measures in the City's opinion: "All erosion control works must be implemented prior to any work being undertaken on the site."
- The following note is to be included on all servicing and grading plans: This approval is subject to the following conditions:
    - The Applicant shall be responsible for the cost of relocating, restoring, and repairing any utilities and other underground services, resulting from installation of any proposed storm sewer connection.
    - Any deviation from the approved plan with respect to grading or storm drainage system shall nullify this approval and require submission of revised plan for approval.
    - The Applicant must obtain City of Oshawa approval for the location of any proposed utilities or services within any City road allowance.
    - The Applicant must obtain the approval of the utility authority for any proposed utility extension or service connection.
- Basement (or lowest) floor elevations.
- Invert of proposed connection at the face of the building and at the property line.
- Invert of proposed connection and main at the point of connection to the main.
- Location, size, length, grade, material and bedding of all sanitary sewers and connections.
- Rim and invert elevations of proposed maintenance holes.
- Sanitary sewer design calculations.
- Location, length, size, and grade of existing and/or proposed sewer and watermains, including invert and rim elevations of maintenance holes.
- Final crown line grade and elevation of road (may be existing or proposed).
- Elevations at the back edge of existing sidewalks or, if there is no existing sidewalk, the elevations of existing ground at the back edge of future sidewalk and the elevations of the future sidewalk.
- Location and elevations of existing or future curb and gutters. If curb and gutters are not existing, the elevations at the edge of the existing traveled road.
- Location of all existing above and below ground utility installations, including the size of pipes or conduits.
- Location and size of existing and/or proposed driveway openings.

- Location, size, and species of existing street trees.

2.3.3 Design Criteria

The design of the site's services shall be in conformance with the City's design criteria outlined in this manual and other agency standards.

The design of the site's grading plan shall be in conformance with the City's design criteria outlined in this manual and the City's Accessibility Design Standards.

A Professional Engineer shall perform the grading design for any residential buildings containing three or more dwelling units and for any development other than residential.

All Landscape Plans shall be prepared by an accredited professional Landscape Architect in good standing with the Ontario Association of Landscape Architects (OALA). The Landscape Architect shall coordinate with all other consulting professionals to ensure accurate representation of the site and the proposed development.

Where there is a landscape plan proposed as part of the site plan application, the Professional Engineer designing the site grading plan shall review the landscape plan and shall provide the City with a declaration advising that the proposed landscape works are in conformance with the site grading plan.

Once construction is completed, the professional designing the grading plan shall provide the City with a Lot Grading Certificate and any required Retaining Wall Certificates in a form similar to the sample provided in Appendix 7 and Appendix 9, respectively of this manual.

Vehicle turning path checks using the design vehicle are to be completed for all site plan development private laneways and intersections. The design vehicle shall be determined in consultation with the City. The analysis shall consider vehicles for waste collection, snow removal and EMS.

2.3.4 Inlet Control Devices

Inlet control devices (ICDs) should be used on new sewer systems where surface storage is the objective, or on the outlet of stormwater management facilities for peak flow control.

Orifice plates may be used as catch basin restrictions to prevent surcharging in the storm sewer system. However, the City of Oshawa does not support the use of orifice plates as a method of achieving quantity control targets for a development site due to their ease of tamper. Instead, orifice tubes are recommended to be used for site quantity control. Consideration will be given to the specification of plates for smaller orifice sizing where the Applicant provides details satisfactorily demonstrating tamper resistance.

2.3.5 Underground Storage

Underground storage is only permitted within private sites. Underground storage is not permitted within the City right-of-way (ROW) or on any City property where the facility would be maintained by the City of Oshawa.

In the absence of City criteria, at a minimum, the flowing information must be provided

when underground storage is proposed:

- Frequency of inspection and components required to be inspected
- Training requirements for inspection and maintenance
- Frequency and approach for sediment removal
- Monitoring requirements to verify structural integrity
- Cost estimate for maintenance and inspection

Underground storage systems must include an emergency overflow system and clearly defined overland flow route sized to convey the 100-year storm in the event that the subsurface facility becomes clogged or inoperable.

2.3.6 Roof Storage

Due to the potential for tamper, the use of rooftop storage is discouraged. Consequently, Engineering Services does not typically recognize rooftop controls in the onsite stormwater calculations. If deemed necessary due to site constraints, the use of roof storage must be approved at the City's discretion, subject to the following:

- The design must comply with Design Requirements for Rooftop Storage – CLOCA Technical Guidelines for Stormwater Management Submissions (latest edition).
- The site plan agreement shall identify the inclusion of rooftop storage as part of the onsite stormwater quantity control measures.
- Certification of completion must be submitted by the Professional Engineer.

Refer to Section 7.6.2 of this document for information on Surface Storage.

2.3.7 Site Plan Storm Sewer Connections

Oshawa By-Law 9-90 establishes the basis upon which plans relating to grading and the disposal of storm and surface water shall be approved. Section 5a) states:

"No sewer connection shall be constructed on any City road allowance or other public land except by City forces or under a contract let by the City. Any work done for or by the City shall be under the control of the Commissioner of Economic and Development Services and its scheduling shall be dependent on the workload at the time of application."

In order to properly layout and locate proposed sewer connections the City requires the following information:

1. The Applicant is required to provide a Northing and Easting of the centerline of all proposed underground structures that require a tie-in to any storm line or facility owned by the City of Oshawa. The coordinates must be NAD83-ORIG based.
2. The Applicant is required to provide project control from the original site plan survey. All project control must have a Northing, Easting and Elevation (down to the nearest mm). The coordinates must be NAD83-ORIG based. The Applicant may also choose to provide the coordinates (Northing, Easting, Elevation) of minimum

three existing (3) property bars of the property being serviced in lieu of project control local to the site. The coordinates must be NAD83-ORIG based.

The following information shall be shown on the servicing plans:

1. Connection point along the mainline. A distance from the upstream and downstream centerline of maintenance holes that are on either side of the pipe segment that is being broken into.
2. A dimension from a property corner to the point where the storm connection crosses the property line.
3. Any coordinates of proposed structures that are being tied into.
4. City of Oshawa benchmark as published by Cosine.
5. Any site benchmarks are to be shown.
6. Proposed pipe invert at property line.
7. Length of pipe within the road allowance.
8. Identify pipe crossing clearances.

Refer to Storm Connection By-Law 9-90 for further information.

2.3.8 Waste Collection

City Administered Collection of Waste

Municipal Waste Collection Service on private property requires special consideration during the design and planning process based on the City of Oshawa Waste Guidelines and Design Standards. The standards make sure that collection can be done safely and efficiently.

For those properties that choose not meet the standards for municipal collection, the property owner must arrange for waste collection services through a private waste collection contractor at their own expense.

Privately Administered Collection of Waste

Access to the collection facilities must be designed to allow the waste collection vehicle to enter the site and gain access to the facility, empty the containers, turn around on site, and exit the site without backing onto the street. All such movements must be made safely with minimal movements other than those required to collect the container. It will be assumed that all parking spaces are occupied at the time of servicing. The standard TAC turning template for a SU9 truck with an outside turning radius of 12.8 m is to be used in planning these requirements.

2.3.9 Final As-Builts

Lateral Location Sheets

Lateral location sheets (see Section 11.3 for “As-Built” Design Requirements) are required for the final as-built municipal storm service connections to approved Site Plan with a

known civic address, new connections and/or replacement connections.

The following information is required on Lateral Location Sheets:

- North arrow
- Lateral pipe diameter, material, and class
- Mainline pipe diameter, material, and class
- Length of lateral
- Elevation and depth at property line
- Elevation at Main Line House and lot number, if available, or house number of adjacent property
- A distance to the closest maintenance hole, hydrant, or valve
- A sketch of house/building with offset and distance to property line and mainline storm sewer (Measurements must be taken at a 90° angle from the corner of the building and then parallel to the mainline, where possible)
- Reference City Storm Sewer numbering system for all maintenance holes and catch basins
- One connection per lateral location sheet (unless the same lot/address)

2.4 Electric Vehicle Parking Design Criteria

Electric Vehicle (EV) parking spaces are universal in design to accommodate both accessible permit holders and non-accessible parking users. As such, appropriate parking control signs should be considered in the design as per OTM Book 5.

The installation of all public EV charging infrastructure on City properties and within the streetscape must not create barriers to mobility or access for those with disabilities or other accessibility challenges.

Where a parking facility serves multiple buildings or accessible entrances, EV Parking Spaces should be distributed to enable users to park near to as many accessible entrances as possible.

Bollards will be installed to protect EV Charging Stations from damage. Location of said bollards must not block access.

EV Parking Spaces must be a minimum width of 3.4 m and length of 5.4 m for off-street parking locations, meeting the standards for “Type A” accessible parking spaces outlined in Ontario Regulation 191/11, as amended. For on-street parking locations, follow accessible parking space design requirements as per the Oshawa Accessibility Design Standards.

EV Parking Spaces must have a maximum running slope and cross-slope of surface at 1:50 (2%) in new and rehabilitated parking lot designs.

An access aisle must be provided adjacent and parallel to each EV Parking Space that is at least 1.5m wide and clearly indicated by high colour contrast diagonal pavement markings. This access aisle can be shared with another accessible and/or EV Parking Space.

EV parking ground surface must be firm, stable, and slip resistant.

EV parking Spaces should have lighting to operate the EV charging infrastructure in a safe environment. Lighting should be enough to easily read associated signs, instructions, or controls on the EV Charging Station and provide sufficient lighting around EV Parking Spaces for safety and security.

2.5 Roundabout Design Submission Requirements

A Roundabout Design Checks Package shall be submitted at the 30% stage of design and consist of the following drawings and information:

- Horizontal Geometry Dimensions
- Design Vehicle Turning Movements
- Entry Path Radii
- Entry Angles and Sight-to-the-Left
- Speed-Radius Calculations
- Geometric Design Summary

The following additional information should be submitted at the 60% or 90% stage of design:

- Combined Sight Distance or Clear View Area Diagram
- Pavement Marking and Signage Drawings
- Landscape Plan
- Illumination Plan
- Construction Staging Plan (if applicable)

3. Roadways

3.1 General

The purpose of this section is to outline the engineering design criteria requirements pertaining to roadways in the City.

This document shall be read in conjunction with the City's standard drawings (OS-Series) as well as all applicable Ontario Provincial Standards Specifications (OPSS), Ontario Provincial Standards Drawings (OPSD) and Transportation Association of Canada (TAC) specifications, standards and guidelines referenced or recommended by the City. It is the responsibility of the Applicant to ensure latest version of these standards are used in their design. Generally, the latest edition of the Geometric Design Guide for Canadian Roads issued by the TAC shall be used in the geometric design of City roads. Where not specifically discussed in this Design Manual, the TAC Geometric Design Guide for Canadian Roads shall govern.

Roadway design shall consider recommendations in the Region's Vision Zero Strategic Road Safety Action Plan in the planning and design of City's roads. The road design shall also consider best practices outlined in the latest version of the City's Neighbourhood Traffic Management Guide for designing safe roads in new neighbourhoods and developments. A design criteria document is required to be prepared for each project and included in the first engineering submission to the City. The document shall include the criteria used for the various project components and any deviation from the standards, with the applicable justification for the deviations and proposed mitigations. Consideration will be given to extreme cases or exemptions from the preferred limits with justification from the Engineer.

3.2 Road Classification

All roadways in new developments shall conform to City and Region's Official Plans.

Through both Official Plan documents, the following hierarchy of roads and streets have been established:

Road Type	General Function	Typical Right-of-Way (ROW) Width	Intersection & Access
Arterial Type A	Large volumes of all types of traffic. May include HOV or bus lanes.	36 m to 45 m	Intersection with freeways and other arterial roads. Direct access generally not permitted.
Arterial Type B	Moderate volumes of all types of traffic. May include HOV or bus lanes.	30 m to 36 m	Intersection with arterial and collector roads. Direct access generally not permitted.

Road Type	General Function	Typical Right-of-Way (ROW) Width	Intersection & Access
Arterial Type C	Lower volumes of all types of traffic.	26 m to 30 m	Intersection with arterial and collector roads. Direct access may be permitted (minimum 12.0 m single lots).
Collector	Moderate volumes of traffic primarily moving between points of origin and arterial roads.	Urban: 20 m to 26 m Rural: 30 m	Intersection with arterial, collector and local roads. Direct access permitted.
Local	Light volumes of traffic moving between points of origin and collector roads.	Urban: 20 m - 18 m (with justification) - 16 m Service Road Rural: 30 m	Intersection with collector and local roads. Direct access permitted. Intersection with arterial roads to be discouraged.

Roadway classification and right-of-way (ROW) width will be confirmed at the Draft Plan Approval stage.

3.3 Geometric Design

Generally, the geometrics in this table are intended for an urban design situation.

Geometric Detail	Arterial	Collector	Local
Right-of-Way Width (metres)	Type B – 30-36 Type C – 26-30	20-26	20 18 (with justification) *See Note 9 16 (service road) *See Note 9
Pavement Width (metres)	Type B – 14.5 Type C – 14.5 (11 first stage)	10	8.5 residential 10 industrial/ commercial
Design Speed (km/hr)	Type B – 80 Type C – 70	60	50
Minimum Curve Radius (metres) (Low speed urban design)	Type B – 380 Type C – 260	175	110
Minimum Intersection Spacing (metres)	200	60	3 Way – 40 4 Way – 60
Intersection Angle	80-90º	80-90º	80-90º

Geometric Detail	Arterial	Collector	Local
Minimum Tangent Length Through Intersection (metres)	120	90 at arterial roads 60 at other roads	60
Minimum Grades (%)	0.5	0.5	0.5
Maximum Grades (%)	5	5	5
Minimum Safe Stopping Sight Distance(metres)	Type B – 140 Type C – 110	85	65
Minimum Sag Curve K Factor (Urban illuminated)	Type B – 16 Type C – 12*	9*	6* *(4) Intersection under stop control
Minimum Crest Curve K Factor	As per TAC Guide	As per TAC Guide	As per TAC Guide
Superelevation	Site Specific	None	None
Curb Return Radii	Refer to OS-500 Series	Refer to OS-500 Series	Refer to OS-500 Series
Width of Traffic Lane (metres) (Add 0.25m buffer for curb lanes)	3.5 – 3.75	3.5	2.75 residential 3.5 industrial/ commercial
Width of Parking Lane (metres)	n/a	2.6	2.6
Width of Turning Lane (metres)	3.3	3.3	n/a

Notes:

1. Additional ROW and/or pavement width may be required in specific situations to provide for such features as bus bays, turning lanes, upgraded landscape features or medians, bike lanes, Multi-Use Paths (MUP), additional underground services, or utilities. For standard cross-sections and utility locations on City roads, refer to the standard drawings, OS-200 series. Engineering Services shall be consulted for specific ROW requirements for roads during Draft Plan submissions as requirements may differ from the standard drawings in certain situations. ROW widths shall be considered minimum and may be increased in specific situations.
2. Pavement width is measured from the theoretical ‘face-of-curb’, which is estimated to be 150 mm from the back edge of the curb.
3. Calculations should be based on design speed and the use of operating speed will only be permitted in restrictive urban areas.
4. Refer to the TAC Guide for the difference between intersection spacing and driveway/entranceway management.
5. Adjust centerline road grade as required to achieve a minimum 0.5% curb grade along a horizontal curve.

6. All profile grade changes >1% shall be designed with vertical “K” curves as outlined in the table above. Minimum horizontal curvature, minimum stopping sight distance, and desirable maximum grades are the normal limiting values. They are to be improved where technically required but may not be lowered without the expressed consent of the City. Use of ‘stacked’ minimum/maximums are not permitted. The use of minimum horizontal curvature and minimum vertical curve at the same location will not be permitted.
7. For geometrics and dimensions of turn lanes, storage length, taper length, minimum travel lane width, and length of raised medians, refer to the appropriate sections of the TAC Guide. Associated traffic volumes and T.I.S. (Traffic Impact Study) recommendations must also be considered in the design.
8. Stopping sight distance and intersection sight distance based on design speed shall be as per the TAC Guide.
9. Lots on the side of the street with no sidewalk must have a setback of 7.0m from property line to the garage door.

3.4 Intersections

All intersection line painting shall be as per OS-401, Ontario Traffic Manual (OTM) Book 11 and Section 9 of this Design Manual.

Refer to the Region for traffic signal design, which are under the Region’s jurisdiction.

The Region shall be consulted regarding the design of any transit infrastructure and signals as it relates to the intersection design.

3.4.1 Sight Triangles

Sight triangles are required at all intersections between two collector roads and where any class of road intersects with an arterial road. Although typically not required at local-to-local intersections, sight triangles will be required at locations where geometric constraints exist to ensure safety requirements are met for both pedestrian and vehicular traffic. Refer to the City’s Zoning By-Law Number 60-94 as Amended for clarifications on Corner and Driveway Sight Triangles. All sight triangles shall be calculated based on TAC Guide Chapter 9 requirements.

General Guidelines for Sight Triangles:

- In urban areas when buildings are located at the property line, lack of sight triangles is best addressed by means of “4 way stop” conditions or “no right turn on red” for signalized intersections.
- The area within the sight triangle as defined in Section 2.3.3.2 – Sight Triangles, of the TAC Geometric Design Manual, should be free of obstructions that block a motorist’s view of potentially conflicting vehicles, pedestrians, and cyclists entering the travel lanes.
- Ensure there is adequate space for a refuge area adjacent to the crosswalk by removing / relocating obstructions to facilitate the clear and unobstructed view of on-coming vehicles.

- Ensure that vegetation is set-back from the crosswalk and that there is sufficient space for snow storage during the winter months.
- Ensure the area within the sight triangle is well lit.
- If the sight triangle for the desired operating speed and intersection control is obstructed, efforts should be made to eliminate, move, or mitigate the obstruction.
- To improve sight lines, restrict parking near intersections, properly trim vegetation, move stop lines back from crosswalks, and use curb extensions.
- Mature trees should be trimmed when branches encroach into the sight triangle area. Planting of new trees in the sight triangle area is discouraged.
- Avoid the placement of utilities, road signs, transit stops, and other similar boulevard elements in the sight triangle.

Guidelines for Corner and Driveway Sight Triangles as per City's Zoning By-Law Number 60-94 as Amended:

- In a sight triangle, in all zones except a Urban Growth Centre (U.G.C.) Zone, no building, structure or man-made feature is permitted to be erected or maintained to a height greater than 0.9 m above the grade of the centerline of the abutting street, at any point in the sight triangle directly opposite that grade of the street.
- On any lot, in a driveway sight triangle, in all zones except a U.G.C. Zone, no building, structure or man-made feature is permitted to be erected or maintained to a height greater than 0.9 m in any area which is bounded by the street line, the side of a driveway leading from that street, and a straight line joining the points in the street line and the side of the driveway line which are a distance of 3.0m from the point of their intersection.

3.5 Roundabouts

Roundabouts in new developments shall conform to the City of Oshawa Standard Drawings for 36 m diameter and 27 m diameter roundabouts (OS-801 to OS-804). Prior justification must be provided if another diameter of roundabout is planned. A Roundabout Design Checks Package shall be provided for each roundabout being proposed at the 30% stage of design. The package should be approved by the City before proceeding to further stages of roundabout design.

The design vehicle shall be a tractor semi-trailer (WB-20) for all movements for a 36 m diameter roundabout, and a transit bus (B-12) for all movements for a 27 m diameter roundabout.

Entry path radii must be drawn for all directions using splines. Splines must be drawn with 1.5 m offsets from face of curb and 1.0 m offsets from roadway centerline. No offsets shall be assumed from any other pavement markings. Entry path radii should be converted to fastest-path speeds assuming 2% outward crossfall using Equation 3.2.1 and Table 3.2.2 of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (June 2017). Fastest-path entry speeds should be between 35 and 40 km/h, depending on traffic distribution and site context.

Roundabouts at existing intersections will need to be more flexible in terms of diameter, to best accommodate existing site constraints. However, a Design Checks Package is still required at the 30% stage of design. The package shall be approved by the City before proceeding to further stages of roundabout design.

In general, roundabouts shall be designed in accordance with the TAC Canadian Roundabout Design Guide (January 2017) and good engineering design principles.

Concrete for truck aprons and splitter islands shall be 32 Mpa at 28 days. Please see Section 9.3.6 for more details on pavement markings for roundabouts.

Truck Apron shall be constructed using a minimum of 325 mm reinforced impressed concrete on a minimum of 400 mm Granular 'A'. Mountable curbs shall be as per OS-603.

Splitter Islands shall be constructed using a minimum of 100 mm impressed concrete on a minimum of 325 mm Granular 'A'.

Materials shall conform to the following:

- Colour hardener shall be A-01 Terra Cotta (CCI-100). Colour shall be integral to concrete. A sealer shall be applied to preserve the integrity of the concrete/colour and minimize damage.
- The impression style shall be 200 mm x 200 mm running bond (Unilock Unigranite A pattern) placed perpendicular the centerline of the road.
- One coat of Cure and Seal as manufactured by Concreation Canada Inc., Toronto, and supplied by the above shall be applied at the time and at a coverage rate as per the manufacturer's recommendations or approved equivalent.

3.6 Parking

Where approved by the City, the minimum dimensions of an accessible parking space that is adjacent and parallel to a drive aisle from which vehicle access is provided must be 2.6m wide and 7.1m in length. The entire length of an accessible parking space must be adjacent to a 1.5m wide accessible barrier free aisle or path.

For off-street parking standards, refer to the City of Oshawa Zoning By-Law 60-94 and cross-reference the O. Reg. 191/11: Integrated Accessibility Standards.

3.6.1 On-Street Parking Plan

Where townhouse blocks fronting municipal roads are proposed, the Applicant shall provide an On-Street Parking Plan in accordance with the requirements of O. Reg. 191/11: Integrated Accessibility Standards with each engineering submission showing the proposed available on-street parking and conforming to the following design requirements:

- Provide one on-street parking space for every four townhouses.
- Parking shall be limited to one side of the street.
- Parking spaces shall be shown as follows:
    - Internal parking spaces (parking spaces that are not on the end of a line of parking spaces) are to be 6.7 m x 2.6 m

- Outer parking spaces (parking spaces at the beginning or end of a line of parking spaces) and parking spaces that are open at both ends are to be 5.6 m x 2.6 m
- Parking spaces between driveways shall be a minimum of 9.6 m long to comply with Traffic By-Law General Condition 4.29 Parking Near Driveway

- No person shall park a vehicle on a roadway in front of or within 2 m of a driveway.
- No parking shall be permitted within 10 m of an intersection as per Traffic By-Law General Condition 4.32 Parking Near Intersection.
- No person shall park a vehicle on a highway within 10 m of an intersection, or where official signs to that effect are displayed.

