The design information contained in this manual is intended to provide guidance beyond legislative and standard design practices for use in the City of London (the City). There will be site specific situations where the design will depart from these practices as it is not possible nor is it the intention of the City to anticipate every situation. The City intends to review and revise the Manual from time to time. The City also acknowledges that other references such as the ‘Standard Contract Documents for Municipal Construction Projects’ are to be used in conjunction with this manual. The 2012 update of this manual also incorporates design information from the City’s former Subdivision & Development Guide Manual to provide consistent and current design information for development projects in one single document.

The City of London maintains its right to accept or refuse any design submissions and requires an acceptable design for any given circumstance.

The technology of converting text documents into pdf files (Portable Document Format) is not always accurate so you may occasionally find errors in the text or graphics. The following drawings have been provided in a larger more legible scale for your conveyance:

- FIG. 5.2 – Rainfall Intensity Duration Curve
- FIG. 5.1 – Storm Sewer Design Chart
- FIG. 3.1 – Sanitary Sewer Design Chart

Requests for additional information please contact Development Services Ismail Abushehada Manager of Development Engineering (ibushehada@london.ca).
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1 INTRODUCTION

The information contained herein comprises the “Design Specifications and Requirements” which are to be utilized for the design of works within the City of London on municipally owned road allowances, municipally owned property and for municipally owned infrastructure on easements.

The design information contained in this manual is intended to provide guidance beyond legislative and standard design practices for use in the City of London (the City). There will be specific situations where the design will depart from these practices as it is not possible nor is it the intention of the City to anticipate every situation.

This document, along with the City of London Standard Contract Documents for Municipal Construction Projects, the Ontario Provincial Standard Specifications, the Ontario Provincial Standard Drawings, and the City of London Facility Accessibility Design Standards (FADS) provide the basis for the design of municipal construction projects and works intended for assumption by the City of London. Where specific design information for new subdivisions is not applicable to other sections in this manual, it is added to Section 18 ‘Drafting and Design Requirements for New Subdivisions.

These specifications and drawings may be revised from time to time as considered necessary by the City of London. It will be the responsibility of the professional engineer who is performing the contract administration for the work to verify that the installation of these systems will be in accordance with the latest revision of these Specifications.

The City of London maintains its right to accept or refuse any design submissions. The City requires an acceptable design for any given circumstance. Notwithstanding any item that may be contained or not included herein, the decision of the City concerning any matter shall be final.

Both municipally managed and development led projects should be considered a service delivery to present or future tax payers of that area. Responsible service delivery is achieved through balancing the technical needs of the project proponent with the social costs to the taxpayers.

The recently published National Guide to Sustainable Municipal Infrastructure, known as the InfraGuide Best Practices, has listed numerous initiatives which better recognize social costs of construction and suggest methods to address these costs. One of the primary requests of the public is to pay greater attention to reducing disruption to businesses and to the traveling public. A post 2004 Environmental and Engineering Services Department construction survey confirmed that although London taxpayers were generally happy with construction quality, they desired better attention to maintaining through traffic, maintaining accesses, and more communication of planned closures.

The primary goals of managing projects, whether City or development led, in right of ways include:

1. Public and worker safety;
2. Quality of work and appropriate payments;
3. Maintaining access to businesses and homeowners whenever possible;
4. Maintaining through traffic for vehicles and pedestrians;
5. Ensuring proper insurance coverage and risk management;
6. Minimizing inconvenience from noise, dust, delay, and vibration; and
7. Providing timely and accurate information regarding ongoing construction.

1.1 GENERAL INFORMATION

1.1.1 Definitions

For the purpose of these specifications, the following definitions will be recognized:

a. “City” shall mean The Corporation of the City of London

b. "Contractor" means a person, partnership, or corporation who contract to undertake the execution of work commissioned by the City to install or maintain sewers, private drain connections, maintenance holes, catch basins and other appurtenances.

c. "Developer" shall mean the Owner or party specifically named in a Development Agreement or in a Subdivision Agreement.

d. "Engineer" shall mean the City Engineer for the City of London or the City Engineer’s authorized representative.

e. "Inspector" means the person(s) authorized and supplied by the City to see that the installation is executed according to the specifications and the approved plan(s) in a good workmanlike manner according to the latest City of London practices and standards.

f. "Main" means every water pipe, except services and portions of private mains as herein defined, installed on the public road allowance or on any other land upon which the City has obtained easements.

g. “OPSD” means Ontario Provincial Standard Drawings

h. "Owner" Shall include any person who or any firm or corporation that is the registered owner of the property under consideration or any agent thereof, a person entitled to a limited estate in land, a trustee in whom land is vested, a committee of the estate of a mentally incompetent person, an executor, an administrator and a guardian.

i. “OBC” means Ontario Building Code

j. “PDC” means a private drain connection

k. “Product Approval Committee” means the committee that approves products which may be used for construction of works which on City of London Projects or works which will be assumed by the City of London.

l. “Subdivider” means the Owner or Party specifically named in a Subdivision Agreement.
m. "Water Service" means every water pipe installed from a connection on a main or private main to the meter location or, for a fire service, to the inside of the exterior wall of a structure.

n. "Water Service extension" means the portion of a water service from the property line to the meter location, or for a fire service to the inside of the exterior wall of a structure, i.e. an extension of a service stub.

o. "Water Service stub" means the portion of a water service from a main to the property line which will always include one control valve.

p. “UCC” means Utilities Coordinating Committee which is a committee made up of representatives of utility companies and City of London Administrative staff coordinating the construction of and the location of utilities within City road allowances.

1.1.2 Metric Usage

All plans, drawings, specifications, details, descriptions, notes or any other terms included in the Engineering drawings, specifications and tender package are to be dimensioned or referred to in the Metric system of measurement.

1.1.3 Location of Utilities

a) Typical Right-of-ways - all works to be located in a City right-of-way are to be located in accordance with UCC drawing UCC-1M (2002-05-23). Refer to Figure 1.1 of the The City of London Utilities Coordinating Committee (U.C.C.) Orientation Manual for additional details. Locating works in non-standard locations from these must be approved by the appropriate division Development Services and the Utility Coordinating Committee. Additional information about the UCC can be found on the City of London web page at: http://www.london.ca/d.aspx?s=/Consultant_Resources/UCCmanual.htm

b) Window Street Rights-of Ways - all works to be located in a window street right-of-way are to be located in accordance with UCC drawing UCC-2M. Refer to Figure 1, 2, 3.1, 3.2, 3.3 of the City of London Utilities Coordinating Committee (U.C.C.) Orientation Manual. Additional information about the UCC can be found on the City of London web page at: http://www.london.ca/d.aspx?s=/Consultant_Resources/UCCmanual.htm
1.1.4 Drawing Standards

Information relating to Drawing Standards, Legal Plan submission requirements, Record Drawings, and Digital drawing submission requirements can be found under “Plan Submission Standards” on the City of London Web Page at:
http://www.london.ca/d.aspx?s=/Consultant_Resources/PlanSubmissionStandards.htm

1.1.5 Standard Drawings

Reference to City of London SR, SW and W-CS are City of London Standard Drawings and are found in the City of London Standard Contract Documents for Municipal Projects.

“Standard Contract Documents for Municipal Construction Projects” can be found on the City of London web at:

1.1.6 Municipal Consent Application (MCA)

Prior to construction of works on public property, the Owner or their agent must file a Municipal Consent Application and receive approval from the Utilities Co-ordinating Committee (UCC) for work on Public Property.

The City's Municipal Consent Application (MCA) process has been computerized and is accessed from the following URL www.london.ca/municipalconsents. A copy of the MCA program manual in pdf* can be downloaded by clicking on the link. All users and applicants must first register to gain access. To register, please download and print the MCA Registration Form in pdf* and return the completed form to the attention of the UCC Secretary by email or by fax 519-661-6422. Once registered, you will be sent a login and password by email.

In situations where the road will be assumed by the City at a future date, and the works are in a non-standard location, this deviation must also be approved by UCC.

1.1.7 Innovative Design Submissions

These requirements must be applied to all design applications. It is recognized that in some instances, unique circumstances may arise where some requirements cannot be accommodated. In these cases, the onus is on the proponent to demonstrate how the proposed design deviates from the requirements, yet still meets the spirit and intent of this overall document. Deviations must be reviewed and accepted by the appropriate divisions in Environmental Services and approved by the City Engineer.
1.1.8 **File Manager Process**

New Draft Plan Applications will be processed through the new File Manager Process (implemented May/June 2008). Additional information, reference material, Guidelines, Templates, etc. relating to the File Manager Process can be found on the City of London web Page at: [http://www.london.ca/d.aspx?s=/Planning_and_Development/Development_Approvals/FileManager_Main.htm](http://www.london.ca/d.aspx?s=/Planning_and_Development/Development_Approvals/FileManager_Main.htm)

1.1.9 **Facility Accessibility Design Standards**

All works to be constructed within a City of London road allowance, municipally owned property or on municipally owned easements are to be consistent with the Facilities Accessibility Design Standards.
1.2 ACKNOWLEDGEMENT OF SOURCES

This document consists of a compilation of design practices used by the City of London. It has not been the City of London’s objective to develop servicing design information. Rather, this compilation consists primarily of information that has been developed by the other agencies and governments, chosen by the City of London for use within our municipality.

The City of London acknowledges the following sources of design practices in the development of this document.

1. Corporation of the City of London Water By-Law W-1, Regulation of Water Supply in the City of London;
2. Corporation of the City of London Drafting Standards and Submission Requirements (Revised March 12, 2012);
3. Corporation of the City of London Sanitary Sewerage Servicing Study;
6. Corporation of the City of London Zoning By-Law No. Z-1, (March 1995);
7. Corporation of the City of London Policy Manual;
8. Corporation of the City of London Official Plan
10. Ministry of the Environment, Guidelines for the Design of Water Distribution Systems, (latest revision);
12. Ministry of the Environment, Noise Assessment Criteria in Land Use Planning, (June 1994);
14. Ministry of Transportation, Geometric Design Standards for Ontario Highways;
15. Ministry of Transportation, Noise Barrier Wall Guidelines;
17. Ontario Building Code;
18. Ontario Concrete Pipe Association;
19. Ontario Provincial Standard Specifications;
20. Ontario Provincial Standard Drawings;
21. Ontario Traffic Manuals;
22. Ontario Water Resources Act;
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2 TRANSPORTATION

2.1 ROADS DESIGN

2.1.1 Design Speed

Design speed shall be based on the following chart:

<table>
<thead>
<tr>
<th>Posted Speed (km/h)</th>
<th>Design Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 and below</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>100</td>
<td>120</td>
</tr>
</tbody>
</table>

In cases where development will lead to a lowered posted speed, it may be possible to use the future reduced posted speed.

2.1.2 Centreline Radii

i) Freeways, Expressways, and Arterials

Centreline horizontal curves for freeways, expressways and arterials shall be derived from Table C3-3 of the Geometric Design Standards for Ontario Highways. This chart is a summary of typical design speeds versus standard super elevation grades taken from C3-3.

<table>
<thead>
<tr>
<th>Design Speed (km/h)</th>
<th>Minimum Radius (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>40</td>
<td>700</td>
</tr>
<tr>
<td>50</td>
<td>1100</td>
</tr>
<tr>
<td>60</td>
<td>1600</td>
</tr>
<tr>
<td>70</td>
<td>2200</td>
</tr>
<tr>
<td>80</td>
<td>3000</td>
</tr>
<tr>
<td>90</td>
<td>3500</td>
</tr>
<tr>
<td>100</td>
<td>4500</td>
</tr>
</tbody>
</table>

1. Source: Geometric Design Standards for Ontario Highways – Table C3-3

b) Collector and Local Streets For new Construction

Note: Refer to Section 18 regarding additional design information for new subdivisions.
i) Collector roads and local streets shall have centerline horizontal curves which meet or exceed the City of London Standard “Minimum Centerline Radii of Curvature for Roads in Subdivisions”. Refer to Fig.2.1.

ii) Local Streets with bends of approximately 90 degrees are to have a minimum inside street-line radius in accordance with the following:

<table>
<thead>
<tr>
<th>Road Allowance</th>
<th>Street Line Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.0m</td>
<td>9.0m</td>
</tr>
<tr>
<td>19.0m</td>
<td>9.5m</td>
</tr>
<tr>
<td>18.0m</td>
<td>10.0m</td>
</tr>
</tbody>
</table>

Note:
Bends of 90 degrees are only permitted on local streets. Refer to Fig.2.2

iii) For window street design information reference should be made to Section 1.1.3 b).

c) Reconstruction Projects

The reconstruction of existing roads are to have the centreline horizontal alignments reviewed by the applicable Project Manager on a site specific basis.

2.1.3 Radii for Curb & Gutter

a) Intersection Radii for curb and gutter should be measured at edge of pavement. The following chart illustrates the required radii.

<table>
<thead>
<tr>
<th>From:</th>
<th>Arterial</th>
<th>Collector</th>
<th>Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial</td>
<td>15m</td>
<td>15m</td>
<td>12m</td>
</tr>
<tr>
<td>Collector</td>
<td>15m</td>
<td>7.5m</td>
<td>7.5m</td>
</tr>
<tr>
<td>Local</td>
<td>7.5m</td>
<td>7.5m</td>
<td>7.5m</td>
</tr>
<tr>
<td>Industrial Streets</td>
<td>15m</td>
<td>15m</td>
<td>15m</td>
</tr>
</tbody>
</table>

b) Intersection Radii on Bus Routes & Daylighting Requirements

i) All intersections that have, or are proposed to be, future bus routes are to have 15.0m radii regardless of the classification of the road.

ii) a 3.0m daylighting triangle is required where a 15.0 m radius is needed at the intersection of a collector street to a collector street;

iii) a 6.0m daylighting triangle is required when on any road type connection to an arterial road.
c) Cul-de-sacs
The minimum required radii of curvature for curb & gutters for a residential and industrial cul-de-sac are as per City of London SR-5.0 and SR-5.1.

2.1.4 Lane Widths

For multi-laned roads or channelized intersections, minimum lane widths shall be based on the following chart.

<table>
<thead>
<tr>
<th>Description</th>
<th>Width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Turn Lane</td>
<td>3.0</td>
</tr>
<tr>
<td>Left Turn Lane</td>
<td>3.0</td>
</tr>
<tr>
<td>Through Lane</td>
<td>3.5</td>
</tr>
<tr>
<td>Curb Lane</td>
<td>4.0</td>
</tr>
<tr>
<td>2-way Left Turn Lane</td>
<td>4.0</td>
</tr>
</tbody>
</table>

1 – Use this width only if there is no bike lane on the road; when a bike lane is present use the “Through Lane” width.

2 – No cap in rural areas where there are no curbs present, a 0.5m paved shoulder should be constructed in conjunction with the Through Lane to provide a 4.0m paved surface.

NOTE: In situations with higher design speeds or higher road classifications, wider lane widths may be required.

2.1.5 Right of Way, Pavement and Boulevard Widths

Pavement widths, right of way widths and boulevard widths shall be based on the following chart. (edge of pavement to edge of pavement)

<table>
<thead>
<tr>
<th>Category</th>
<th>Usage³</th>
<th>R.O.W. (m)</th>
<th>Pavement (m)</th>
<th>Boulevard (m) Both Sides⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>Freeway</td>
<td>90</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>Expressway</td>
<td>60</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>Arterial (2 way)</td>
<td>36</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>Arterial (1 way)</td>
<td>26</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>Primary Collector</td>
<td>26</td>
<td>Varies</td>
<td>6.0</td>
</tr>
<tr>
<td>Minor – Residential</td>
<td>Secondary Collector¹</td>
<td>21.5</td>
<td>9.5</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Local⁴ (greater than 60 units²)</td>
<td>20</td>
<td>8.0</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>(30 – 59 units)</td>
<td>19</td>
<td>7.0</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>(0- 29 units)</td>
<td>18</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Minor -</td>
<td>Local</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Refer to Section 18 regarding additional design information for new subdivisions.
<table>
<thead>
<tr>
<th>Category</th>
<th>Usage(^5)</th>
<th>R.O.W. (m)</th>
<th>Pavement (m)</th>
<th>Boulevard (m) Both Sides(^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Window Street</td>
<td>(greater than 60 units(^5))</td>
<td>15.5</td>
<td>8.0</td>
<td>5.0/2.5</td>
</tr>
<tr>
<td></td>
<td>(30 – 59 units(^5))</td>
<td>14.5</td>
<td>7.0</td>
<td>5.0/2.5</td>
</tr>
<tr>
<td></td>
<td>(0-29 units(^5))</td>
<td>14.5</td>
<td>7.0</td>
<td>5.0/2.5</td>
</tr>
<tr>
<td>Minor-industrial and Commercial</td>
<td>Cul-de-sacs (less than 185m)</td>
<td>20</td>
<td>8.0</td>
<td>6.0</td>
</tr>
<tr>
<td>All other usages</td>
<td>21.5</td>
<td>9.5</td>
<td>6.0</td>
<td></td>
</tr>
</tbody>
</table>

1. The pavement width of Secondary Collectors shall be widened to 11m when they connect to Primary Collectors and Arterials. The storage length shall be 45m, taken from the end of the curb and gutter radii and the return taper should be 30m. The right-of-way at these widenings should be increased to 22.5 m.

2. The pavement width of Local Roads serving 60 units or more shall be widened to 10m when they connect to Primary Collectors and Arterials. The storage length shall be 30m, taken from the end of the curb and gutter radii and the return taper should be 30m. The right-of-way at these widenings should be increased to 21.5m.

3. For Road Classifications refer to Schedule C – Transportation Corridors – Official Plan of the City of London.

4. For reconstructed local roads: If the measurement of the existing road width is less than defined in the previous chart, then use the chart width. If the measurement of the existing road width is greater than 8m, then reconstruct at 8m.

5. Total number of units is based on number of units serviced by the local street including the window street units.

6. The boulevard widths are all to be in accordance with UCC-1M where applicable and UCC-2M. Refer to Section 1.1.3 a) for further UCC-1M design criteria and Section 1.1.3 b) for further UCC-2M design criteria.
2.1.6 **K Values**

On vertical curves, K factor shall be derived from the following table:

<table>
<thead>
<tr>
<th>Design Speed (km/h)</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>110</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crest Vertical Curve Minimum K(^1)</td>
<td>15</td>
<td>25</td>
<td>35</td>
<td>50</td>
<td>70</td>
<td>90</td>
<td>120</td>
</tr>
<tr>
<td>Sag Vertical Curve Minimum K(^2)</td>
<td>18</td>
<td>25</td>
<td>30</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>60</td>
</tr>
</tbody>
</table>

1. Source: *Geometric Design Standards for Ontario Highways*, Table C4-6.
2. Source: *Geometric Design Standards for Ontario Highways*, Table C4-8.

For more information on design speed, refer to section 2.1.1.

2.1.7 **Maximum and Minimum Road Grades**

a) The maximum grades of roads shall be derived from the following table:

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Maximum Grade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway</td>
<td>3</td>
</tr>
<tr>
<td>Expressway</td>
<td>4</td>
</tr>
<tr>
<td>Arterial</td>
<td>6</td>
</tr>
<tr>
<td>Primary Collector</td>
<td>6</td>
</tr>
<tr>
<td>Secondary Collector</td>
<td>8</td>
</tr>
<tr>
<td>Local</td>
<td>8</td>
</tr>
</tbody>
</table>

The minimum road grades on all roads shall be 0.5%.

b) Flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.

c) In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.
2.1.8 **Vertical Curves**

When the numerical difference between two road grades exceeds 1% a vertical curve must be incorporated using the following criteria:

- Use k value from 2.1.6
- Vertical curve length shall be numerically greater than or equal to the design speed
- When matching new vertical curves into existing ones, match the K values to provide continuity.

2.1.9 **Drainage Issues**

a) **Overland Flow Routes**

i. The design of all road profiles for New Development Projects are required to accommodate and direct major overland flow routes (OLFR) to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the SWM Unit for information, assistance, review and acceptance, all to the satisfaction of the City Engineer.

ii. The design of all major road profiles for Capital Works Projects (i.e. existing rural roads, Transportation EA’s, etc.) are required to consider major overland flow routes (OLFR) and where possible, accommodate and direct the OLFR’s to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the SWM Unit for information, assistance, review and acceptance, all to the satisfaction of the City Engineer.

iii. In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a formalized OLFR Route, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.

iv. In order of preference, OLFR should be directed along:

a) arterial and primary collector roads;

b) secondary collector roads;

c) local streets;

d) parks, open spaces; and

e) rear yards.

b) **Culverts Under Roads**

i) New culverts or culverts that are being redesigned, replaced or impacted by road works/road widenings must be designed to meet the hydraulic requirements established by MTO for inlet or outlet control culverts.

ii) City practice requires that culverts must convey the minimum storm events as specified below:

<table>
<thead>
<tr>
<th>Classification of Road</th>
<th>Minimum Storm Event To Be Conveyed By Culvert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local &amp; Secondary</td>
<td>25 year storm event</td>
</tr>
</tbody>
</table>

Note: Refer to Section 18 regarding additional design information for new subdivisions.
<table>
<thead>
<tr>
<th>Collector</th>
<th>50 year storm event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Collector &amp; Arterial</td>
<td>100 year storm event or Regional storm event (250 year), subject to the UTRCA conditions</td>
</tr>
</tbody>
</table>

iii) Further design information regarding culvert designs can be found in Section 5 – Storm Sewer (to be available at a later date).

iv) Information, coordination and acceptance for this design element must be received from the SWM Unit, and should be considered at the earliest stages of design.

c) In the areas where parking bays are introduced, subdrain pipes should be installed longitudinally for the entire length of the parking bay. For material type and construction details refer to SW-3.1, located in the Supplemental O.P.S.S Sewers & Water section of Standard Contract Documents for Municipal Construction Projects Manual.

2.1.10 Rural Asphalt Lift Edge Taper

On rural roads, asphalt in all lifts shall be laid so that the edge of pavement is inclined at a 45-degree angle. Base lifts of asphalt shall be laid wider than surface lifts, so that a consistent slope is maintained.

2.1.11 Pavement Structure

a) Geotechnical Report
   A geotechnical report shall be completed unless otherwise noted by the City’s Project Manager.

b) Maximum Benkelmen Beam Spring Rebound

<table>
<thead>
<tr>
<th>CLASS OF ROAD</th>
<th>MAXIMUM SPRING BENKELMEN BEAM REBOUND (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local (Less than 60 units)</td>
<td>2.50</td>
</tr>
<tr>
<td>Local (60 or more units)</td>
<td>1.90</td>
</tr>
<tr>
<td>Secondary Collector</td>
<td>1.50</td>
</tr>
<tr>
<td>Primary Collector (incl. Industrial)</td>
<td>1.25</td>
</tr>
<tr>
<td>Arterial</td>
<td>0.64</td>
</tr>
<tr>
<td>Freeway</td>
<td>0.50</td>
</tr>
</tbody>
</table>

c) Municipal Projects

The pavement structure of all roads being constructed or repaired under a Municipal Project, and in New Subdivisions, shall be based on the following table:

<table>
<thead>
<tr>
<th>Subgrade Type</th>
<th>Component</th>
<th>Local</th>
<th>Collector</th>
<th>Arterial</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Weak&quot;</td>
<td>Asphalt</td>
<td>90</td>
<td>130</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>Gran. A</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

Note: Refer to Section 18 regarding additional design information for new subdivisions.
If the geotechnical investigation determines the native material is stronger & free draining, a reduction in the Granular B thickness could be considered.

**Equivalency Factors:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>2.00</td>
</tr>
<tr>
<td>Recycled Asphalt</td>
<td>1.80</td>
</tr>
<tr>
<td>Granular A</td>
<td>1.00</td>
</tr>
<tr>
<td>Granular B</td>
<td>0.67</td>
</tr>
</tbody>
</table>

1. Source: **TAC - Pavement Design and Management Guide**, Table 6.5, 6.6, 6.7
   - Top-coat asphalt laid on Freeways, Expressways, Arterials, and Primary Collectors shall over existing, freshly laid hot mix asphalt, cold in-place recycled, or milled asphalt, shall have a minimum lift thickness of 50mm.
   - Granular A shall be placed at a minimum depth of 150mm
   - A tack coat shall be applied on all milled surfaces and in situations where placement of asphalt lifts is separated by more than two weeks.

### 2.1.12 Transition Between Road Types

Transition from two lanes to four or from four lanes to six should be made using the taper dimensions noted in the table in Section 2.1.14 in relation to design speed. The transition should be clearly signed with a Wa-23 and a Wa-40 as per the Ontario Traffic Manual – Book 6. Transition from hard surface to loose surface should be signed with a Wa-25 and a Wa-25T.

### 2.1.13 Access and Sight Distance

As determined from Figure E3-8 of the **Geometric Design Standards for Ontario Highways**, the following stopping sight distances shall be provided at intersections and accesses:

a) On new intersections and major accesses such as large commercial or industrial development, the desirable decision sight distance shall be provided.
b) On all other new accesses, the minimum decision sight distance shall be provided.

c) For existing accesses and single family residences, the minimum stopping sight distance shall be provided.

This figure assumes a line of sight from the driver of a vehicle entering the intersection (1.05m above the pavement surface) to the headlights of an approaching vehicle (at a height of 0.38m). Design speeds for the intersecting roadways are listed in Section 2.1.1 of this manual. Note also that section 4.24 of City of London By-law Z-1 may require a further setback from the right-of-way of structures over 1m in height.

2.1.14 Length of Turning Lanes

Requirement for a turning lane shall be determined by the Transportation Division during the site plan review process, subdivision review, design or redesign of an arterial roadway.

Length of the tapered and parallel portions of the turn lane shall be determined using the following table:

<table>
<thead>
<tr>
<th>Design Speed (km/h)</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taper Length (m)</td>
<td>60</td>
<td>65</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>Parallel Length¹ (m)</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

1. Source: Geometric Design Standards for Ontario Highways, Table E9-1.

- For more information on design speed, refer to section 2.1.1. Note that distances should be increased for grades above 2% or unusual traffic conditions. Distances may be decreased if there are physical limitations on lane lengths.

- Storage requirements should be determined by a traffic study. The minimum storage on an arterial road intersection shall be 45m. On primary collectors and secondary collectors that intersect arterials, minimum storage shall be 45m. On all other types of intersections and accesses, minimum storage shall be 30m. In either case, storage distance starts 15m from the centreline of the cross street or at the stop bar.

- Where constrained in an urban situation, parallel length may be reduced to 0m and taper length may be reduced to 45m.
2.1.15 Sidewalks, Bicycle Lanes and Pedestrian Walkways

a) Residential Subdivisions:
   i) Sidewalks are required on both sides of all collectors or arterial roads and where the road width is in excess of 8.0m measured edge of pavement to edge of pavement.
   ii) Sidewalks are required on both sides for the complete length of any road on which a school property fronts.
   iii) Sidewalks may be required on both sides of an entrance road to a subdivision from an arterial road as specified by the City Engineer.
   iv) Sidewalks are required on one side only of cul-de-sacs and streets containing or serving 40 or more units.
   v) Sidewalks are required on one side of abutting arterial and primary collector streets along the full frontage of the subdivision, or as otherwise specified by the City Engineer.
   vi) Sidewalks are to be located on the outside of a crescent street, unless approved otherwise by the City Engineer.
   vii) Sidewalk Gradient – All sidewalks should follow the road gradient in a residential subdivision. The minimum gradient of a sidewalk in a subdivision is 0.5% and the maximum gradient of a sidewalk is 8%.
   viii) All sidewalks constructed in residential subdivisions shall have a minimum crossfall of 2% and maximum crossfall of 4% consistent with the boulevard crossfall.

b) Industrial Subdivisions:
Sidewalks are required on all streets within industrial subdivisions, and are required on abutting arterial and primary collector streets or as otherwise approved by the City Engineer.

At commercial, multi-family and industrial driveways the thickness shall be 150mm reinforced, together with a granular base, unless otherwise approved by the City Engineer.

General:
Sidewalks may be required on one side of any street if it forms part of the pedestrian system of a particular area.

d) Sidewalks that are separated from the curb and gutter by a boulevard shall be constructed at 1.5m in width and 100mm in depth using concrete. Sidewalk constructed as curb-face, shall be constructed at 1.8m in width and 100mm in depth. Depth of concrete should be increased to 150mm when sidewalk crosses a commercial access or egress. Depth of concrete shall be increased to 150mm at ramps on collector roads and higher road classifications where a risk exists of vehicles driving over them (refer to City of London SR 1.0, 1.1, 1.2, 1.3, 1.4 & 1.5, and UCC-1M).

To review the City of London SR’s please follow the link below:

For window street design information reference should be made to Section 1.1.3 b).

e) Reconstruction projects are to have the sidewalk replaced or repaired if an existing
sidewalk is in place. In the absence of a sidewalk the designer is to verify with the Transportation Division – Warranted Sidewalk List to determine if a new sidewalk is to be installed.

f) 1.5m wide on-street bicycle lanes are to be incorporated into the road network in accordance with the City of London Bicycle Transportation Network Plan. The designer is to review and confirm requirements with the Transportation Division.

Pavement structure for the on-street bicycle lanes are to be as per the required pavement structure for the class of road on which the bicycle lane is being constructed.

g) Pedestrian walkways are to be constructed as per City of London SR-7.0.

h) General & Widths – When designing a standard 3.0m or 4.6m width walkway, ensure that the full width of the walkway is sidewalk and no grassed area. As well, ensure that catch basins are located in a manner as not to disrupt walkway usage. An example is a catch basin at the end of a walkway, as per City of London Drawing Standards SR-7.0.

Sidewalk – To have a crossfall of 20mm/m or alternative swales, as per City of London Drawing Standard 7.0.

Removable Posts – Are to be installed at both ends of the walkway or as approved by the City Engineer, as per City of London Drawing Standard SR-8.0.

Chain Link Fence – Chain link fences are to comply with the requirements of OPSS-541 and OPSD-900.01 except for the following amendments:
- the height of the fence shall read 1.2m
- the footing detail, part a: shall read in concrete.

Pedestrian Handrail – Where walkway grades exceed 8%, pedestrian handrails are to be constructed on one side of the walkway in line with the removable posts. Hot dipped galvanized handrails are to conform with OPSD-915.01.

Stairs – Where walkway grades exceed 10%, stairs with footings are to be constructed in accordance with City of London Drawing Standard SR-6.0.

Rise and Run Dimensions – Are to comply with the following:
Minimum rise – 125mm
Minimum rise – 200mm
Minimum rise – 255mm
Minimum rise – 380mm

Intermediate Landings – Where the total change in grade exceeds 1.8m, intermediate landings (no less than 1.5m) are to be provided.

Sidewalk and Stair Concrete – To have at least minimum strength of 30 MPa with 5% to 7% air entrainment and low slump.

Stair Reinforcement – To be #15M diameter bars together with 40mm of cover in accordance with City of London Drawing Standard SR-6.0.

Driveway Locations – To be located as far from the walkway as possible.
Details – A plan & profile is required for all pertinent walkway designs together with all pertinent details.

Sidewalk Alignment – When there is a jog in the street line then a smooth transition (radius of 30.0m) should be shown between the two sidewalks.

Barricade and/or Warning Sign – A barricade and/or warning sign is required at the limit of a dead end street and/or end of a proposed sidewalk on an existing right-of-way where the sidewalk terminates (Refer to OPSD-906.01).

Sidewalk Termination – A temporary sidewalk shall be constructed from the end of a proposed sidewalk to the adjacent road edge, at the curb & gutter and/or gravel shoulder as required by the City Engineer.

i) Trees to be planted in accordance with the "City of London Tree Planting Guidelines".

2.1.16 Curb and Gutter

a. Types and Applications

ii) Concrete Barrier Curb with Wide Gutter as per OPSD 600.01 shall be used on all arterial and primary collector roads, and within commercial and industrial subdivisions with a 21.5m road allowance.

iii) Concrete Barrier Curb with Wide Gutter as per OPSD 600.01 shall be used for all reconstruction projects unless otherwise noted by the City’s Contract Administrator. The designer is to verify curb and gutter type with the appropriate contract administrator.

iv) Concrete Semi-mountable with Standard Gutter as per OPSD 600.06 shall be used on all streets in new subdivisions with a road allowance up to and including 21.5m.

v) Concrete Barrier Curb as per OPSD 600.11 shall be used on an island in a cul-de-sac and medians on roads.

b) Transition/Termination

i) A transition of 3.0m is required between curb types.

ii) Curb termination as per OPSD 608.01 shall be used within temporary turning circles and dead end streets or intersections which abut or are adjacent to a future phase of a subdivision.

c) Catchbasins

i) Refer to Storm Sewer Section 5.16 in this manual for design information regarding catchbasins.

ii) A concrete curb setback is required for all catchbasins and curb inlet catchbasins located on the right-of-ways. Refer to City of London SR-3.0.
iii) Curb inlet catchbasins shall be used exclusively on roads classified as Arterials or higher, or in areas where there is an interest to drain the road surface more quickly.

iv) Mini-catchbasins should be installed at low points in arterial roads and higher road classifications until placement of top asphalt. (see Section 5.16.15).

d) **Curb Radii Elevations** – Required at all Beginning of Curves (B.C.) and End of Curves (E.C) of curvatures of intersections, cul-de-sacs, islands and medians. **Note: a gutter elevation is required at the top end of all cul-de-sacs.**

  *Curb Radii Grades* – A minimum of 0.5%.

  *Curb & Gutter Around Full Radius* – Required at all intersections of subdivision streets and boundary road works adjacent to existing and future development. The curb & gutter is to be extended around the full radius at the corner and the sidewalk is to meet.

  *Concrete Strength* – Refer to OPSS 353.05.01

e) **New Access**

Any new accesses to existing roads are required to attain a permit from the Environmental Programs and Customer Relations Division.

2.1.17 **Erosion Control Blanket**

Straw mat and curled wood excelsior type erosion blankets shall conform to OPSS-572. For types not described in this standard, North American Green SC150 or approved equal shall be used. See also Sediment & Erosion Control, Section 10 in this manual.

2.1.18 **Pavement Markings**

Durable pavement marking locations shall be designed in accordance with the Ontario Traffic Manual – Book 11. Proposed designs shall be submitted to the Transportation Division for approval, one week prior to application. Application shall follow completion of top coat asphalt, within 24 hours.

Temporary pavement markings shall be applied as directed by the Transportation Division.
2.1.19 Pavement Reinforcement

Pavement reinforcement in the form of stepped milled joints shall be used for road widening, lane additions, and utility cuts greater than 1m in width and 3m in length.

Utilize the requirements noted in City of London SR-13.1: *Stepped Milled Joint Pavement Reinforcement Detail*. Joints should be out of the alignment where tires will normally track. The pavement and granular base for the reinforcement shall be identical to or greater than the existing road structure. Notwithstanding this, a minimum of 150mm of granular ‘A’ (to 98% Proctor) and 100mm of compacted hot mix asphalt (to 97% Marshall) shall be used. Where there is significant truck transport traffic, increase this minimum to 200mm of granular ‘A’.

2.1.20 Roadside Protection

Roadside protection shall be applied in accordance to the Ministry of Transportation’s Roadside Safety Manual.

2.1.21 Sediment & Erosion Control

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area; an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.

2.2 INTERSECTIONS

2.2.1 At Grade Road/Rail Intersections

All railway crossings at grade in built-up areas shall be protected by the text warning sign “Cyclists Use Caution Crossing Tracks”.

2.2.2 Road/Road Approach Grades

Refer to TAC – Geometric Design Guide for Canadian Roads – Figure 2.3.2.2.
2.3 TRAFFIC CALMING

2.3.1 Application and Methodology

Traffic calming measures are applied on primary and secondary collectors in residential areas, and occasionally on local roads. They enhance residents’ quality of life by encouraging low traffic speeds and volumes, minimizing conflicts between types of street users, and discouraging through traffic. Traffic calming makes the area safer and more inviting for pedestrians and cyclists, without restricting local motorists’ access to the arterial road network.

To be effective, traffic calming shall be applied only after careful study of the local transportation network and land use. It should be implemented on an area-wide basis, considering impacts on the surrounding road system. Non-motorized modes of travel should not be impeded by the applied measures. Consultation on the impact of the measures on emergency services, transit, snow plowing, street cleaning and garbage removal shall be completed as part of the planning process.

Traffic calming is only one design tool for safer roads. The most effective traffic calming measures have modest negative impacts on some aspects of the area in which they are installed. Because of this, other techniques such as education and enforcement, and design factors such as pavement width and street network design, should be considered in any traffic calming study.

Generally, traffic calming features should be spaced no more than 200m apart to achieve maximum efficiency.
The following 6 measures can be used to obstruct through traffic.

<table>
<thead>
<tr>
<th>Traffic Calming Measures That Obstruct Through Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directional Closure</td>
</tr>
<tr>
<td>Diverter</td>
</tr>
<tr>
<td>Full Closure</td>
</tr>
<tr>
<td>Intersection Channelization</td>
</tr>
<tr>
<td>Right In / Right Out</td>
</tr>
<tr>
<td>Raised Median Through Intersection</td>
</tr>
</tbody>
</table>
The following 6 measures can be used to reduce vehicle speeds and through traffic.

<table>
<thead>
<tr>
<th>TRAFFIC CALMING MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO REDUCE VEHICLE SPEEDS &amp; THROUGH TRAFFIC</td>
</tr>
</tbody>
</table>

- **CHICANE**
- **CURB EXTENSIONS / PARKING BAYS**
- **CURB RADIUS REDUCTION**
- **RAISED MEDIAN ISLAND**
- **MID-BLOCK RAISED MEDIAN WITH CROSSWALK**
- **TRAFFIC CIRCLE**

Note: Refer to Section 18 regarding additional design information for new subdivisions.
2.3.2 Signage

a) Entrance points to areas in which traffic calming measures have been installed, shall be posted with the Traffic Calmed Neighbourhood sign. See section 4.5.2 in the T.A.C. Canadian Guide to Neighbourhood Traffic Calming.

The Transportation Division may elect to use appropriate regulatory signs from the Ontario Manual of Uniform Traffic Control Devices as a traffic calming measure. Appropriate signage may include, but is not limited to, Maximum Speed, Right or Left Turn Prohibited, One Way, and Stop signs.

b) Street Name Signing
   Refer to Figure 2.3.1

2.3.3 Curb Extensions and Reduced Radii

Curb extensions are the delineation of the parking lane through the addition of a roll-over curb and gutter. The impact is that the through lanes are visually and spatially constricted at all times like they are when vehicles are parked along one side of a roadway. Tangent sections should be 5m at intersections, fire hydrants and public walkways. Tangent sections should be 15m at bus stops. Tapers in and out of curb extension streets should be made over a minimum of 30m. Reduced radii are used on the inbound radius into a local street. The impact of the reduced radii is to force vehicles to slow down considerably before making the turn. This calms the traffic speeds on the collector road as well as the local street. Refer to Fig. 2.3 – Curb Extensions and Reduced Radius.

2.3.4 Speed Humps

Speed humps are used to reduce vehicle speeds, by causing discomfort to occupants of vehicles crossing them at high speeds. Refer to Fig. 2.4 - Speed Hump.

The hump shall consist of an 80mm high, 3m-long raised table, with 1.5m long ramps on the leading and trailing edges for an approximate grade of 5.3%. The table shall be crowned for a grade of not less than 1%, to allow drainage. The sides of the hump shall be ramped to the edge of pavement to allow drainage along the gutter. Both edges of the ramps should be milled and keyed into the existing asphalt to provide a continuous road surface. The leading edge of the ramp shall be marked with durable solid white reflective triangles, with the point at the top of the ramp. A Speed Hump sign (T.A.C. Canadian Guide to Neighbourhood Traffic Calming Wa-50) shall be installed beside the leading edge of the ramp.

2.3.5 Diverter

A diverter is a barrier placed diagonally across an intersection, to force turns and prevent travel in a straight line. It is used to reduce through traffic by prohibiting travel in some directions.

The diverter should be not less than 1.5m in width at its narrowest point. The barrier shall consist of semi-mountable curbs to allow emergency vehicles to negotiate the turn in an emergency, and either
a) bollards spaced at 1.5m intervals along its centreline, or

b) sufficiently dense landscaping to prevent crossing by vehicles.

2.3.6 Rights In/Rights Out Raised Concrete Median (“Pork Chop”)

a) A raised concrete median is used to prohibit straight-through and left turn movements both into and from the protected approach and shall be designed in accordance with the most current City of London Access Management Guidelines, section 2.1. To review the City of London Access Management Guidelines please follow the link below: http://www.london.ca/d.aspx?s=/Transportation/traffic_studies2.htm

b) A rights in/rights out island should only be used in locations where it is very difficult/or impossible to implement on street raised concrete median. A rights in/rights out island is roughly triangular, and placed in the centre of an intersection approach. A minimum size of $10\text{m}^2$ is required to provide pedestrian refuge. Both the in and out lanes shall be not less than 6m in width. The island shall be protected by barrier curb OPSD 600.01, except at pedestrian crossings.

The signage shall be in compliance with Figure 4.16 in the Canadian Guide to Neighbourhood Traffic Calming, with equivalent signs for those required by the drawing.

2.3.7 Directional Closure

A directional closure is a concrete island or curb extension that physically obstructs one or more lanes of a roadway at an intersection. It may restrict entry or exit. The closure shall be protected by barrier curb OPSD 600.01, except at pedestrian crossings.

Signage shall be equivalent to the following:

a) for an exit-only closure, Figure 4.11(a), Canadian Guide to Neighbourhood Traffic Calming, or

b) for an entrance-only closure, Figure 4.11(b), Canadian Guide to Neighbourhood Traffic Calming

Equivalent signs shall be substituted for the signs required in the drawings.