3.7 Geotechnical Investigation and Road Structure Design Soil Sampling

Test holes shall be taken using a drill rig capable of taking soil samples and determining soil penetration resistance. The drilling should be supervised and recorded by a qualified soils technician.

A certified Soils Laboratory with membership in CCIL (Canadian Council of Independent Laboratories) must perform a complete soils analysis at minimum 100 m intervals along the centerline of proposed roadways noting soil types, depths, moisture content, consistency, and water table in determining soil classification and frost susceptibility.

Boreholes shall extend 0.50 m below the lowest underground services or a minimum of 3.50 m below the proposed finished crown elevation. Should poor or unstable soil conditions be encountered, additional boreholes will be required to determine the limits of such.

Sufficient soil samples shall be taken of each type of soil horizon. A minimum of two samples should be analyzed per borehole.

All soils should be retained by the soils consultant until the City determines if more soils analysis will be necessary.

3.7.1 Soils Analysis and Classification

The soils samples shall be analyzed in accordance with ASTM Specifications.

The results shall be plotted on a grain size distribution curve according to the U.S. Bureau of Soils Classification. The percentages of Clay, Silt, and Very fine sand and silt shall be shown for each sample.

% Clay	0.005mm to 0.0mm
% Silt	0.050mm to 0.005mm
% VF SA & Silt	0.104mm to 0.005mm

The soil classification can be obtained by plotting the % Clay and % Silt on the U.S. Bureau of Soils classification triangular chart.

The soils shall also be categorized according to the City's Frost Susceptibility Chart.

A copy of the Borehole logs and the grain size analysis charts should be included in the soils report.

The borehole log, along with the sample analysis, are to be plotted on the road profile drawings (including GPS coordinates) showing the proposed sub-grade depths and submitted as part of the geo-technical report for review by Engineering Services.

If in the opinion of the City, more tests and/or more information are needed on the soils profile to determine the depth of excavation, the City will notify the Applicant to request the information required.

The City will not be responsible for any delays due to insufficient information contained in the soil report.

No rough road grading can proceed in a subdivision until the results of the soil tests have been evaluated by the City and notification has been sent to the Applicant outlining the requirements for sub grade construction of the roadways.

3.7.2 On-Site and Excess Soil Management

It is the Applicant's responsibility to ensure that the rules for soil management and excess soil quality standards are met in accordance with O. Reg. 406/19: On-Site and Excess Soil Management.

3.7.3 Design of Road Structure

Road structure designs shall be in accordance with the City's Standards noted on OS-200 series.

- Granular materials must conform to OPSS.
- Use of Crusher Run Limestone will be considered on its own merit.
- Reclaimed materials (RAP, RCM), glass, ceramic, air cooled blast furnace, nickel, gypsum, or steel slag shall not be used in the production of Granular A, Granular B or SSM unless approved by City's Inspector.
- Since there may be instances where the Applicant needs to apply broad guidelines to specific problems, consideration will be given to special designs not covered by the City's Standards.
- Road designs shall be determined using the City's Pavement Design Guidelines chart. These guidelines may be adjusted depending upon soil moistures, plasticity, drainage problems, and the number of underground services being constructed. The time of year that the road will be constructed should also be considered when developing the pavement design.
- Unacceptable and high borderline soils will require removal to 1200 mm below the finished road grade.
- Subdrains will be required on all streets and will be placed according to the depth of excavation and the ground water conditions encountered. In areas where ground water could be a potential problem, under drains shall be placed at the subbase elevation. Refer to City's Standard OS-200 Series.

- Where a change in sub grade depth occurs, a minimum 10.0 m transition must be provided. Care should be taken to ensure positive drainage of the under drains.
- Road structure design shall be based on a minimum service life of 25 years for the surface and 50 years for the base.
- A note shall be placed on drawings indicating that any road constructed after October 15th shall be constructed to the City of Oshawa Type E road design (1200mm).

Frost Susceptibility Chart

Group Classification	% Silt	% VF Sand & Silt
Acceptable	0-39	0-44
Borderline No 1	40-42	45-48
Borderline No 2	43-44	49-51
Borderline No 3	45-46	52-54
Borderline No 4	47-48	55-57
Borderline No 5	49-50	58-60
Unacceptable	51-100	61-100

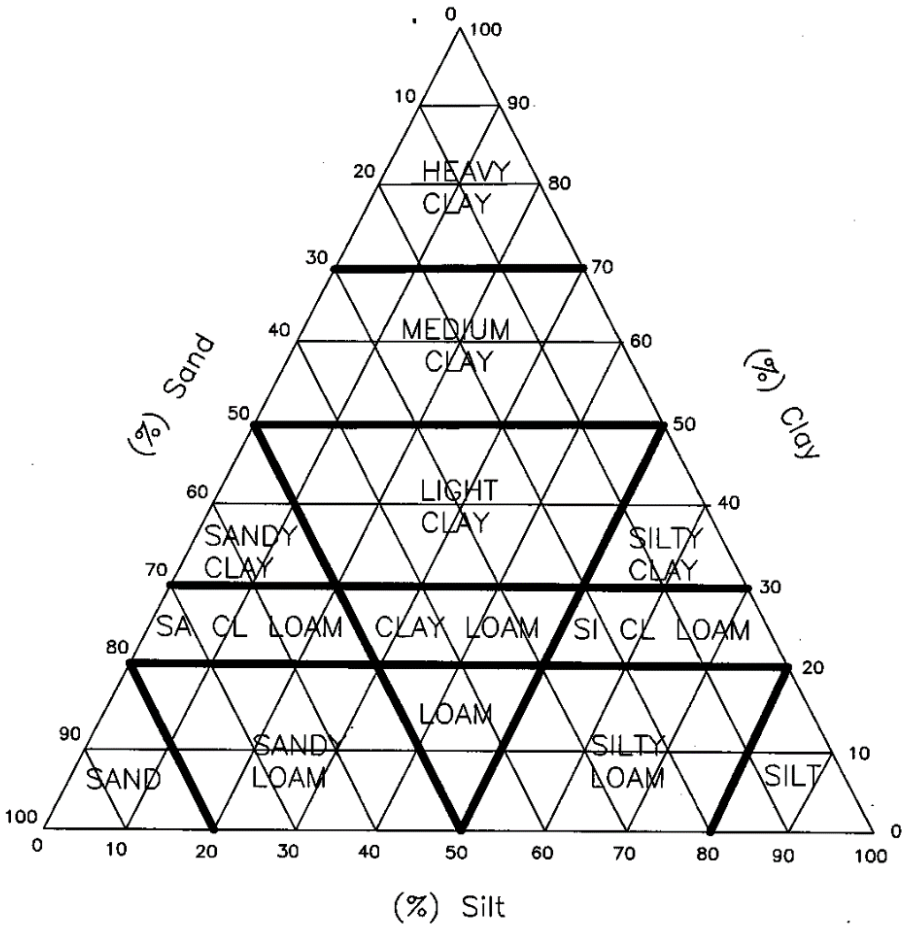
To determine Group Classification, use the most severe condition:

Granular Base Equivalency Chart

Material	GBE Factor
Asphalt	2
Expanded Asphalt	1.5
Granular A	1
Granular B	0.667
Select Subgrade Material	0.5

U.S. Bureau of Soils Classifications

Classification	Grain Size mm
% Clay	0.005mm to 0.0mm
% Silt	0.050mm to 0.005mm
% VF SA & Silt	0.104mm to 0.005mm



CITY OF OSHAWA		DEVELOPMENT SERVICES DEPARTMENT
CHK'D:	SOILS CLASSIFICATION (U.S. BUREAU OF SOILS)	REVISION No.
APP'D:		DATE: MAR. 5, 2012
DATE: MAR. 5, 2012		

City of Oshawa Pavement Design Guidelines

Residential Streets – PG Asphalt Grade – 58-28

Sub-grade Material Classification	Clay	Silt	VF SA & Silt	HL3	HL8	Granular A	Granular B	Total Depth	Total GBE
Type A – Sandy Loams, Clay Loams, Sandy Clays	25-35	10-20	<25%	50	50	150	300	550	GBE548
Type B – Light to Medium Clay	40-55	25-35	25-30	50	50	150	350	600	GBE581
Type C – Medium to Heavy Clay	55+	25-35	25-40	50	50	150	450	700	GBE647
Type C – Acceptable to Light Borderline	N/A	35-45	40-55	50	50	150	450	700	GBE647
Type D – Light to High Borderline	N/A	40-50	45-59	50	50	150	550	800	GBE713
Type E – High Borderline to Unacceptable	N/A	+45	+50	50	50	150	950	1200	GBE977

*Indicates imported Select Sub-grade Material

Collector Streets – PG Asphalt Grade – 64-28 XJ

Sub-grade Material Classification	Clay	Silt	VF SA & Silt	HL3HS	HDBC	Granular A	Granular B	Total Depth	Total GBE
Type A – Sandy Loams, Clay Loams, Sandy Clays	25-35	10-20	<25%	50	80	150	320	600	GBE608
Type B – Light to Medium Clay	40-55	25-35	25-30	50	80	150	370	650	GBE654
Type C – Medium to Heavy Clay	55+	25-35	25-40	50	80	150	470	750	GBE720
Type C – Acceptable to Light Borderline	N/A	35-45	40-55	50	80	150	470	750	GBE720
Type D – Light to High Borderline	N/A	40-50	45-59	50	80	150	570	850	GBE786
Type E – High Borderline to Unacceptable	N/A	+45	+50	50	80	150	920	1200	GBE1017

*Indicates imported Select Sub-grade Material

Arterial Streets – PG Asphalt Grade – 64-28 XJ

Sub-grade Material Classification	Clay	Silt	VF SA & Silt	HL3HS or HL1	HDBC	Granular A	Granular B	Total Depth	Total GBE
Type A – Sandy Loams, Clay Loams, Sandy Clays	25-35	10-20	<25%	50	80	150	320	600	GBE628
Type B – Light to Medium Clay	40-55	25-35	25-30	50	80	150	420	700	GBE687
Type C – Medium to Heavy Clay	55+	25-35	25-40	50	80	150	520	800	GBE753
Type C – Acceptable to Light Borderline	N/A	35-45	40-55	50	80	150	520	800	GBE753
Type D – Light to High Borderline	N/A	40-50	45-59	50	80	150	620	900	GBE819
Type E – High Borderline to Unacceptable	N/A	+45	+50	50	80	150	920	1200	GBE1017

*Indicates imported Select Sub-grade Material

The above guidelines may be adjusted depending on soil moisture contents, plasticity, drainage problems, amount of underground services to be installed and time of year construction will take place.

3.8 Concrete Curb and Gutter

Concrete curb with standard gutter shall be as per OPSD 600.040.

Semi-mountable concrete curb and gutter shall follow and OPSD 600.020.

Two stage curb and gutter shall be as per the City's Standard OS-602. OS-602 is a modified version of OPSD 600.070 to incorporate the City of Oshawa requirements.

Concrete curb and gutter conforming to City's Standard OS-601 shall remain in effect for infill areas and where repairs are required to roads with that standard, unless otherwise advised/approved by the City.

Gutter elevations shall be 30 mm below the edge of pavement elevation.

Concrete curb only (also known as Concrete Barrier Curb) shall conform to OPSD 600.110.

Concrete curb section(s) adjacent to concrete sidewalk(s) shall conform to City Standard OS-303.

Driveway entrances shall conform to City Standards OS-320, OS-321, OS-322 and OS-323.

Curb depressions are required at roadway intersections as per City of Oshawa Standard OS-304 to accommodate concrete sidewalk ramps. (Adjust curb width where OS-601 is used.)

Where a weir is required to provide for overland flow, the full curb height may be reduced as per OS-316.

Concrete shall conform to OPSS 353 having a minimum compressive strength of 32 MPa at 28 days.

Acceptance criteria associated with the construction of two-stage curb and gutter is provided in Section 8.5.1 of this Design Manual.

3.9 Concrete Sidewalk

Concrete sidewalk(s) shall conform to City's Standards OS-301, OS-302 and OS-303.

Concrete sidewalk ramps shall conform to City Standard OS-304.

All concrete ramps to include Tactile Walking Surface Indicator (T.W.S.I) as per OPSD 310.039.

The T.W.S.I strip to be Neenah Foundry Detectable Warning Plate or approved equivalent.

An accessible pedestrian signal pole as per Region Standard S-410.011 to be installed at all signalized intersection crossings or as required.

Concrete sidewalk(s) shall have a minimum thickness of 130mm except through driveways where the minimum thickness shall be 150mm. Wire mesh is required where sidewalk is placed through high density residential, commercial, and industrial driveways.

Type 'B' and Type 'C' Arterials Roads shall include MUP on one side and sidewalk on the other side or bike lanes where appropriate.

Concrete sidewalks shall be constructed on both sides of all Arterial and Collector roads.

Concrete sidewalk shall generally be constructed only on one side of all Local roads. Depending on land uses along the road and surrounding active transportation infrastructure the City reserves the right to require that sidewalks be provided on both sides of a local road. The appropriate side is to be determined based on predicted pedestrian movement, generally serving most pedestrians. Where there is no appreciable difference in predicted pedestrian movement on either side, the north and east sides shall be used as defaults to maximize exposure to the sun during winter months.

Concrete sidewalks are not to be constructed on cul-de-sacs. However, where direct access is provided to a park, recreation site, path/walkway or large pedestrian generator via the cul-de-sac, sidewalk shall be provided on one side only.

Standard width of sidewalk shall be 1.8m for Arterial Roads and 1.5m for Collector and Local roads. The City reserves the right to adjust the width of sidewalk for any road depending on land uses along the road and surrounding active transportation infrastructure.

Refer to City Standard OS-200 series for typical location within the ROW.

Unique locations may require additional sidewalk width based on urban design, higher volumes of expected pedestrian traffic or combined use with cycling.

The linear design of the sidewalk should avoid the use of low points whenever possible. When low points are unavoidable, they should be located within a driveway or at a ramp location.

Any sidewalks requiring temporary and/or long-term termination shall be terminated in accordance with OS-410. Refer to OTM Book 7 (Temporary Conditions) for required signage within the context of temporary conditions.

Concrete sidewalk ramp locations take precedent over any proposed driveway location.

3.10 Asphalt Multi-Use Path within Right-of-Ways

A Multi-Use Path (MUP) is located within an existing or new public ROW Refer to the City's Parks Development Design Standards when designing for a Multi-Use Trail that is outside a public ROW.

Type 'B' and Type 'C' Arterials Roads shall include MUP or bike lane on one side and sidewalk on the other side, where appropriate. Requirements for MUP on Collector Roads to be confirmed with Transportation Master Plan submission.

3.10.1 General Design considerations for Multi-Use Path

- Asphalt path(s) shall conform to City of Oshawa Standard OS-306.
- All asphalt shall conform to asphalt acceptance criteria in Section 8.5.4 of these design criteria.
- Typical width shall be 3.0m unless otherwise approved by the City.
- Road crossings and pavement markings shall conform to the OTM Books 15 and 18.
- Painted yellow center line is required for all MUPs.

3.10.2 Lateral Clearances

Lateral clearances are areas to the side of the path surface that improve safety conditions for path users by providing space for avoiding collisions, running off the path, or falling – all without risk of colliding with any fixed object.

The preferred minimum lateral clearance for a MUP is 1.0m. Warning signage or other mitigation measures, such as a visually contrasting cane-detectable surface (e.g., TWSI) shall be provided where lateral clearance is less than 1.0m.

The minimum lateral clearance for any class of MUP's shall be 0.50m unless approved by the City. Lateral clearances of less than 0.5m shall be justified by the presence of some constraint that cannot be reasonably overcome, such as large trees or existing structures.

Where possible, lateral clearance areas are to be designed, constructed, and maintained free from any obstruction.

3.10.3 Slopes

Due to accessibility requirements, running slopes on MUP's should be limited to 5% (or match existing road grade), and cross-slopes should be limited to between 2% and 4% (including crowned configurations). Where a running slope greater than 5% cannot be avoided, engineers should consult with stakeholders and use their best judgement to determine which of the following two options is preferred:

- Design the sloped segment to be continuous with adjacent sections of trail or road, adding mitigation measures such as warning signage and rest stops; or
- Design the segment as a grade-separation, in consultation with the City's Engineering Services Department. This would accommodate a wider range of possible strategies, such as ramps and/or switchbacks.
    - Ramps should be designed to meet and exceed the Ontario Building Code and the City of Oshawa's Accessibility Design Standards where possible. These include all the dimensional requirements for stairs and ramps as well as requirements for surfaces, guards, handrails, and most other components.
    - Where a switchback is desired, it should be designed to conform with the requirements for ramps that are noted above. Avoid design features that encourage or facilitate fast cycling (long, straight runs, greater widths) because the turning radii used for switchbacks are not suitable for such a use.

Lateral clearance areas should match the slope of the MUP and should also not exceed 4%. Any area outside of the lateral clearance, but within 2.0m of the shared-use surface, should not exceed a downward slope of 16.7% (6:1) without a guide rail but may include a steeper uphill slope.

3.11 Walkways

Walkways shall conform to City Standards OS-310 and OS-311. Walkways shall be designed to promote proper circulation of pedestrian traffic and, if necessary, provide an overland flow route for storm flows greater than pipe capacity.

Walkway block width should be 6.0 to 9.0m in length with a minimum of 3.0m wide paved concrete walkway central to the walkway block and with a chain link fence on both sides. Refer to City Standard OS-901 for fencing details. Adequate lighting shall be provided for all walkways serving access to school properties, public buildings or providing a link from one road to another road.

Chain link fence heights shall be:

- 0.9m in the “front yard”
- 1.5m in the “side yard”
- *1.8m in the “side yard” when connecting to an active park or school

*Ensure that the height of the “side yard” fence for the walkway matches the height of the “rear yard” chain link fence.

Bollards shall be installed as per City Standard OS-312 when the walkway extends to the road with a curb depression for a ramp or where a curb depression is constructed to provide for an overland flow route.

3.12 Driveways

Driveways shall conform to City Standards OS-320, OS-321, OS-322 and OS-323. Refer to the TAC Guide for Access design where applicable.

Driveways must be designed to conform to the following minimum requirements:

- Driveway grades shall be as per OS-323.
- The minimum spacing between driveways and between driveways and sidewalk ramps shall be 1.30 m. For driveway spacing between different land uses and suggested minimum corner clearance, refer to the TAC Guide.
- Minimum corner clearance dimensions are set out in the TAC Guide.
- The minimum clear distance between the edge of driveway and a utility structure, hydrant or tree shall be 1.00 m.
- Driveways shall have a minimum clearance of 11.0 m to the face of curb of any intersecting street (i.e., corner lots).
- A property shall have a frontage greater than 16.0 m to permit a second driveway access. The minimum spacing between the driveways on the same property shall be 7.5 m.
- When laying out residential driveways in new subdivisions, generally driveway width should be from edge-to-edge of the garage. The minimum driveway width should be 3.5 m, save and except for street townhomes and/or semi-detached houses where a 6.0 m lot frontage should have a driveway width of 3.0 m. A 0.5 m driveway flare shall be provided on the right side (nearest approaching side from the curb lane) of any residential single car driveway on an arterial road.
- The suggested minimum clear throat length for driveways depending on its development type can be found in the TAC Guide.
- For left-turn turn restrictions, a right-in/right-out access may be considered. Typical left-turn restrictions with a pedestrian refuge area at a driveway along an undivided

roadway is illustrated in the TAC Guide.

- Every effort shall be made to ensure catch basin are not located at the end of driveways.
- Where driveway widenings are required, the width of the entrance in the boulevard and curb depression should generally match the width of the driveway on private property. However, where this is not achievable due to utilities or street trees, the maximum angle for a driveway flare shall be no greater than 30 degrees (Refer to OS-320)

3.13 Boulevards

Boulevards shall be defined as the land area between the property line and curb and shall be constructed at positive crossfall grades no less than 2% **nor greater than 10%**. Exceptions may be permitted to allow a positive minimum grade of 1% to accommodate an overland flow route through the boulevard. (Refer to Section 3.8 for curb height permitted to provide overland flow routes.)

Where an overland flow route is located in a boulevard at an access road to a storm water management facility a reverse sloped boulevard may be permitted. Any reverse sloped overland flow route shall be constructed at grades no greater than 2%. Supporting calculations shall be provided to ensure adequate overland flow route surface treatment is provided against erosion.

Refer to OS-316 for additional details regarding overland flow routes in boulevards.

Sod shall be placed on all boulevard areas unless otherwise approved by the City's Engineering Services Department. Refer to OS-225 for additional details regarding boulevard treatment.

Topsoil and Sod shall be in accordance with OPSS 802 and 803.

Topsoil shall meet the Topsoil Acceptance Criteria found in Section 8.5.10. Testing shall be carried out according to this section's minimum testing requirements.

Boulevard shall be constructed to include a minimum uniform depth of 220mm of **screened topsoil compacted to 95% proctor**.

3.14 Street Tree Planting

Typically, there should be no more than 10% of any one tree species in a subdivision. Boulevard tree selection should be low growth and salt tolerant. Please refer to the City's Parks Development Design Standards for more guidelines on street tree species composition requirements. Inspection during planting is essential (e.g., wire baskets need to be removed, otherwise roots will girdle killing the tree in a few years).