2.3.8 In/Rights Out (“Banana”) Island

An In/Rights Out Island is a curved island positioned to discourage left turns and through traffic movements from the protected approach. The island shall be not less than 5m in length and 1.5m in width. A minimum size of $10\text{m}^2$ is required to provide pedestrian refuge. Both the in and out lanes shall be not less than 6m in width. The island shall be protected by barrier curb OPSD 600.01, except at pedestrian crossings.

Where possible, the island should terminate so that it does not intersect the crosswalk. Signage shall consist of:

a) a Hazard Marker sign Wa-33L mounted under a Keep Right sign Rb-25 at the leading edge of the island, and
b) a Right Turns Only sign Rb-42 on the right hand side of the protected lane, opposite the signs in (a).

2.3.9 Roundabouts

A roundabout is a raised island located in the centre of an intersection, which requires vehicles to travel through the intersection in a counter-clockwise direction around the island.

Refer to Figures 2.5, 2.5A, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14 and/or 2.15 as required for appropriate details.

All approaches to the circle shall be protected by a Yield sign, so that vehicles already traveling on the roundabout have right-of-way over vehicles entering it. A One Way sign Rb-21A, indicating a counter-clockwise direction of travel, shall be installed on the centre island opposite each approach.

The curb and gutter in the island shall be barrier style OPSD 600.01.

For maintenance purposes, sanitary maintenance holes are not permitted to be located within the raised centre island of the roundabout. The sanitary maintenance hole is to be located within the apron of the island. Storm maintenance holes may be located within the centre island of the roundabout, provided the proposed landscaping does not hinder access to the maintenance hole.

2.3.10 Raised Median Traffic Islands

Raised median traffic islands may be installed in the centre of roads with at least 8m existing pavement width. A concrete island is used to reduce pavement width and thereby reduce the speed of passing traffic.

A minimum width of 4.0m shall exist between the curb faces on both sides of the island. The island shall be not less than 5m in length, with the maximum length dictated by local conditions. A longer island is desirable. The island shall be not less than 15m distant from all intersections. It should have barrier curb around its perimeter, except at pedestrian ramps and driveways. Wherever possible, the grade of the road should be restored so that water drains to the existing curb and gutter. In this case, gutter-less curb may be installed around the perimeter of the island. Both ends of the island shall be marked with Keep Right Rb-25 sign, mounted over a Hazard Marker Wa-33L sign.

Refer to Fig. 2.9 - Calming Island Location Drawing

2.3.11 Subdivision Collector Road Entrance

In general entrance into subdivision onto secondary collector roads from arterial roads (widened road allowance to 28 m with median feature) are not encouraged by the City. Where a new secondary collector road is proposed opposite an existing collector road with a widened gateway treatment, the new road is to be widened and aligned to be compatible with the existing road consistent with Fig. 2.16 and to the satisfaction of the City Engineer.
Note: The Policy for use of gateway treatment is under review as of the time of publishing this document. Please confirm applicable policy with staff prior to submitting plans indicating a gateway design.

2.3.12 Temporary Measures

Temporary traffic calming measures shall be reviewed and approved by the Transportation Division prior to installation.

2.3.13 Box Forms

When islands (medians) are being constructed, Box Forms are to be placed where future road signs or hazard markers are to be installed, when the sign or marker will be located in concrete or asphalt. The Box Form should be located approximately 1.0m from the end of the island, and centred in the island at this location (typical). The Box Forms are available, free of charge from the City of London Transportation Operations Division (661-2500 ext. 4923).

2.4 TRAFFIC SIGNALS

2.4.1 Traffic Control Signal Warrants

Traffic signals shall be considered warranted if:

a) intersection conditions meet or exceed the warrant requirements of Section 4.3 of the Ontario Traffic Manual – Book 12;

b) approval is granted by the Parking & Traffic Signals Division; and

c) approval is granted by City Council as per City Policy 25(15).

2.4.2 Intersection Pedestrian Signal (I.P.S.) Warrants

Intersection pedestrian signals shall be considered warranted if:

a) conditions meet or exceed the warrant requirements of Section 4.8 of the Ontario Traffic Control Manual – Book 12;

b) approval is granted by the Parking & Traffic Signals Division, and

c) approval is granted by City Council as per City Policy 25(15).

2.4.3 Electrical Design

Electrical design for intersections shall be governed by the following three documents, in order:

a) The City of London’s Traffic Signal and Street Lighting Specifications (STS);
2.4.4 Signal Plant Design

The design of Traffic Signals, Temporary Traffic Signals and the Relocation of Existing Traffic Signals must be completed, signed and sealed by a fully qualified Professional Electrical Engineer that meets the criteria identified in the Registry, Appraisal and Qualification System (RAQS) list. Designs must be submitted to the Parking & Traffic Signal Division for review and acceptance prior to any construction work being undertaken.

2.4.5 Pavement Markings

Permanent pavement markings shall be designed in accordance with the Ontario Traffic Manual – Book 11. Proposed designs shall be submitted to the Parking & Traffic Signals Division for approval, prior to application.

2.4.6 Materials

Materials used for traffic signals shall be in conformance with the requirements of the City of London Traffic Signals and Street Light Specifications.
2.5 STREET LIGHTING

2.5.1 Warrants

Street lighting shall be considered warranted on all roads in urban areas.

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

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

2.5.2 Arterial and Primary Collectors Design

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

The design of street illumination shall conform to the requirements set out by ANSI/IESNA RP-8-00.

2.5.3 Secondary Collectors and Local Design

The design of street lights for Local Streets & Secondary Collector roads must be designed, signed and sealed by a Professional Engineer. Residential street light designs should be completed based on the following points and be submitted on street light design drawings. The design should then be submitted through the normal development approval process to the Parking & Traffic Signal Division for acceptance.

1. The drawings shall specify the type of pole, fixture, conduit, lamp wattage, and conductor being used. The drawings shall also show the location of the transformers and power disconnects.

2. Street lights should be spaced approximately 30 to 35 m apart and indicated by an open circle. Designs that exceed the 35m spacing must be supported by detailed photometrics that meet the RP-8-00 standard. Designs must be done using the Luminance criteria for all tangent sections of roadways. For curved roadway sections the Illuminance criteria may be used.

3. The light should be placed on one entire lot at the property line whenever possible.
4. The maximum number of lights that can be attached to a single circuit is 10 unless voltage drop calculations are provided that demonstrate the circuit can accommodate the load.

5. A disconnect is to be placed beside every transformer where a connection originates.

6. Existing street lights shall be shown as solid black circles.

7. The street light cable should be indicated by a black line with an SL imposed on the line.

8. Designers should be aware of driveway locations and living room windows when determining the location of lights.

9. The design is to be drawn at a 1:500 scale.

10. Final designs must be accepted by the City of London's, Parking & Traffic Signal Division.

2.5.4 Roundabout Lighting

The lighting requirements for roundabouts should comply with the City of London Roundabout Lighting standard. (see Figures 2.12 to 2.14). If the City's standard lighting is not used then detailed photometrics must be provided that meet the RP-8-00 standard and the Transportation of Canada's Roundabout Lighting Standard. Center lighting should be avoided as this is difficult to maintain and may not provide adequate lighting in the roundabout.

2.5.5 Walkway Lighting Design

Walkway lighting designs shall be comprised of the following:

1. 70W HPS Lithonia KAD luminaries;

2. 4.6m pole (green powder coated galvanized square tapered steel or aluminium)

3. The first light from the street should be 15m from the sidewalk or 15m from the edge of pavement if no sidewalk is present;

4. Spacing along of the light along the walkway should be approximately every 30m, noting most walkways require only one additional light usually located at the rear of the residential property line; severe bends or stairs may require tighter spacing;

5. Walkway lights are to intersect street circuits at a junction box located at one end of the walkway;

6. Street light wire shall be placed in a 50mm RPVC duct;

7. The light is to be placed within 1m of the fence line in the walkway;
8. Bollards located at either end of a lit walkway must be removable for maintenance purposes.

2.5.6 Residential Street Light Installation & Inspection Guidelines

1. The same light standard must be used from one end of a street to the other regardless of how many phases of construction are involved.

2. Poles and luminaries take a minimum of 8 weeks to be delivered. The City does not stock any residential street lights for new construction.

3. A power disconnect must be installed at the transformer. All installations must be inspected by the Electrical Safety Association (ESA) prior to London Hydro doing the power connection to the disconnect. The Contractor is responsible for arranging inspection with ESA.

2.5.7 Materials

Materials used for traffic signals shall be in conformance with the City of London’s Traffic Signal and Street Light Specifications.

2.6 CONSTRUCTION SIGNAGE

2.6.1 General

Use the Ontario Traffic Manual - Book 7 - Temporary Conditions for all construction signage applications.

2.6.2 Traffic Management Plans

2.6.2.1 Definition

The Traffic Management Plan (TMP) is a construction scheduling tool that effectively harmonizes the construction project’s physical requirements with the operational requirements of the City of London, the transportation needs of the road users within the City and access concerns of the local residents.

2.6.2.2 Traffic Control Plan vs. Traffic Management Plan

The requirements of the Ministry of Labour and the Ontario Traffic Manual Book 7 construction works (the requirements for a Traffic Control Plan (TCP) and Traffic Protection Plan (TPP)) are different from the City of London’s Traffic Management Plan (TMP). The TMP is a plan that shows the construction methodology that will ensure through traffic movement, utility services, pedestrian traffic and vehicular access to the areas adjacent to the construction site, while allowing for the construction of the desired works. TCP’s and TPP’s list specific temporary signs and barricades to be installed.

For basic, straightforward utility projects, the City will receive a TCP/TPP, review it for General Conformance with City of London Traffic Management Plan Requirements, and OTM Book 7, and decide whether or not to accept the TCP/TPP to allow for the issuance of a PAW. However, the City of London will not complete an in-depth review or accept a
Contractor's Traffic Control Plan or Traffic Protection Plan. For ALL Development related projects and complex, multi stage/multi phase capital works or utility projects; a TMP is required. Please refer to Section 2.6.2.4 TMP Submission Requirements, for further information.

2.6.2.3 When is a TMP Required?
A TMP is required whenever development/utility related works (closure, resurfacing or reconstruction) affect any portion of the City roadway as itemized below:

a) A TMP is required:
   i) For any work being done on the paved portion of an Arterial Road, Primary Collector Road, or Secondary Collector Road;
   ii) Where a full road closure of any class of road (local, secondary & primary collector and arterial) is proposed for longer than ½ a day duration;
   iii) For any partial road closure on an Arterial or Primary Collector Road where the road closure is for any length of time; or
   iv) Any work on downtown core streets (as defined by the Official Plan).
   v) For any work that may affect LTC services, emergency services or will have direct impact on pedestrians.

b) A TMP is not required for work on secondary collector roads or local streets, except as noted in 2.6.2.3.a)ii), above, or in 2.6.2.3 c) exceptions, below.

c) Exceptions:
Some exceptions due to depth of work, width of work, use of road (i.e. fronting a hospital, bus routes, school, etc.), may apply. In these site specific situations, discussion with the Transportation Division will be required to determine if a TMP is required.

TMP's are required for both assumed and unassumed roads if there is an impact on traffic flow. For example, an undeveloped dead end unassumed street may have no public traffic and may not need a TMP.
2.6.2.4 **Traffic Management Submission Requirements**

The complexity of the TMP required is determined by the complexity of the proposed works.

2.6.2.4.1 For basic, straightforward UTILITY projects, the following information shall be provided:

a) a brief description of the work, including the anticipated duration of the work;

b) the location of the buildings/driveways and the municipal address, street names, including cross streets and intersections if any;

c) show all lanes for each road on the drawing and define the proposed lane widths;

d) state the impact on sidewalks, LTC bus stops/school bus stops, driveways (if any), and how they will be addressed.

e) submit 3 copies to the Transportation Planning & Design Division for review and acceptance, 14 days prior to applying for a PAW.

The Traffic Management Plan should be a reflection of a suitable layout from OTM Book 7; quote the Fig. No. for our reference, and refer to Table A for short duration work and Table B for long duration work. The signage and the distances between the signs should reflect the appropriate typical layout figure and tables1.
2.6.2.4.2 For ALL Development related projects, and complex, multi stage/multi phase Capital Works or Utility projects, more detailed information shall be provided, and these plans should form part of the construction detailed design drawing package and tender:

the TMP is required to demonstrate the design staging in a set of drawings, sealed by a Professional Engineer;

b) written verification that all works will be conducted within the Ministry of Labour, OPSS and the Ministry of Transportation standards

c) Full plan coverage of the work area that is drawn to scale, and shows:
   i) property lines
   ii) utility plant locations
   iii) proposed areas of removals (show all physical infrastructures to be removed, including bushes & trees)
   iv) planned restoration
   v) construction staging

d) Typical cross sections drawn to scale showing:
   i) widths of lanes (temporary pavement markings)
   ii) location of temporary traffic barriers & barricades (off set distances)
   iii) depth location and size
   iv) offset distances to 1:1 side slopes

e) The exact/specific location’s road section or intersection affected

f) The type of closure required (e.g. sidewalk, bike path, one lane, two lanes, full closure, etc), the duration of the closure

g) How the closure relates to the stages/phasing of the project (if applicable)

h) How the closure relates to stages of adjacent projects

i) How the closure protects the safe movement of pedestrians and traffic on the right of way, or accessing/egressing the right-of-way, including but not limited to:
   i) LTC bus stops
   ii) sidewalks
   iii) para transit stops
   iv) school bus stops
   v) illumination
   vi) edge drop-offs

j) How the work accommodates: traffic signal operations, storm/sanitary sewer installations, and winter maintenance
k) How notification is planned to coordinate with the above agencies/departments of the public.

2.6.2.5 Specific Requirements of the Plan during Road Resurfacing or Reconstruction

a) On a two lane road section, one lane be open at all times and two-way traffic managed,

b) On a four lane road sections, two lanes (one in each direction) be open at all times,

c) Complete temporary pre-marking of the pavement marking plan, laid out on all new asphalt at the end of each construction day

d) Maintain all traffic signing (by the Contractor) throughout the duration of the project

e) Complete a pavement marking and traffic signing inventory (by the contractor) before and after the project and subsequent re-installation

f) Complete all required sidewalks, turn lanes, traffic islands, traffic signals, pavement marking, traffic signing and associated works/restoration prior to opening a facility to the public.

g) Detour Maintenance Plan that will ensure the quality of the temporary riding surface. Specifically, this shall detail

i) If Hot Mix Asphalt: the type of asphalt, thickness of asphalt, smoothness of surface layer, frequency of cleaning, and any provision for emergency pothole repair in the detour.

ii) If Gravel surface: The type of granular to be placed, the amount of compaction, the smoothness of the surface layer, frequency of maintenance and any provision for emergency grading (grader on site or standby), frequency of calcium to be added for dust suppression

h) A site specific paving schedule that will detail the Contractor’s paving schedule to ensure that on any of the roadway or portion thereof that is open to the public that all vertical deflections in the pavement are reduced to less than 10mm. This plan should include the contractor’s plans to place temporary asphalt, milling out of temporary asphalt and final paving.

i) In unique circumstances, alternative solutions will be considered for approval by the Director of Transportation.

2.6.3 Detour Plans

Detour plans must be authorized through the Transportation Division, two weeks prior to construction. Signs will be placed by the Contractor’s own forces.

2.6.4 Traffic Control

Traffic Control plans must be submitted to Transportation for acceptance.
2.6.5 Pedestrian Safety

Construction Projects in proximity to high pedestrian areas, including schools, commercial areas and any other source of high pedestrian volumes should take extra precaution to separate construction activity from pedestrian movements.

Sidewalks that are closed or removed should have signed alternate detour routes.

Any material deliveries or construction vehicle movements crossing pedestrian areas should be carefully monitored by a traffic control person.

Schools in close proximity to projects should be notified in the preconstruction letters and kept informed of progress.
TRANSPORTATION

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NOTES:
1. PRIMARY COLLECTORS
2. SECONDARY COLLECTORS
3. LOCALS
   a) REFER TO CHART
   b) 90° BENDS (DESIRABLE - 2 MAX./RES.) REFER TO FIG 2.2

DEFORMATION ANGLE

C/L RADIUS OF CURVATURE (LOCAL ROAD)

DEFORMATION ANGLE - \( \Delta \)

CITY OF LONDON STANDARD DRAWING

MINIMUM C/L RADII OF CURVATURE OF ROADS IN SUBDIVISIONS

DWG FIG. 21 | DATE 2012 01 26 | APPROVED BY CITY ENGINEER

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The Corporation of the City of London
Updated: September 2012

Note: Refer to Section 18 regarding additional design information for new subdivisions.
CITY OF LONDON

90° STREET CURVE – LOCAL STREET

FIG. 22  DATE  2002 12 11

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Updated: September 2012

Note: Refer to Section 18 regarding additional design information for new subdivisions.
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Updated: September 2012

Note: Refer to Section 18 regarding additional design information for new subdivisions.

FIG 2.5 DATE 2009 05 19 APPROVED BY

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ROUNDABOUT 17.0m RADIUS (COLLECTOR / COLLECTOR)

NOTES:
FOR NOTES SEE FIG. 2.5A
NOTES:

1. FOR STREETS THAT INTERSECT AT APPROXIMATELY 90° THE PROPERTY LINE MUST BE SETBACK 31.0m FROM THE INTERSECTION OF THE CENTER LINE OF THE R.O.W. OR 8.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 6.0m DRIVEWAY WIDTH.

   OR

   THE PROPERTY LINE MUST BE SETBACK 28.0m FROM THE INTERSECTION OF THE CENTER LINE OF THE R.O.W. OR 5.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 3.0m DRIVEWAY WIDTH.

2. FOR ARTERIAL ROADS OR IF THE ROADWAYS DO NOT INTERSECT AT 90 DEGREES THE PROPERTY LINE MUST BE SET BACK 8.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 6.0m DRIVEWAY WIDTH OR 5.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 3.0m DRIVEWAY WIDTH.

3. ALL DIMENSIONS ARE TO EDGE OF PAVEMENT.

4. FOR COLLECTOR AND LOCAL ROADS THE SPLITTER ISLAND MUST BE A MINIMUM OF 5.5m IN LENGTH (FIG. 2.13). FOR ARTERIAL ROADS THE SPLITTER ISLAND MUST BE A MINIMUM OF 15.0m IN LENGTH (FIG. 2.14).

5. CROSSFALL SHALL BE AWAY FROM THE CENTER ISLAND.

6. FOR ISLAND VEGETATION ZONES AND TYPICAL CROSS-SECTION REFER TO "LANDSCAPING OF CENTRE ISLAND AND TYPICAL SECTION" (FIG. 2.7).

7. FOR SIGNAGE DESIGN REFER TO "ROUNDABOUT SIGNING DESIGN" (FIG. 2.8).

8. SPLITTER ISLANDS SHALL BE CONSTRUCTED AT THE SAME TIME AS THE CENTER ISLAND IS CONSTRUCTED.

WHEN SPLITTER ISLANDS ARE BEING CONSTRUCTED:
BOX FORMS ARE TO BE PLACED WHERE FUTURE ROAD SIGNS OR HAZARD WARNING MARKERS ARE TO BE INSTALLED WHEN THE SIGN OR MARKER WILL BE LOCATED IN CONCRETE OR ASPHALT. THE BOX FORM SHOULD BE LOCATED APPROXIMATELY 1.0m FROM THE END OF THE ISLAND AND CENTERED IN THE ISLAND AT THIS LOCATION (TYPICAL).

THE BOX FORMS ARE AVAILABLE FREE OF CHARGE FROM:
THE CITY OF LONDON - TRANSPORTATION OPERATIONS DIVISION (661-2500 EXT. 4923).

CITY OF LONDON

<table>
<thead>
<tr>
<th>FIG 2.5A</th>
<th>DATE</th>
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</table>

Note: Refer to Section 18 regarding additional design information for new subdivisions.
NOTES:
1. FOR ISLAND VEGETATION ZONES REFER TO 15.6m ROUNDABOUT CROSS-SECTION.
2. CROSSFALL SHALL BE AWAY FROM CENTRE ISLAND.

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ROUNDABOUT 15.6m RADIUS (LOCAL / LOCAL)

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Note: Refer to Section 18 regarding additional design information for new subdivisions.
Note: Refer to Section 18 regarding additional design information for new subdivisions.
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Note: Refer to Section 18 regarding additional design information for new subdivisions.
Note: Refer to Section 18 regarding additional design information for new subdivisions.
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ROUNDABOUT APPROACH WITH BIKE LANES

FIG. 2.10  DATE  APPROVED BY
2009 05 19

Note: Refer to Section 18 regarding additional design information for new subdivisions.
Note: Refer to Section 18 regarding additional design information for new subdivisions.
Note: Refer to Section 18 regarding additional design information for new subdivisions.
Note: Refer to Section 18 regarding additional design information for new subdivisions.
LEGEND

DURASTAR 20 SERIES CURVE # 20-155-R3-FG, 150W HPS, TYPE III LUMINAIRE ON 7.6m AL. POLE C/W 2.4m ARM

NOTES:
1. FOR ISLAND VEGETATION ZONES REFER TO 15.6m ROUNDABOUT CROSS-SECTION.
2. ALL CURB AND GUTTER SHALL BE BARRIER STYLE (OPS D 600.01)
3. CROSSFALL SHALL BE AWAY FROM CENTRE ISLAND.

CITY OF LONDON

ROUNDABOUT 15.6m RADIUS – LIGHTING

FIG. 2.14  DATE  2009 05 19  APPROVED  BY

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The Corporation of the City of London
Updated: September 2012

Note: Refer to Section 18 regarding additional design information for new subdivisions.
NOTES:

1. FOR ISLAND VEGETATION ZONES REFER TO 15.6m ROUNDABOUT CROSS-SECTION.
2. ALL CURB AND GUTTER SHALL BE BARRIER STYLE."OPSD 600.01"
3. CROSSFALL SHALL BE AWAY FROM CENTRE ISLAND.

LEGEND

DURASTAR 20 SERIES CURVE = 20.15S_R3_FG, 150w HPS, TYPE III LUMINAIRE ON
7.6m AL. POLE C/W 2.4m ARM

CITY OF LONDON

ROUNDABOUT 15.6m RADIUS – LIGHTING

FIG. 2.15    DATE    APPROVED BY
2009 05 19
NOTE:

1 - LANDSCAPING IN THE ZONE ON THE ARTERIAL AND THE COLLECTOR SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.

2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.

3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.

4 - ALL OTHER LANDSCAPING HEIGHTS ARE UNLIMITED.

5 - TREE SPACING IS 10-12m.

6 - STREET LIGHTING AS PER STS-17.0A AND STS-17.0B UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

7 - CENTRE MEDIAN ISLAND TO BE TREATED WITH CONCRETE SURFACE.

CITY OF LONDON

SUBDIVISION COLLECTOR ROAD ENTRANCE

FIG 2.16   DATE  2012 10 16   APPROVED BY

Design Specifications & Requirements Manual
The Corporation of the City of London
Updated: September 2012

Note: Refer to Section 18 regarding additional design information for new subdivisions.
3 SANITARY SEWER COLLECTIONS

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3 SANITARY SEWER COLLECTION SYSTEM

3.1 DEFINITION

3.1.1 Public Sewage Systems

A piped collection system that transports wastes of domestic origins which is human body waste, toilet or bathroom waste, waste from other showers and tubs, liquid or water borne culinary and sink water or laundry waste, and such other waste as is suitable for treatment at a sewage treatment facility in accordance with City of London Waste Discharge By-law WM-16 and Drainage By-law No. WM-4.

3.1.2 Private Sewage Systems

A sewage system (or systems), with a total design capacity of 10,000 litres per day or less, shall be designed, constructed, operated and maintained in accordance with Part 8 of the Ontario Building Code.

A sewage system (or systems), with a total design capacity greater than 10,000 litres per day, falls under the jurisdiction of the Ministry of the Environment.

3.2 NON-PERMITTED FLOWS

Connections from foundation, weeping tile drainage or roof drainage are not permitted to enter the sanitary sewer system, in accordance with City of London Drainage By-law No. WM-4, or any hazardous waste as defined under the EPA Regulation 347.

3.3 LOCATION AND ALIGNMENT

Generally sanitary sewers are to be located in front of, or are in locations accessible to each lot and block facing a City Street. Sanitary sewers are to be located 1.5 meters from the centreline of the road (see DWG. U.C.C.-1M and U.C.C.-2M for details and additional design information). Sanitary sewers are to be located on the inside loop of a proposed crescent with the maintenance hole located at a 1.5 metre offset from the centreline of the road.

Where a maintenance hole is designed to be located within the vicinity of a roundabout, sanitary maintenance holes are not permitted to be located within the grassed area of the roundabout. Sanitary maintenance holes must be located in the asphalt area of the street, for maintenance purposes.

3.3.1 Sanitary Sewers on Private Property

Sanitary sewers on private property are regulated by the Ontario Building Code (OBC). Where there are no specific regulations in the OBC, details from this manual will apply.
3.4 **DRAINAGE/SUB-DRAINAGE AREA PLANS**

Drainage/sub-drainage area limits for which sewers are to be designed are to contain and follow the lot/block lines to the proposed maintenance holes located on the R.O.W.

Note: All areas and populations are to be shown for each drainage/sub-drainage areas.

3.5 **EXTERNAL SEWERSHED LIMITS AND DRAINAGE AREAS**

When design abuts undeveloped or un-serviced areas, identify the external sewershed limit to be designed for.

Note: a) All areas and populations are to be shown for all drainage areas within external sewershed limits; and

b) For new subdivisions, references should be made to Chapter 18 New Development.

3.6 **DESIGN CHART**

Sanitary sewer design calculations for approved drainage area plans are to be completed on the standard design chart. See Figure 3.1 for details and additional design information.

3.7 **PEAKING FACTOR CALCULATION**

Peaking factor calculations are to be determined based on the Harmon formula:

\[
M = 1 + \frac{14}{4 + P^{1/2}}
\]

Where \(M\) = ratio of peak flow to average flow

\(P\) = tributary population in thousands

3.8 **DESIGN CRITERIA**

For determining the peak sanitary flows contributing to a sanitary sewer, different criteria are followed depending on the size of the catchment area. These areas are defined as those less than 200 hectares and those greater than 200 hectares.

3.8.1 **Tributary Areas Less Than 200 ha**

When designing for parcels of land less than 200 hectares, the following criteria will apply:

a) Residential Commercial & Institutional

i) Zoning

   Low Density = 30 Units/hectare @ 3 people/unit
   Medium Density = 75 units/hectare @ 2.4 people/unit
   High Density = 150-300 units/hectare @ 1.6 people/unit
(Allowance needs to be made for the bonusing provision in the City’s Official Plan and Zoning By-Law. The minimum density which may be used in the sewer design is 187.5 upha)

ii) Lot Basis
   - Single Family = 3 people/unit
   - Semi-detached = 6 people/unit

iii) Area Basis
    - Single Family = 30 units/hectare @ 3 people/unit
    - Semi-detached = 30 units/hectare @ 3 people/unit
    - Multi-family = 75 units/hectare @ 2.4 people/unit

iv) Commercial/Institutional = 100 people/hectare

v) Elementary School = maximum design number of students and employees, with consumption at 30 Litres/person/day. In calculating the peak flow, it is assumed that the total daily flow will occur over an 8 hour day and an equivalent population will be determined by dividing the total flow by the standard per capita flow of 250 Liters/day. If the design number is not known, the population will be assumed to be 600.

vi) Secondary School = maximum design number of students and employees, with consumption at 30 Litres/person/day. In calculating the peak flow, it is assumed that the total daily flow will occur over an 8 hour day and an equivalent population will be determined by dividing the total flow by the standard per capita flow of 250 Liters/day. If the design number is not known, the population will be assumed to be 1500.

vii) Church = 100 people/hectare

viii) Per Capita Flow = 250 litres/capita/day
ix) Uncertain Development Factor = 1.1
x) Peaking Factor = Harmon
xi) Infiltration = 8640 litres/hectare/day (0.100 l/s/ha)

**NOTE:** The above maximum densities under subsection i) Zoning correspond to the maximum densities for each type of residential land use which is permitted by the City of London Official Plan. The density of residential land use for sanitary sewer design purposes may be adjusted where deemed appropriate by the City Engineer as more information becomes available in terms of the development proposed for a specific parcel(s) of land and the proposed residential land use densities. For specific development applications, the above populations and/or per capita flow may be adjusted where deemed appropriate by the City Engineer. In such cases, the adjustment will be supported by alternate design standards (eg. Ontario Building Code, Ministry of the Environment)

b) Industrial
   i) Flow Allowance – industrial = 25,000 litres/hectare/day. This equals 100 pph.

   **NOTE:** Industrial users with water consumption/sewage discharge design criteria greater than this will be considered heavy water users. Heavy water users should consult with the City of London with respect to their specific requirements for water use and sewage discharge in terms of confirming capacity is available within the municipal infrastructure to meet their needs. Heavy water users should also consult with the City of London prior to any upgrades which will increase their discharge rates to the municipal sewer system.

   ii) Uncertain Development Factor = 1.1
   iii) Peaking Factor = 0.8 x Harmon
   iv) Infiltration = 8640 litres/hectare/day (0.100 l/s/ha)

3.8.2 Tributary Area 200 ha and Larger

When designing for parcels of land 200 hectares and larger, the following criteria will apply:

a) Residential, Commercial and Institutional
   i) Population Allowance = 55 people per hectare (gross area with any ESA areas netted out)

   **Note:** The above maximum density is from the City of London Official Plan. The density may be adjusted by the City Engineer as more information becomes available on a specific parcel of land.
ii) Per Capita Flow = 250 litres/capita/day

iii) Peaking Factor = Harmon

iv) Uncertain Development Factor = 1.0

v) Infiltration Allowance = 8640 litres/hectare/day (0.100 l/s/ha)

b) Industrial

i) Flow Allowance
   – industrial = 20,000 litres/hectare/day [for our internal discussion as to whether this should be 20 or 25,000]

   **Note:** Industrial users with water consumption/sewage discharge design criteria greater than this will be considered heavy water users. Heavy water users should consult with the City of London with respect to their specific requirements for water use and sewage discharge in terms of confirming capacity is available within the municipal infrastructure to meet their needs. Heavy water users should also consult with the City of London prior to any upgrades which will increase their discharge rates to the municipal sewer system.

ii) Peaking Factor = 0.8 x Harmon

iii) Uncertain development factor = 1.0

iv) Infiltration allowance = 8640 litres/hectare/day (0.100 l/s/ha)

### 3.9 PEAK FLOW CALCULATION

Peak flow calculations are to be determined based on the following formula:

Peak Flow (Q) = population X per capita flow X peaking Factor (H) X uncertain development factor + infiltration

Where:
- Peak Flow (Q) = L/s
- Per Capita Flow = 250 litres/capita/day
- Peaking Factor (H) = Harmon (section 3.7)
- Uncertain Development Factor = 1.0 or 1.1 (situation dependant)
- Infiltration Allowance = 8640 litres/hectare/day (0.100L/ha/s)

### 3.10 MANNINGS ROUGHNESS COEFFICIENT

A coefficient of 0.013 is to be used for all concrete and PVC pipe for pipe sizes 200mm to 1650mm. A coefficient of 0.011 is to be used for all pipe sizes 1800mm or greater.
3.11 PIPE SIZE
Pipe size is determined using the formula where the pipe design flow is equal to or greater than the calculated peak design flow:

\[ Q = \frac{1}{n} \times A \times R^{2/3} \times S^{1/2} \]

Where: 
- \( Q \) = Design flow (m³/sec.)
- \( n \) = Manning’s roughness coefficient
- \( A \) = cross sectional area of flow (m²)
- \( R \) = hydraulic radius (area/wetted perimeter)
- \( S \) = slope of pipe (m/m) - %

Notwithstanding the above, the minimum allowable size of a sanitary sewer shall be 200 mm.

On private property, the minimum size for sanitary building sewer shall be 100mm, in accordance with Part 7 of the OBC.

3.12 FLOW VELOCITY
Velocities in sanitary sewers shall be calculated using the following formula:

\[ V = \frac{Q}{A} \]

Where: 
- \( V \) = flow velocity (m/sec.)
- \( Q \) = Design flow (l/sec)
- \( A \) = cross sectional area of flow (m²)

3.12.1 Minimum and Maximum Velocities
The minimum velocity permitted in sanitary sewers is 0.6 m/sec.

The maximum velocity permitted in sanitary sewers is 4.5 m/sec.

To determine velocities based on actual flow, refer to Figure 3.2 “Hydraulic Elements Graph for Circular Pipe”.

3.12.2 Minimum Grades
a) The minimum grade on a 200 mm diameter sanitary sewer is 0.33%. Where there are only a few dwelling units connected to the upper section of a 200 mm sanitary sewer, the minimum grades shall be adjusted as follows:
1 to 5 units 0.61%
6 to 8 units 0.52%
9 to 12 units 0.43%
13 or more units 0.33%

b) The minimum grade on all other sewer sizes shall be established by determining the minimum grade necessary to achieve a velocity of at least 0.6m/sec.

3.13 PIPE MATERIAL

Both rigid and flexible pipe are permitted in the construction of sanitary sewer systems including private drain connections. These materials include concrete and polyvinyl chloride.

The criteria for these materials are described in City of London Standard Contract Documents - Section 410.05.01.

On private property, materials for sanitary building sewers and private sewers shall comply with Part 7 of the OBC.

3.14 PIPE DEPTH AND BEDDING MATERIAL

3.14.1 Minimums

The minimum depth of a sanitary sewer shall be 2.4 m from the finished ground elevation to the obvert of the pipe unless otherwise approved by the City Engineer.

Note, where frost protection is warranted, insulation is required, as per the City of London Drawing Standard W-CS-68.

3.14.2 Maximum Depth of Cover

a) Concrete Pipe

i) See City of London SW-1.0 and SW-1.1 for details and additional design information for bedding standards for Class A, B and C beddings.

ii) Municipal Projects

The maximum allowable cover permitted on concrete pipe to be constructed under a Municipal or Capital Works Project is to be based on OPSD 807.010, 807.030, 807.040 and 807.050.

Where the pipe required exceeds the OPSD charts, the Pipe Pac Program 2000 will be used, utilizing the following variables:

- all units are in metric and conform to C.S.A. standards
- wall thickness is based on C.S.A. A257.2M, Type B wall
- soil density = 2000 kg/m3
- Ontario Highway Bridge Design Code (OHBDC)
- live load magnitude = 25 tons
- projection ratio = 0.70
- lateral pressure ratio = 0.33
- lateral pressure friction ‘m’ = 0.70
- settlement ratio = 0.70
- \( k\mu(\mu) = 0.1924 \)
- variable bedding factors \( B - Lf = 1.9 \quad C - Lf = 1.5 \)
- \( r_{sd}p = 0.49 \) (calculated)
- factors of safety
  - 0.3mm crack D-load = 1.00
  - ultimate earth and live load = (ASTM C 76M)
  - DL.03 ≤ 100 N/m/mm = 1.50
  - DL.03 ≥ 140 N/m/mm = 1.25
  - DL.03 between 100 and 140 N/m/mm = interpolated
- positive projection embankment installation
- maximum depth of cover is based on transition width design
- depth of ground is measured from the ultimate finished ground elevation to the outside top of pipe.

iii) New Subdivisions:

The maximum allowable cover permitted on concrete pipe to be constructed in a new subdivision is to be designed based on transition width, and utilize reinforced concrete pipe only, in accordance with OPD 807.030 and 807.050 (Positive Projecting Embankment Installation only).

Where the pipe required exceeds the OPD Charts, the Pipe Pac Program 2000 utilizing the variables noted in 13.14.2,ii) or 15.13.2,ii) above, or First Principles (using City of London Variables) will be used.

b) Flexible Pipe

The maximum allowable cover permitted on flexible pipe is 10.5 m. The following bedding types are to be used:

- for up to 4.5 m - Type 1 (see City of London SW-1.0)
- for up to 10.5 m Type 2 (see City of London SW-1.0)

c) Maximum Depth of Cover

Where trench conditions are expected to exhibit seeping ground water in silt or fine sand, specified bedding will be defined as 19mm crushed stone entirely surrounded by geotextile.

3.14.3 Crossing Clearances

There are minimum clearances required when sanitary sewers cross other services. In all cases this is measured from outside wall diameter to outside wall diameter.
When crossing over or under a storm sewer, 230 mm clearance is required.

For vertical clearances from the sanitary sewer to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

3.14.4 Minimum Distance between Sewers
The minimum distance between sewers shall be 3.0m as per drawing UCC-1M and UCC-2M. Special cases to be reviewed for site specific design choices and depths.

3.14.5 Trenchless Technologies
When trenchless installation methods are being considered for new works, please refer to Section 17 – Trenchless Technologies (for New Construction).

3.15 MAINTENANCE HOLES

3.15.1 Spacing of Maintenance Holes

The maximum spacing between sanitary maintenance holes shall be 99 metres measured horizontally or 110 metres measured vertically from the top of the maintenance hole, to the springline of the pipe, along the springline to the next maintenance hole and vertically to the top of the maintenance hole.

When spacing of a maintenance hole dictates that the maintenance hole should be placed within the vicinity of a roundabout, sanitary maintenance holes are not permitted to be located within the grassed area of the roundabout. Sanitary maintenance holes must be located within the apron of the island, for maintenance purposes.

Required where there is a change in the direction of the flow, slopes, and/or a change in the diameter of sewers, and/or a lateral sewer connection. Note, a minimum 300mm clearance is required between services within a maintenance hole.

3.15.2 Precast Maintenance Hole Sizing Criteria

All sizing of sanitary precast maintenance holes are based on incoming and outgoing pipe sizes and should be sized and conform to Figure 3.3.

Note, a minimum 300mm clearance is required between services within a maintenance hole.

3.15.3 Maintenance Hole Diameters

Precast maintenance hole diameter requirements are as follows:
a) 1200 mm Diameter
   See OPSD 701.010 and OPSD 701.030 for details and additional design information.

b) 1500 mm Diameter
   See OPSD 701.011 and OPSD 701.040 for details and additional design information.

c) 1800 mm Diameter
   See OPSD 701.012 and OPSD 701.050 for details and additional design information.

d) 2400 mm Diameter
   See OPSD 701.013 and OPSD 701.060 for details and additional design information.

e) 3000 mm Diameter
   See OPSD 701.014 and OPSD 701.070 for details and additional design information.

f) 3600 mm Diameter
   See OPSD 701.015 and OPSD 701.080 for details and additional design information.

Poured Maintenance Holes – Required for maintenance holes which exceed the above maximum pipe sizes for precast maintenance holes. Note, certification by a Structural Engineer is required for all poured maintenance holes.

3.15.4 Maintenance Hole Tees

Maintenance Hole tees are not allowed for any sanitary sewer less than 1200 mm diameter. For sanitary trunk sewers greater than 1200 mm diameter, refer to the storm sewer section 5.14.4. Ensure sewers which slope away from the maintenance hole, but are not intended to take flows from the maintenance hole, have the inverts high enough to not accept sewage.

3.15.5 Maintenance Hole Frame and Covers

Maintenance hole frames and covers are required for all maintenance holes and shall conform with OPSD 401.01. See OPSD 401.01 for details and additional design information.

a) Maintenance hole frames and covers are to be clear of curb and gutters on bends in the road for new construction. Maintenance hole frames and covers may be located in the curb and gutter on reconstruction projects, only as approved.
b) Maintenance hole frames and covers and by association steps must be aligned to avoid being located in the wheel path of the street, and to be located above a benching platform, i.e. to avoid conflict with an inletting or outletting sewer pipe, respectively. Proposed location of maintenance hole frames and covers and by association steps must be shown in plain view on the engineering drawings, represented by a solid circle reflecting the above requirements.

3.15.6 Maintenance Hole Inserts

3.15.6.1 Use of Maintenance Hole Inserts Required During Construction

The use of inserts in sanitary maintenance holes will be required in areas of new construction until such time as the roadway is paved with the top asphalt layer.

3.15.6.2 Watertight Maintenance Hole Lids/Covers

Watertight maintenance hole lids are required when sanitary maintenance holes are located within overland storm flow routes. These locations are within flood plain areas, within gutter locations and within an easement and/or open space area where overland flow is directly over and or adjacent to the maintenance hole lids. Watertight maintenance hole lids are also required under sanitary surcharge conditions. (See City of London SW-5.3 for details and additional design information).

Watertight maintenance hole lids are not required under the following circumstances:

a) Where design dictates that the maintenance hole lids end up in the curb and gutter and where it is possible to rotate the cone so that the maintenance hole lid is clear of the gutter, the cone should be rotated such that a watertight lid would not be required;

b) Where, in the profile design of the street, the maintenance hole is located in the low point of an overland flow route, the maintenance hole may be in standard location, but would be submerged under a greater than two year storm event. Maintenance holes located in a standard location on streets that carry an overland flow route with a continuous grade, or cascading grade (even though some of these may be briefly submerged) do not require watertight lids.

3.15.7 Lockable Maintenance Hole Covers

Lockable maintenance hole covers are required to reduce access by the public. They can be located through park blocks, open space blocks, pumping stations or pollution control plants. See OPSD 401.06 for details and additional design information.

3.15.8 Maintenance Hole Steps

Maintenance hole steps are required for access and are to conform with one of the following:
a) **Maintenance Hole Steps - Hollow**  
   See OPSD 405.010 for details and additional design information.

b) **Maintenance Hole Steps - Solid**  
   See OPSD 405.020 for details and additional design information.