A minimum 3.0m clearance from street light poles is to be provided to accommodate mature tree branches, and 5.0m for larger shaded trees, as well as a pruning schedule to address lighting concerns. Consultation with the City's Parks Department is encouraged for tree planting within the public ROW For tree planting outside of the public ROW, Please ensure that theCity's Parks Development Design Standards are followed and adhered to.The Applicant shall make every effort to group utilities together and offset from centerline between two townhouse blocks to maximize tree planting. A minimum topsoil

volume of 4.0 m^3 is recommended with the expectation of making every effort to increase the volume to as large as is feasible with the site constraints up to a maximum volume of 30 m^3 for a single tree. Refer to P-611 for additional Street Tree Planting Requirements.

3.15 Cul-de-Sacs

Permanent cul-de-sacs shall conform to City Standards OS-520 (Residential), OS-521 (Commercial/Industrial) and OS-522 (Rural).

A cul-de-sac will be the only acceptable method of terminating a non-continuous roadway. The use of cul-de-sacs should be minimized through road network design.

Minimum gutter grades of 0.5% shall be maintained along the flow line of all gutters around cul-de-sacs.

Maximum length of a cul-de-sac is controlled by emergency access requirements – refer to Secondary or Emergency Access Requirements under Section 3.20.

3.16 Temporary Turning Circles

Temporary turning circles shall conform to City Standard OS-523.

The installation of temporary turning circles will be generally permitted to accommodate short term development phasing, but its use will be subject to the City's Engineering Services approval.

Where a road is to be extended in the future, sufficient property and any required easements must be provided, and a temporary turning circle installed having a curb radius of 13.0m and boulevard width to the satisfaction of the City and as per Oshawa Standards OS-520 or OS-521.

3.17 Road Sub-Drains

Road sub-drains will be required to run continuous along both sides of all roads with curb and gutter or as specified in unique situations and shall conform to City Standard OS-220.

Whenever possible sub-drains shall tie into catch basins as illustrated in OS-220. When no catch basin is available, cleanouts as per Region Standard S-100.030 shall be provided for maintenance purposes.

If catch basin knockouts (per OPSD 705.010) are not available, then sub-drains shall be cored into the catch basin. No breaking of the concrete by hammering or chipping will be permitted.

3.18 Utilities

Refer to City Standard Drawings OS-201-206 and OS-208-209 for the location of common trench utilities within the public ROW. Refer also to City Standard OS-226 for common trench details.

The location of any utility ducts crossing roads will be confirmed with the utility company in conjunction with the subdivision design (Utility Coordination Plan). All ducts must be placed in conjunction with road base construction and prior to installation of sub-drains and must conform to City Standard OS-221 and OPSS.MUNI 603. Any duct crossings required

after base asphalt is placed shall be directional bored.

3.19 Downtown Streetscape

Applicants working within the City's Downtown Oshawa Urban Growth Centre (Per Schedule A of the City's Official Plan) should refer to the Oshawa Downtown Streetscape Vision, OADS and O.Reg 191/11 Section 80.29 for direction regarding streetscape and boulevard considerations in this area. These documents can be found on the City's webpage.

3.20 Secondary or Temporary Emergency Access

The City does not support permanent Emergency Access locations and the need for such should be eliminated through road network design techniques.

Any combination of streets, public or private, exceeding 250 m in length from a single access point will require a secondary street access. This distance shall be measured along the center line of the road.

Temporary emergency access locations are discouraged. However, they will be permitted to accommodate the phasing of Plans of Subdivision when all other alternatives have been exhausted.

A temporary emergency access shall be a minimum of 6.0 m in width and constructed to a minimum depth of 360 mm granular A, 40mm HL3 and 40 mm HL8 asphalt. The access shall be constructed as per City Standard OS-315. P-Gates are required at both limits of any secondary or temporary emergency access constructed.

4. Drainage Systems

4.1 General

The purpose of this section is to outline the general design requirements for the construction of storm sewer and foundation collector drainage systems in the City of Oshawa.

Notwithstanding the following criteria outlined under this section, the City By-Law 9-90 related to Storm Sewer Connection requirements shall also apply.

4.1.1 Storm Sewer System

Storm sewers designed and constructed in accordance with the most recent requirements and specifications of the City are required on every road within all plans of subdivisions unless otherwise approved by Engineering Services.

Storm sewers and stormwater management facilities shall be designed to accommodate offsite drainage from future development within the upstream watershed and/or for the drainage of any areas designated by Engineering Services. Should the Applicant wish to seek cost recovery for any over sizing, the City may consider a front ending agreement in accordance with requirements of the Development Charges Act. Storm drainage shall be directed to a suitable outlet to the satisfaction of Engineering Services.

Channel works, bridges, culverts, and all other drainage structures or works shall also be designed and constructed in accordance with the most recent requirements and specifications and are to be approved by the City and all other applicable agencies such as the MECP, the MNRF, etc.

4.1.2 Overland Flow Routes

Overland flow routes and maximum ponding depth and extents shall comply with the forthcoming City's Stormwater Management Master Plan. In the absence of City Guidelines, reference should be made to CLOCA's *Technical Guidelines for Stormwater Management Submissions* (October 2020). Per CLOCA guidelines, maximum surface ponding should not exceed 0.3m in the 100-year event. For events exceeding the 100-year, an emergency overflow system must be provided to safely convey overland flows to a suitable outlet.

4.2 Storm and Foundation Drain Collector Sewer

4.2.1 Storm and Foundation Drain Collector Sewer Design

For the purpose of storm sewer design, foundation drains connected to a FDC pipe shall be designated as Type I System and foundation drains connected to the storm sewer shall be designated as Type II System. Foundation drains are not permitted to be connected to the sanitary sewer system without written permission from the Region.

Type I System – Foundation Drains connected to the Foundation Drain Collector

The storm sewer will be shallow (1.20m minimum cover) and will be discontinuous through high points at the top end of the system. Connections to the storm sewer will generally be restricted to catch basins, storm sewer connections as required by the Storm Sewer Connection By-Law 9-90 and roof water leader connections as per Section 5.4.

- The storm sewer shall be designed using the City's one-year intensity- duration-frequency curve.
- For new subdivision developments a maximum storm sewer capacity of 80% shall be maintained for systems conveying the one-year intensity storm, unless otherwise approved by the Engineering Services Department. The FDC pipe shall be designed sufficient in capacity to convey anticipated flows as determined through a hydrogeological study but shall not be less than 0.075 litres per second per dwelling unit connected.
- The FDC pipe shall outfall to a free outfall above the elevation of the 100-year flood line.
- For new subdivision developments a maximum FDC pipe capacity of 80% shall be maintained.

Type II System – Foundation Drains connected to the Storm sewer

- The storm sewer shall be designed assuming free-flow conditions using the Toronto – Bloor Street ten–year intensity–duration–frequency curve. The storm sewer shall be deep (2.75m minimum cover) and will be continuous throughout the complete street length with individual foundation drain service connections to each dwelling unit.
- For new subdivision developments a maximum storm sewer capacity of 80% shall be maintained for systems conveying the Toronto-Bloor Street ten-year intensity storm.
- A 100-year hydraulic gradeline analysis shall be prepared for this system. The resulting hydraulic gradeline shall be plotted on the detailed design drawings.
- The underside of the footing elevation shall be designed such that it is located at minimum 0.60m above the 100-year hydraulic gradeline elevation at the point of the foundation drain connection to the storm sewer. The resulting minimum underside of footing elevations shall be plotted on the grading and plan-profile design drawings.

4.2.2 Run-off Calculations

Storm sewers shall be designed for storm drainage run-off based on the Rational Method. Where the drainage area is larger than 10 hectares, the Rational Method calculations must be checked against computer models. The larger of the flows is to be used in the design of the sewer system.

$Q = 27.77 A \times I \times R/0.036$

Where;

Q = Design flow in litres per second
A = Drainage area in hectares
I = Run-off co-efficient
R = Rainfall intensity in centimeters per hour

All storm sewer design calculations shall be completed on City of Oshawa design sheets. A sample of the design sheet is included in Appendix 1. An electronic sample is available on request.

Drainage Area

Drainage area is the gross area in hectares of the watershed, which has been defined and/or approved by the City of Oshawa.

Run-off Co-efficient

The run-off co-efficient is determined either by the type of land use or by the type of surface, whichever is greater.

a)

Type of Land Use	**Run-off Co-efficient (I)**
Single Family Residential (Frontage greater than 12.2 m)	0.50
Single Family Residential (Frontage less than 12.2 m)	0.65
Semi-Detached Residential	0.65
Townhouses, Row Houses	0.75
Back-to-Back Townhouses	0.90
Apartments / Mixed Use	0.85
Commercial	0.90
Industrial	0.90
Schools	0.65
Institutional	0.50-0.90
Conservation Land	0.20
Open Space & Recreation	0.20

b)

Type of Surface	**Run-off Co-efficient (I)**
Impervious	0.90
Unpaved	0.40 – 0.60
Grass, Woods, or Railroad	0.20

Rainfall Intensity Duration Curves

The intensity of rainfall shall be determined using the City of Oshawa standard Intensity – Duration – Frequency Rainfall Curves.

Design Storm	Rainfall Intensity Formula
1 Year	R = 51.95 / (T+3.8) ^ 0.7755
2 Year	R = 64.77 / (T+4.0) ^ 0.784
5 Year	R = 92.96 / (T+4.0) ^ 0.798
10 Year	R = 102.10 / (T+3.0) ^ 0.787
25 Year	R = 110.00 / (T+2.0) ^ 0.776
50 Year	R = 144.80 / (T+3.0) ^ 0.803
100 Year	R = 177.00 / (T+4.0) ^ 0.820

See Appendix 2.

When designing a Type I system, the one-year curve shall be used.

When designing a Type II system, the ten-year curve shall be used.

Time of Concentration

$T = T_C$ (entry) + T_p

Where;

T = total time of concentration in minutes at the point under consideration
T_C (entry) = entry time at the first catch basin
T_p = time of pipe flow in the sewer

Use;

T_C (entry) = 5 minutes (Type II System)
T_C (entry) = 10 minutes (Type I System)

Or;

T_C (entry) = $T_o + T_g$ (if approved by the City)

Where;

T_o = total time of overland flow determined as per Appendix 3
T_g = time of gutter flow determined as per Appendix 4

Note: The use of $T_o + T_g$ to determine T_C (entry) will only be accepted under specific circumstances, and only when prior approval of the City has been given.

4.3 Storm and Foundation Drain Collector Sewer Requirements

4.3.1 Pipe Capacity

The flow capacity of pipe shall be determined by Manning's Formula by using n=0.013 for all storm sewer pipes (concrete, PVC, HDPE) of all sizes.

Manning's Formula

$V = 1.0 \times R^{2/3} \times S^{1/2}$ (m/sec)

$Q = V \times A$ (m^3/s) = $10^3 \times V \times A$ (L/sec)

V: velocity in metres per second (m/s)
Q: capacity in litres per second (L/s)
A: cross sectional area in metres squared (m^2)
R: hydraulic radius D/4 with D in metres
S: slope of hydraulic grade line in metres/metres (m/m)
n: roughness coefficient = 0.013
V and Q are based on actual diameter

The minimum main line storm sewer pipe size shall be 250 mm diameter.

The minimum foundation drain collector (FDC) sewer pipe size shall be 250 mm diameter.

4.3.2 Velocity Control

The velocity in storm sewers shall be limited to a minimum of 0.75m per second, and a maximum of 4.00m per second.

The maximum decrease in velocity from one pipe to another through a maintenance hole shall not exceed 0.60m per second.

4.3.3 Location

The location within the road allowance of storm sewer systems and/or FDC pipe shall be in accordance with City of Oshawa OS-200 series drawings.

Foundation Drain Collector pipe shall generally be located in a common trench with the sanitary sewer pipe.

4.3.4 Alignment

Storm sewer(s) shall be constructed in a straight line between maintenance holes unless radial pipe has been designed and approved.

Generally, a minimum clearance of 0.25m shall be provided between the outside of the pipe barrels at the point of crossing for storm and sanitary sewers. Watermains shall normally cross above sewers with sufficient vertical separation (minimum 0.25m) to allow for proper bedding and structural support of the watermain and sewer main. When it is not possible for the watermain to cross above the sewer, the watermain passing under the sewer shall be protected by providing a vertical separation of at least 0.5m between the invert of the sewer and the crown of the watermain. Separation between watermains and sewers shall conform to the latest edition of the MECPs "Design Guidelines for Drinking-Water Systems". Adequate structural support for the sewer shall be provided to prevent excessive deflection of joints and settling. In the event the minimum clearances cannot be obtained, then the pipes at the crossing shall be concrete encased to ensure that the pipes are properly bedded.

Radius pipe may be allowed for storm sewers provided that a maintenance hole is located at the beginning and at the end of the radial section.

Properly deflected sewer pipes within the manufacturer's specifications are permitted upon approval from the City's Engineering Services Department.

4.3.5 Pipe Size Changes

No decrease of pipe size from a larger size upstream to a smaller size downstream will be allowed unless approved by the City's Engineering Services Department.

4.3.6 Pipe Classification and Bedding

The type of bedding and class of pipe shall be designed to accommodate both the ultimate dead load and a live load equivalent to Highway H-20 Loading, regardless of the location of the sewer, except when the sewer crosses a railroad in which case Railway E-80 Loading shall be used instead of Highway Loading.

The type and classification of storm sewer pipe and bedding shall be as follows:

Alternative 1: Concrete Pipe

- Specifications: OPSS 1820.
- Non-Reinforced Concrete Pipe CSA A257.1 - M1982.
- Reinforced Concrete Pipe CSA A257.2 - M1982.
- Non-Reinforced Concrete Pipe may be used for pipe sizes up to and including 375 mm diameter.
- Minimum strength of non-reinforced pipe shall be Class 3.
- Minimum strength of reinforced pipe shall be Class 65-D.

Alternative 2: Polyvinyl Chloride Pipe (PVC)

- PVC pipe may be used for pipe sizes up to and including 600 mm in diameter.
- Specifications: OPSS 1841, CSA B182.2, CSA B182.3.
- The class of PVC pipe shall not have an SDR (standard dimension ratio) greater than 35.
- Bedding for PVC pipes shall be class "P" bedding as per Regional Municipality of Durham Standard S-200.010.

Alternative 3: High Density Polyethylene (HDPE) – Smooth Walled Interior Pipe

- HDPE smooth walled interior pipe with gasketed bell and spigot joints may be used for pipe sizes up to and including 600mm in diameter.
- Specifications: OPSS 1840, CSA B182.6.
- Bedding for HDPE pipes shall be Class "P" bedding as per Regional Municipality of Durham Standard S-200.010.
- Use of corrugated steel pipes (CSP) for construction of storm sewers is not

permitted unless approved by the City's Engineering Services Department.

- Manufactured tees must be used for storm sewer connections if the sewer is 450 mm diameter or smaller.
- Connections to storm sewer 525mm diameter and larger may be made using field installed tees such as mortared-in bells or strap-on saddles.
- The maximum allowable deflection of main line sewer when using PVC pipe shall be as per manufacturer's specification.
- Bedding material(s) for all storm sewer related pipe shall conform to Regional Municipality of Durham S-200.010 and S-100.040 (Common Trench Bedding Detail), OPSD 802.010 (Flexible Pipe), OPSD 802.030 (Rigid Pipe Bedding – Type 1 or Type 2 Soil), OPSD 802.031 (Rigid Pipe Bedding – Type 3 Soil), OPSD 802.032 (Rigid Pipe Bedding – Type 4 Soil) and OPSD 802.034 (Rigid Pipe Bedding and Cover In Embankment).
- The width of trench at the top of the pipe must be carefully controlled to ensure that the maximum trench width is not exceeded unless additional bedding or higher strength pipe is used.

4.3.7 Headwalls

Headwalls shall be as per OPSD standards. Headwall wing walls shall be installed as per OPSD 804.040 for sewers sized 600mm to 2400mm. Fencing, as per OPSD 972.131, shall be provided where the dimension from top of headwall to the invert of the outlet exceeds 1.0m. Headwall fencing shall be galvanized.

4.4 Calcium Carbonate Mitigation – Foundation Drain Collector

For a new subdivision development, the Applicant will be required to undertake a groundwater study to assess the potential for calcium carbonate formation in foundation drains. The study shall include the drilling and placement of sufficient boreholes to identify groundwater elevations in the proposed plan and to highlight areas within the plan where building footings may be located at or below the seasonal groundwater level. Chemical analysis shall be carried out for groundwater within the depth of influence of the foundation drain system. The analysis should include field pH, alkalinity, iron, DOC, and major anions/cations to allow assessment of the state of saturation of the natural groundwater with respect to calcium carbonate.

Through the overall design of grades within the plan, the Applicant shall minimize the number of footings located at or below the seasonal high groundwater level. This is intended to minimize groundwater flow to foundation drains and limit the rate of calcium build-up and potential basement flooding.

Where a groundwater study has identified that the groundwater is either saturated or near saturation levels with respect to calcium carbonate and the planned footing elevations are at or below the seasonal high groundwater levels, the Applicant shall ensure that washed 19 mm clear stone from pit source is used around footing drains and beneath the floor slab. The affected building lots shall be identified on the engineering drawings for

subsequent inclusion as a condition in the Subdivision Agreement.

4.5 Maintenance Hole Requirements

4.5.1 Maintenance Hole Types

Maintenance holes may be either pre-cast or poured in place and shall be designed and constructed in accordance with the most recent OPSD standards and specifications.

Although the OPSD standard drawings provide details for maintenance holes up to certain maximum depths and sizes, the Applicant shall analyze, individually, each application of the standards related to soil conditions, loading and other pertinent factors to determine structural suitability.

In all cases where the standard drawings are not applicable, the maintenance holes shall be individually designed and detailed.

4.5.2 Location and Spacing

Maintenance holes shall be located at each change in alignment, grade, or pipe material, at all storm sewer main junctions, at all rear yard catch basin leads connection to sewer main, at the beginning or end of radius pipe sections and at intervals along the pipe to permit entry for maintenance to the sewer.

Maximum spacing of maintenance holes shall be 120m for sewers 1200mm or less in diameter and 150m for sewers greater than 1200mm in diameter.

Storm sewers shall be installed to the limits of subdivision development, being terminated by installation of a storm maintenance hole or storm sewer stub as approved by the City's Engineering Services Department. The design of the terminal maintenance hole must allow for the future extension of the sewer or storm sewer stub.

4.5.3 Maintenance Hole Details

Maintenance hole openings shall be located on the side of the maintenance hole parallel to the flow for straight run maintenance holes, or on the upstream side of the maintenance hole at all junctions.

The change in direction of flow in any maintenance hole shall not be greater than 90 degrees.

Safety gratings shall be provided in all maintenance holes 5.0m in depth or more as per OPSD standards.

Maintenance hole ladder rung(s) shall be as per OPSD standards.

All new maintenance holes placed within existing, proposed, or future road surface locations shall be integrated frame and cover maintenance hole system (or approved equivalent), unless directed otherwise by the City.

The use of modular precast adjustment units will not be permitted within the roadway unless directed by the City.

Watertight maintenance hole cover as per OPSD 401.030 shall be provided for any FDC

maintenance holes located within an overland flow route or stormwater ponding area.

Regardless of the amount of drop required, the obvert of the upstream pipe shall not be lower than the obvert of the downstream pipe. Maintenance holes shall be provided with drops not less than the total amount as determined by the following:

Drop required for Transition

Where there is a change in the size between the pipes connected to a maintenance hole, the deflection angle of benching wall relative to the centerline of sewer pipe shall be not more than 12.5 degrees, and a drop shall be provided between the invert elevations, of inlet and outlet, as determined by the following:

$H_a = K_a (d_v)^2 / 2g$

Where;

H_a = required drop in metres
K_a = 0.1 for contraction (reducing size) **or** = 0.2 for expansion (increasing size)
d_v = difference in velocity (m/s)
g = 9.8m/s

Drop required for Bend

The centerline radius of a bend, “R”, in a maintenance hole shall be not less than the diameter of the inlet pipe, D, and a drop shall be provided as determined by the following:

$H_b = K_b V^2 / 2g$

Where;

H_b = required drop in metres
K_b = 0.4 when D < R £ 2D **or** = 0.2 when 2D < R
V = velocity of inflow (m/s)
g = 9.8 m/s

4.5.4 Benching in Maintenance Hole

Storm Maintenance Holes:

Depending on the amount of drop provided, the following provisions shall be made:

- 0.25 m or less — Provide benching in straight line between the inverts of inlet and outlet pipes.
- over 0.25 m up to 1.80 m — Provide vertical curve benching to direct the flow tangentially into the outlet pipe. The maximum height of the bottom of the curve benching is to be 0.45 m measured from the invert of outlet pipe.
- over 1.80 m — Provide a 0.30 m deep tumbling basin in the maintenance hole

Foundation Drain Connection Maintenance Holes:

- 0.25 m or less — Provide benching in straight line between the inverts of inlet and outlet pipes.

- over 0.25 m up to 1.80 m — Provide vertical curve benching to direct the flow tangentially into the outlet pipe. The maximum height of the bottom of the curve benching is to be 0.45 m measured from the invert of outlet pipe.
- over 1.80 m — Provide an external structure per Regional Municipality of Durham standard S-100.080

4.6 Catch basin and Connection Requirements

4.6.1 Catch basin Types

Catch basins may be either pre-cast or poured in place and shall be designed and constructed in accordance with the most recent OPSD and OPSS requirements.

Rear yard catch basins shall be sumpless.

Any special catch basins and inlet structures proposed must be fully designed and detailed by the Applicant for approval by the City's Engineering Services Department.

Frame and grate for catch basin (s) shall be as detailed in the OPSD standards. The "bicycle proof" catch basin grate, as per OPSD 400.020, shall be required for all catch basins located in the City. Any adjustment and setting of the frame and cover shall be completed in accordance with details as provided in the OPSD standards.

4.6.2 Location and Spacing

For design purposes assume that one catch basin will be required for each 0.3 hectare of upstream-undeveloped area.

The maximum spacing for catch basins shall be 90m on each side of the roadway. (However, with Type II systems, and subject to the approval of the City's Engineering Services Department, increased spacing may be permitted.)

Double catch basins shall be installed at the low point of any road. In locations where there is a small contributing drainage area, a single catch basin may be considered.

Catch basins shall generally be located upstream of all pedestrian crossings and at the point of curvature on the upstream side of all curb returns.

Catch basins shall not be permitted within a sidewalk ramp depression.