Note:  
   i) All steps are to be galvanized steel or aluminium; and  
      ii) A detail or restoration plan is required for the relocation of maintenance hole steps within existing maintenance holes, where applicable; and  
      iii) Maintenance hole steps shall be located to avoid conflict with an inletting or outletting sewer pipe. Access to maintenance holes must be above the benching platform.

c) Reference to Section 3.15.5 for alignment information for location requirements for the maintenance hole frame and cover.

### 3.15.9 Maintenance Hole Drop Structures

Sanitary drop structures are required when the difference in invert elevations between the upstream and outlet sewers in the maintenance hole is equal to or greater than 0.6 metres. (See City of London SW-2.0 for details and any additional design information).

### 3.15.10 Maintenance Hole Safety Landings

Maintenance hole safety landings are required at the mid-point depth of the maintenance hole, when the depth of the maintenance hole is between 5.0 and 10.0 metres. Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0m to 15.0m deep. See City of London SW-2.5 for details and additional design information.

Note: Incoming pipes are to be below safety landings, where possible.

### 3.15.11 Benching

All maintenance holes require benching at the bottom of the maintenance hole and should conform to OPSD 701.021. Benching height should be increased to obvert to increase hydraulic benefit as required.

Note: Where benching is different from OPSD 701.021, a benching detail is required.

### 3.15.12 Steps in Benching

Steps in maintenance hole benching are required when the pipe diameter is greater than 900 mm and benched to springline, and when the pipe diameter is greater than...
450 mm and benched to crown. See City of London SW-5.2 for details and additional design information.

3.15.13 **Adjustment Units**

Maintenance hole adjustment units are required on all maintenance holes to ensure that proper grade is provided between the top of the maintenance hole and the maintenance hole lid. Ensure that the difference in grade between the maintenance hole lid and the first ladder rung does not exceed 600 mm. See City of London SW-5.0 for details and additional design information. Clay brick will not be allowed for use as maintenance hole adjustment units.

3.15.14 **Head Losses**

a) Generally, when velocities in the downstream pipe from a maintenance hole exceed a velocity of 1.2 m/s, head losses must be accounted for in the design of the sewer. In order to absorb head losses that may exist in maintenance holes, it may be necessary to improve the benching in the maintenance hole or increase the size of the downstream pipe where possible. Lowering the crown of the outgoing sewer below the crown of the incoming sewer by the amount equal to the head loss, however, is the most effective method of accounting for head loss in most cases.

b) Drops in maintenance holes to compensate for Head Loss ($H_L$) shall be calculated using the following formula:

$$H_L = K_L \frac{V^2}{2g}$$

Where

- $K_L =$ Head loss coefficient
- $V =$ downstream velocity
- $g = 9.8 \text{ m}^2/\text{sec}$

Note: Also see Figure 3.4 for quick reference for head losses in maintenance holes.

c) Head loss coefficients ($K_L$) are to be applied as follows:

i) **90 degrees**
   - No benching or deflector, or where they are only up to springline.
   - $K_L = 1.5$

ii) **90 degrees**
   - Benching or deflector to crown of sewers.
   - $K_L = 1.0$

iii) **Less than 90 degrees**
   - Multiply the head loss coefficient for a 90 degree bend by a head loss ratio factor from the following chart:
iv) **Junctions**

- **Tee**
  - Outlet at right angles to inlets and no deflector between inlets.
  - $K_L = 1.5$

  Deflector between inlets for full height and width of incoming flows.
  - $K_L = 1.0$

- **Side and cross junctions**
  - Value of $K_L$ is obtained from the following chart:

v) For $K_L$ values for calculating head losses in curved sewers (radius pipe), see Figure 3.5.

#### 3.15.15 Maintenance Hole Access

1. Maintenance Hole Access for Municipal Sewers Located within Easements or Where Sewers Located Outside of Paved Road Surface
a) Access to maintenance holes for the purpose of maintenance is to be provided in all circumstances. When designing maintenance access roads for sewers, generally the maintenance access road/path will have a 3.0 meter wide hard asphalt surface with a 4.0 meter wide granular base. Adequate curves and turn-around facilities are required for maintenance vehicles to manoeuvre. Slopes (4% maximum), cross falls (2% minimum to 4.5% maximum) and drainage of access roads are also to be addressed in the design.

b) Where sanitary sewer maintenance holes are installed below the flood line, the engineer shall be consulted and access road alternatives may be considered in this situation.

**Note:**

i) A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s); and

ii) The design and construction of sewer maintenance access roads in City Parks and Open Spaces will require the review and approval of both Parks Planning and the Environmental & Engineering Services Department. Wherever possible, sewer access roads in City Parks and Open Spaces shall be integrated into the public open space pathway networks and respect the City’s natural heritage features.

See Section 3.17 for easement requirements.

2. **Maintenance Hole Access Below Flood Line**

Where sanitary sewer maintenance holes are installed below the 100 year flood line, the engineer shall be consulted, and access road alternatives may be considered in this situation.

In this situation, maintenance hole lids must conform to 3.15.6.

3.15.16 **Maintenance Hole Construction Practices**

a) The void between the sewer pipe and the cored hole of the precast maintenance hole section shall be filled with cement bricks and approved non-shrinkable grout. Pre booted maintenance holes will be allowed but only with previous approval by the City. All joints between bricks are to be completely filled with concrete mortar. Bricks are to be parged on the outside. Parging shall contain an approved bonding agent. All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with the manufactures specifications.

b) All precast maintenance hole section joints shall contain an approved rubber gasket. In areas of high groundwater, exterior joint collars or external wrapping (eg. ‘Cretex’ waterproofing or equivalent, installed as per manufacturer’s
specifications) of the maintenance hole joints will be required. This requirement may be waived if it can be demonstrated that, based on specific groundwater conditions, the standard rubber gasket is sufficient to prevent infiltration.

c) A minimum 300 mm vertical/horizontal clearance between openings on the inside of the maintenance hole is required for all sewer and PDC connections.

d) All maintenance hole frame and covers shall be adjusted to the finished road grade by means of metal shims at each corner or by means of an approved precast adjustment ring. Metal shims are to be at least 75 mm x 200 mm (3” x 8”) and their thickness is to be determined by the adjustment required. The space between the bottom of the maintenance hole frame and cover and the top of the precast maintenance hole is to be at minimum the thickness of one adjustment unit and at maximum 300 mm. See City of London SW-5.0 for details and additional design information.

e) Where adjacent maintenance holes are located in close proximity to one another, the area between the adjacent maintenance holes shall be backfilled in accordance with the specifications in the following table:

<table>
<thead>
<tr>
<th>Distance Between Adjacent Maintenance Holes</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 metres or less</td>
<td>concrete or crushed stone</td>
</tr>
<tr>
<td>0.6 metres to 2.4 metres</td>
<td>granular material</td>
</tr>
<tr>
<td>more than 2.4 metres</td>
<td>approved native material or granular material</td>
</tr>
</tbody>
</table>

The above noted backfill shall be compacted to the standard Proctor Density specified in the soils report, or as approved by the City Engineer.

3.15.17 Private Drain Connections to Maintenance Holes

Residential sanitary private drain connections are **NOT** to be constructed into any sanitary maintenance holes.

3.15.18 Sampling/Inspection Maintenance Holes

a) **Requirements**

   Sampling/inspection maintenance holes are typically required where Institutional, Commercial and Industrial developments outlet to sanitary sewers owned and maintained by the City. Sampling/inspection maintenance holes are required for all industrial and commercial sites.

b) **Location**

   If required, Sampling/Inspection Maintenance Holes shall be located on private property as close as possible to the property line, or as approved by the City Engineer.
c) **Minimum Size**

Sampling/Inspection Maintenance Holes shall be a minimum of 1200mm diameter. A larger diameter Maintenance Hole may be required if noted on the Building Permit Application Drawings.

Sampling/Inspection Maintenance Holes that have more than one inlet sewer shall be increased in size to ensure that there is a minimum of 0.9m benching length downstream of all inlet sewers.

Maintenance Holes shall be to OPSD standards – see Section 3.15.3, and Figure 3.7 for further details.

### 3.16 PRIVATE DRAIN CONNECTIONS (PDCs)

#### 3.16.1 Location

PDCs to single family and semi detached lots are to be located in accordance with City of London SW-7.0.

PDCs to multi-family (town housing, row housing and apartments), commercial and industrial blocks are to be connected to a maintenance hole on the R.O.W. See section 3.16.3 for further details.

PDC’s shall be installed at 90° to the sewer main where possible. Under no circumstances will flow from the PDC enter the main against the flow in the main. Where horizontal or vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable. Single family and semi detached lot Sanitary PDC’s shall NOT be connected to a maintenance hole.

Note: Where design constraints arise (ie: top end of cul-de-sac or crescent), PDCs may have to be located in reverse location and identified as such on the servicing drawings.

#### 3.16.2 Minimum Size and Grade

a) The minimum diameter and grade of a PDC for residential, single family and semi-detached lots is 100 mm @ 2.0%.

b) The minimum diameter and grade of a PDC for a residential multi-family block is 150 mm diameter @1.0%.

c) The minimum diameter and grade of a PDC for a non-residential block is 150 mm diameter @ 1.0%.

d) The minimum diameter and grade of a PDC for a commercial block is 150 mm diameter @ 1.0%.

e) The minimum diameter and grade of a PDC for an institutional block is 200mm diameter @1.0%.
Note: The actual size of the PDC required for multi-family, non residential, commercial and institutional blocks is dependant on the flows.

3.16.3 Connections to Sewers/Maintenance Holes

a) Residential

PDCs 100 mm and 150mm in diameter must be connected to the main sewer. No sanitary PDCs are to be constructed into any sanitary maintenance hole.

b) Multi-family, Commercial, Institutional and Industrial

PDCs 200 mm in diameter and larger are to be connected to the main sewer at maintenance holes.

c) Connections to Existing Sewers for Lot Infill Situations

i) In a situation where a lot severance or lot infill condition exists, and a new sanitary service will be connected to an existing sanitary mainline, the advocate of the severance/infill, or his agent, must determine if the existing sanitary sewer is a combined or poorly separated sewer and is therefore at risk of surcharging, or if the sewer is a dedicated sanitary sewer but has a history of surcharging. This information can be obtained from Wastewater Engineering Division. If it is determined that there is a surcharge risk, the development advocate must provide surcharge protection to his development.

ii) When connecting PDC’s to existing sewers in a lot infill situation, connections must be made utilizing an approved saddle or premanufactured tee, in accordance with OPSS 410, as amended by the Supplemental Standards for Sewer and Water (SW) in the City of London Standard Contract documents for Municipal Connection Projects.

d) Maximum Depth of Sewer Where Direct PDC Connections Permitted

Direct connection of private drain connections to sanitary sewers greater than 8 meters in depth will not be permitted. Where a sanitary sewer is greater than 8 meters in depth, and local servicing is required, it will be required to provide a shallower local sewer to which private drain connections may be made. Deviations from this will require the approval of the Director of Wastewater and Treatment or the City Engineer.

3.16.4 Vertical Clearance

For vertical clearances from the sanitary PDC to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

3.16.5 PDC Detail

Typical PDC connection to the main shall be as per City of London SW-6.0.
3.16.6 PDC Risers

a) Type I
Required for sewer depths greater than or equal to 4.5 m and for excavations in stable bank conditions, see City of London SW-6.1 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

b) Type II
Required for sewer depths greater than or equal to 4.5 m and for excavations in unstable bank conditions, see City of London SW-6.2 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

3.16.7 PDC Cleanouts

PDC Cleanouts or alternative access shall be provided for new construction and shall be located on the City side of the property line. These shall conform to SW-6.3. In the case where an inspection manhole is installed on private property, and that inspection manhole is accessible by the City, a PDC cleanout will not be required.

On private property, sanitary building sewers and private sewers shall be provided with cleanouts/maintenance holes, in accordance with Part 7 of the OBC. Private cleanout/maintenance holes shall be located off of the right of way.

3.16.8 Pipe Material

Refer to Section 3.13.

3.16.9 Depth and Bedding

The minimum depth of a sanitary PDC shall be 2.4 metres from the finished property line elevation to the obvert of the PDC. The maximum cover on a sanitary PDC shall be based on the following:

a) Concrete Pipe
   The maximum allowable cover permitted on concrete PDCs is to be as per Section 3.14.2 a).

b) Flexible Pipe
   The maximum allowable cover permitted on flexible PDCs is to be as per Section 3.14.2 b).

3.16.10 Marking and Recording PDC Service Connections
Brown painted surface stakes 40mm X 90mm (standard 2” X 4”) shall be placed after trench restoration to mark the termination of sanitary PDC’s. These stakes shall extend from PDC invert to minimum 450mm above finished boulevard grade.

Plugged or capped service connections shall be marked on the top surface of the last 3m of the upstream end of the pipe with yellow PVC adhesive tape (50mm wide) labeled continuously in black lettering (40mm wide) “CAUTION SANITARY SEWER”.

New PDCs to Existing Properties – To be constructed to 1.2m inside the road allowance.

PDCs to Parklands – Location, design and where warranted to be reviewed and approved by Parks Planning & Design.

3.17 EASEMENTS

Easements are required for all sewers to be assumed by the municipality located outside a road allowance on privately owned property.

An easement is required to ensure the municipal services and utilities crossing the site can be properly installed and maintained by the appropriate authority (municipality or private). An easement provides the right to use private land for a specific purpose which is in the public’s interest.

All manholes located within easements require hard surface access. Refer to Section 3.15.15 for hard surface details.

3.17.1 Types of Easements

a) Multi-purpose Easement for Municipal Services

Are required for sanitary sewers and access roads that cross a site and which are maintained by the City.

b) Utility Easement

Utility easements are required for telephone, hydro, gas and cable television services. Each utility company should be consulted for their specific requirements.

c) Private Easements
Private easements are required for private sanitary sewers and access roads that cross a parcel of land to service other private lands. A joint access and maintenance agreement between the interested parties shall be entered into.

d) **Temporary Easements and Working Easements**

Temporary easements are required for sanitary sewers and access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

Working easements are required, as necessary during construction, to allow for the safe construction and finishing of the surface restoration. Once construction is completed, the working easement is released.

3.17.2 **Minimum Easement Widths**

Easement widths are determined by the diameter of the pipe being installed and the depth of cover from the centreline of the road/ground over the pipe to the invert of the sewer or watermain. Fig 3.6 shows how an easement width is to be determined. The minimum width of a sewer easement at a depth of up 2.4 metres, shall be 4.8 metres (2.4 metres each side of sewer).

3.18 **ODOUR CONTROL**

**Odour Control and Design Considerations for Sanitary Sewers/Systems to Reduce Sewer Gas and H2S Creation**

The MOE Design Guidelines for Sewage Works also provides information and guidelines with respect to odours and corrosion in sewers. In general, problems have been experienced with the development of sewer gases which cause odours and corrosion of concrete sewer infrastructure due to:

a) hydraulic design which induce turbulence in flow and encourage the release of sewer gases (i.e. sewer forcemains which jet into manholes or chambers, poor benching or transitions where sewers outlet into an existing sewer, high sewer slopes which induce hydraulic jumps, elevation changes with poor transitions)

b) long residence time of sewage in sewer systems (ie: sewer systems, pumping stations and forcemains which service new developments and have low flows initially, pumping stations and forcemains with long forcemains)

It should be noted that effluent quality which exceeds Waste Discharge By-laws also contributes to the potential to create sewer gases.

Every effort should be made to minimize the conditions or designs which may lead to the creation of sewer gases (odours and corrosion). Where it is not possible to avoid these types of situations, it will be a requirement to mitigate the impacts through the use of means acceptable to the City of London. Examples of this may be:
1. The use of chemical dosing of City approved or accepted oxidizing agents to address pumping stations and forcemains with long retention times, either on a short term or long term basis.

2. The use of corrosion resistant materials (such as plastic pipe or liners) in situations where it is not possible to improve hydraulic conditions which will introduce turbulence and sewer gas creation.

### 3.19 SEDIMENT AND EROSION CONTROL

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for all Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area; an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.
SANITARY SEWER COLLECTION SYSTEMS

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FIGURE 3.1 SANITARY SEWER DESIGN CHART
FIGURE 3.2 HYDRAULIC ELEMENTS GRAPH FOR CIRCULAR SEWERS
FIGURE 3.3 MAXIMUM PIPE SIZES FOR PRECAST MANHOLES
FIGURE 3.4 HEAD LOSSES IN MAINTENANCE HOLES
FIGURE 3.5 $K_l$ VALUES FOR CALCULATING HEAD LOSSES IN CURVED SEWERS
FIGURE 3.6 MINIMUM EASEMENT WIDTHS
FIGURE 3.7 SAMPLING MAINTENANCE HOLE – SANITARY AND STORM SEWERS
Design Specifications & Requirements Manual

Note: Refer to Section 18 regarding additional design information for new subdivisions.

The Corporation of the City of London
Updated: September 2013

### SANITARY SEWER DESIGN SHEET

**CITY OF LONDON**

**SANITARY SEWER DESIGN CHART**

| SHEET | SHEET NUMBER | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | SHEET | 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VALUES OF $f_f$ AND $n_f/n_f$

RATIO OF DEPTH TO DIAMETER $d/D$

HYDRAULIC ELEMENTS $V_f$, $Q_f$, $A_f$, AND $R_f$

NOTE:
1. INFORMATION TAKEN FROM THE AMERICAN SOCIETY OF CIVIL ENGINEERS (A.S.C.E.) MANUAL.
<table>
<thead>
<tr>
<th>MAINTENANCE HOLE INSIDE DIAMETER (mm)</th>
<th>MAX. PIPE SIZE FOR STRAIGHT THROUGH INSTALLATION (mm)</th>
<th>MAX. PIPE SIZE FOR RIGHT ANGLE INSTALLATION (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
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<td>450</td>
</tr>
<tr>
<td>1500</td>
<td>825</td>
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</tr>
<tr>
<td>1600</td>
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<td>600</td>
</tr>
<tr>
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<tr>
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<td>2400</td>
<td>1950</td>
</tr>
<tr>
<td>3000 x 2400</td>
<td>1950</td>
<td>1650</td>
</tr>
</tbody>
</table>

**NOTES**

1. ALL DIMENSIONS ARE FOR CONCRETE PIPE.
2. ALL DIMENSIONS ARE IN MILLIMETRES.
3. KNOCKOUTS FOR SMALL DIAMETER CATCH BASINS LEAD SIZES 300mm OR LESS COULD BE PROVIDED IN ADDITION TO WHAT IS SHOWN.
4. INFORMATION TAKEN FROM THE ONTARIO CONCRETE PIPE ASSOCIATION (O.C.P.A.)

**MAXIMUM PIPE SIZES FOR PRECAST MAINTENANCE HOLES**

<table>
<thead>
<tr>
<th>DWG</th>
<th>DATE</th>
</tr>
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<tbody>
<tr>
<td>Fig. 3.3</td>
<td>2002 12 17</td>
</tr>
</tbody>
</table>
Note: Refer to Section 18 regarding additional design information for new subdivisions.
MINIMUM WIDTH OF EASEMENT - FROM OIL OF SEWER - METERS

NOTES:
1. MINIMUM EASEMENT WIDTH
   MEASURED FROM OIL OF SEWER PIPE.
   BILLY PUSHED SURFACE ELEVATION - WIDTH OF EASEMENT REQUIRED = 0.5 M
   EACH SIDE ON A TOTAL WIDTH OF 1.0 M.
2. TYPHOON FIELDS, OPENSPACE, ETC. 0.1 M MIN.
   0.5 M ON ONE SIDE OF SEWER OIL AND 0.5 M ON THE OTHER OR AT MOST 0.5 M WIDER
   THAN THE MINIMUM WIDTH OBTAINED FROM THIS CHART, AS REQUIRED BY THE CITY ENGINEER.

CITY OF LONDON

MINIMUM EASEMENT WIDTH

DMG FIG. 36 DATE 2012 01 26
NOTES:

1) DETAILS NOT INDICATED SHALL BE IN ACCORDANCE WITH CITY OF LONDON STANDARDS FOR MAINTENANCE HOLE CONSTRUCTION

2) MAINTENANCE HOLE SHALL BE LOCATED ON PRIVATE PROPERTY AS CLOSE AS POSSIBLE TO THE PROPERTY LINE OR AS APPROVED BY THE CITY ENGINEER.

3) 1200mm DIAMETER OR LARGER, PRECAST MAINTENANCE HOLE TO THE CITY OF LONDON STANDARDS IS ACCEPTABLE.

4) LARGER MAINTENANCE HOLE SIZE WILL BE REQUIRED IF NOTED ON BUILDING PERMIT APPLICATION DRAWINGS.

5) MAINTENANCE HOLES THAT HAVE MORE THAN ONE INLET SEWER WILL BE INCREASED IN SIZE TO ENSURE A MINIMUM OF 900mm BENCHING LENGTH DOWNSTREAM OF ALL INLET SEWERS (SEE DETAILS ABOVE)

6) MAINTENANCE HOLE STEPS TO BE IN ACCORDANCE WITH OPSD-405.010 & OPSD-405.020

7) CLASS OF CONCRETE 130MPA AT 28 DAYS

NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

CITY OF LONDON

SAMPLING MAINTENANCE HOLE SANITARY & STORM SEWERS

FIG 3.7. DATE 2005 08

Note: Refer to Section 18 regarding additional design information for new subdivisions.
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4 SEWAGE PUMPING STATIONS

4.1 DEFINITION AND PURPOSE

A pumping station is a component of the sanitary sewage collection system that conveys domestic and other suitable sewage to a sewage treatment facility. The need for pumping sewage arises when:

- The existing topography and required minimum sewer grades create deep sewers that have high construction costs. The sewage is raised and then conveyed by gravity.
- Basements are too low to discharge sewage to the main sewer.
- Sewage must be conveyed over a ridge.
- The sewage must be raised to get head for gravity flow through a treatment plant.
- Discharge outlets are below the level of the receiving body of water.
- An existing gravity system is not yet available. A pumping station will enable development and growth in accordance with the applicable Community Plan.

4.2 PERMITTED USES

Discharges to sanitary sewer systems shall comply with:

- The City of London Waste Discharge By-law 16
- The City of London Drainage By-law WM-4

4.3 DESIGN CRITERIA

4.3.1 General

The design of the pumping station must conform to the current City of London standard, SEWAGE PUMPING STATION PHILOSOPHY, as described in the SCADA standard on the City’s website, and all other related standards, codes and regulations, unless authorized and approved by the City Engineer and other approval authorities.

The following information is to be provided prior to the commissioning of any pumping station:

- Provide a pre-start health and safety review as per OHSA, NFPA-820 and the Ontario Electrical Safety Code
• Provide a plastic laminate fact sheet on the pumping station, including lowest basement elevation, location of forcemain outlet to gravity system and bypass invert elevation. The fact sheet shall be a minimum size of 11” x 17” and mounted adjacent to the control panel.

• Provide a plastic laminate with process flow diagram indicating valves and key interlocks shall also be included.

• A separate information document providing firm design range for inflow rate, optimum inflow rate for station that they are designing to, estimated operating costs for the pumping station including HVAC, heating and odour control, estimated pump life, retention time, volume and drain time of the forcemain, life of pumping station and when next upgrade is required due to estimated projected flow, detention time in forcemain and odour potential considerations.

4.3.2 Site Layout and Servicing

Pumping stations and access to pumping stations are to be located above the 100 year flood limits unless approved otherwise by the City Engineer and other regulatory agencies. The site shall have good vehicular access and maneuvering area, and minimize potential adverse environmental impacts. The facilities layout shall allow for future expansion, and comply with front, rear and side yard set backs according to the applicable zoning and site plan standard and requirements, and convenient location of portable generator.

Building construction shall be architecturally pleasing, in relation to surrounding community, and low maintenance. Permanent structures shall be masonry or concrete construction. Temporary structures shall not be of wood frame construction. Cladding for temporary structures shall be of pre-formed FRP or pre-finished metal and include provisions to protect the building from vehicles.

Building insulation requirements, interior finish, and minimum interior building temperature shall be as directed by the City Engineer.

Building design, layout and construction materials shall be to the satisfaction of the City Engineer. Facility design and layout shall have regards to making confined space entry user friendly, optimizing sight and retrieval lines and comply with OHSA regulation.

Landscaping of the site shall be low maintenance and architecturally pleasing, well-graded, minimal grass areas and landscaped to the satisfaction of the City Engineer. Site drainage shall not drain onto adjacent private property.

Fencing shall be 1.8m high chain link fence with lockable gates that are sized appropriately. Include warning and municipal address signage as per current City standards. Barbed wire fence shall be used as per current City fence by-law PS-1, and as directed by the City Engineer.
Provide adequate exterior lighting of the pumping station facilities such as access, parking, provide security hardware and alarms for all exterior doors, windows and exterior equipment to the satisfaction of the City Engineer.

Exterior lighting may be controlled by motion sensor or photo-eye as directed by the City Engineer.

All control equipment and panels shall be indoors unless approved by the City Engineer.

All utility meters such as gas, hydro, water meter reader, shall be mounted on the exterior of the building.

Access to the site shall include provision for parking of maintenance vehicles and standby/emergency equipment. Roads shall be asphalt surfaced in parking and maneuvering areas and provide convenient removal and storage of snow, and turn around for trucks, tankers and heavy equipment.

All utilities including phone and computer communications servicing the site shall be underground unless authorized by the City Engineer. Design, installation and planning of services shall be according to requirements of applicable codes, regulations and the local utility authority.

4.3.3 Structural

The pumping station shall be evaluated for uplift and resistance to all combined or single loadings considering soil conditions, ground water level, and frost action. Uplift shall be determined when the structure is completely empty and dry, free of equipment, roof slab removed, and the structure watertight. Design the base slab to withstand all earth loadings when the structure is completely filled to maximum level, roof slab on, and all equipment installed. Provide crane and hoist design including appropriately sized hatches for convenient pump and equipment removal.

Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

4.3.4 Flow Capacity

The pumping station flow capacity shall be based on the peak hourly flow rate determined from the peak flow calculation as outlined in Section 3.0, SANITARY SEWER DESIGN and consider low flow conditions, as approved by the City Engineer. The flow capacity of the pumping station should be able to maintain a desirable cleansing velocity of 0.9m/s with a minimum velocity of 0.60m/s, and a maximum velocity of 3.0m/s in all piping. The design of new pumping stations shall allow for future modification or expansion to meet the requirements of the tributary area of the pumping station.
4.3.5 **Pumps**

Multiple pumps shall be provided and sized to provide firm capacity. When two pumps are used, firm capacity shall be maintained by one pump and shall be of the same size.

When multiple pumps are used, firm capacity shall be maintained by the remaining pumps when the largest pump is out of service. The capacity of the largest pump will be equal to the required firm capacity. All pumps must undergo a hydrostatic and operating test performed by the manufacturer prior to installation.

All pumping stations that are required to handle screenings shall be designed to handle the screenings in a method that is in keeping with the low maintenance philosophy of the pollution control operation. Pumping stations shall be equipped with in-channel grinders upstream of pumps and shall be installed so that sewage flow bypasses the grinders through coarse screens in the event the grinders fail or require maintenance. Pumping stations equipped with chopper pumps or inline grinders and screens shall match the model and manufacturer of equipment currently being installed in the City's sanitary collection system.

Pumps handling raw wastewater shall be capable of passing spheres of at least 76mm diameter. Pump suction and discharge openings shall be at least 100mm in diameter.

Pumps shall be positioned so that under normal operating conditions, they will operate under a positive suction head. When the pump is a suction-lift type, it shall be a self-priming or a vacuum-priming type pump.

Electrical equipment and components such as motors, lights, cables, conduits, switch boxes, control circuits, etc., shall comply with the Ontario Electrical Safety Code (OESC), CSA approved, and comply with the City SCADA Standards. A copy of the SCADA standard can be found on the City website.

Each pump shall have a separate intake. The configuration of the wet well and pump intakes shall prevent vortex formation and air locking.

Design a sump with two pumps in the dry well to remove leakage or drainage and discharge above the maximum high water level of the wet well. Provide dual check valves and gauges on discharge and suction lines for each sump pump. Do not connect water ejectors to a potable water supply. Provide drainage for all floor and walkway surfaces. Pump seal leakage is to be conveyed via appropriately sized channel/s complete with grating directly to the sump. Size the sump pump to convey the maximum pump seal water discharge that would occur in the event of a pump seal failure and provide necessary alarm activation. All sump pumps are to be submersible.

The pumps and controls of pumping stations, and pumping stations operated as part of treatment facilities, shall be selected to operate at varying delivery rates and
designed to deliver as uniform a flow as practicable in order to minimize hydraulic surges.

The minimum efficiency, duty life, type and materials of construction for pump and impeller shall be approved by the City Engineer. Preferred voltage is 600 VAC, 3PH.

Dry pit submersible pumps are to be considered in areas susceptible to flooding.

Design all pumps to prevent air locking.

4.3.6 Channels

Dual channels will be utilized and equipped to allow isolating and de-watering each unit. The channel invert shall be 75-150mm below the inlet of the sewer and the entrance to channels shall be designed for equal flow distribution. Design guards to protect maintenance personnel from equipment and drainage to prevent slippery floor areas.

4.3.7 Pump Controls

All controls shall comply with the City SCADA Standards that are located on the City’s website.

4.3.8 Valves and Fittings

Provide suitable shut off valves on the suction line of dry pit pumps. Pump suction lines should be designed using 90° short radius down-turned flared elbows; wall pipe shall be flanged with water stop collar; all valves including eccentric reducer shall be flanged; all flanges welded; minimum pipe size shall be NPS-4. All isolation valves shall be located inside chambers for access.

Shutoff and check valves with suitable guards are required on the discharge line of all pumps except screw type pumps. Locate check valves between the shut off valve and pump. Use appropriate check valves and install horizontally on the discharge piping. Ball checks may be installed vertically on the discharge pumping. All valves shall be capable of withstanding normal pressure and water hammer. All valves shall be operable from the floor level and be readily accessible for maintenance. Use outside levers for swing check valves with suitable guarding. All valves, valve operators, fittings, concentric increasers, elbows, double branch elbows, and risers shall be flanged, all flanges welded. Spacers shall be 150-300mm long with one flanged end and one grooved end for Victaulic coupling.

Valves, check valves, drains, fittings and headers shall be of stainless steel, 316 or better, construction. Pipe materials shall be approved by the City Engineer. Identification including flow direction of all piping is required. Painting of non-stainless piping is also required.
Pump discharge to connect to main header pipe with a “Y” connection above the spring-line so that any gravel in the system doesn’t flow back into the discharge pipe causing blocking of check valves.

4.3.9 Flow Measurement

Flow measurement devices are required for all pumping stations and properly located for accurate readings with valving and fittings for maintenance with minimum downtime. Flow monitoring equipment shall be able to determine and record rate of flow, duration, volumetric sum, and frequency for each pump and each bypass, and interface with City SCADA requirements.

Provide a spool piece for each mag meter and provide a spool piece for each bypass as directed by the City Engineer. The spool piece depends on forcemain location and wet well retention time. If it is determined that enough time is available to remove the forcemain and install a spool piece safely, then a forcemain by-pass would not be required.

4.3.10 Wet Wells

All pumping stations with a capacity greater than 100 litres/sec shall have divided wet wells that are properly interconnected. The wet well shall have provisions such as a shear or sluice gate or knife valve to facilitate continuous operation during maintenance and to allow dewatering of one portion of the wet well.

The volume of the wet well shall be based on the design average flow with a filling time of a minimum of 30 minutes between the firm capacity start and by-pass. When the wet well is designed for flow equalization, provisions to prevent septicity shall be included. Factors to consider when determining the size are: the volume required for pump cycling based on the pump manufacturer’s duty cycle recommendations; appropriate dimensions to minimize turbulence; vertical separation between pump control points; sewer inlet elevation; capacity required between alarm levels, basement flooding and overflow elevations; and the number, spacing and size of pumps. The high water level shall be set 300mm below the invert of the inlet sewer and the low water level shall be 300mm minimum or twice the pump suction diameter above the centre line of the pump volute. The wet well floor shall have adequate slope to the intake hopper and the horizontal area of the hopper shall be kept to a minimum.

Provision for air displacement in wet wells shall be made by natural means consisting of 0.10% of the well cross-sectional area, or a minimum two 100mm diameter inverted “j” or gooseneck pipes with insect screens extending 900mm above finished grade. One vent pipe should extend to within 300mm above the obvert of the inlet sewer. The other vent pipe should extend to the underside of the wet well roof slab.

Wet wells are to be designed to be self cleaning and to minimize grit accumulation.
4.3.11 Heating and Ventilation

Adequate ventilation, as per O.H.S., Building Code and NFPA shall be provided for all pumping stations. Underground dry wells and wet wells with screens or mechanical equipment require mechanical ventilation. The ventilating fan should be orientated to direct fresh air into the wet well at a point 900mm above the alarm level rather than just exhaust from the wet well. Interconnection between the wet well and dry well is not allowed and vents shall not open or be connected to any building ventilation system. Where continuous ventilation is required, air shall be pre-heated. Consideration for the installation of air scrubbers shall be made as directed by the City Engineer.

For dry wells, over 4.6m deep, multiple air inlets and outlets should be used. Dampers, fine screens or other obstructions are not to be used on exhaust or fresh air ducts.

Switches and controls to operate ventilation equipment shall be conveniently located and marked. All intermittently operated ventilation equipment shall be interconnected with the respective lighting system. Consideration should also be given to automatic controls where intermittent operation is used. The manual lighting and ventilation switch shall override the automatic controls.

The fan blades shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment shall be designed for all dry wells. The electrical equipment and components shall meet the requirements for electrical equipment in Section 4.3.5.

Wet well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by NFPA 820. Air shall be forced into the wet well by mechanical means rather than solely exhausted from the wet well. The air change requirements shall be based on 100 percent fresh air. When permanent ventilation equipment is not practical, portable ventilation equipment shall be designed for use at submersible pump stations and wet wells.

Dry well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by NFPA 820. A two-speed ventilation system may be used to conserve heat. The air change requirements are based on 100 percent fresh air.

Locate the fan switch for ventilation equipment to the satisfaction of the City Engineer.

An engineered heat recovery system that considers energy efficiency and recovery is to be designed where:

- there is a requirement for 100% fresh air into a space within a pumping station
- an air scrubber system is required for wet well odour control
Engineering designs should consider potential for a heat recovery system in the sewage wet well such as a glycol recovery system to capture and return heat to the station.

4.3.12 **Water Supply**

Water supply shall be potable unless authorized by the City Engineer.

Water supply shall be equipped with back-flow preventers to prevent contamination of the water system and all plumbing shall conform to the Ontario Building Code.

Water supply shall be a minimum 25mm.

4.3.13 **Access**

Access shall consider the City's Confined Space Entry procedures and policy. Provision shall be made to facilitate easy and efficient removal of pumps, motors, and other mechanical and electrical equipment. A suitable and safe means of access for persons wearing self-contained breathing apparatus shall be provided to wet and dry wells and valve chambers.

Stairs shall be provided for vertical heights greater than 1.2 metres. Maximum vertical distance between work platforms and landings shall be 3 metres. Safety landings shall be constructed as work platforms.

Provide davit base anchors where required for DBI Sala standard equipment that complies with City confined space standards.

Equipment such as access hatches, ladders, service platforms, guards, grates and handrails, shall be constructed of a suitable material when exposed to wet and/or corrosive conditions.

4.4 **SUCTION-LIFT PUMP STATIONS**

Suction lift pumps shall also meet the applicable design requirements of Section 4.3 above.

Suction-lift pumps shall be of the self-priming or vacuum-priming type. Suction-lift pump stations using dynamic suction lifts exceeding the limits outlined in the following sections may be approved upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction-lift as measured from "lead pump off" elevation to centerline of pump suction, friction, and other hydraulic losses of the suction piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 1.8 m.
Self-priming pumps shall be capable of rapid priming and re-priming at the "lead pump on" elevation. Such self-priming and re-priming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 7.6 m in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 1.2 m from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 6.7 m.

Vacuum-priming pump stations shall be equipped with dual vacuum pumps capable of removing air from the suction-lift pump automatically and completely. The vacuum pumps shall be adequately protected from damage due to wastewater. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 6.7 m.

The pump equipment compartment shall be above grade or offset and shall be effectively isolated from the wet well to prevent a hazardous and corrosive sewer atmosphere from entering the equipment compartment. Wet well access shall not be through the equipment compartment and shall be at least 1 m by 1 m clear opening with spring-loaded, shock assist hatches. Gasketted replacement plates shall be provided to cover the opening to the wet well for pump units removed for servicing. Valving shall not be located in the wet well.

4.5 SUBMERSIBLE PUMP STATIONS

Submersible pumps shall meet the applicable requirements under Section 4.3, except as modified in this Section.

Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle and shall meet the requirements of the Ontario Hydro Electrical Safety Code and CSA for such units. An effective method to detect shaft seal failure or potential seal failure shall be provided.

Submersible pumping stations shall be designed so that pumps are readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well. Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be outside the wet well. Controls shall be designed in accordance with City SCADA Standards.

The motor control center shall be located outside the wet well, be readily accessible, and be protected by a conduit seal or other appropriate measures meeting the requirements of the Ontario Hydro Electrical Safety Code, to prevent the atmosphere...
of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal.

Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage. They shall meet the requirements of the Ontario Hydro Electrical Safety Code standards for flexible cords in wastewater pump stations. Ground-fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal-fittings shall be corrosion resistant and constructed in a manner to prevent the entry of moisture into the cable. They shall also be provided with strain relief appurtenances and be designed to facilitate field connecting.

Valves required under Section 4.3.8 shall be located in a separate valve chamber. Provisions shall be made to remove or drain accumulated water from the valve chamber. The valve chamber may be dewatered to the wet well through a drain line with a gas and watertight valve. Check valves that are integral to the pump need not be located in a separate valve chamber if the valve can be removed from the wet well in a convenient and efficient manner.

Separate valve chambers shall be insulated and heated to prevent freezing.

### 4.6 ALARM AND MONITORING SYSTEMS

Pumping station alarms and equipment shall comply with the pumping station control philosophy as described in the City SCADA Standards.

Integration into the SCADA system is to be complete by City forces. This includes PLC programming and operator interface all as per the current applicable charge-out rates.

### 4.7 EMERGENCY OPERATION

The objective of emergency operation is to prevent the discharge of raw or partially treated wastewater to any waters and to protect public health by preventing back up of wastewater and subsequent discharge to basements, streets, and other public and private property. Pumping stations shall be designed to provide temporary pumping around the station and enable isolation of the forcemain and pumping station, by means of isolation valves inside and outside the pumping station.

#### 4.7.1 Emergency Power

Emergency power is required for all pumping stations. There shall be sufficient capacity of emergency power to start up and maintain the total confirmed pumping station capacity of the station, the SCADA system and all other electrical equipment for 24 hours, unless otherwise approved by the City Engineer.
All pumping stations shall be equipped with an onsite generator. A genset plug compatible with existing City generators may be installed as directed by the City Engineer.

Generators shall be capable of running full station load powered by natural gas or diesel as directed by the City Engineer. The design of generators shall meet all applicable regulations.

4.7.2 By-pass Overflows

By-pass overflow shall be provided by gravity to existing storm sewer system or allow for emergency pumping to other gravity outlet. Emergency sanitary sewer overflow (SSO) outletting upstream of the SWM facility or directly to a SWM facility is not permitted.

By-pass and overflow monitoring and totalization is required and shall comply with City SCADA Standards.

4.7.3 Instructions and Equipment

Wastewater pumping stations and portable equipment shall be supplied with a minimum of five complete sets of operational instructions, including emergency procedures, maintenance schedules (1 Consultant, 2 Operations, 1 pumping station, 1 Wastewater Division), and such tools and spare parts as may be necessary. The consultant will ensure that this documentation will be provided along with the necessary training for operation and maintenance of the equipment prior to commissioning.

4.8 FORCEMAINS

At design pumping rates, a desired cleansing velocity of at least 0.90 m/s) shall be maintained. The minimum force main diameter for raw wastewater shall not be less than 100 mm.

An air relief valve shall be at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves. Fittings and isolation valves shall be stainless steel.

Forcemain design shall include transient analysis and consider the provision of water hammer relief.

Force mains should enter the gravity sewer system at a point not more than 200 mm above the flow line of the receiving maintenance hole.
Pipe and joints shall be equal to water main strength materials suitable for design conditions. The force main, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. The need for surge protection chambers shall be evaluated. Force main pipe materials shall be approved by the City Engineer.

Force main construction near streams or water works structures and at water main crossings shall meet applicable requirements.

Friction losses through force mains shall be based on the Hazen and Williams’s formula or other acceptable methods. When the Hazen and Williams formula is used, the following value for "C" shall be used regardless of pipe material:

<table>
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<th>Pipe Diameter</th>
<th>C-Factor</th>
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<tr>
<td>100-150mm</td>
<td>100</td>
</tr>
<tr>
<td>200-250mm</td>
<td>110</td>
</tr>
<tr>
<td>300-600mm</td>
<td>120</td>
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<td>Over 600mm</td>
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When initially installed, force mains may have a significantly higher "C" factor.

The force main shall be appropriately identified when they are constructed of material that may cause the force main to be confused with potable water mains.

Force main shall be tested to ensure there is no leakage. Specify method of testing.