Wherever possible, catch basin(s) located in a driveway curb depression shall be avoided.

4.6.3 Connections

All catch basin laterals, whether concrete, polyvinyl chloride or ribbed polyvinyl chloride pipes, shall conform to the requirements as outlined under Section 4.3.6.

Subdrain connections to catch basins shall be cored by mechanical means. No chipping or breaking of the concrete wall will be permitted.

The minimum size and grade of catch basin connections shall be in accordance with the following:

Diameter	Single Catch basin	Double Catch basin	Two Double Catch basins
250 mm	0.35%	1.40%	5.50%
300 mm	0.15%	0.50%	2.00%

200 mm diameter catch basin connections shall only be permitted where constraints prevent the use of a 250 mm diameter and must be approved by Engineering Services. If a 200 mm diameter catch basin connections is approved, the minimum grade of catch basin connection shall be 1.20% for single catch basin and 4.8% for double catch basin.

Catch basin inverts to be a minimum of 1.24 m below final rim elevations. No more than two (2) bends are permitted in the catch basin lateral connection. The first bend shall be placed as close as possible to the catch basin wall.

4.6.4 Rear Yard Catch basin Leads

Rear yard catch basin leads shall be concrete encased from the property line to the basin, as per Region of Durham Standard S-200.010.

4.7 Foundation Drain Connection (FDC)

All FDC to new sewers shall be constructed using manufacturer's standard tees and wyes unless otherwise approved by the City's Engineering Services Department.

All FDC shall be 150 mm diameter concrete or PVC pipes and shall be installed aligning downstream at a minimum grade of 2%.

For the required strength and bedding of a concrete foundation drain connection, refer to the Concrete Pipe specification as outlined under Section 4.3.6.

The class of PVC FDC pipe shall not have an SDR (standard dimension ratio) greater than 28.

Bedding of PVC FDC shall be class "P" as per Region of Durham Standard S-200.010.

All FDC lateral connections between the street line and the home footing drain shall be 150 mm in diameter to facilitate cleaning.

The design of the FDC system shall minimize the extent of drop structures to reduce cascading of turbulent flow.

4.8 Easements

The following are the minimum permanent easement widths required for City of Oshawa municipal services:

Type of service, Size & Depth	Minimum Width of Easement
• Single sewer less than 600mm dia. and less than 3.7m deep, centred on easement.	6.0m
• Single sewer less than 600mm dia. and more than 3.7m deep, centred on easement	9.0m

Easements that have a combination of two mains, either sewer or watermain, should

refer to the Region of Durham's easement requirements as stated in their Design Specifications for Engineering Submissions (Chapter 6).\

Refer to Section 5.6 for rear yard catch basin easement requirements.

5. Lot Grading

5.1 General

The purpose of this section is to outline the engineering design criteria requirements pertaining to subdivision lot grading and site grading plans in the City.

The design and construction of grading is of considerable importance to the City. While the below criteria reflect the minimum City requirements with respect to grading, the Applicant and their consultants are responsible for designing and constructing a finished product based on the following objectives:

- No adverse impact to adjacent lands.
- Storm drainage self-contained within the developing property.
- The riparian rights of adjacent lands to be respected.
- Positive surface drainage directed away from all buildings.
- All existing perimeter ground elevations of the developing property to be maintained.
- Property owners to be provided with maximum use of their property.
- The use of retaining walls and/or terracing to be minimized.
- Existing trees to be preserved wherever practicable.
- Ponding to be minimized.
- The use of rear lot catch basins to be minimized.
- Generation of excess soil to be minimized.

While the criteria presented in this section has been primarily developed to provide guidance to residential subdivision development, the basic principles shall apply to other types of land development as well.

A Master Lot Grading Plan shall be prepared to a scale not less than 1:500 for single family or semi-detached areas or 1:250 for multi-family areas, showing the overall drainage, grading, house type, etc. in a plan of subdivision. This plan must also show the directions of the minor and major storm flows within the limits of the development.

A Site Grading Plan is required as part of a building permit application drawn to a scale not less than 1:250, for a single building lot in a subdivision, showing all proposed grading and drainage details for the site. This plan shall also include the Applicant's Professional Engineer's Declaration of Compliance with the reviewed Master Lot Grading Plan. Declaration of Compliance by an approved alternate will also be accepted.

The Applicant should read this section in conjunction with the Development Engineering Process Guide (D.E.P.G.) document.

5.2 Lot Grading Design – General

The drainage from all lands within the limits of the development must be self-contained.

Drainage over abutting lands will only be permitted in situations where such drainage merely continues the existing pattern of natural overland flow and has no adverse impact to lands external to the subject development.

Master Lot Grading Plans shall be submitted for all lots and blocks in new developments in accordance with the Engineering Drawing requirements in Section 2 of this document. The City shall review all grading plans with the intent of ensuring sites are suitable for the erection of buildings as well as providing satisfactory drainage for all land within the development.

Storm water flows more than the design capacity of the piped storm sewer system shall be accommodated as overland flow within the roadway or defined swales and in such a manner as to carry excess flow to an approved point of acceptance. The analysis should be based on a storm event with the one hundred (100) year return period.

Generally major overland routes shall follow the road network.

If overland flow must be conveyed between private lots or properties, the City will request a block conveyance as opposed to an easement. The block must be of sufficient width to convey the 100-year flow with adequate freeboard to adjacent private properties.

Upon acceptance from the City, Master Lot Grading Plans shall be referenced in all development agreements and remain on file with the City. Certification from the Applicant's Professional Engineer, or an approved alternate, shall be submitted to the City of Oshawa ensuring that all lot grading has been completed in compliance with the Master Lot Grading Plan, within permissible tolerances. A sample of the Form Letter from approved alternate to Applicant's Engineer related to certification of site grading plans can be found in Appendix 8 of this manual.

Lot grading shall in all cases be designed and constructed to conform to the drainage pattern approved for the design and construction of the City's minor and major storm system.

5.2.1 Front Yards

Grades designed for front yards shall be controlled by the elevations at the property (street) line. The front yards of all residential lots shall be graded to drain toward the street.

The minimum slope for front yards shall be 2%.

The maximum slope for front yards shall be 8%.

Any differential between the street line and the front of the house that cannot be accommodated by a uniform slope within the range as specified above shall be designed as follows:

- a maximum of 3(H):1(V) slope with a maximum vertical height of 1.50m for each terrace.
- a retaining wall with a maximum height of 1.50m for each terrace.
- or a combination of the above.

5.2.2 Driveways

All driveways be required to slope away from the garage with a minimum driveway grade of 2%, from the garage doorsill to the finished grade at the property line, unless otherwise approved by Engineering Services. In addition to the above resolution the following conditions shall apply:

- The maximum design grade of driveways shall be 8%. The maximum constructed grade shall be 10%.
- Driveways should not be used as outlets for any swales. Where driveways abut each other at the property line, a shallow swale or depression between the driveways is encouraged to prevent “sheet flow” on the driveways.
- Rainfall leaders shall not discharge directly on a driveway.

5.2.3 Side Yards

The maximum slope in side yards shall be 3(H):1(V).

In areas where the above objective cannot be met, steps and/or retaining walls (maximum height of 1.50m for each terrace) shall be required.

A minimum 0.6m wide apron sloping 2% away from the foundation wall shall be constructed along one side of the building to allow proper access to the rear yard.

The minimum grade for a side yard swale shall be 2%

The maximum depth for any side yard swale shall be 500mm measured on the low side.

The minimum depth for any side yard swale shall be 150mm measured on the low side.

The maximum slope for a side yard swale shall be 2:1.

The maximum flow allowable to any side yard swale shall be that from 4 detached lots’ rear yards (inclusive of the two lots on which the swale is located) or 0.1 hectares, whichever is less.

Drainage swales shall be located on the common lot line between adjacent lots.

Where the separation between buildings does not facilitate the grading of an acceptable swale, the use of rear to front drainage types shall generally not be permitted.

Where combined side yards between two buildings are 1.2m or less, a cap consisting of 0.30m depth of light to medium clay material should be placed between the backfill and a top layer of 75mm of clear stone. on top of

Where combined side yards between two buildings are greater than 1.2m, topsoil and sod shall be specified.

A typical side yard swale cross-section shall be included on the master lot grading plan.

5.2.4 Rear Yards

The minimum slope for rear yards shall be 2%.

The maximum slope for rear yards shall be 8%.

All rear yards shall be graded to maximize the useable rear yard area with a minimum outdoor living area to be no less than 56 m² for single family homes; 46 m² for each semi-detached unit, and 37 m² per unit for row housing. The useable rear yard area shall be located within 5.0m of the rear wall of the housing unit and shall have a minimum slope of 2% and a maximum slope of 5%.

Any proposed terracing to overcome height differentials may be accommodated by a uniform slope within the range as specified above as follows:

- a maximum of 3(H):1(V) slope with a maximum vertical height of 1.50m for each terrace.
- a retaining wall with a maximum height of 1.50m for each terrace.
- or a combination of the above provided that the combined vertical height does not exceed 1.50m for each terrace.

To facilitate fence installation, maintenance, and stability, a 1.0m wide fencing platform, with minimum 2% and maximum 8% grades, shall be provided between the top of slope along applicable property lines.

All rear yard drainage shall be directed away from the houses to outlet at the curb, sidewalk or catch basin.

The maximum flow in rear yard swales that may be discharged onto the road allowance at any one location is that from 4 detached lots' back yards or 0.1 hectares, whichever is less.

The maximum flow in rear yard swales shall be that from 6 semi-detached lots or 10 detached lots, or 16 street townhouse lots or an equivalent combination thereof. However, in no case shall the length of rear yard swale exceed 60m.

The maximum area contributing to the rear yard swale shall be 0.2 hectares.

The minimum grade for a rear yard swale shall be 2%.

The maximum depth for rear yard swales shall be 750 millimeters measured on the low side.

The minimum depth for rear yard swales shall be 230 millimeters measured on the low side.

The maximum side slope for rear yard swales shall be 3(H):1(V).

A typical rear yard swale cross-section shall be included on the master lot grading plan.

5.3 Site Grading Plan

A Site Grading Plan for each individual lot shall be submitted to the City as part of the building permit application for each residential lot. This plan must conform to the intent of the Master Lot Grading Plan in every respect. The plan shall generally be prepared at a 1:250 scale unless clarity of presentation dictates otherwise. The plan be prepared in accordance with the standard drawing OS-1003, OS-1004, OS-1005 and the drawing requirements provided in Section 2 of this document.

An Engineer, or an approved alternate, must certify that they have reviewed the Site Grading Plan and that the proposed grading conforms to the intent of the reviewed Master

Lot Grading Plan and that the proposed dwelling unit is compatible with the grading. In order to certify conformance, all proposed grades must agree with the Master Lot Grading Plan, along with house and grading type. The use of retaining walls within the lot, not reflected on the Master Lot Grading Plan, shall be discussed with, and agreed upon by the City prior to certification.

All Grading Plans for any sites that containing or more than three residential dwelling units and for any development other than residential shall be prepared stamped by a Professional Engineer. Grading plans for sites containing three or less residential units may be prepared by an accredited professional Landscape Architect or an Ontario Land Surveyor.

Please refer to Section 2.3 for details on Site Plan Design Guidelines and Section 2.3.2 for Site Plan Grading requirements.

5.4 Roof Water Leaders

Roof water leaders shall be connected directly to the storm sewer system for any residential buildings containing three or more dwelling units and for any development other than residential. For townhouse development, the roof water leader at the front of the housing units shall be connected to the storm sewer.

When LIDs are proposed and where feasible, roof water leaders shall be discharged directly to LIDs.

Roof water leaders discharged to the surface shall be directed to front and rear yard permeable areas only and not to the side yard swale, and shall avoid promoting flows to driveways, sidewalks, or pathways.

The grading certificate shall confirm that roof water leaders and LIDs have been correctly installed in accordance with Site Grading Plan submitted with the building permit application.

5.5 Retaining Walls

The use of retaining walls shall be minimized in developing the Master Lot Grading Plan and subsequent individual Site Grading Plans.

Where retaining walls are required along development limits or adjacent future public lands within the plan, the Master Lot Grading Plan shall identify the location, length, height, material, and type of proposed wall. The design of any such walls shall be carried out by a Professional Engineer in conjunction with the Master Lot Grading Plan.

The Master Lot Grading Plan shall also reflect the proposed location of any other retaining walls of 1.0m height or greater to be constructed on lots or blocks within the plan. Detailed design of these ‘internal’ walls will not be required at the Master Lot Grading Plan stage.

Where retaining wall(s) over 1.0m high are proposed on a Site Grading Plan and the retaining wall(s) were not previously identified or designed with the Master Lot Grading Plan, design of the wall(s) shall be carried out by a Professional Engineer and be designed in accordance with the recommendations contained in the Geotechnical report(s).

Retaining walls shall have the following maximum heights:

- 1.5 m in residential areas without integrated fencing.

- 3.0 m integrated retaining wall/fence in residential areas.
- 3.0 m retaining wall or integrated retaining wall/fence in commercial/industrial areas without terracing.
- Any walls higher than 3.0 m will require terracing.

The construction of any wall noted above shall be field reviewed and certified by the Professional Engineer upon completion of construction. A sample of the certification required can be found in Appendix 9.

Retaining walls shall be designed and constructed entirely on one property so that tie backs or wall footings do not cross boundaries. Retaining walls shall be located entirely on private property unless otherwise approved by Engineering Services.

A minimum setback of 0.5m shall be maintained from the tiebacks to the foundation of any structure.

A minimum setback of 0.15 metres shall be maintained from the top or base of any wall and any property line. Fencing and/or a security barrier shall be required at the top of all retaining walls per OBC requirements that are 0.6m high or greater. They shall be designed in conjunction with the retaining wall and appear on the stamped retaining wall drawings.

5.6 Rear Yard Catch basins

If a catch basin is deemed necessary to facilitate drainage, the Applicant will be required to provide a 3.0m wide easement in favor of the City. The easement shall be centered on the lot line and the storm connection and catch basin shall be offset 0.75m from the lot line so that the service is located entirely within one lot. The City does not support storm connections traversing multiple lots.

The use of front yard catch basins shall be avoided.

The use of rear yard catch basins is permitted as a means of improving surface drainage conditions. Where the topography is steep, consideration shall be given to the need for additional catch basins. The City may request additional catch basins in specific situations to avoid future drainage issues.

Where rear yard catch basins are utilized, the foundation walls of the adjacent units shall be extended so as not to be undermined by any future maintenance of the rear yard catch basin and lead. A cross section shall be provided at the worst-case scenario showing the rear yard catch basin lead in relation to the adjacent foundation walls.

The maximum depth of ponding at a blocked catch basin shall be 0.30m and no ponding of water is permitted within 0.30m (freeboard) of an opening of a house.

See Section 5.2.4 for rear yard lot grading information.

6. Erosion and Sediment Control Guidelines

6.1 General

The latest version of the Sustainable Technologies Evaluation Program (STEP) Erosion and Sediment Control Guide for Urban Construction (latest edition) shall form the basis for the preparation and approval of erosion and sediment control proposals. Applicant to ensure later edition of the S.T.E.P Erosion and Sediment Control Guide is used.

Multi-stage erosion and sedimentation control plans will be required by the City of Oshawa for the earthworks, servicing, building construction and ESC decommissioning stages of development and must be acceptable to Engineering Services prior to commencing any work on the site.

The approved erosion and sediment control measures shall be in place and be maintained at all times in good condition prior to the commencement of and during construction.

Alternative measures, such as lot drains and temporary bulkheads may be employed at Stage 3 – Building Construction if approved by Engineering Services. The Applicant is responsible for meeting all provisions set out in O.Reg. 406/19 On-Site and Excess Soil Management as made under the Environmental Protection Act.

The proponent is responsible for obtaining any necessary approvals from the Central Lake Ontario Conservation Authority (CLOCA), including permits, before commencing any work on site.

Development setbacks from watercourses shall be established in conjunction with City of Oshawa, MECP / MNRF and CLOCA, and shall consider the respective guidelines and requirements of such.

Removal or injury of trees located on City owned land requires permission from the City of Oshawa as per City Trees By-Law. Removal or injury of trees located on Regional Woodland requires permission from Durham Region as per Regional Woodland By-law. Refer to City and Region websites for these By-Laws, respectively.

The Construction Management team will address the management and/or relocation of existing trees that conflict with the design. Trees are to be protected in conjunction with a Tree Preservation Plan/Report. Refer to the Parks Development Design Standards for tree inventory and preservation requirements.

6.2 Guidelines

1. All surface water pumped from the site shall be treated by one or a combination of temporary sedimentation basins, oil-grit separators, silt sacks, sand filters, upflow chambers, swirl concentrators or other appropriate controls. If the water has been trapped for more than 48 hours and reasonably clear visually, then de-watering operations may be conducted provided the water is not permitted to discharge directly into receiving bodies of water.

2. All storm drainage inlets on the site shall be protected with filters, or equivalent barriers meeting accepted design criteria, standards and specifications accepted by the Applicant so as not to admit sediment-laden runoff escaping from the disturbed areas of the site.

3. A formal erosion risk assessment, as laid out in Section 6.2 of the latest STEP guideline, is required for construction projects that meet any of the following criteria:

   (a) Extent of land disturbance is greater than 10ha and duration is longer than 30 days.

   (b) Construction activities are planned within a CLOCA regulated area.

   (c) The site drains to Species-At-Risk habitat.

4. The following criteria apply to land disturbance activities that result in runoff leaving the site:

   (a) Concentrated runoff from adjacent areas passing through the site shall be diverted around areas of land disturbance, if practical. Otherwise, sediment control fences placed along the edges of the channel containing runoff shall protect the concentrated runoff. This will reduce the amount of sediment contaminating the concentrated runoff.

   (b) All activities on the site shall be conducted in a logical sequence to minimize the area of bare soil exposed at any one time.

   (c) Any soil or dirt piles must be stockpiled in such a way that it will not erode and find its way to a watercourse or a roadway. Any stockpiled topsoil shall not be uncovered for more than thirty (30) days after which it shall become covered with mulch, vegetation, traps, etc., and shall not be allowed within the vegetated buffer strip required to protect a warm water or cold-water fishery. A sediment control fence shall be erected around the storage pile during the entire time when it is left uncovered. Stockpiles will not be permitted on dedicated park lands.

   (d) Precautions shall be taken to ensure that mud will not be tracked offsite by any vehicle exiting the site through the installation of mud mats, shaker racks and/or wheel washers. Roads shall be kept free and clear of mud and dust tracking as directed by the City Inspector.

   (e) A sediment control fence shall be installed as required to protect adjacent areas.

   (f) A three (3) m wide buffer strip of undisturbed land must be provided along the perimeter of the downslope of the site. It must be entirely located upon the site, which is to be developed. The buffer zone shall be increased to fifteen (15) m and thirty (30) m respectively when the site abuts warm water or cold-water fisheries.

(g) For ***sites*** with extensive fill requirements, the Applicant may waive the requirements for stabilization of disturbed land after thirty (30) days of inactivity provided that the sediment control measures have been implemented to the satisfaction of the Engineer.

(h) Crossing watercourse only at approved locations with rubber tire vehicles preferred.

(i) Streambed shall not be used as a vehicle or equipment route.

5. Runoff from the area of land disturbance on the site shall be controlled as follows:

(a) A multi-barrier approach be taken to erosion and sediment control to create a resilient system to protect the natural environment. The multi-barrier approach should be applied per Section B2: Sediment Control Practices of the Erosion and Sediment Control Guide for Urban Construction (latest edition).

(b) All ***disturbed land*** left inactive shall be stabilized by seeding, sodding, mulching, or covering, or other equivalent control measures. The period of inactivity shall be at the discretion of the Applicant but shall not exceed thirty (30) days or such longer period as deemed advisable at the discretion of the Engineer.

(c) For *sites* with less than two (2) hectares of ***disturbed land*** at one time and slopes less than twelve (12%) percent grade, filter fence (the minimum required erosion and sediment control measure) shall be placed along all side slope and downslope sides of the ***site*** and one or more sediment traps shall be constructed. The design of the sedimentation traps shall be consistent with the Sustainable Technologies Evaluation Program (STEP) Erosion and Sediment Control Guide for Urban Construction (latest edition) sediment control pond design guidelines (Page B2-29).

(d) For ***sites*** with two (2) or more hectares of ***disturbed land*** at one time, or with slopes greater than twelve (12%) percent grade, or where a channel originates in the area of ***land disturbance***, filter fence shall be placed along all side slope and downslope sides of the ***site*** and one or more sedimentation ponds/basins shall be constructed. The design of the sedimentation pond/basin shall be consistent with the Sustainable Technologies Evaluation Program (STEP) Erosion and Sediment Control Guide for Urban Construction (latest edition) sediment control pond design guidelines (Page B2-32).

6. ESC Winterization and Snow Management.

Consideration must be given to ESC challenges for Sites that remain active over winter.

Pre-winter ESC inspection and maintenance

- Inspect erosion controls to ensure secure installation and condition.
- Ensure sediment basins/traps have been cleaned to provide adequate

storage capacity.

- Ensure all exposed subgrades get graveled or tracked in order to create a rough soil surface that will help to slow down runoff velocity.
- Check for adequate stabilization of all exposed areas (slopes or stockpiles).

Stabilization Schedule Before Winter

September 15

- All disturbed areas must be seeded and mulched.
- All slopes must be stabilized, seeded, and mulched.
- All grass- lined ditches and channels must be stabilized with mulch or an erosion control blanket.
- NOTE: Mulch application rate should be doubled when stabilizing for winter to prevent wash out during spring melt.

November 15

- All stone-lined ditches and channels must be constructed and stabilized.
- Slopes that are covered with riprap must be constructed by this date.

December 1

- All disturbed areas where the growth of vegetation fails to be at least 75 mm tall or at least 75% of the disturbed soil is covered by vegetation, must be protected for over-winter.

Snow Management

Prepare a snow management plan showing the following:

a. Enlarged access points – to provide snow storage.
b. Snow pile locations downstream of exposed soil areas.
c. ESC measures be cleared of snow in preparation of inspection and maintenance.
d. Drainage structures shall be kept open and free of snow and ice dams.
e. Removal or replacement of storm inlet sediment controls at locations that may cause safety concerns (due to ponded water and ice).

7. Rehabilitation of the ***site*** shall include:

(a) the leveling and re-grading of affected lands.

(b) the planting of trees.

(c) the replacement of topsoil – minimum 100 mm depth for areas to be further developed, and a minimum 200 mm depth for all other areas.

(d) the stabilization of replaced topsoil through sodding, hydro seeding, mulching or such other methods as may be acceptable to the Engineer.

7. Stormwater Management

7.1 General

There are five watersheds within the City as follows:

1. Oshawa Creek
2. Harmony Creek
3. Montgomery Creek
4. Corbett Creek (drains into the Town of Whitby)
5. Farewell Creek (drains from the Municipality of Clarington)

The location of these creeks is illustrated in the City's Official Plan.

Of the five, Oshawa Creek and Harmony Creek are the two primary watersheds. The City has completed and endorsed major studies on both of these primary watersheds. Any development occurring within these watersheds shall respect the recommendations of these studies. Copies of these studies can be obtained from the Central Lake Ontario Conservation Authority (CLOCA) website.

The Corbett Creek Master Drainage Plan was completed by the Town of Whitby and is available on the Town of Whitby website.

7.2 Design References

7.2.1 Applicable Acts

Provincial:

- Clean Water Act (2006)
- Conservation Authorities Act (1990)
- Drainage Act (1990)
- Environmental Bill of Rights (1990)
- Municipal Act (2001)
- Ontario Water Resources Act (1990)
- Ontario Endangered Species Act (2007)
- Ontario Environmental Protection Act
- Ontario Provincial Policy Statement
- Environmental Assessment Act (1990)

Federal:

- Species at Risk Act (2002)
- Fisheries Act (1985)
- Canadian Environmental Assessment Act (1999)

7.2.2 General Stormwater Design References

- Stormwater Management Practices Planning and Design Manual (Ministry of Environment (MOE), 2003)
- Ministry of Transportation Highway Drainage Design Standards (MTO, 2008)
- Ministry of Transportation Drainage Management Manual (MTO, 1995)
- Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation (C.V.C.) and Toronto and Region Conservation Authority (TRCA), 2011)
- Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (Credit Valley Conservation (C.V.C.) and Toronto and Region Conservation Authority (TRCA), 2016)
- Low impact Development Stormwater Management and Planning and Design Guide (Sustainable Technologies Evaluation Program, Living Website)
- Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications (Conservation Authorities Geoscience Group, June 2013)
- Water Management, Policies, Guidelines, Provincial Water Quality Objectives (available on the MECP website)
- Central Lake Ontario Conservation Authority Technical Guidelines for Stormwater Management Submissions (CLOCA, 2020)
- A Guide to Conducting a Climate Change Analysis at the Local Scale: Lessons Learned from Durham Region (February 2020)

7.3 Submission Requirements

Submission requirements for SWM plans shall comply with the City's Development Engineering Process Guidelines (DEPG), which is currently under development. Additionally, submission requirements outlined in Section 6.0 of CLOCA's Technical Guidelines for Stormwater Management Submissions (October 2020) should be followed.

7.4 Stormwater Management Criteria

Stormwater Management Criteria shall comply with City's SWM Master Plan which is currently under development. In the absence of City Guidelines, reference should be made to the applicable watershed and sub-watershed studies, CLOCA, and MECP best practice guidelines at the discretion of the City. The following sections outline minimum best practice criteria that should be followed.

7.4.1 Water Quantity Control Criteria

Stormwater quantity control requirements should comply with the relevant Watershed Plan based on the project location, site specific studies, and CLOCA guidelines. For CLOCA guidelines, reference should be made to quantity control guidelines outlined in CLOCA's

Technical Guidelines for Stormwater Management Submissions (October 2020). Per the CLOCA guidelines, quantity control design should meet the following Criteria:

- Maintain Watershed Boundaries – Efforts should be made to maintain watershed boundaries and flow patterns. Pre-consultation is mandatory for any proposed change to watershed boundaries.
- Post-to-Pre-Controls – Unless otherwise stated by the City, post-development peak flows must not exceed corresponding pre-development rates for all design storm events or as per the Master Environmental Servicing Plan (MESP), or approved watershed, subwatershed or site-specific studies.
- Overcontrol – If there is a known deficiency in the downstream conveyance system, additional quantity control measures may be required based on the capacity of the receiving system.
- No Downstream Impacts – In some cases, quantity control may not be required due to the nature of the hydrologic responses of creeks and timing of peak flows, as per approved watershed, subwatershed or site-specific studies, and subject to approval of the City and CLOCA.

7.4.2 Water Quality Control Criteria

Stormwater quality control requirements should comply with the relevant Watershed Plan based on the project location, site specific studies, and CLOCA guidelines. For CLOCA guidelines, reference should be made to quality control guidelines outlined in CLOCA's Technical Guidelines for Stormwater Management Submissions Best management practice (BMPs) must be applied to all developments to provide quality treatment as per the Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual (M.O.E 2003).

In accordance with City practice, prior to discharge to the receiving storm sewer system, high density, commercial and mixed-use lands require on-site water quality treatment in the form of OGS. Consideration shall be given to specification of an alternative quality control measure that provides quality treatment for runoff from paved parking areas at the discretion of the City of Oshawa.

Water quality treatment will be required for all new developments within the City. Quality control measures should be designed to provide Enhanced levels of treatment per MOE guidelines, this may be achieved using a treatment train approach.

Oil Grit Separator

Where oil grit separators or other storm water quality control technologies are required to meet Total Suspended Solids (TSS) removal targets, technologies with Environmental Technology Verification (ETV) shall be used and shall be sized in accordance with ETV protocols.

7.5 Design Requirements

7.5.1 Hydrology

Hydrological analysis is required for the design of all SWM infrastructure. Depending on

the size, characteristics, and complexity of the SWM system, hydrological analysis may be completed manually, using modified rational method, or with the use of a computer model. Computer modelling is recommended for any sites that are greater than 5 hectares. For smaller sites, less than 5 hectares, manual calculations, such as modified rational method, will be accepted.

Modified Rational Method

The Modified Rational Method is a runoff estimation method based on an empirical formula relating the peak flow rate to the drainage area, rainfall intensity and a runoff coefficient. For Rational calculations and recommended input parameters reference should be made to Section 4.2 of this document.

Runoff Coefficients

Recommended runoff coefficients based on land-use and surface cover are provided in Section 4.2 of this document.

Adjusted Runoff Coefficients

Per MTO guidelines, calculated runoff coefficients (C) shall be increased for larger storm events as follows:

- 25-year storms – Increase C by 10%
- 50-year Storms – Increase C by 20%
- 100-year Storms – Increase C by 25%

The adjusted runoff coefficient should not exceed 1.00.

Intensity-Duration-Frequency (IDF)

IDF data for the City is presented in Section 4.2 and in Appendix 2 of this document.

Computer Models

For guidelines on computer models, reference should be made to the established hydrology modeling in site specific studies. In the absence of City criteria, CLOCA guidelines are recommended.

Per CLOCA guidelines, the preferred hydrology model is Visual Otthymo, however, other models will be considered upon consultation. Sources for all values / approaches used in the determination of hydrologic parameters must be specified in SWM submissions. Typical values to be used in the calculation of hydrologic parameters including Initial Abstraction (IA), Depression Storage (DPSI), Manning's 'n' Values, Curve Numbers (CN), Total Imperviousness (TIMP), and Directly Connected imperviousness (XIMP), are provided in Appendix C of CLOCAs *Technical Guidelines for Stormwater Management Submissions* (October 2020).

Design storms used in hydrologic modelling should be as per the site-specific model (sub watershed study, MESP, etc.) or as per CLOCA guidelines. Designs should be analyzed under various design storms and the storm with the greatest impact used as a basis for design.

The Infiltration parameters (SCS, Horton, Green & Ampt) used are to be as per the site-specific model or as specified by the City.

7.5.2 Hydraulics

Per CLOCA guidelines, where a site is within the regulation limits and may impact a floodline, hydraulic modelling must be provided. Hydraulic models are to be as per the site-specific study or as requested by the City.

7.5.3 Climate Change

Drainage systems should be tested to ensure safe conveyance of runoff during extreme rainfall events. CLOCA may require additional climate change considerations, reference should be made to the *Technical Guidelines for Stormwater Management Submissions* (October 2020). As knowledge and research develops on the impact of climate change on SWM infrastructure, the City reserves the right to update their climate change requirements for the analysis of SWM infrastructure. Consultation with the City's Engineering Services Department should be undertaken at the outset of a project to establish the climate change criteria for the specific project scope.

7.6 Stormwater Management Facility Design Guidelines

The design of stormwater management facilities shall comply with the M.O.E *Stormwater Management Practices and Design Manual* (MOE 2003) as well as CLOCAs *Technical Guidelines for Stormwater Management Submissions* (October 2020), as well as any additional site specific, or City's requirements.

7.6.1 Wet Ponds

Wet ponds are the preferred type of stormwater management facility in the City. Recommended wet pond design guidelines are as follows:

General Requirements

- Wet ponds should be designed in accordance with MECP guidelines documented in Section 5.4 of the Stormwater Management Practices and Design Manual (March 2003).
- Construction of instream ponds that impede the passage of fish are prohibited.
- Beaver deterrent shall be considered as part of the wet pond infrastructure design. Proposed beaver deterrent methods must inhibit beavers from entering SWM pond outlet pipes or control structures. This may take the form of grating or fencing around the inlet of the control structure. Combination beaver deterrent methods may also be used in conjunction with grating or fencing. Combination devices may include the use of pond levelers as an additional means for water flow should beavers dam around the outside of the fencing or grating. All proposed beaver deterrent methods must include an operation and maintenance plan for frequency of inspection and methods for cleaning. All beaver deterrent methods shall be approved at the discretion of the City.
- All sediment that is removed from the SWM facility shall be stored on site in a designated sediment drying area within the site's pond block.

Grading

- The side slopes above the permanent pool shall not be steeper than 5:1.
- The side slopes below the permanent pool shall not be steeper than 3:1.
- A transition Zone (safety ledge) shall have a minimum vertical depth of 1.0m and the slope shall not be steeper than 6:1.
- A 5.0m wide safety buffer with a maximum crossfall grade of 5.0% shall be provided around the perimeter of the pond.

Forebay and Forebay Berming

- The forebay bottom and side slopes should be lined with Terrafix Blocks or equivalent and the side slopes shall not be steeper than 5:1.
- The forebay berm shall be lined with Terrafix Blocks or equivalent and the top elevation shall be set at the permanent pool water level.
- A pipe connecting the main cell and the forebay should be provided in the forebay berm to allow for winter drawdown. The conveyance pipe invert should be located sufficiently above the anticipated 10-year accumulated sediment depth but shall not be less than 0.60m above the forebay invert. Reference should be made to the City‘s SWM master plan for further guidance on berm conveyance pipes for winter drawdown.

Permanent Pool, Extended Detention, and Quantity Control Requirements

- The permanent pool shall have a minimum depth of 1.5m and a maximum depth of 3.0m.
- The preferrable extended detention storage depth is less than 1.0m but shall not exceed 1.5m.
- The preferable active storage depth is less than 1.8m but shall not exceed 2.5m.
- Where a pond is designed for both quantity and quality control, the quantity control storage begins above the requirements for extended detention (i.e. the erosion storage volume cannot be considered as part of the quantity control volume).

Inlet Structures

- The invert elevation of the inlet pipe shall be at the permanent pool level.

Outlet Structures

- A minimum 0.30m freeboard is required above the maximum emergency spillway elevation and the top of the pond berm.
- A reverse sloped pipe outlet shall be used to draw water from below the surface. The pipe should be set to draw water from a minimum of 0.6m above the pond bottom and below the expected ice depth. The outlet of the reverse slope pipe shall be set at the permanent pool elevation.
- The outlet control structure/chamber shall be contained in a maintenance hole and embedded into the banks of the pond and shall include a mechanism to lower the water level in the pond during winter months as per current City practice. Any valves used within the outlet control structure shall be made of a non-corrosive material or

have a protective coating such as a cadmium or zinc.

- The pond outlet to a receiving watercourse must be set above the 2-year floodplain elevation in the receiving watercourse.
- The pond's emergency spillway must be designed to convey the uncontrolled 100-yr peak flow. In circumstances where overland overflow is not feasible, an intake structure must be designed assuming 50% blockage of the inlet grate.

Landscaping

- The side slopes of the pond should be sodded from 0.6m below the permanent pool up to the top of the extended storage detention.
- A landscaping plan shall be prepared for the pond. Landscape plans shall comply with the TRCA Stormwater Management Pond Planting Guidelines. All facilities must use native plants and non-invasive species only.

Pond Access, Operation and Maintenance

- The pond should be designed to be drawn down and maintained, primarily via gravity flow, to a maximum depth of 0.50m.
- The outlet draw-down pipe should be flush with the bottom of the pond invert. A 0.50m deep lined sump with slopes not steeper than 5:1 should be incorporated into the design at this location.
- A minimum 4.0m wide access road shall be provided for maintenance purposes. Access roads must provide access to the forebay(s), main cell(s), and all inlet, outlet, and other control or conveyance structures. The access road, curbs, and sidewalks shall be designed considering the use of heavy equipment to be mobilized to the site for pond cleanout. Reinforced concrete shall be used for curbs and sidewalks, with increased concrete thickness at the pond entrance.
- Access roads should have a minimum cross-fall of grade of 2% and a maximum of 4%.
- Access roads should have a minimum slope of 2% and maximum of 10%.
- Access roads should have a minimum inside turning radius of 10m. Where possible, access roads should have two access points such that the road is looped to key components. When a looped access road is not practical, turn-around facilities with minimum centerline turning radius of 16m should be provided for maintenance vehicles to maneuver.
- If an access road is below the 100-year flood line, the road is required to have a turfstone surface or approved alternative on a granular base. The turfstone voids shall be filled with granular A.
- If there is a trail system linking the pond to the surrounding lands, then a standard 5.0m wide plateau (3.0m wide asphalt trail + 1.0m flat shoulders on both sides) shall be provided.

7.6.2 Surface Storage

The following requirements should be considered when using surface storage:

- The maximum allowable ponding depth is 0.3m.
- All runoffs must be stored on site for events up to and including the 100-year unless a major system outlet in provided adjacent to the site and is approved by the City.
- Runoff in excess of the 100-year event must have a defined overland flow route and an approved outlet.

7.6.3 Low Impact Development (LID)

The City supports the use of Low Impact Development (LID) for use on City property or private commercial or industrial lots. However, the use of LID facilities on private residential lots is not permitted by the City. Typical LID facilities include the following:

- Bioretention Systems.
- Enhanced Grass Swales.
- Infiltration Swales or Dry Swales.
- Green Roofs.
- Permeable Pavement.
- Soakaways, Infiltration Trenches and Chambers.
- Perforated Pipe System.
- Rainwater Harvesting.
- Vegetated Filter Strips.

LIDs should be designed per Best Management Practices (BMPs) and design guidelines outlined in the following documents:

- Stormwater Management Practices Planning and Design Manual (Ministry of Environment (MOE), 2003).
- Low impact Development Stormwater Management and Planning and Design Guide (Sustainable Technologies Evaluation Program, Living Website).
- Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (Credit Valley Conservation (CVC) and Toronto and Region Conservation Authority (TRCA), 2016).
- Low impact Development Stormwater Management and Planning and Design Guide (Sustainable Technologies Evaluation Program, Living Website).

Where LIDs are proposed, inspection, and operation and maintenance details must be provided. Consultation with the City should be completed prior to the proposal of any LIDs within the City ROW or Municipal lands.

7.7 Stormwater Management Facility Operations and Maintenance

The Applicant shall prepare an operations and maintenance manual for the stormwater management facilities. Operation and maintenance plans shall be per the MECP's Stormwater Management Practices Planning and Design manual (MOE, 2003) and as required by the City's CLI ECA.

Stormwater Management Inspection Planning

The design and review of stormwater management practices, including guidance for stormwater management sewage works approvals and future maintenance shall be in compliance with Section 53 of the Ontario Water Resources Act. Inspections shall be in compliance with the City's Consolidated Linear Infrastructure - Environmental Compliance Approval (CLI-ECA).

SWM system inspections determine required maintenance activities. During the first two years of operation, inspections should be made after every significant storm to ensure proper functioning (average is about four inspections per year).

8. Construction & Material Testing – New Subdivisions

8.1 General

The purpose of this section is to aid the Applicant by outlining the construction responsibilities and approval process pertaining to City's standards and Specifications as related to the construction of roads and services in new subdivision development.

The Applicant should read this section in conjunction with the Development Engineering Process Guide (DEPG) document Post Construction Process.

This section deals with specific construction requirements while the DEPG Post Construction Process describes the details related to the acceptance process of the services and requirements or obligations of the Applicant to obtain reductions of the securities for the municipal services covered by the agreement.

8.2 Contract Document Review

Refer to the DEPG for submission and review requirements of the subdivision contract document. At all times the Applicant shall be responsible to ensure all City's standards, criteria and specifications are adhered to. Where any error or omission is later discovered within the contract document, the Applicant acknowledges that the City of Oshawa's criterion shall take precedence.

8.3 City Inspection Responsibilities

The Applicant shall be responsible to administer the contract including the provision of ***full-time onsite*** inspection services.

The City will perform periodic inspections to assure that the City's requirements are being adhered to.

8.3.1 On Site Inspections

The City's inspection shall include, but not limited to the following:

- Liaise with the Applicant on matters pertaining to the construction process.
- Provide regular site inspections during the construction process to ensure that City Standards and Specifications are being adhered to and that the work being performed is in accordance with the Subdivision Agreement.
- All proof rolls shall be performed according to the City's proof roll criteria as defined in Section 3.7 and Section 8.5.9 of this document.
- The Applicant shall provide a Closed-Circuit Television (CCTV) Inspection Report including a complete list of deficiencies for sanitary sewer mainline, storm sewer pipe (including the pipe connecting the main cell and the forebay), foundation drain collector pipe and catch basin leads. All CCTV inspection reports must be

submitted to the City within5 business days prior to the placement of surface course asphalt. CCTV Inspection Reports for subdrains and FDC/storm sewer connections may be requested by the City Inspector on an as needed basis.

- CCTV Inspection Reports shall conform to the Region's CCTV inspection requirements.
- Participate in joint inspections of Stage 1 and Stage 2 services to identify deficient work, confirm completion of such and to issue inspection acceptance certificates for Provisional and/or Final Acceptance of services culminating with the eventual assumption of the subdivision development by the City. The consultants written inspection reports are to be provided to the City inspector 72 hours after inspection has been completed.

Copies of all inspection reports are to be submitted to the City in a digital format acceptable to Infrastructure Services. Co-ordination of joint inspections shall be arranged through the City's Engineering Services Department.

Joint follow-up inspections to assess, confirm deficiencies are not to be arranged unless and until the Applicant has inspected the contractor's work and is satisfied that it meets the City Standards and Specifications.

8.3.2 Related Inspections

The City's related inspection shall include, but not limited to the following:

- Investigate any complaints pursuant to the construction process received by the City and forward the information to the Applicant for corrective action.
- Inspect constructed roadways within the subdivision phases as well as adjacent City roads to ensure maintenance of a clean, mud-free condition. Developers are to submit requests for winter maintenance by October 15th annually. All maintenance holes and catch basins must be adjusted; ramping will not be permitted.
- Inspect sedimentation control devices such as, but not limited to; catch basins, siltation fences, rock check dams and temporary siltation ponds, to ensure proper maintenance and state of good repair. The CLOCA's Erosion and Sediment Control Inspection Guide latest edition shall form the basis for proper installation and inspection procedures of ESC measures.

The City Inspector shall report any infractions related to the above items to the Applicant for the necessary corrective action(s). Should the Applicant fail to initiate the required corrective action(s) in a reasonable time, the City Inspector shall make arrangement to have the corrective action(s) undertaken by City forces and/or contract services. Should this action be taken, all related costs will be charged back to the Applicant through the roadway damage and siltation control deposit on file with the City as part of the performance security provided by the Applicant and through the Subdivision Agreement or through the draw down of the Letters of Credit on file as deemed appropriate.

8.3.3 Referee Testing

The Applicant shall reimburse the City for all costs incurred while attending referee testing. This shall include staff time, mileage, and meals. The cost per day shall be as per

Schedule D in the subdivision approvals agreement. When referee testing is invoked, the sample must be tested for compliance to all Marshall properties.

8.4 Material Testing – New Subdivisions

The Applicant shall engage the services of a certified Laboratory (membership in CCIL) to provide quality control testing during all phases of the construction process.

The Laboratory shall be responsible for conducting tests on compaction, granular material, concrete, and asphalt. Tests are to be conducted in accordance with current OPSS and CSA standards and procedures.

The Laboratory shall assess any problems related to materials/quality control, which may arise during the construction process and recommend corrective measures as required.

Copies of all laboratory and/or field tests conducted shall be forwarded to the City Inspector on a daily basis.

City's Laboratory personnel may conduct periodic quality control testing for comparison purposes and is not intended to replace the testing responsibilities of the Developer/Engineer.

Grain size analysis shall be performed on subgrade materials to confirm that the proposed subgrade material classification is still being met. The City shall receive a map showing test locations and results prior to placing any granular materials in the road base.