**4.9 SAFETY**

The design of the pumping station shall give due regard to safety for the protection of maintenance personnel and visitors from hazards:

a) Enclose the station site with 1.8m chain link fence, lockable gates, designed to discourage entry by unauthorized persons and animals; provide safety, unauthorized entry and municipal address signage, as per City standards;

b) Handrails and guards are to be installed around tanks, trenches, pits, stairwells, and other hazardous areas;

c) Gratings are to be installed over areas where access for maintenance is required;

d) Confined space entry shall comply with the Pollution Control Operation and OHSA regulations. Facility design and layout shall have due regard to make confined space entry user friendly, optimizing sight and retrieval lines;
e) All personnel must be trained to operate and maintain pumping station equipment and facilities to the satisfaction of the Pollution Control Operation;

f) Gas detection and monitoring equipment where required. Where gas alarms are provided, install an indicator light outside the building so that the operator can check gas levels before entering the building.

g) Portable ventilation and blower equipment, intrinsically safe, with sufficient hose, where required;

h) Portable lighting equipment intrinsically safe, where required;

i) Appropriately placed warning signs for slippery areas, non-potable water fixtures, low head clearance, open service maintenance holes, hazardous material storage areas, flammable fuel storage areas, etc.;

j) Adequate ventilation in pumping chambers;

k) Provisions for lockout and tag-out of mechanical and electrical equipment;

l) Eyewash fountains and safety showers were required;

m) Fire extinguishers and emergency lighting.

4.10 SEDIMENT & EROSION CONTROL

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area; an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.
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5 STORM SEWER COLLECTION SYSTEM

5.1 DEFINITION AND PURPOSE

Storm sewers are commonly thought of as closed conduit drainage systems below the surface of the ground that collect surface water created from rainfall or other forms of precipitation. However, storm systems may consist of one or any combination of pipes, ditches, culverts, open channels and storm water management facilities that carry storm water flows.

5.2 PERMITTED USES

Storm sewers shall be designed to collect storm water discharge from pervious and impervious areas both on private lands and public lands via catchbasins and storm private drain connections. Indirect connections of foundation drains (footing tile) via sump pumps to storm PDCs are permitted. Drainage of foundation drains (footing tiles) shall be in accordance with City of London Drainage By-law No. WM-4.

Storm Drainage on private property requires a building permit before installation.

5.3 LOCATION AND ALIGNMENT

Generally storm sewers are to be located in front of, or are in locations accessible to each lot and block facing a City Street. Sanitary sewers and maintenance holes are to be located 1.5meters from the centreline of the road (see DWG. U.C.C.-1M and U.C.C.-2M for details and additional design information).

Storm sewers are to be located on the outside loop of a proposed crescent with the maintenance holes at a 1.5 m offset from the centre line of the road.

Where a maintenance hole is designed to be located within the area of a roundabout, storm maintenance holes are permitted to be located within the grassed area of the roundabout, provided any proposed landscaping does not hinder the access to the maintenance hole.

5.3.1 Storm Sewers on Private Property

Storm sewers on private property are regulated by the Ontario Building Code (OBC). Where there are no specific regulations in the OBC, details from this manual will apply.
5.4 **DRAINAGE/SUBDRAINAGE AREA PLANS**

Drainage/sub-drainage area limits for which sewers are to be designed for are to contain and follow the lot/block lines to the proposed maintenance holes located on the R.O.W.

Note: All areas and coefficients are to be shown for each drainage/sub-drainage areas.

5.5 **EXTERNAL WATERSHED LIMITS AND DRAINAGE AREAS**

When design abuts undeveloped areas, identify the external watershed limit to be designed for.

Note: All areas, coefficients and time of concentrations are to be shown for all drainage areas within external watershed limits.

5.6 **DESIGN CHART**

Storm sewer design calculations are to be completed on the standard design chart. See Figure 5.1 for details and additional information.

5.7 **PEAK FLOW CALCULATION**

Flows shall be calculated using the formula:

\[ Q = 2.78 \times A \times C \times I \]

where:
- \( Q \) = peak flow (l/s)
- \( A \) = area (hectares)
- \( C \) = runoff coefficient

\( I \) = average rainfall intensity (mm/hr)

5.8 **DESIGN CRITERIA**

5.8.1 **Storm Design Curve**

The criterion used in the design of storm sewers is generally to be based on the 1 in 2 year City of London Rainfall Intensity curve. (See Figure 5.2). Major overland flow routes are to be designed for storms greater than a 2 year storm. This is explained further in Section 9.0, Grading.

5.8.2 **Time of Concentration**

a) The time of concentration for residential areas (single family/semi detached) at the upstream end of a system shall be 19.0 minutes. For all other areas refer to Figure 5.3.
b) The time of concentration is to be adjusted when lateral flows account for 50% or more in the design flows.

i) Adjusted time of concentration shall be calculated using the formula:

\[ T_{c-adj} = \frac{(T_{cl})(Q_t) + (T_{ct})(Q_l)}{(Q_t + Q_l)} \]

where:
- \( T_{c-adj} \) = adjusted time of concentration (min.)
- \( T_{ct} \) = time of concentration in the trunk sewer (min.)
- \( Q_t \) = design flow in the trunk sewer (l/s)
- \( T_{cl} \) = time of concentration in the lateral sewer (min.)
- \( Q_l \) = design flow in the lateral sewer (l/s)

ii) The adjusted time of concentration is used downstream of the junction manhole.

5.8.3 Runoff Coefficients

Runoff coefficients are based on the amount of impervious area for a particular land use:
- Parks, open space and playgrounds = 0.20
- Single family/semi detached = 0.50
- Townhouse/rowhouse = 0.65
- Apartments = 0.65 - 0.70
- Commercial, institutional and industrial = 0.70 - 0.90
- Densely built, paved = 0.90

5.8.4 Intensity

Rainfall intensity is to be taken from Figure 5.2 “Rainfall Intensity - Duration Curve for Storm Sewer Design”.

5.9 MANNINGS ROUGHNESS COEFFICIENT

A coefficient of 0.013 is to be used for all concrete and PVC pipe for pipe sizes 300mm to 1650mm. A coefficient of 0.011 is to be used for all pipe sizes 1800mm or greater.
5.10 PIPE SIZE

Storm sewer pipe sizing is based on the following formula, where the pipe design flow is equal to or greater than the calculated peak sewage flow:

\[ Q = \frac{1}{n} \times A \times R^{2/3} \times S^{1/2} \]

where:
- \( Q \) = Design flow (l/sec.)
- \( n \) = Mannings roughness coefficient
- \( A \) = cross sectional area of flow (m²)
- \( R \) = hydraulic radius (area/wetted perimeter (m))
- \( S \) = slope of pipe (m/m) - %

Notwithstanding the above, the minimum size storm sewer pipe permitted is 300 mm.

On private property, the minimum size for storm building sewer shall be 100mm, in accordance with Part 7 of the Ontario Building Code.

5.11 FLOW VELOCITY

Velocity shall be calculated using the following formula:

\[ V = \frac{Q}{A} \]

where:
- \( V \) = flow velocity (m/sec)
- \( Q \) = Design flow (l/sec)
- \( A \) = cross sectional area of flow (m²)

5.11.1 Minimum Velocity

The minimum velocity permitted in storm sewers is 1.0 m/sec.

5.11.2 Maximum Velocity

The maximum velocities permitted in storm sewers are:

- 4.5 m/sec for 300 mm to 825 mm diameter sewers, and
- 6.0 m/sec for 900 mm diameter and larger storm sewers.

To determine velocities based on actual flow, refer to Figure 5.4 “Hydraulic Elements Graph for Circular Pipe”.

Note, anchoring or concrete encased sewers are required for steep grades and/or velocities.
5.11.3 Minimum Grades

a) The minimum grade on a 300 mm diameter storm sewer is 0.54%.

b) The minimum grade on all other sewer sizes shall be established by determining the minimum grade necessary to achieve a velocity of at least 1.0m/sec.

c)

5.12 PIPE MATERIAL

Both rigid and flexible pipe are permitted in the construction of storm sewer systems including private drain connections and catchbasin leads. These materials include concrete, polyvinyl chloride and high-density polyethylene.

The criteria for using these materials is described in the City of London Standard Contract Documents for Municipal Construction Projects - Section 410.05.01.

On private property, materials for storm building sewers and private sewers shall comply with Part 7 of the OBC.

5.13 PIPE DEPTH AND BEDDING MATERIAL

5.13.1 Minimums

The minimum depth of a storm sewer shall be 1.5 m from the finished ground elevation to the obvert of the pipe. Where minimum depths cannot be achieved and therefore frost protection is warranted, insulation is required as per City of London W-CS-68.

5.13.2 Maximum Depth of Cover

a) Concrete Pipe

i) See City of London SW-1.0 and SW-1.1 for details and additional design information for bedding standards for Class A, B and C beddings.

ii) Municipal Projects

The maximum allowable cover permitted on concrete pipe to be constructed under a Municipal or Capital Works Project is to be based on OPSD 807.010, 807.030, 807.040 and 807.050.

Where the pipe required exceeds the OPSD charts, the Pipe Pac Program 2000 will be used, utilizing the following variables:

- all units are in metric and conform to C.S.A. standards
- wall thickness is based on C.S.A A257.2M, Type B wall
- soil density = 2000 kg/m³
- Ontario Highway Bridge Design Code (OHBDC)
  - live load magnitude = 25 tons
- projection ratio = 0.70
- lateral pressure ratio = 0.33
- lateral pressure friction 'm' = 0.70
- settlement ratio = 0.70
- $k \cdot \mu(\mu) = 0.1924$
- variable bedding factors $B - Lf = 1.9$  $C - Lf = 1.5$
- $r_{sup} = 0.49$ (calculated)
- factors of safety
  - 0.3mm crack D-load = 1.00
  - ultimate earth and live load = (ASTM C 76M)
    - $DL.03 \leq 100 \, N/m/mm = 1.50$
    - $DL.03 \geq 140 \, N/m/mm = 1.25$
    - $DL.03$ between 100 and 140 $N/m/mm = interpolated$
- positive projection embankment installation
- maximum depth of cover is based on transition width design
- depth of ground is measured from the ultimate finished ground elevation to the outside top of pipe.

iii) New Subdivisions

The maximum allowable cover permitted on concrete pipe to be constructed in a new subdivision is to be designed based on transition width, and utilize reinforced concrete pipe only, in accordance with OPSD 807.030 and 807.050 (Positive Projecting Embankment Installation only).

Where the pipe required exceeds the OPSD Charts, the Pipe Pac Program 2000 utilizing the variables noted in 13.14.2.ii) or 15.13.2.ii) above, or First Principles (using City of London Variables) will be used.

b) Flexible Pipe

The maximum allowable cover permitted on flexible pipe is 10.5 m. The following bedding types are to be used:

- for up to 4.5 m - Type 1 (see City of London SW-1.0)
- for up to 10.5 m Type 2 (see City of London SW-1.0)

d) Where trench conditions are expected to exhibit ground water in silt or fine sand, specified bedding will be defined as 19mm crushed stone entirely surrounded by geotextile.
5.13.3 Crossing Clearances

There are minimum clearances required when storm sewers cross other services. In all cases this is measured from outside wall diameter to outside wall diameter.

When crossing over or under a sanitary sewer, 230mm clearance is required.

For vertical clearances from the storm sewer to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

5.13.4 Minimum Distance Between Sewers

The minimum distance between sewers shall be 3.0m as per drawing UCC-1M and UCC-2M. Special cases to be reviewed for site specific design constraints and depths.

5.13.5 Trenchless Technologies

When trenchless installation methods are being considered for new works, please refer to Section 17 – Trenchless Technologies (for New Construction).

5.14 MAINTENANCE HOLES

5.14.1 Spacing of Maintenance Holes

The maximum spacing between storm maintenance holes is dependent on the pipe size. The maximum spacing between maintenance holes when the pipe is 300-975mm diameter shall be 99m measured horizontally or 110m measured vertically from the top of the maintenance hole to the springline of the pipe, along the springline to the next maintenance hole and vertically to the top of the maintenance hole.

Following are the maximum allowable horizontal spacing for the corresponding pipe sizes, larger than 975mm:

<table>
<thead>
<tr>
<th>Length</th>
<th>Sewer Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>99m</td>
<td>300 – 975mm</td>
</tr>
<tr>
<td>130m</td>
<td>1050 – 1350mm</td>
</tr>
<tr>
<td>160m</td>
<td>1500 - 1650mm</td>
</tr>
<tr>
<td>305 m</td>
<td>1800 mm and larger</td>
</tr>
</tbody>
</table>

When spacing of a maintenance hole dictates that the maintenance hole should be placed within the area of a roundabout, storm maintenance holes are permitted to be
located within the grassed area of the roundabout, provided any proposed landscaping does not hinder the access to the maintenance hole.

Required where there is a change in the direction of the flow, slopes, a change in the diameter of sewers, and/or a lateral sewer connection. **Note, a minimum 300mm clearance is required between services within a maintenance hole.**

### 5.14.2 Pre-cast Maintenance Hole Sizing Criteria

All sizing of storm pre-cast maintenance holes are based on incoming and outgoing pipe sizes and should be sized and conform to Figure 5.5.

**Note, a minimum 300mm clearance is required between services within a maintenance hole.**

### 5.14.3 Maintenance Hole Diameters

Pre-cast maintenance hole diameter requirements are as follows:

a) **1200 mm Diameter**  
   See OPSD 701.010 and OPSD 701.030 for details and additional design information.

b) **1500 mm Diameter**  
   See OPSD 701.011 and OPSD 701.040 for details and additional design information.

c) **1800 mm Diameter**  
   See OPSD 701.012 and OPSD 701.050 for details and additional design information.

d) **2400 mm Diameter**  
   See OPSD 701.013 and OPSD 701.060 for details and additional design information.

e) **3000 mm Diameter**  
   See OPSD 701.014 and OPSD 701.070 for details and additional design information.

f) **3600 mm Diameter**  
   See OPSD 701.015 and OPSD 701.080 for details and additional design information.

**Poured Maintenance Holes** - Required for maintenance holes which exceed the above maximum pipe sizes for precast maintenance holes. **Note, certification by a Structural Engineer is required for all poured maintenance holes.**
5.14.4 **Maintenance Hole Tees**

Maintenance hole tees can be constructed in lieu of regular maintenance holes on 1200 mm diameter or greater trunk sewers. See City of London SW-5.1 for details and additional design information.

Note: a) No deflections or lateral connections are to be constructed within the proposed maintenance hole tee.

b) Maintenance hole tees are to be located upstream to a deflection or change in sewer sizes.

5.14.5 **Maintenance Hole Frame and Covers**

Maintenance hole frames and covers are required for all maintenance holes and shall conform with OPSD 401.01. See OPSD 401.01 for details and additional design information.

Maintenance hole frames and covers and by association steps must be aligned to avoid being located in the wheel path of the street, and to be located above a benching platform, i.e. to avoid conflict with an inletting or outletting sewer pipe, respectively. Proposed location of maintenance hole frames and covers and by association steps must be shown in plan view on the engineering drawings, represented by a solid circle reflecting the above requirements.

**Note, maintenance hole frame & covers are to be clear of curb & gutters on bends in the road.**

5.14.6 **Lockable Maintenance Hole Cover**

Lockable maintenance hole covers are required to reduce access by the public. They can be located through park blocks, open space blocks, pumping stations or pollution control plants. See OPSD 401.06 for details and additional design information.

5.14.7 **Maintenance Hole Steps**

Maintenance hole steps are required for access and are to conform with one of the following:

a) **Maintenance Hole Steps - Hollow**

   See OPSD 405.010 for details and additional design information.

b) **Maintenance Hole Steps - Solid**

   See OPSD 405.020 for details and additional design information.

Note: a) All steps are to be galvanized steel or aluminum.
b) A detail or restoration plan is required for the relocation of maintenance hole steps within existing maintenance holes, where applicable.

c) Maintenance hole steps shall be located to avoid conflict with an inletting or outletting sewer pipe. Access to maintenance holes must be above the benching platform.

d) Refer to Section 5.14.5 for alignment information for location requirements for the Maintenance hole frame and cover.

5.14.8 Maintenance Hole Drop Structures

Storm drop structures are required when the difference in invert elevations between the upstream and outlet sewers in the maintenance hole is equal to or greater than 0.9 m. See City of London SW-2.0 for details and any additional design information.

5.14.9 Maintenance Hole Safety Landings

Maintenance hole safety landings are required at the mid-point depth of the maintenance hole, when the depth of the maintenance hole is between 5.0m and 10.0m. Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0 m to 15.0 m deep. See City of London SW-2.5 for details and additional design information.

Note: Incoming pipes are to be below safety landings, where possible.

5.14.10 Benching

All maintenance holes require benching at the bottom of the maintenance hole and shall conform to OPSD 701.021. Benching height should be increased to obvert to increase hydraulic benefit as required.

Note: Where benching is different from OPSD 701.021, a benching detail is required.

5.14.11 Steps in Benching

Steps in maintenance hole benching are required when the pipe diameter is greater than 900 mm and benched to spring line, and when the pipe diameter is greater than 450 mm and benched to crown. See City of London SW-5.2 for details and additional design information.

5.14.12 Adjustment Units

Maintenance hole adjustment units are required on all maintenance holes to ensure that proper grade is provided between the top of the maintenance hole and the maintenance hole lid. Ensure that the difference in grade between the maintenance
hole lid and the first ladder rung does not exceed 600 mm. See City of London SW-5.0 for details and additional design information. Clay brick will not be allowed for use as maintenance hole adjustment units.

5.14.13 Head Losses

a) Generally, when velocities in the downstream pipe from a maintenance hole exceed a velocity of 1.2 m/s, head losses must be accounted for in the design of the sewer and larger PDC’s. In order to absorb head losses that may exist in maintenance holes, it may be necessary to improve the benching in the maintenance hole or increase the size of the downstream pipe where possible. Lowering the crown of the outgoing sewer below the crown of the incoming sewer by the amount equal to the head loss, however, is the most effective method of accounting for head loss in most cases.

b) Drops in maintenance holes to compensate for Head Loss (\(H_L\)) shall be calculated using the following formula:

\[
H_L = \frac{K_L \cdot V^2}{2g}
\]

Where:
- \(K_L\) = Head loss coefficient
- \(V\) = downstream velocity
- \(g\) = 9.8 m²/sec

Note: Also see Figure 5.6 for quick reference for head losses in maintenance holes, and Section 5.14.10 for benching.

c) Head loss coefficients (\(K_L\)) are to be applied as follows:

i) 90 degrees
No benching or deflector, or where they are only up to spring line.
\(K_L = 1.5\)

ii) 90 degrees
Benching or deflector to crown of sewers.
\(K_L = 1.0\)

iii) Less than 90 degrees
Multiply the head loss coefficient for a 90 degree bend by a head loss ratio factor from the following chart:
iv) Junctions
- Tee
  Outlet at right angles to inlets and no deflector between inlets.  
  \( K_L = 1.5 \)

  Deflector between inlets for full height and width of incoming flows. 
  \( K_L = 1.0 \)

- Side and Cross Junctions
  Value of \( K_L \) is obtained from the following chart:
v) For $K_L$ values for calculating head losses in curved sewers (radius pipe), see Figure 5.7.

5.14.14 Maintenance Hole Access

A 3.0m to 4.6m wide topsoil and sodded access without trees, plantings or other obstructions is required for maintenance vehicles and equipment used to access and service all storm maintenance holes with easements, open space areas, designated blocks and existing right-of-ways (i.e. boulevard). Adequate curves and turn-around facilities are required for maintenance vehicles to maneuver. Slopes (10% maximum), crossfalls (2% minimum) and drainage of access roads are also to be addressed in the design.

Note: A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s).

See Section 5.17 for easement requirements.

5.14.15 Maintenance Hole Construction Practices

a) The void between the sewer pipe and the cored hole of the precast maintenance hole section shall be filled with cement bricks and approved non-shrinkable grout. Pre booted maintenance holes will be allowed but only with previous approval by the City. All joints between bricks are to be completely filled with concrete mortar. Bricks are to be parged on the outside. Parging shall contain an approved bonding agent. All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with the manufacturer’s specifications.

b) All pre-cast maintenance hole section joints shall contain an approved rubber gasket.

c) A minimum 300 mm vertical/horizontal clearance between openings on the inside of the maintenance hole is required for all sewer and PDC connections.

d) All maintenance hole frame and covers shall be adjusted to the finished road grade by means of metal shims at each corner or by means of an approved pre-cast adjustment ring. Metal shims are to be at least 75 mm x 200 mm (3" x 8") and their thickness is to be determined by the adjustment required. The space between the bottom of the maintenance hole frame and cover and the top of the pre-cast maintenance hole is to be at minimum the thickness of one adjustment unit and at maximum 300 mm. See City of London SW-5.0 for details and additional design information.

e) Where adjacent maintenance holes are located in close proximity to one another.
f) The area between the adjacent maintenance holes shall be backfilled in accordance with the specifications in the following table:

<table>
<thead>
<tr>
<th>Distance Between Adjacent Maintenance Holes</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 metres or less</td>
<td>concrete or crushed stone</td>
</tr>
<tr>
<td>0.6 metres to 2.4 metres</td>
<td>granular material</td>
</tr>
<tr>
<td>more than 2.4 metres</td>
<td>approved native material or granular material</td>
</tr>
</tbody>
</table>

The above noted backfill shall be compacted to the Standard Proctor Density specified in the soils report, or as approved by the City Engineer.