8.4.1 Minimum Testing Requirements

Compaction

Area	% Compaction	Frequency	Test Location Identification
Mainline sewer trench	95% (514.17.08)	15m, 0.6m maximum lift	Street Distance from downstream maintenance hole, i.e., MH 23 + 30m
Mainline Watermain Trench	95% (514.17.08)	15m, 0.6m maximum lift	Street, Station and Offset
Road Sub-base	95% top 1.2m (501.08.02)	15m "Z" Pattern	Street, Station and Offset
Service Trenches	Same as Road Sub-grade	Random Selection	Lot Number
Watermain Crossings	Same as Road Sub-grade	Each crossing	Street, Station
Utility Trenches*	95% (sub-grade) (501.08.02)	Each crossing	Street, Station, or Adjacent Lot Number

***Note:** Utility crossings are to be placed prior to placement of granulars

Compaction

Area	% Compaction	Frequency	Test Location Identification
Curb Line Bedding	100% (501.08.02)	15m	Street, Station and Left or Right i.e., 0+030 R
Granular 'B'	100% (501.08.02)	15m "Z" Pattern	Street, Station and Offset i.e., 0+120, 3.5m R
Granular 'A'	100% (501.08.02)	Same as Granular 'B'	Same as Granular 'B'
Asphalt**	Table 9 (OPSS 310)	15m each lane	Street, Station and Left or Right, i.e., 0+120 south

****Note:** Recycled asphalt (RAP) is accepted by the City of Oshawa, up to 30% RAP is permitted in base asphalt and up to 15% RAP is permitted in surface asphalt. Any RAP placed at over 20% requires a PG AC Bump down of 1 grade.

Ex 58-28 52-34 over 20% RAP
20% RAP or less over 20% RAP

Concrete

Item	Test Location Frequency	Identification
Curb and Gutter	▪ 1 Test per 50 m^3 of concrete. ▪ Minimum 3 cylinders per location to break at 7 and 28 days. ▪ Minimum of 1 test per day that concrete is poured. ▪ Slump and air tests at each sampling location. ▪ Conformity with OPSS 1350.	Station, left or Right or Station, North, South, etc.
Sidewalk	▪ 1 Test per 50 m^3 of concrete. ▪ Minimum of 3 samples per location to break at 7 and 28 days. ▪ Minimum of 1 test per day that concrete is poured. ▪ Slump and air tests at each sampling location. ▪ Conformity with OPSS 1350.	Station, left or Right or Station, North, South, etc.

Asphalt

Item	Test Location Frequency	Identification
All Hot Mix	▪ Samples to be taken every 500t or per day of paving for each type of Hot Mix. ▪ Samples to be taken on every street paved. ▪ Temperature shall be recorded for each sample taken (ambient air and hot mix temp.). ▪ Minimum 1 Marshal Test and 1 extraction test per day of paving.	Station, left or Right or Station, North, South, etc.

Item	Test Location Frequency	Identification
	▪ Conformity to OPSS 1003, 1101, 1150 (AADT>5000) required. ▪ One additional sample to be taken and saved for further testing in the event of required referee testing. ▪ Weather conditions shall be recorded with corresponding HMA sample. ▪ Mix design is to be approved by City of Oshawa.	

Granular

Item	Test Location Frequency	Identification
Gran A, B and Select Subgrade Material	▪ All gravel shall meet OPS muni 1010 including % crushed. ▪ OPS 1010-B shall be invoked. ▪ Samples shall be taken as per table B-2 in OPS 1010-B. ▪ Minimum of 1 gradation test shall be analyzed per street. ▪ Minimum of 1 sample of granular shall be analyzed per day if Granular material is being imported to site. ▪ There is no borderline result for a Granular Material. The sample either passes or fails. ▪ If a sample fails the gradation, testing frequency should be increased until the City is satisfied that material consistently meeting the specifications is being delivered. ▪ No RAP or Crushed Concrete material is permitted in Granular Materials. ▪ Crusher Run Limestone is not permitted to be used as a Granular A material unless approved by City Inspector. ▪ Granular tests shall be submitted to the City no more than 48 hours after Granular material is sampled. ▪ A map showing each test location and its result (pass or fail) shall be produced and submitted to the City prior to placing base asphalt.	Station, left or right or Station, North Lane, South Lane, etc.

Topsoil

Item	Test Location Frequency	Identification
Topsoil	▪ Topsoil sample shall be collected from suppliers' stockpile prior to being imported to site. The sample shall be tested and meet the requirements found in Section 8.5.10, Topsoil acceptance requirements section. ▪ 1 sample of Topsoil shall be tested for every 250 linear meters of area that topsoil will be applied. ▪ Samples shall adhere to the requirements found in Section 8.5.10 Topsoil acceptance requirements section.	Station, left or right or Station, North Lane, South Lane, etc.

8.5 Acceptance Criteria

General

- Guidelines should be established by the Applicant for the protection of Municipal Infrastructure during house construction.
- Procedures for concrete placement (hot and cold weather), cutting of control joints and curing of concrete shall be strictly adhered to.
- Completion of driveway and boulevard areas by the homeowners/builders will not be a determining factor for the replacement of deficient curb and gutter or sidewalk.
- All concrete shall adhere to OPSS MUNI 1350. The concrete temperature at the time of discharge from the truck shall be between 10 and 28°C as per OPSS MUNI 1350.07.02.

8.5.1 Construction of Stage 2 Services

Construction of Stage 2 services shall not commence until:

- The calendar year following the installation of Stage 1 services;
- The television inspection of services has been completed and any deficiencies rectified;
- At least 80% of the buildings on the street have been completed.

Notwithstanding the above all services, shall be completed within 12 months from completion of 80% of the buildings on the street or within 42 months of the commencement of construction of Services on the Plan, whichever occurs first. However, the City's Commissioner retains the right to direct the Subdivider to complete Stage 2 services at any time, at his sole discretion.

8.5.2 Two Stage Curb and Gutter Acceptance Criteria

Reinforced base curb

- As per OS-602; OPSS 353.
- All curb with structural damage is to be removed and replaced.
- Minimum length of curb replacement to be 1.5m. No remaining section to be less than 1.5m.
- Hairline and/or shrinkage cracks may be left in place provided the crack width is not greater than 0.5mm.
- Based on test results any sections that do not meet the specified concrete design criteria are to be removed and replaced.
- No sawcuts to be made in the base curb.

Top curb and gutter

- As per OS-602 ; OPSS 353.
- All curb and gutter with structural damage is to be removed and replaced.
- Curb and gutter with cracks greater than 0.5 mm in width is to be removed and replaced.
- Diagonal and/or longitudinal cracks are to be removed and replaced.
- Curb and gutter sections with over 25% spalling or scaling are to be removed and replaced.
- Misaligned, settled or sections causing excessive ponding are to be removed and replaced.
- Based on test results any sections that do not meet the specified concrete design criteria are to be removed and replaced.
- Minimum length of replacement to be 1.5 m. No remaining section to be less than 1.5 m in length.
- 1.5 m sections are not to be considered the standard. Only two (2) consecutive 1.5 m sections are allowed.
- Reflective cracks shall not be saw-cut.
- Deficient top curb and gutter to be removed and replaced prior to the placement of surface asphalt.

8.5.3 Sidewalk Acceptance Criteria

As per OS 300 series standard drawings and OPSS 206, 310, 314, 351, 501, 510 Sidewalk shall be removed and replaced under the following circumstances:

- Sidewalk or ramps constructed in excess of maximum or below minimum grade or crossfall.

- Structural damage.
- Misaligned, heaved, or settled by generally causing a discontinuity of 10 mm or greater.
- Spalling or scaling over 25%.
- Tooled perpendicular edges.
- Improper curb taper lengths as per OS-304 (this shall also include removal and replacement of the curb & gutter).
- Graffiti or imprints and/or depressions causing ponding.
- Where expansion joint material has not been installed to full depth of the concrete sidewalk.

Corrections to any deficiency must be a minimum 1.5 m length or between either existing control joints. Corrections at sidewalk ramps may also necessitate corrections to adjacent curb and gutter sections.

8.5.4 Asphalt Acceptance Criteria

- All asphalt shall conform to OPSS 310.
- All PGAC shall conform to OPSS 11-01.
- OPS 310 Table 7 and Table 9 shall be deleted and replaced with amended Table 7 and Table 9 presented below.

TABLE 7

Tolerances for the Job-Mix Formula Aggregate Gradation and Asphalt Cement Content

Mix	Attribute	Tolerances on the Job-Mix Formula (Note 1) %	
		Acceptable	Rejectable
Surface Course	DLS, 4.75 mm Sieve size	< 7.0	> 7.0
	600 µm sieve size	< 4.5	> 4.5
	75 µm sieve size	< 2.5	> 2.5
Binder and Levelling Courses	DLS, 4.75 mm sieve size	< 8.5	> 8.5
	600 µm sieve size	< 5.0	> 5.0
	75 µm sieve size	< 2.5	> 2.5
All Mixes	Asphalt Cement	4.7%-5.4%	Less than 4.7% Greater than 5.4%

Note:
1. Tolerances on the job-mix formula apply as both plus and minus from the job-mix formula percent.

TABLE 9
Air Void Criteria for Hot Mix Asphalt Types (LS-265)

Mix	Acceptable %	Rejectable %
DFC	2.5 to 4.5	< 2.5 and > 4.5
All Other Mixes	2.5 to 5.5	< 2.5 and > 5.5

- The contractor shall be solely responsible to ensure that the quality control tests, specifically for aggregate gradation, asphalt cement content and/or air void content fall within the acceptable limits category of OPS 310 Table 8 and amended Table 7 & 9. Results are either Acceptable or Rejectable.
- Asphalt cores are not an acceptable substitute for referee samples and will only be undertaken at the discretion of the City. Failure to produce a proper referee sample as per the City's design criteria may result in the City denying a referee test request, and as such, the asphalt results represented by the proposed referee test will be deemed rejectable.
- Surface course asphalt shall not be placed after November 15. It is the sole responsibility of the Applicant, their consultant, and their contractor to ensure the paving is completed in conformance with the requirements set out in OPS specifications. All testing results submitted in support of this paving must meet the requirements specified in the City of Oshawa Design Criteria. Any paving completed outside the OPS operational constraints will be deemed rejectable by the City and will be the sole responsibility of the developer, financial and otherwise, to remove and replace. The City will not accept any pavement placed outside of the operational constraints within the OPS specifications.
- Base asphalt shall not be placed after December 1. It is the sole responsibility of the Applicant, their consultant, and their contractor to ensure the paving is completed in conformance with the requirements set out in OPS specifications. All testing results submitted in support of this paving must meet the requirements specified in the City of Oshawa Design Criteria. Any paving completed outside the OPS operational constraints will be deemed rejectable by the City and will be the sole responsibility of the developer, financial and otherwise, to remove and replace. The City will not accept any pavement placed outside of the operational constraints within the OPS specifications.
- Any requests to pave beyond the above dates should come in a form of a written recommendation, from the engineering consultant (signed on Company letterhead) detailing the reason for the request to pave outside the specified timelines, their understanding of the information noted above, and the asphalt supplier's recommendations.
- All paving requires use of an approved MTV (material transfer Vehicle) / Shuttle buggy for transfer of hotmix to the spreader.
- Any hot mix asphalt (HMA) being placed after Nov 1st shall require the addition of a warm mix additive. The type of warm mix additive being used shall be approved by the City of Oshawa. A new mix design shall be submitted to the City of Oshawa.
- All hot mix asphalt mix designs shall have minimum of 5% asphalt cement content.
- Maximum temperature for hot mix asphalt shall be 165°C; any asphalt heated above this maximum shall be considered rejectable.
- No paving shall take place in the rain unless authorized by City of Oshawa.
- Any Job Mix Formula (JMF) adjustments must be approved by the City of Oshawa. The request shall consist of a properly filled out JMF adjustment form signed and

stamped by a member of PEO and should include a reason for the request.

- Any JMF adjustment submitted after paving and QA results have been completed will not be accepted unless the City of Oshawa deems the change is required.
- The Contractor shall use an approved method of re-heating, re-working, and compacting all centerline longitudinal cold joints. Contractor shall use an infra-red heating system, capable of maintaining a minimum temperature of 93°C to produce a welded joint, without scorching or burning the mix. The density of the asphalt at any longitudinal joint measured within 0.3 m of the joint, shall be within 1.5% of the mainline mat density.
- All paving shall be in echelon, or the use of a joint heater could be considered as an alternate.
- The City of Oshawa shall receive 2, 1 litre asphalt cement samples within 24 hours of paving. The sample shall be obtained as per OPS11-01.08.03.
- Any hot mix placed not conforming to the Operational constraints described in OPSS 310.07.06.02 will be considered rejectable.
- Any corrective action proposals submitted by the Applicant will be reviewed by the City of Oshawa. The final decision on the corrective action will be solely at the discretion of the City of Oshawa.
- Tack coat shall be applied as per OPSS 310.
- Minimum size of any asphalt patch is dependent upon available compaction equipment and the ability to properly compact the granular base and HMA
- Minimum dimension of an asphalt patch shall be determined by the City of Oshawa inspector.
- The City of Oshawa shall not accept more than a 30 mm thickness of HMA padding unless otherwise approved by the City's inspector.
- Based on the supporting information made available, the City shall identify the limits of all deficient HMA that has been placed. All costs associated with addressing the deficient HMA shall be borne by the Developer. Base asphalt inspections shall have representation from City construction staff, the Applicant's consultant, and the consultant's geotechnical engineer.
- Any base asphalt that has been left exposed for over 42 months shall be deemed rejectable and as such shall be removed and replaced prior to placing surface asphalt.

8.5.5 Material Specification for Performance Graded Asphalt Cement (OPSS MUNI 1101)

All asphalt cement shall conform to OPSS MUNI 1101.

8.5.6 Calcium Carbonate Acceptance Criteria

The Applicant shall undertake visual inspection of the foundation drain collector (FDC)

main for calcium carbonate build-up once per year after homes have been connected to the system. The initial inspection shall be carried out within one year after the first home is connected to the system and every year thereafter until assumption. If calcium carbonate build-up is identified through any inspection, the City shall be notified, and the Applicant shall take necessary investigations to identify the lots contributing to the calcium build-up and their laterals shall be cleaned. The Applicant shall initiate a higher frequency of inspection in such areas to determine the rate of build-up and frequency of cleaning required. Prior to final assumption, the Applicant shall complete a CCTV inspection of all FDC mains to ensure that the system is clean. The video shall be submitted to the City with a report from the Developer, summarizing the dates and findings of all inspections performed since connection of the first home, any issues encountered with respect to calcium carbonate, their location, and actions taken. The report shall be submitted in a format acceptable to Infrastructure Services.

8.5.7 Bridge Acceptance Criteria

Ontario Regulation 160/02 – Standards for Bridges, dictates that the structural integrity, safety and condition of every bridge shall be determined through the performance of at least one inspection every 2 years under the direction of a Professional Engineer and in accordance with the Ontario Structure Inspection Manual; as published and amended by the Ministry of Transportation.

The following will be required;

- An OSIM Inspection report signed and sealed by a Professional Engineer licensed to practice in the Province of Ontario certifying substantial completion of the structure and structural integrity of the structure prior to opening to traffic.
- Complete OSIM Inspection every 2nd year from the date of substantial completion to Stage 1 Final Acceptance. A current OSIM Inspection report (within 60 days) must be submitted to the City prior to Stage 1 Final Acceptance certificate being issued by Construction Services.
- Applicant shall be responsible to satisfactorily address/repair all deficiencies noted in the inspection reports and maintain the structure prior to any acceptance procedures by the City and as necessary during interim inspections to address safety concerns and standard maintenance requirements.
- In addition to the OSIM Report the following, but not limited to, will be required for Stage 1 Provisional Acceptance:
    - All shop drawings, indicating “as constructed”, mix designs, manufacturer specifications and construction photos.
    - All testing results (bearing capacity, compaction, granular gradation, etc.) reinforcing steel inspections, girders (including mill certificates), concrete piles, pre-cast concrete inspection records, asphalt, waterproofing membranes and waterstops inspection records, etc. as appropriate.
    - All extra work orders, written field instructions/notes and construction photos

8.5.8 Compaction of Granular Materials

- Granular Material must have a moisture content not less than 2% or more than 1% higher than the optimum moisture content.
- Compaction testing of Granular A material must take place within 72 hours of paving operation.
- Compaction testing of Granular B material must take place within 72 hours prior to placing concrete or Granular A material on the compacted Granular B material.

8.5.9 Proof Rolls

A Proof Roll is required on the road subbase prior to placing any granular materials and on the Granular A material prior to placement of base asphalt.

The City's Inspector shall be given 24 hours' notice prior to any proof roll activity.

The City's Inspector shall be given all proof roll reports within 24 hours of performing the proof roll. These reports should include a sketch indicating limits of proof roll and any modifications that are required. These modifications shall also be placed on the As-built drawings that are supplied to the City. No asphalt shall be placed until proof roll reports have been received by the City's Inspector.

Any modifications required due to soft sub-base shall be modified a minimum of 300 mm across the entire width of the road. Consideration shall be given to address subsurface drainage concerns.

Where the Applicant is taking a different course of action to the recommendations of the Soils Consultant, a written explanation for the variance shall be provided to the City with the copy of the Soils Consultant's recommendations. The use of a form following the format illustrated in the Appendix 6 is acceptable.

A representative from the Applicant, Soils Consultant, and City Inspector shall be present at all proof rolls.

The equipment used to perform the proof roll shall be a tri-axel dump truck filled with an approximate load of 15 tons. If this equipment is not available the City's Inspector may accept another piece of equipment that he/she feels will provide an acceptable load, approximately 20 tons.

The City's Inspector shall have the final decision on all pavement design modifications required due to unacceptable deflections or field conditions observed during the proof roll.

8.5.10 Topsoil Acceptance Criteria

Topsoil shall be tested for the following parameters and meet the specifications provided:

- pH 5.5 – 7.5
- Organic Matter (%) 4-15
- Total Salts (mmhos/cm) <1.5
- Phosphorus (ppm) 10-60
- Potassium (ppm) 80-250
- Calcium (ppm) 1000-4000
- Magnesium (ppm) 100-300
- Sodium (ppm) <200
- Sodium Adsorption Ratio <15
- Chloride (ppm) <100
- Sand % 20-75
- Silt % 5-50
- Clay % 5-30

A general fertility guideline for turf grass shall also be submitted. This guideline shall include recommendations for type of fertilizer and/or other soil enhancement chemicals to be added as well as providing an application rate. The recommended enhancements shall be applied as per the recommendation.

If any of the above guideline's are not met, the City will require a signed recommendation from an Agronomist indicating recommendations and materials to be added to the topsoil to make it suitable for use.

- Topsoil shall be screened and free of stones, roots, subsoil, clay lumps, litter and/or other deleterious materials.
- Topsoil shall not contain any sod clumps, crab grass, or noxious weeds.
- Topsoil shall not be delivered or placed in a frozen or excessively wet state.
- Topsoil shall not be stockpiled on lands that have intended parkland uses.

8.5.11 Stormwater Management Facility (SWMF) Acceptance Criteria

Following the construction of the SWMF, a qualified professional is required to certify that the constructed facility, structural details and geotechnical recommendations were monitored and inspected routinely during construction and, as such, are built in accordance with the approved design.

The Design Conformance Certificate must be accompanied by a CCTV Inspection Report for the pipe connecting the main cell and the forebay and a recent topographic survey of the SWMF and associated features.

9. Pavement Markings, Signage, and Street Lighting

9.1 Pavement Markings

9.1.1 General

Generally, all pavement, hazard and delineation marking designs shall conform to all latest edition applicable OTM and OPS requirements.

A solid yellow centerline is required on all arterial and collector roadways and shall conform to the OTM requirements.

All proposed pavement markings must be installed prior to opening any roadway to traffic.

9.1.2 Stop Bar

Stop bars are required at all intersections with an arterial road, at all collector/collector intersections, at all all-way stops at all signalized intersections and shall be located as per the OTM and/or OS-401. Applicable vehicle turning templates shall determine the appropriate location of any left-turn lane stop bar. Stop bars shall be 60cm in width. Solid yellow centerline tails are required at all stop bars, shall be 10cm in width, and shall be installed to the following lengths, measured from the stop bar:

- 30 m on urban roadways
- 60 m on rural roadways

Main street stop bar(s) shall be perpendicular to main street roadway. Minor street stop bar(s) shall be parallel to main street roadway.

9.2 Crosswalks and Crossovers

9.2.1 Conventional crosswalks

A Pedestrian Crosswalk is typically located at signalized and un-signalized intersections. Crosswalks shall be aligned perpendicular to the road. These crosswalk lines are required at all intersections with an arterial road, signalized intersections, all-way stop intersections, collector/collector intersections (only where sidewalks exist) and they shall be located as per City Standard OS-401, the TAC Guide and OTM Book 15. Crosswalk lines shall be 10 cm in width. The location of the pedestrian crossings shall determine the location of pedestrian crossing ramps.

9.2.2 Pedestrian Crossovers (PXOs) at Mid-Block Locations

The design of all traffic signs and pavement marking details for midblock locations shall conform to the design requirements of OTM Book 15 and 18. Note that crosswalks are typically located 6 m from the nearest end of the yield line, whereas with Pedestrian Crossovers (PXO) the distance is 12 m.

The proponents are encouraged to proactively investigate and consult with the City on Mid-Block locations where pedestrian crossing is anticipated even if the justification is not met for a PXO based on the criteria outlined in OTM Book 12 Justification 6 for Pedestrian Volume and Delay.

9.2.3 Bike Crossings / Crossrides

Refer to OTM Book 18 for road design at intersections with crossrides.

9.2.4 Multi-Use Path (MUP)

MUPs within the public ROW require a solid yellow centerline. In-boulevard MUPs may be marked by a white bicycle symbol, a pedestrian symbol, and a white directional arrow to indicate the direction of travel. These should be placed on the path surface after major intersection crossings or at key entry points. Refer to OTM Book 18 for details on MUP pavement marking requirements.

9.2.5 Pavement Markings-Type

Permanent pavement markings shall be as per OPSS 710,1714 and 1716 and are to be installed upon completion of Stage 1 and 2 paving and prior to opening the roadway to traffic. OPSS 710.07.09.05 spray application thickness shall be 0.80 mm ± 0.15 mm (not 0.30 mm ± 0.15 mm as published).

Glass beads shall meet the requirements of OPSS 1750. Acceptable manufacturers are those listed on MTO's DSM listing (see DSM #5.85.38). Note that Subsection 1714.05.04 of OPSS 1714 requires both premixed and surface applied glass beads for the screed application method.

Stop bars and symbols shall be placed by the extrusion (screed) method, spray method is not accepted. Appropriate straightedges shall be used for all line work and templates are to be used for symbols.

Temporary pavement markings shall be as per OPSS 710 and OPSS 1716 and are to be installed upon completion of Stage 1 paving and prior to opening the roadway to traffic.

9.2.6 Obliteration of Existing Pavement Markings

Prior to placement of new and/or replacement pavement markings, obliteration of existing pavement markings shall be completed by abrasive blasting as per OPSS 710 Special Provision No. 710S03. The lines shall be completely removed with no residual paint.

9.2.7 EV Parking Signage and Pavement Markings

EV Parking Spaces will be clearly marked with appropriate pavement markings and signage to designate an EV Parking Space and communicate the EV Charging Station etiquette and rules.

Vertical signage must be reflectorized and display the EV parking symbol and information text. Vertical signage must ensure the size of 0.3 m wide by 0.6 m high, at minimum, and be mounted at a height of 1.5 m to 2.0 m from the ground / floor. Vertical signage must ensure a high tonal contrast is provided between signage and background environment.

All pavement markings must be slip resistant and clearly visible through the use of high tonal contrast compared to the surface of the EV Parking Space.

All pavement markings must be located in the center of the EV Parking Space and be at least 1.0 m long.

The blue colour required for identification of accessible parking spaces and access aisles in accessible parking shall not be used for pavement marking of EV Parking Spaces. Green colouring shall be used to identify EV Charging Stations. The surface of the EV Parking Space must be marked stating “EV CHARGING ONLY”.

The City shall endeavor to use signage, EV symbols and pavement markings that are the same as other municipalities in Durham Region to promote a common user experience across Durham Region.

9.3 Signs

9.3.1 General

All proposed signage should generally conform to the OTM requirements, unless otherwise specified. The City Council policy on related to signage can be found in Appendix 5.

Existing utility poles are acceptable for mounting, if feasible (as per OS-406).

All proposed signage must be installed prior to opening any roadway to traffic.

9.3.2 Street Name Signs – Location

Street name signs shall be placed at each intersection and shall identify each street at the intersection. The location of the street name signs shall be as per OS-407.

Street name signs may be installed on light or hydro poles if positioned in an appropriate location (as per OS-406).

Where the above poles are not available, signs are to be installed on the following.

(a) **Decorative Street Name Signs:** 75 mm O.D. posts powder coated black.

(b) **Standard Street Name and Veteran Street Name Signs:** 100 mm x 100 mm square pressure treated wooden posts.

(c) **Mast Arm Signs:** traffic signals (as per Region of Durham standards).

All poles must meet all applicable OPS requirements for materials, such as OPSS 1601 for wood posts.

9.3.3 Street Name Sign – Type

Unless otherwise approved intersection street name signs shall be double sided and be as per OS-411 – Street Name Sign – Standard, OS-412 – Street Name Sign – Downtown Decorative, and/or OS-413 – Street Name Sign – Decorative, For New Subdivisions.

The City has two standards for street signs. The basic standard street name sign is a 180 mm or 200 mm extruded aluminum blade sign with reflective white lettering on a non-reflective blue background.

Where approved, the Applicant may choose a decorative sign (ROSCO style) with reflective white lettering on a non-reflective background in a choice of available colours including a community name and graphic, if applicable.

9.3.4 Traffic Control/Regulatory Signs

All Regulatory and Warning signs shall conform to the OTM and/or any other legislative requirements for location, type, size, sign materials, reflectivity, and installation.

9.3.5 Fasteners and Mounting Brackets

All fasteners and mounting brackets are to be stainless steel or hot dipped galvanized according to CAN/CSA G164. All hardware shall have bolt heads. Hex key threaded plugs for securing signs will not be accepted.

9.3.6 Pavement Marking and Signage- Roundabouts

Signs and pavement markings at roundabouts shall conform to the latest edition of the TAC Manual of Uniform Traffic Control Devices (MUTCD). Pedestrian and cyclist accommodation shall follow Ontario Traffic Manual (OTM) Books 15 and 18, respectively.

9.3.7 School Zone

Where the subdivision incorporates a school area, all related signage (i.e., school zone, school crossing ahead, and school crossing) shall conform to OTM and/or any other legislative requirements. .

9.3.8 Park Area

Where the subdivision incorporates a park area, 40 km/h speed limit and WC-3 (play area) signs are to be installed on all streets surrounding the park area.

9.3.9 Signage on Regional Roads

For signage on Regional roads, refer to the Region of Durham’s design standards and specifications.

9.3.10 Policy and Procedure Regarding Decorative Lighting and Signage

Use of decorative street lighting and street signage must meet the City’s criteria as set out in this manual. A copy of the policy and procedure is provided in Appendix 5. **Prior to the first submission of engineering drawings, the Applicant must indicate, in writing, their intent to use decorative lighting and signs.**

9.4 Street Lighting

9.4.1 Lighting Levels

The street lighting levels shall be based on the latest available ANSI/IESNA RP8 Recommended Practice: Lighting Roadway and Parking facilities. The City Council policy related to Decorative Street Lighting can be found in Appendix 5.

The recommended levels for each type of roadway are described below:

Horizontal Luminance - the recommended measurement for standard roadways. The calculations to be performed for a roadway are average, uniformity and veiling ratio; Table 1 illustrates the acceptable levels for horizontal luminance.

Horizontal Illuminance - the recommended measurement for intersections, including curvilinear road sections, cul-de-sacs, and roundabouts; Table 2 illustrates the acceptable levels for horizontal illuminance.

Vertical Illuminance - the recommended to measure lighting at pedestrian areas to ensure the safety of pedestrians; Table 3 illustrates the acceptable levels for vertical illuminance.

Table 1 – Lighting Design Criteria for Streets*

Street Classification	Pedestrian Activity Classification	Average Luminance Lavg (cd/m2)	Average Uniformity Ratio Lavg/Lm1n	Maximum Uniformity Ratio Lmax/Lmln	Maximum Veiling Luminance Ratio Lv,max/LlIYg
Major	High	1.2	3.0	5.0	0.3
	Medium	0.9	3.0	5.0	0.3
	Low	0.6	3.5	6.0	0.3
Collector	High	0.8	3.0	5.0	0.4
	Medium	0.6	3.5	6.0	0.4
	Low	0.4	4.0	8.0	0.4
Local	High	0.6	6.0	10.0	0.4
	Medium	0.5	6.0	10.0	0.4
	Low	0.3	6.0	10.0	0.4

* Values in Table 1 are derived from IESNA RP-8-22.

‡ Rural roads shall not have street lighting unless deemed necessary due to dead ends, intersections and/or curved road sections. Where deemed necessary by the city, rural roads shall meet the requirements of local roadways with low pedestrian conflict.

To determine illuminance requirements for curved roads, refer to RP-8-22 for illuminance to luminance ratio calculation.

Table 2 – Recommended Design Criteria for Walkways Within Road Right of Way*

Condition	*E.v"'* lux (fc)	Ev,.119 lux (fc)	Eavg/Emtn
High pedestrian activity	10 (0.9)	5 (0.5)	5.0
Medium pedestrian activity	5 (0.5)	2 (0.2)	5.0
Low pedestrian activity	2 (0.2)	1 (0.1)	10.0

Values in Table 2 are derived from IESNA RP-8-22.

Table 3 – Pavement Illuminance criteria for Full Intersection lighting*

Functional Classification	Pedestrian Activity Level Classification			E.vg/Emin
	High	Medium	Low	
Major/Major	34/3.2	26/ 2.4	18/1.7	3.0
Major/Collector	29/2.7	22/2.0	15/ 1.4	3.0
Major/Local	26/2.4	20/1.9	13/ 1.2	3.0
Collector/Collector	24/2.2	18/1.7	12/1.1	4.0
Collector/Local	21/2.0	16/1.5	10/0.9	4.0
Local/Local	18/ 1.7	14/ 1.3	8/0.7	6.0

Values in Table 3 are derived from IESNA RP-8-22.

Table 4 – Pavement Illuminance Criteria for Partial (isolated) Intersections*

Road Classification	Pavement Classification			Uniformity Ratio
	R1 lux/fc	R2 &R3 lux/fc	R4 lux/fc	f.vglfmin
Major	6/0.6	9/0.8	8/0.7	3.0
Collector	4/0.4	6/0.6	5/0.5	4.0
Local	3/0.3	4/0.4	4/0.4	6.0

Values in Table 4 are derived from IESNA RP-8-22.

9.4.2 Design Criteria

Designs shall endeavour to provide consistent illumination for street lighting throughout the City while meeting the requirements in this document.

Street lighting shall be designed by the City, or their approved lighting designer / consultant, taking into consideration, the requirements to promote safety and security for drivers and pedestrians, control glare, minimize lighting trespass onto adjacent properties, minimize direct upward light emissions, energy conservation and minimize over lighting.

Street lighting within the City shall be standard ‘cobra head’ style except in specified areas and any other areas where special approvals have been granted. In areas illuminated with decorative lighting, all efforts shall be made to meet the requirements of this document; however, it is acceptable for average illumination levels to be lower than prescribed as long as the uniformity ratio is met, and approvals are received from the City’s Chief Engineer.

Pole Offsets for Roadway Surfaces

Refer to the City of Oshawa Standard Drawings (OS-200 series) for standard cross-sections and utility pole locations on City roads.

Where pole offsets and proposed locations are not possible, lighting calculations and proposed pole locations shall be reviewed to determine the best possible location for poles and the design shall be reviewed by the Chief City Engineer or designate.

Pole Heights and Spacing

Street light pole heights and spacing shall vary based on the luminaire wattage and the type of luminaire and the roadway classification in order to best meet the criteria outlined in the ANSI/IESNA RP8.

For new residential areas, the recommended street light pole location shall be on lot lines between properties to assist in the elimination of light trespass into houses.

All street lighting designs shall be done based on the specific roadway.

Obstruction of Light and Photocontrols by Foliage

The presence of low overhanging foliage may seriously obstruct the light delivered to the pavement as well as impede traffic movement. Tree trimming becomes essential to keep up with growth. Field personnel should work closely with forestry organizations and property owners to maintain illumination requirements while minimizing tree appearance issues and horticultural damage It is important to note that even with high-mounted luminaires, it is not necessary to prune all trees to the height of the luminaire, but it is imperative to prune those branches that fall below the useful beam. This is a line from the luminaire to the midpoint between adjacent luminaires. Foliage midway between luminaires and below lamp level helps to screen the view of distant sources; the reduction in glare improves visibility and comfort for motorists and pedestrians alike. This gain is particularly important on local-traffic and residential roadways, where limited funds usually require relatively long luminaire pole spacing, with correspondingly high candlepower at angles near the horizontal plane.

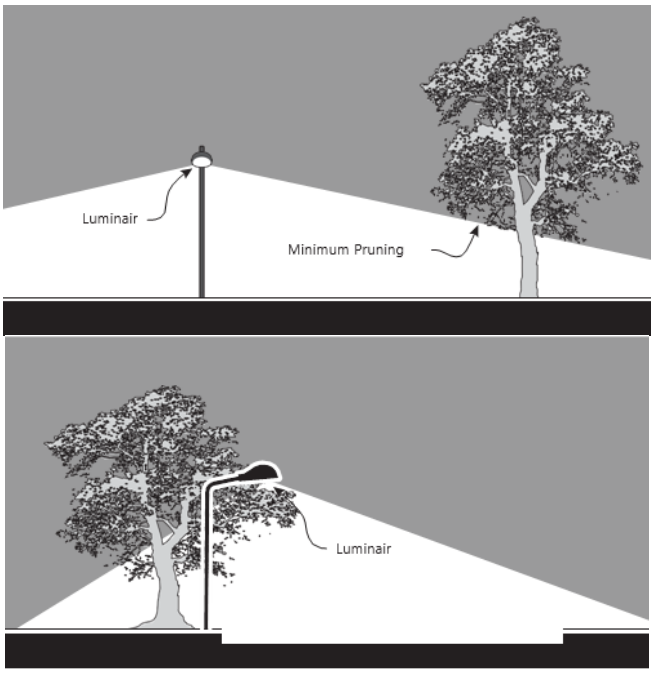


Figure A – Light beam angles VS pruning

It is also important to note that foliage interference may lengthen luminaire operating time unnecessarily and increase energy use if the foliage blocks environmental light from reaching the luminaire's photocell; the photocell will react as if the sun has set and turn the luminaire on. Figure B illustrates top and front views of the relationship of tree shapes and luminaire overhang requirements. These are intended to serve as a guide for determining proper overhang distances of luminaires of different mounting heights and for different types of trees.

Foliage interference affects more than just the illuminance on the roadway pavement. The adequate lighting for the sidewalks should not be overlooked. There can be instances on residential and other local-traffic streets where good sidewalk illumination is even more important than lighting of the street itself. Generally, this can be attained either by altering the luminaire positions or by pruning, or a combination of both.

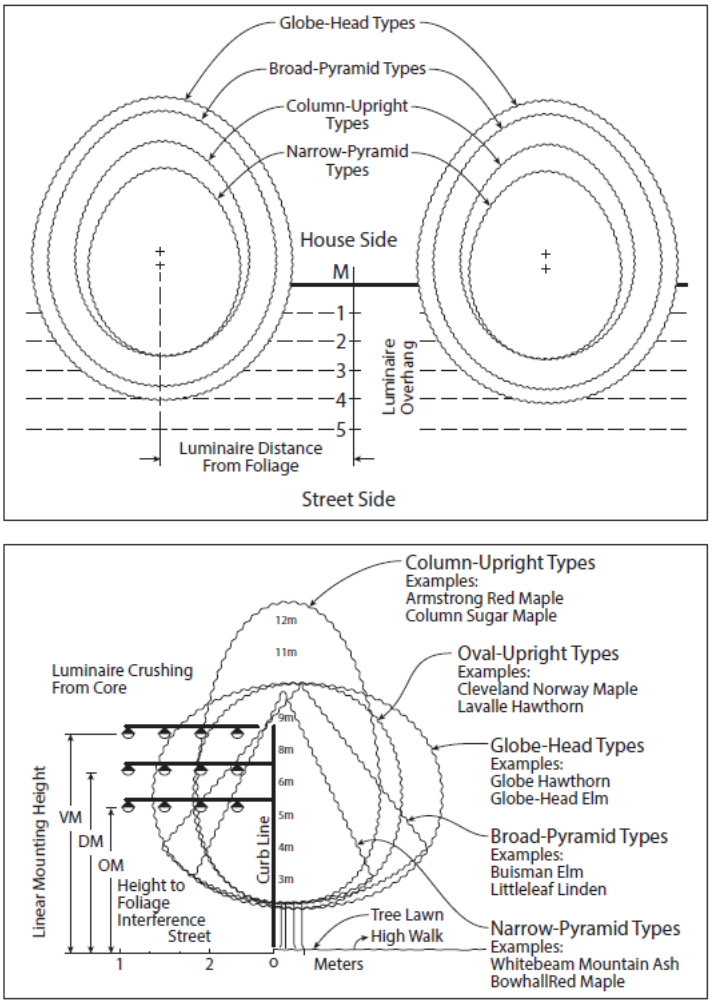


Figure B – Tree shapes in relation to luminaire overhang

Designers should be directed to the City of Oshawa's Parks Development Design Standards (latest edition) for minimum separation between streetlights and street trees.

Light Level Calculations

Luminance is the preferred measure for roadway surfaces as it measures the light that is reflected from the roadway surface to the observer looking down at the roadway and is used as a measurement to ensure minimal over-lighting.

For standard roadway surfaces, the City, or their approved lighting designer / consultant, is required to calculate the horizontal luminance.

For roadway surfaces that are curvilinear, illuminance is the preferred measure as the levels are not dependent on an observer and only consider the light available at the surface regardless of the location of the observer.

- The City or their approved lighting designer / consultant shall, as a minimum, perform the following street lighting calculations:
    - Horizontal Luminance Criteria for Roadways (Table 1)
    - Vertical Illuminance Criteria for Pedestrian Areas (Table 2)

    - Illuminance Criteria for Intersections (Table 3)

- The City or their approved lighting designer / consultant shall perform street lighting calculations such that the lighting levels are as close to the acceptable averages as possible without significant over lighting. Pole spacing, wattages and pole heights shall be adjusted to ensure over-lighting, trespass light and glare are minimized.
- The City or their approved lighting designer / consultant shall perform all calculations using the industry standard 0.8 light loss factor for new LED street lighting luminaires.
- The City or their approved lighting designer / consultant shall prepare drawing submissions for the lighting level calculations that shall include the following:
    - Layout of the roadway with grid points within the edge of pavement
    - Horizontal luminance calculation for the entire standard roadway showing Average, Uniformity (Avg/Min)
    - A separate horizontal illuminance calculation for each intersection, curvilinear road section, roundabout or cul-de-sac, including the intersection to the existing street, including Average, Uniformity (Avg/Min); o A separate vertical illuminance calculation for each cross walk or sidewalk if it is immediately adjacent to the edge of pavement, including Average, Uniformity (Avg/Min) and,
    - A legend indicating the type of luminaires, pole/mounting heights, quantities of each luminaire, light loss factor used, and wattages used.

Acceptable lighting software(s) shall be the latest version of any of the following:

- AutoLUX
- AGi32
- Cooper Luxicon
- GE Aladdin
- Visual

Other System Components

Other lighting system components that must be considered are wiring, underground conduit, power connection points, and fusing. These system components shall be designed to meet current CEC requirements and the local electrical utility Construction Practices

9.4.3 Materials and Installation

Light pollution contributes to sky glow, glare, light trespass, light clutter, decreased visibility at night and energy waste. The City recognizes the effects that light pollution has on the environment and therefore has an interest in reducing the amount of light pollution generated by street lighting. As such, the City has selected full cut-off fixtures for all applications.

Developers may request an equivalent manufacturer's decorative or standard lighting; however, the Chief City Engineer or designate shall review all requests and advise if it is acceptable. All new street lighting shall be LED.

Developers must contact the City's Engineering Department for an up-to-date list of approved luminaires for use in street lighting design.

Should there be a request for a substitute or an equivalent product, all requests shall be provided in writing to the Chief City Engineer or designate, for review prior to any ordering or installing. The Chief City Engineer will review all requests and advise in writing if the requested product is acceptable.

Cut sheets must be supplied to the City by the developer and must include the minimum following requirements:

- Full part number must be shown for review
- Cut off classification or BUG rating of fixture and distribution type
- Wattage and pre-wired voltage of fixtures

All City approved fixtures must meet the following minimum requirements:

- Must be CSA approved (or equivalent as per National Building Code of Canada)
- All street light drivers shall be Multi-Volt 120V-277V
- All street light drivers shall be dimmable
- All Street lights shall be equipped with 7 pin NEMA receptacles for photocell/control system operation
- All street light photometric distributions shall be as required by the nature of each project
- All streetlights LED engines shall have a Correlated Colour Temperature of 4000K
- All streetlights shall be protected through the use of an internal surge protector rated for use in the area of installation

The City of Oshawa currently has three street light standards that are acceptable in new residential development.

The basic standard includes a cobra head streetlight mounted on a grey concrete pole. The Applicant may also choose a decorative standard that uses a Victorian style coach lamp and polished black octagonal concrete pole. The City has also approved the Trafalgar Telecommunications pole as an alternative decorative lighting standard.

It should be noted that the use of the Trafalgar Pole will require the execution of a separate agreement with the Applicant, the City's Engineering Services Department, and the respective telecommunication companies.

9.4.4 New Developments

New development may include residential subdivisions, commercial, industrial, or institutional development that will create a new intersection onto an existing roadway or that will create a new road or an extension to an existing roadway. The following section describes the mandatory requirements for Construction and Installation of street lighting systems for new developments.

Construction Guidelines

Ducting

a) All street lighting cables shall be installed in CSA Type 50 mm PVC Type 2 Direct Buried Ducts (DB2) in the main trench from the power source to the street lighting location.

b) From the main trench to the inside of the street lighting aperture, the street lighting cables shall be installed in black poly pipe or 50 mm flex duct, per ESA.

c) All ducts shall be solvent welded together as part of the installation procedure.

d) Where street lighting conductors cross the road, the 50 mm duct shall be installed through the road crossing duct in a continuous installation.

e) All turning radii in duct shall be sized sufficiently so as to facilitate the pulling of the street lighting conductors.

f) In certain instances, concrete encasement of the ducts around bends may be required to act as a thrust block. Any concrete encasement requirement shall be noted on the design drawings.

g) Ducting shall extend into the pole to the hand well.

Trenching

a) Street lighting ducts shall be co-located in Joint Use Trenches with other shallow service utilities wherever possible.

b) All Street lighting trenches shall be mechanically compacted to 98% Standard Proctor Density (SDP) to avoid settlement and 100% SPD under roadways and sidewalks.

c) Trenches shall provide a minimum cover of 750 mm over the direct buried street lighting duct.

d) Street lighting ducts shall be surrounded by a 150 mm thick sand envelope.

e) Warning tape shall be installed over all street lighting duct locations at a depth halfway between the final grade and the top of the upper most duct in accordance with the latest Electrical Safety Authority Standards and specifications.

Cabling

a) Street lighting cables shall only be installed through ducts after trench is backfilled.

b) Street lighting cables shall not be spliced.

c) All cabling shall be in accordance with the ESA and sized so that voltage drop meets the ESA requirement of 5% maximum voltage drop to last light on circuit.

Connections

a) All connections are to be per ESA standards and specifications.

b) All connections to circuit breakers / pole breakers are to be inspected and certified by ESA prior to energization.

Disconnects

a) A suitable disconnect (Pole Breaker or Pedestal) shall be installed in accordance with ESA.

b) A Pole Breaker disconnect shall be installed on the first street light pole in each circuit or a pedestal shall be installed to provide power to the street lighting circuit per OPUC Standards.

Fusing

a) Street lighting cables shall be fused in the transformer and in the street lighting hand hole.

Street Lighting Pole Installation

a) Poles shall be installed via auger method of installation utilizing a boom truck to place the pole. Should field conditions prevent the use of the auger method of installation, then the Street Lighting System Inspector shall dictate an alternate method.

b) Poles shall be backfilled and compacted to 95% SPD.

c) Poles shall be verified plumb prior to Acceptance of Maintenance and Assumption by the City.

Grounding

a) Street lighting pedestals shall be grounded to ESA requirements by utilizing two ground rods at the disconnect.

b) A continuous jacketed green ground from the disconnect to the last light on each circuit.

c) shall be installed with the street lighting conductor.

d) Every fifth and / or last street lighting on each circuit from the disconnect shall be grounded with a ground rod / ground plate.

e) Ground wire shall not be installed between the transformer and the disconnect.

Inspection Guidelines

a) Street lighting Inspections shall be completed by the Electrical Safety Authority. Notwithstanding any direction from the City or the Design Engineer, all work shall fully conform to all Electrical Safety Authority Codes.

b) It is the Installing Contractor’s responsibility to notify all Inspecting Authorities of construction schedules a minimum of 72 hours prior to commencement of works. The City does not provide full time construction inspection services; however, a City Inspector (or its Designated Representative) shall perform periodic inspections or as required to generally monitor the quality and progress of the works.

City Inspectors (or Designated Representative)

a) The city inspector shall endeavor to:
    i. Liaise with the Design Engineer on matters pertaining to the construction process and progress.
    ii. Provide periodic site inspections during the construction of the works to ensure that the City Standards are being adhered to and that the work being performed is in accordance with the approved drawings.
    iii. In conjunction with the Design Engineer, inspect constructed street lighting system.
    iv. Participate in joint inspections with the Design Engineer /Local Utilities and Contractor for purposes of building permit release, street lighting system repairs, acceptance for maintenance and final assumption of municipal services.

b) The City Inspector shall investigate any complaints pursuant to the construction process received by the City and forward the information to the Developer / Contractor for corrective action.

c) The City Inspector shall report any infractions related to the above items to the Developer/Design Engineer for necessary corrective actions. Should the Developer / Design Engineer fail to initiate the required corrective actions in a reasonable time, the City Inspector may make arrangements to have the corrective actions undertaken by City forces and / or contract services. Should this action be taken, all related costs, and administrative fees shall be charged back to the Developer.

Contractors

a) The Contractor shall notify the Design Engineer a minimum of 72 hours prior to construction to arrange for a pre-construction meeting.

b) The Contractor shall apply for ESA Inspection prior to commencing installation of plant.

c) The obtaining of an ESA Connection Authorization shall be the sole responsibility of the installing Contractor. The Contractor shall provide a copy of the ESA Inspection Certificate to the Design Engineer upon receipt from the ESA.

Design Engineer

a) The Design Engineer shall carry out daily inspection and supervision of all constructed municipal infrastructure during the course of installation of the Street lighting System and complete a daily construction log report.

b) Upon completion of construction and subsequent Energization, the Design Engineer shall perform both day and night inspections to verify that the street lighting system has been installed, and is operating, per design.

c) In the event that the site inspections reveal any deficiencies, the Design Engineer shall inform the contractor of said deficiencies and re-inspect after resolution.

d) Once all outstanding have been corrected, the Design Engineer shall prepare certification letters and submit them to the City as part of the as-constructed submission process.

ESA Inspection

a) The Contractor shall arrange for and pay for ESA inspection throughout the entire scope of work in accordance with the latest ESA standards and specifications.

b) Should the ESA have any questions or concerns relating to the Street lighting System shown on the “Approved for Construction” Drawings, the Contractor shall notify the Design Engineer who shall then be responsible for resolving the matter.

c) In accordance with the latest Electrical Code, the ESA Inspector shall inspect the installation of the street lighting system, all hand hole connections, bonding and fusing, and any other portion of the street lighting system works that is deemed necessary.

d) No street lighting system can be connected and energized without the ESA Connection Order issued by the ESA. Contractor to submit ESA Connection Order to the local utilities company for connection energization with copy to the Design Engineer.

e) The Contractor shall provide the ESA Inspection Certificate to the Design Engineer.

10. Utility Coordination

10.1 General

The mandate of this process is to establish a final design location for all above ground and below ground utility plant and structures having respect to limit and coordinate structure locations, so as to provide reasonable accommodations in accordance with Street Tree Planting Policy and Procedure. Roadway street lighting design shall also be in accordance with the Illumination Engineering Society/American National Standards Institute (IES/ANSI) RP-8-21: Design of Roadway Facility Lighting. To identify all utility servicing work and to provide for municipal consent within new subdivisions, the Applicant must submit Utility Coordination Plans (UCP) as part of the engineering submission for review and approval. The purpose of which is to establish the location of street lighting and non-municipal utility services in a coordinated manner. This will formally recognize and provide for the requirements of the above ground hardware and utility plant needed for the delivery of various utility services that acknowledges and illustrates their relationship in the municipal road allowance with all other municipal services and the private driveway locations. The conclusion of this plan forms the basis to determine street tree planting in accordance with Street Tree Planting Policy and Procedure.

The acceptance of UCP as part of the engineering that form Appendix "II" of the Subdivision Agreement forms the municipal consent by the City for the installation of the utilities.

Any external utility servicing plant required as part of servicing for the subdivision which needs to be extended on existing municipal road allowances is subject to a municipal consent application process through the Design Services Division of the City’s Engineering Services Department.

10.2 Plan Submission Requirements

The UCP forms an integral part of the engineering submission requirements as set out in the DEPG document. The Applicant must solicit the utility designs early in the process of the pre-engineering exercise to establish all of the servicing requirements of the subdivision. The UCP must be included as part of the first engineering design. Acceptance of the UPC's is required, prior to consideration of pre-servicing approval and/or final engineering submission for preparation of the Subdivision Agreement. In addition, it is required for the proponent to submit plans to indicate locations of existing and proposed utilities and identify potential conflicts with existing and proposed street trees for City review and approval.

The plans are to be at a scale of not less than 1:500 and must illustrate the drawing requirements as per Section 2. The following criteria must be maintained:

10.2.1 Utility Locations and Separations

- The minimum clear distance between edge of PUC transformers and driveways shall be 1.00 m.
- The minimum clear distance between edge of PUC transformer and proposed trees shall be 3.0 m

- No structures, utility cabinets or equipment to be within 3.0 m of the operating side of PUC transformer, 1.5 m from other sides.
- The minimum clear distance between driveways and the following shall be 1.00 m:
    - Utility Structures;
    - Hydrants;
    - Trees.
- The minimum clear distance between sidewalks and the following shall be 0.50 m:
    - Edge of Utility Pedestals;
    - Vaults;
    - Streetlights;
    - Hydrants
- Utility pedestals, PUC transformers, trees, hydrants, and light poles shall not be located within the intersection daylight triangles.
- Underground utility service must maintain a 1.2 m vertical clearance under proposed trees.
- All proposed above ground utility structures must fall outside the proposed tree dripline.
- Road allowance property lines with all lot and block property line fabric of the subdivision with their corresponding street names, lot, and block identification numbering.
- Street curb lines and sidewalks.
- Proposed driveway location illustrating actual width to match the housing form.
- Street lighting and wiring schematics, connection to transformer with locations of disconnect switches.
- Maintenance holes, catch basins, hydrants shown with all main line piping together with corresponding service connections, and any specific traffic controls.
- Community mailbox locations. Locations for mailboxes should always provide consideration for accessibility with a priority to locate them adjacent to the municipal sidewalk. Additional location criteria are as follows.
    - Along the flankage (side yard) of corner lots.
    - Next to an open space or park lands.
    - Not closer than 10 m from a fire hydrant or bus stop.
    - Location shall not impede vehicular and/or pedestrian sight lines.
    - Locations not adjacent to sidewalks shall not be constructed except at the sole discretion of Engineering Services.

10.3 Pre-Construction

Prior to the installation of any utilities, the UCP must be endorsed by the respective utility authority and accepted by Engineering Services.

Municipal Consent must also be granted by the City's Engineering Services Department for any utility installation required beyond the limits of the subdivision plan prior to construction of the proposed services.

10.4 Construction

The location of any utility ducts crossing roads will be confirmed with the utility company in conjunction with subdivision design (Utility Coordination Plan). All ducts must be placed in conjunction with road base construction and prior to installation of sub-drains and must conform to City Standard OS-221.

Any duct crossings required after base asphalt shall be directional bored in accordance with OPSS.MUNI 416.

10.5 Post-Construction

The installation of all utilities is completed as private contracts by the Applicant. Following installation of utilities as per the UCP, the Applicant is required to provide "As-built" drawings as part of the final acceptance process as set out in the DEPG document.

Any additional utility plants required post-construction that are not included on the UCP must be approved through the Municipal Consent process. Where municipal consent is taking place on an un-assumed road, the utility company must circulate the Applicant who shall acknowledge receipt by stamping the drawings.

Any temporary poles required during the building process will not be permitted within the ROW. Power supply within the ROW for the temporary system must be approved through the Municipal Consent process.

10.6 Pre and Post Construction Surveys

Prior to the issuance of any Permits or Agreements, the City may may request that pre-construction surveys for the work area and/or haul routes be completed prior to the start of any construction. These surveys may take the following forms:

- Photos and/or videos
- LiDAR survey

The scope, location(s) and type of any pre or post construction survey shall be at the sole discretion of the City of Oshawa. All costs associated with the survey(s) shall be carried by the applicant. Following completion of the construction work, a post construction survey shall be carried out using the same method as the pre-construction survey. A final report shall be submitted to the City including the data and an assessment of the data collected. If damage to City infrastructure has occurred, a recommendation of the proposed remediation shall be included in the report. Repairs of any damaged infrastructure shall be borne by the applicant.

Pre and Post Inspection Requirements

Photo and/or Videos: All pre and post inspections must include photos showing existing cracking and rutting depths.

1. **High-Resolution Photos and Videos**: Capture high-resolution images and videos of the right-of way and adjacent properties before and after construction. This documentation helps in comparing conditions and identifying any damage caused by construction activities
2. **Multiple Angles and Detailed Coverage**: Ensure that photos and videos are taken from multiple angles, especially in areas prone to potential damage, such as intersections, curbs and sidewalks.
3. **Favorable Conditions**: Conduct surveys in favorable lighting conditions to minimize shadows and ensure clear visibility of all details
4. **Clean and Clear Surfaces**: Ensure that the surfaces being photographed are clean, dry, and free of debris, ice, or snow
5. **Professional Oversight**: Engage professional survey firms with relevant experience to supervise and complete the work.

LiDAR Assessment: Where a LiDAR assessment is required by the City, it shall be achieved using a large-scale surface monitoring survey of the roadway. This should provide accuracies of ±5mm in relative terms between sessions, with critical elevation data. A survey-grade drone with a relative accuracy of ±5mm vertical is recommended for cost-effective and safe data collection.

1. **Equipment**:
    - Survey-grade Real Time Kinematic (RTK) GPS enabled RPAS (Remotely Piloted Aircraft System) with a parachute recovery system certified by Transport Canada to overfly people.
    - Full-frame photogrammetric payload with a gyro-stabilized mount.
2. **Data Collection**:
    - Execute collection in at least two perpendicular directions using automated mission planning software and automated trigger intervals with a minimum of 80% side and forward overlaps.
    - Conduct collection in favorable lighting conditions with minimal shadowing or uniform lighting.
    - Ensure the road surface is clean of debris, dry, and not covered by ice or snow. Arrange road brushing if necessary.
3. **Resolution and Accuracy**:
    - Achieve a minimum Ground Sampling Distance (GSD) or resolution of 5mm or better over the entire subject surface.
    - Install and survey Ground Control Points (GCPs) at intervals not exceeding 150m along the subject roadways.
    - Re-level GCP elevations for every session in relation to site Benchmarks (BMs) and update elevations to eliminate seasonal variations such as frost heave and rutting.

- Provide a GCP residual and drone processing summary report, including certification of the vertical accuracy achieved (proof of ±5mm accuracy).

4. **Audit Points**:
    - Establish audit points at locations equal to or exceeding the number of GCPs employed. These should be leveled as part of the control level loop, with horizontal locations based on GPS.
5. **Required Outputs**:
    - A Drone Processing and GCP residual report, approved by a supervising professional.
    - An ortho-rectified mosaic (ortho-mosaic) with a 5mm resolution or better.
    - A photogrammetric point cloud dataset (.LAS) with RGB color information.

Professional Requirements:

- The work must be supervised by a professional survey firm (Ontario Land Surveyor) with relevant experience.
- The firm must be a commercial drone operator with certified staff (Transport Canada Advanced Pilot certificate required) and a commercially registered drone system.

Reporting and Remediation

- Provide a detailed report comparing pre- and post-construction conditions. This report shall include any observed changes in cracking or rutting depths in any 3m interval, supported by photographic or survey evidence along with recommendations of the proposed remediation.
- Areas showing additional cracking in the Post Construction survey must be reviewed by City staff and repaired to the satisfaction of the City, which may include crack sealing or asphalt patching.

Areas showing additional rutting depths must be analyzed to determine if the rutting is limited to the asphalt or extends below it. The City will provide remediation options based on this analysis.

11. “As-Built” Requirements

The As-built information provided to the City must satisfy the following requirements.

11.1 As-Built Field Survey

- Final location of all above ground utility structures.
- Location of duct crossings shown on UC plans.
- All storm sewer and FDC sewer pipe lengths and grades (including rear yard catch basin and any block service connections).
- All maintenance hole and catch basin locations, rim elevations and inverts.
- Pipe sizes.
- Distance between maintenance holes.
- Street light locations.
- Start and finish locations of any roadside protection elements.
- Pavement markings.
- Crownline elevations at 20 m intervals to be shown on lot grading plans or in profile on construction drawings.
- Any and all details related to field adjustments to location, grade or elevation of the municipal services that was required or requested during construction. This includes changes to the road design, subgrade depth, granular depth and subdrain depths.
- All control grade elevations shown on stormwater management pond detailed plan (if applicable) which include but are not limited to pond inverts, berm, weirs, orifice plates, riser pipe, inlet and outlet elevations, piping inverts, lengths, and grades.
- Elevations of any major overland flow routing through walkway blocks or servicing easements, which must be shown on the lot grading plans or construction drawings.
- For City of Oshawa Capital projects this additional As-built information shall also be included:
    - Street tree locations
    - Back and front edge of sidewalk/MUP grades at 20 m intervals
    - Culvert inlet and outlet invert elevations

11.2 As-Built Drawings

The As-built drawings consist of the most up to date Issued for Construction (IFC) engineering drawings which have been revised to show the As-built conditions. As-built drawings shall be provided in accessible (to City Standards) PDF format and an AutoCAD file in a format compatible with the City of Oshawa’s current version of AutoCAD.

Refer to the Professional Engineers of Ontario document entitled “Use of the Professional Engineers Seal” (latest edition) for the definition of and distinction of As-Built and Record

drawings.

Upon completion of the project the required As-built measurement forms for the City of Oshawa services shall be completed and submitted to Engineering Services.

As-Built drawings shall consist of the original engineering drawings which have been revised to show As-built conditions. As-built drawings shall be provided in hard copy and accessible (as per City of Oshawa standards) electronic PDF.

Drawing numbers must also be included on the plans that correspond to the Engineering Services file number for the project.

For City of Oshawa Capital Works projects, CAD files shall also be submitted. CAD files shall be in a format compatible with the City of Oshawa's current version of AutoCAD.

Original design information (inverts, grades, etc.) shall remain on the drawing, with a diagonal line struck through it and As-built information boxed in, adjacent to original information.

i.e., ~~E. INV 97.55~~ (Original Design Invert) INV 97.62 (As-Built Invert)

The As-built drawings for City services shall incorporate all revisions of the following items:

- Percent grade for sewers, roads, and Multi-Use Paths (MUP)
- Invert elevations and stations
    - Storms sewers at maintenance holes, plugs, and catch basins
    - FDC sewers at maintenance holes and plugs
- Pipe length, size, material type, class, and bedding
- Distance from property line for storm and FDC sewers.
- Storm and FDC house connections' locations and elevations
- Any changes to the road design, subgrade depth, granular depth and subdrain depths.
- "As-built" shall be shown in the revision column with date. All previous notations shall be left on the drawing to allow the City to confirm the drawing includes all previous revisions.
- Street names shall be in conformity with the registered plan (40M) or as approved by the City.

Submitted AutoCAD files shall be:

- In a format compatible with the City of Oshawa's current version of AutoCAD
- Delivered with an integrated coordinate system being UTM NAD83, Zone 17
- Purged of all non-essential CAD information

AutoCAD files shall be named by drawing numbers as specified for "Issued for Construction" drawings. Provide a copy of all CAD drawings on a CD or DVD, or USB flash drive labelled with the City's contract or subdivision number.

The list of drawings for "As-built" record need only include the plan/profile construction drawings, general lot grading plans, the Utility Coordination Plans and any plans related to the construction of a stormwater management facility.

11.2.1 Storm and FDC Drainage Plans

Two copies of storm and FDC drainage plans and electronic files shall be submitted to Engineering Services for permanent record. The electronic files shall be in GIS format and/or the City's current version of AutoCAD, utilizing UTM coordinates of NAD83 Zone 17 sub-metre accuracy.

11.2.2 As-Built Design Sheets

Two complete sets and the electronic file of design sheets recalculated to conform to As-built measurements for City of Oshawa services shall be submitted to Engineering Services for permanent record.

11.2.3 Lateral Location Sheets

Lateral location Sheets (see Appendices 11 & 12) are required for municipal storm and FDC service connections to existing dwellings, vacant lots with a known civic address, new connections, and replacement connections.

The following information is required on Lateral Location Sheets:

- Reference Municipal Contract number, Regional Contract number, or Plan of Subdivision number.
- North arrow.
- Lateral pipe diameter, material, and class.
- Mainline pipe diameter, material, and class.
- Length of lateral.
- Elevation and depth at property line.
- Elevation at Main Line (for Sanitary and Storm connections).
- House and lot number, if available, or house number of adjacent property.
- A distance to the closest maintenance hole, hydrant, or valve.
- A sketch of house/building with offset and distance to property line and mainline sewer or watermain (Measurements must be taken at a 90° angle from the corner of the building and then parallel to the mainline, where possible).
- Reference City Storm Sewer numbering system for all maintenance holes and catch basins.
- One connection per lateral location sheet (unless the same lot/address).

11.2.4 Shop Drawings

One complete set of shop drawings with the As-built conditions shall be completed and submitted to Engineering Services for permanent record.

11.2.5 Camera Inspection

Refer to the Region of Durham's Construction Specifications for Regional Services, Section 01450, Clause 1.07 - Camera Inspection for the correct format.

11.3 As-Built Submission Requirements

11.3.1 General Requirements

The required drawings are to illustrate the "As-Built" information on the original drawings in a drafting format that conforms to Technical Services requirements set out in Section 2 of and the design standards of this manual. The 'As-Built' drawings must include, but not be limited to, the following "As-Built" Field Survey information:

The "As-Built" engineering submission package shall consist at a minimum of the following drawings in accessible (as per City standards) PDF format, full size hard copy format and AutoCAD format:

- Plan and Profile Plan(s).
- Master Lot Grading Plan(s).
- Stormwater Management Facility Plan(s).
- Utility Coordination Plan(s).
- Street Lighting Plan(s).
- Final measurement form for sketches showing FDC and Storm Sewer Service connection.

11.3.2 Master Lot Grading Plan(s)

- Crownline elevations at the same proposed elevation intervals including high and low points.
- Elevations at all lot corners adjacent to the ROW.
- Overland flow route elevations through walkway blocks or servicing/drainage easements.
- Spill over elevations for ponding at low points.

11.3.3 Plan and Profile Drawing(s)

In Plan View

- Maintenance holes and catch basins, including MH system ID and CB leads.
- Rear yard catch basins, leads and easements, including RLCB system ID, size,

slopes, lengths, flow arrows and easement dimensions.

- Sewers including size, flow arrows, and system ID.
- Watermain, valves, hydrants, and bends.
- Distance from property line for storm and FDC sewers.
- Service connections.
- Headwalls or outlets.
- Gutter Data and Catch basin Table information.
- Culvert pipe lengths, sizes, materials, and inlet/outlet invert elevations.
- Start and finish location of any roadside protection elements.
- Crownline elevations at the same proposed elevations, Percent grades for roads and multi-use paths.
- Any and all details related to field adjustments to location, grade or elevation of the municipal services or roads that was required or requested during construction. This includes changes to the road design, subgrade depth, granular depth and subdrain depth.

In Profile View

- All storm sewer and FDC sewer pipe lengths, size, materials, dimension ratio, class, bedding and grades.
- All maintenance hole and catch basin locations, sizes, rim elevations and inverts.
- Safety grates information and elevations.

11.3.4 Stormwater Management Facility Plan(s)

All control grade elevations shown on stormwater management pond detailed plans (if applicable) which include but are not limited to:

- Pond Inverts.
- Berm elevations and sizes.
- Weir elevations and sizes.
- Orifice plates/tubes elevations and sizes.
- Overland flow routing elevations, grades, and surface treatments.
- Riser pipe elevations, sizes, lengths, materials, class, bedding and grades.
- All storm sewer pipe lengths, materials, class, bedding and grades.
- All maintenance holes, catch basins, quality and quantity control structure locations, rim elevations and inverts.

11.3.5 Utility Coordination Plan(s)

- All above ground utility structure locations and offsets from driveways (streetlights, street trees, transformers, utility pedestals and vaults, community mailboxes, etc.).
- Location of all underground road duct crossings.
- Location of all underground hydro services.

11.3.6 Street Lighting Plan(s)

Street lighting As-built drawings should consist of the following information:

- All above ground streetlights, power supply and handwell locations as per Contractors install/ red line drawings.
- Location of all underground ducts as per Contractors install/ red line drawings.
- Revised street lighting charts and wiring diagrams as per Contractors install/ red line drawings.

11.3.7 Final Measurement Forms

Final Measurement Forms (FMFs) are to be prepared in accordance with the format and information provided in Appendices 11 and 12 and with the following:

- FMFs are to be prepared on 215.9 x 279.4 mm (letter) size paper at a scale of 1:500
- Lot numbers, lot lines, curb lines, sidewalk lines and road centerlines
- Storm and FDC sewer size and length
- Distance between maintenance holes and storm and FDC house connections
- Storm and FDC house connection locations and as-built invert elevations
- Distance from property line to storm and FDC sewers
- Distance between storm and FDC house connections at the main line sewer
- Distance between storm and FDC house connections at the termination point (typically 1.5 m within the lot line)