5.14.17 Sampling/Inspection Maintenance Holes

a) Requirements
   Sampling/Inspection Maintenance Holes are required where Commercial, Industrial and sometimes Institutional developments outlet to storm sewers owned and maintained by the City. The requirement for sampling/inspection maintenance holes will be reviewed on a site specific basis, through the Site Plan Review Group.

b) Location
   If required, sampling/inspection Maintenance Holes shall be located on private property as close as possible to the property line, or as approved by the City Engineer.

c) Minimum size
   Sampling/Inspection Maintenance Holes shall be a minimum of 1200mm diameter. A larger diameter Maintenance Hole may be required if noted on the Building Permit Application Drawings.

   Sampling/Inspection Maintenance Holes that have more than one inlet sewer shall be increased in size to ensure that there is a minimum of 0.9m benching length downstream of all inlet sewers.

   Maintenance Holes shall be to OPSD standards – see Section 5.14.13, and Figure 5.10 for further details.
5.15  PRIVATE DRAIN CONNECTIONS (PDCs)

5.15.1  Location

PDCs to single family and semi-detached lots are to be located in accordance with City of London SW-7.0.

PDCs to multi-family (townhousing, rowhousing and apartments), commercial and industrial developments are to be connected to a maintenance hole or sewer on the right-of-way. See section 5.15.3 for further details.

PDCs shall be installed at 90° to the sewer main where possible. Under no circumstance will flow from the PDC enter the main against the flow in the main. Where horizontal or vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable.

Note: Where design constraints arise (ie top end of cul-de-sac or crescent) PDCs may have to be located in reverse location and identified as such on the servicing drawings.

5.15.2  Minimum Size and Grade

a) The minimum diameter and grade of a PDC for a residential, single family and semi-detached lot is 100 mm @ 2%.

b) The minimum diameter and grade of a PDC for a residential multi-family block is 300mm diameter @1.0%.

c) The minimum diameter and grade of a PDC for a non-residential block is 375mm diameter @ 1.0%.

d) The minimum diameter and grade of a PDC for a commercial block is 300mm diameter @ 1.0%

e) The minimum diameter and grade of a PDC for an institutional block is 375 mm @ 1.0%.

Note: The actual size of the PDC required for multi-family non-residential, commercial and institutional blocks is dependant on the flows.

5.15.3  Connections to Sewers/Maintenance Holes

a) Residential

Storm PDCs 100mm, 150mm, 200mm and 250mm in diameter are to be constructed to the main sewer, except in cases where a maintenance hole is located at the top end of a system (i.e. cul-de-sac).
b) Multi-family, Commercial and Institutional

Storm PDCs 300mm in diameter and larger are to be connected to the main sewer at the maintenance hole, except in cases where the main sewer is 900 mm in diameter or larger, in which case the PDC may be connected directly into the sewer.

c) Connections to Existing Sewers for Lot Infill Situations

i) In a situation where a lot severance or lot infill condition exists, and a new storm service will be connected to an existing storm mainline, the advocate of the severance/infill, or his agent, must determine if the existing storm sewer is a combined or poorly separated sewer and is therefore at risk of surcharging. This information can be obtained from Wastewater Engineering Division. If it is determined that there is a surcharge risk, the development advocate must provide surcharge protection to his development.

ii) When connecting PDC’s to existing sewers in a lot infill situation, connections must be made utilizing an approved saddle or pre manufactured tee, in accordance with OPSS 410, as amended by the Supplemental Standards for Sewer and Water (SW) in the City of London Standard Contract documents for Municipal Connection Projects.

5.15.4 Vertical Clearance

For vertical clearances from the storm PDC to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

5.15.5 PDC Detail

Typical PDC installation to the main, as per City of London SW-6.0.

5.15.6 PDC Risers

a) Type I

Required for sewer depths greater than or equal to 4.5 m and for excavations in stable bank conditions, see City of London SW-6.1 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

b) Type II

Required for sewer depths greater than or equal to 4.5 m and for excavations in unstable bank conditions, see City of London SW-6.2 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.
5.15.7 PDC Cleanouts

Where PDC cleanouts are required within the right-of-way, they shall conform to SW-6.3. On private property, storm building sewers and private sewers shall be provided with cleanouts/maintenance holes, in accordance with Part 7 of the OBC. Cleanout/maintenance holes shall be located in accordance with SW 6.3.

5.15.8 Pipe Material

See Section 5.12 for acceptable pipe material.

5.15.9 Depth and Bedding

The minimum depth of a storm PDC shall be 1.5 m from the finished property line elevation to the obvert of the PDC. The maximum cover on a storm PDC shall be based on the following:

a) Concrete Pipe
   The maximum allowable cover permitted on concrete PDCs is to be as per Section 5.13.2 a.)

b) Flexible Pipe
   The maximum allowable cover permitted on flexible PDCs is to be as per Section 5.13.2.b).

5.15.10 Marking and Recording PDC Service Connections

Green painted surface stakes 40mm X 90mm (standard 2" X 4") shall be placed after trench restoration to mark the termination of storm PDC’s. These stakes shall extend from PDC invert to minimum 450mm above finished boulevard grade.

Plugged or capped service connections shall be marked on the top surface of the last 3m of the upstream end of the pipe with orange PVC adhesive tape (50mm wide) labeled continuously in black lettering (40mm wide) “CAUTION STORM SEWER”

New PDCs to Existing Properties – To be constructed to 1.2m inside the road allowance.

PDCs to Parklands – Location, design and where warranted to be reviewed and approved by Parks Planning & Design.

PDCs Not Required – When the Geotechnical Engineer certifies that storm PDCs are not required, as per the City of London Drainage By-Law (WM-4).
5.16 CATCHBASINS

Catchbasins are to be provided to collect drainage from both pervious and impervious areas. The following are the general guidelines to be used in the provision of catchbasins and catchbasin leads.

5.16.1 Location

a) Street - On street corners and intersections, the catchbasin is to be located 0.6 m from the BC or EC of the curvature, and/or located on the line or 1.5m from the centre of the lot to avoid conflicts with driveway and lot servicings respectively.

b) Lot/Rear Yard - The catchbasin and lead are to be located 0.6 m from the property line, entirely on one lot or block.

c) Parks - Catchbasins are to be located to minimize flow across pathways and provide positive drainage from park facilities.

5.16.2 Minimum Lead Diameter and Grade

a) Street - The minimum diameter and grade of a catchbasin lead on a street is 250 mm @ 0.69% (velocity of 1.0 m/s).

b) Lot - The minimum diameter and grade of a catchbasin lead in a rear yard is 300 mm @ 0.54% (velocity of 1.0 m/s).

c) Parks - The minimum diameter and grade at the catchbasin lead in a park is 250mm at 0.69% (velocity of 1.0m/s).

5.16.3 Spacing

The desired maximum distance between catchbasins or from a crest in a road to a catchbasin is 90 m, measured along the curb line for each side of the road.

5.16.4 Types of Catchbasins

a) Catchbasin - 600 mm x 600 mm

Catchbasins (CB) are to be constructed on all streets and some rear yards, see OPSD 705.010 for details and additional design information. Also, refer to Section 5.16.7 for details and additional design requirements.

b) Curb Inlet Catchbasin

Curb inlet catchbasins (CICB) are to be constructed at all low points in the curb and gutter on local, secondary collector and primary collector roads. Curb inlet catchbasins are to be constructed exclusively on all arterial road networks. See City of London SW-3.0.
Note: Driveway locations are to be identified where curb inlet catchbasins are required.

c) **Catchbasin Maintenance Hole**

Catchbasin maintenance holes (CBMH) are to be constructed in rear yards, see City of London SW-4.0 for details and additional design information. Also, refer to 5.16.7 for additional design requirements.

d) **Ditch Inlet Catchbasins**

Ditch inlet catchbasins (DICB) are to be constructed for ditch drainage along arterial roads, where arterial grading can not be provided. They are also to be constructed for temporary block drainage and for outlets/inlets within a stormwater management pond. See OPSD 702.040 and OPSD 702.050 or OPSD 705.030 and OPSD 705.040 for details and additional design information.

e) **Twin Inlet Catchbasins**

Twin inlet catchbasins (OPSD 705.020) are to be used in lieu of curb inlet catchbasins under specific circumstances such as:

a) At a sag in a street with no curb and gutter

b) In industrial subdivisions where barrier or mountable curb is specified, where driveway locations are not determined.

c) As approved on a site specific circumstance by the City engineer.

5.16.5 **Depth of Cover**

The minimum depth of cover over a catchbasin lead is to be 1.5 m within the road allowance and 1.2 m off the road allowance.

Note: Where minimum depths cannot be achieved and therefore frost protection is warranted, insulation is required as per City of London W-CS-68.

5.16.6 **Allowable Ponding**

a) No surface ponding is allowed to develop under a 2 year design storm event. Ponding on major overland flow routes allows for 300 mm on street catchbasins and 450 mm on rear yard catchbasins. See Grading Section 9.2 and 9.4 for further design information.

b) In new developments, flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.
c) Flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.

d) In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.

5.16.7 Requirements for Length of Leads

Standard catchbasins (600 x 600), maintenance hole catchbasins and maintenance holes are to be constructed/connected in accordance with the following:

a) Catchbasins within 9.0 m of a maintenance hole are to have their leads connected into the maintenance hole.

b) Catchbasin leads 9.0 to 15.0 m may have their leads connected into the main sewer.

c) Catchbasin leads 15.0 to 30.0 m in length may be constructed by:

i) having a catchbasin at one end and the other connected into a maintenance hole or a sewer 900 mm in diameter and larger, or by

ii) having the lead connected into a sewer 825 mm in diameter or smaller at one end with a maintenance hole catchbasin at the other end.

d) Catchbasin leads over 30.0 m in length, are to be connected into a maintenance hole or a sewer 900 mm in diameter or larger at one end and have a maintenance hole catchbasin at the other end.

5.16.8 Catchbasin Frame and Grates

a) Catchbasin Cast Iron Frame and Flat Square Grate

To be constructed in conjunction with a catchbasin - 600 mm x 600 mm and a catchbasin maintenance hole. See OPSD 400.02 for details and additional design information.

b) Catchbasin Cast Iron Curb Inlet Overflow Plate

To be constructed in conjunction with a curb inlet catchbasin. See OPSD 400.09 for details and additional design information.

c) Ditch Inlet, Galvanized Steel, Honey Comb – Grating

To be constructed in conjunction with a ditch inlet catchbasin. See OPSD 403.01 for details and additional design information.
5.16.9 Catchbasin Steps

a) Maintenance Hole Steps - Hollow

To be constructed in conjunction with a pre-cast catchbasin maintenance hole. See OPSD 405.010 for details and additional design information.

b) Maintenance Hole Steps - Solid

To be constructed in conjunction with a catchbasin maintenance hole. See OPSD 405.020 for details and additional design information.

5.16.10 Catchbasin Connections

a) Catchbasin Connection - Rigid Pipe Sewer

To be constructed in conjunction with a catchbasin - 600 mm x 600mm. See OPSD 708.010 for details and additional design information. Catchbasin lead bedding Class B & Class C to be in accordance with City of London Standard SW – 1.0. Structural design of concrete catch basin leads to be in accordance with section 5.13.

Flexible Pipe:

Catch basin lead bedding type 1 (up to 4.5m) & type 2 (up to 10.5m), in accordance with City of London Drawing Standard SW-1.0.

b) Catchbasin Connection - Flexible Pipe Sewer

To be constructed in conjunction with a catchbasin - 600 mm x 600mm. See OPSD 708.030 for details and additional design information.

c) Vertical Requirements

Where Catch Basin leads are to be installed at greater than 45° vertically, installation shall be as per OPSS 410.07.13, as amended by City of London Supplemental Standards for Sewer and Water.

5.16.11 Maintenance Hole Adjustment Unit

Maintenance adjustment units are required to ensure that the difference in grade between the top of the catchbasin maintenance hole lid and the first ladder rung does not exceed 600 mm. See City of London SW-5.0 for details and additional design information.
5.16.12 Catchbasin Lead Material

Both rigid and flexible pipes are permitted for the construction of catchbasin leads. These materials include concrete and polyvinyl chloride. In most cases flexible catchbasin leads are constructed.

The criteria for using these materials are described in the Standard Contract Documents for Municipal Construction Projects, Section 410.05.01.

5.16.13 Concrete Curb Setbacks

Concrete curb setbacks are to be constructed in conjunction with all catchbasins (600 mm X 600 mm and curb inlet catchbasins) located within curb and gutter on the right-of-ways. Concrete curb setbacks shall not be implemented when curb face sidewalk is specified. See City of London SR-3.0 for details and additional design information.

5.16.14 Minimum Building Setbacks

Required for all catch basin leads which abut a lot line adjacent to a building. These setbacks are to be equivalent to the City of London sewer easement setbacks. If setbacks cannot be achieved then the following is required:

a) Reduced setbacks and adjacent underside of footing elevations (i.e. footings to be outside of the trench excavation)

b) A separation of at least 3.0m between buildings adjacent to the catch basin lead.

c) A minimum 1.0m offset from the face of the wall of the building to the catch basin must be provided.

Details – Plan & profiles of all rear yard catch basin leads are required together with all pertinent details.

5.16.15 Mini Catchbasins

Mini Catchbasins shall only be installed on arterial roads as per a), b) and c) below. Mini catchbasins shall not be used on primary collector or lower classification roads unless otherwise directed by the Engineer.

a) Mini Catchbasins shall be installed to collect runoff water when arterial roadways are reconstructed during the period between installation of base asphalt and surface asphalt. The mini catchbasins shall conform to the ABT Polydrain 900 Series. (See Fig. 5.9)

b) Mini catchbasins shall only be installed at the sag points of vertical curves, directly in front of the Curb Inlet Catchbasin, and finished flush with the base
asphalt. The mini catchbasin shall be connected to the CICB with a 150mm PVC lead. The frame and grate of the mini catchbasin shall be D.I., with stainless steel latches, have a nominal 67% open area, be bicycle proof, and meet HS25 load ratings for roads and highways. Mini catchbasins are to be retrofitted, installed after the base asphalt is applied.

d) Prior to surface asphalt placement, the mini catchbasin frame and grate shall be remove, and the catchbasin pot and lead shall be completely filled with concrete. The CICB shall be completely sealed with concrete and parged.

5.16.16 Catch Basin Subdrains

Pipe subdrains shall be provided on both sides of all catchbasins installed in hard surface areas. Subdrains are not required in rear lot catch basins or in catch basins located in grassed areas.

All subdrains shall be 150mm diameter, minimum 3.0m long, either of perforated corrugated steel pipe or PVC pipe. Perforations shall consist of 6mm holes in four rows positioned at 4, 5, 7 and 8 o’clock and 75mm apart longitudinally in both materials.

Pipe subdrains shall be connected to the 200mm knockout provided in the catch basin pot, typically at subgrade elevation, shall be laid parallel with the curb, and at the same grade as finished road grade. Pipe subdrains shall be capped at the upstream end with a pre manufactured end cap or with cement brick and non shrink grout.

Where pipe subdrains are required for use as a French drain in lot drainage situations, pipe subdrains shall be fully bedded in 19mm stone, which, in turn, will be completely surrounded by geotextile.

For all other conditions, pipe subdrains shall be completely wrapped in Terrafix 270R or approved equivalent.

All connections should be in accordance with City of London Drawing Standards SW-3.1.

5.17 EASEMENTS

Easements are required for all sewers to be assumed by the municipality located outside a road allowance on privately owned property.

An easement is required to ensure the municipal services and utilities crossing the site can be properly installed and maintained by the appropriate authority (municipality or private). An easement provides the right to use private land for a specific purpose which is in the public’s interest.
All manholes located within easements require surface access. Refer to Section 5.14.14 for access details. Maintenance vehicle access is not required for rear lot catch basin manholes.

5.17.1 Types of Easements

a) Multi-purpose Easement for Municipal Services

Are required for watermains, sanitary & storm sewers, catchbasins, drains, stormwater management ponds, channels and/or access roads that cross a site and which are maintained by the City.

Note: Typically, easements are not required for rear yard catchbasins. If rear yard catchbasins are designed to receive water from municipal lands, such as parklands, easements are required.

b) Utility Easement

Utility easements are required for telephone, hydro, gas and cable television services. Each utility company should be consulted for their specific requirements.

c) Private Easements

Private easements are required for private storm sewers, access roads and other private services that cross a parcel of land to service other private lands. A joint access and maintenance agreement between interested parties shall be entered into.

d) Temporary and Working Easements

Temporary easements are required for watermains, sanitary & storm sewers, drains, stormwater management ponds, channels and/or access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

Working easements are required, as necessary during construction, to allow for the safe construction and restoration of the disturbed surface area. Once construction is completed, the working easement is released.

Temporary easements are required for storm sewers and access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.
5.17.2 **Easement Widths**

Easement widths are determined by the diameter of the pipe being installed and the depth of cover from the centreline of the road/ground over the pipe to the invert of the sewer or watermain. Figure 5.8 shows how an easement width is determined. The minimum width of a sewer easement shall be 4.8 m (2.4 m per side).

5.18 **STORM SEWER INLET AND OUTLET STRUCTURES - HEADWALLS**

Headwalls are required at the end of all storm sewer systems which provide for a transition from the storm sewer to an open channel, river, creek, SWM pond or other receiving body of storm water. In some cases headwalls are required at the inlet of a storm sewer and/or large storm drain.

5.18.1 **Types of Headwalls**

The following headwall designs are based on the velocity and in certain cases the diameter of the storm sewer, which was taken from Municipal Works Design Manual (Municipal Engineers Association - MEA) and Ontario Provincial Standard Drawings.

There are five types of headwall designs and they are as follows:

a) **Under 1.3 m/s with pipes diameters under 600 mm** - see OPSD 804.03 for details and additional design information.

b) **Under 2.1 m/s – MEA Type I (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04)**

c) **2.1 m/s to 2.7 m/s - MEA Type II (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04; and 1 baffle post)**

d) **2.7 m/s to 4.6 m/s - MEA Type III (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04; and 3 baffle posts)**

e) **4.6 m/s to 10.0 m/s - MEA Type IV (stilling basin), or detail design.**

5.18.2 **Concrete Strength**

The concrete for all headwalls is to have a minimum strength of 30 MPa with a 5% to 7% air entrainment and 70 to 90 mm slump.

5.18.3 **Chamfers**

All exposed corners of all headwalls should be chamfered 25 mm or more depending on the size of the headwall.
5.18.4 Weeping Tiles

Weeping tiles are to be provided on each side at the base of the sewer outlet and extended through the headwall. On larger headwalls they are placed on the side or wing walls.

5.18.5 Baffle Posts

Baffle posts are to be provided for sewer flows between 2.1 m/s and 4.6 m/s. The location of the posts are per the type of headwall (refer to Municipal Works Design Manual). The height of the baffle posts should be equal to the full depth of flow. Sizing of the posts are 1/6 the size of the pipe diameter together with reinforcing bars.

5.18.6 Grill/Grates

Hot dipped galvanized grills/grates are to be placed over the storm outlets horizontally or vertically as required and should be fixed to the headwall with anchor bolts. Grills and grates shall comply with OPSD 804.05.

5.18.7 Railing

A railing is required on all headwalls which exceed 1.0 m in height from the top of the headwall to the proposed top of slope. See OPSD 980.101 for details and additional design information. All headwalls are to have a swale at the top of the structure to allow for surface drainage.

5.18.8 Rip Rap/Rock Protection

Rip rap is to be constructed at the end of all headwalls of all storm sewer systems and is to be placed in accordance with OPSD 810.01 and the following design criteria:

a) on the bottom and sides up to design water levels;

b) downstream until the projection of the side walls meet the channel side slopes at half the design water depth of flow; and

c) for headwalls at creeks and rivers, extend rip rap or gabion protection to creek or river.

Protection is to provide a smooth hydraulic flow for headwall discharge and creek or river flows.

Note: Rip rap design information etc. is to be in compliance with OPSS-1004. The minimum size of rip rap is 100 mm and the maximum size is 200 mm. Rock protection shall be well-graded in sizes ranging from 100mm to 500mm.
5.19 **Sediment & Erosion Control**

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area; an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.
## Storm Sewers

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Note: Refer to Section 18 regarding additional design information for new subdivisions.

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<th>Location</th>
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STORM SEWER DESIGN CHART

DMG: FIG. 6.1 | DATE 2012 01 26

CITY OF LONDON
Note: Refer to Section 18 regarding additional design information for new subdivisions.
Note: Refer to Section 18 regarding additional design information for new subdivisions.
NOTE:

1. INFORMATION TAKEN FROM THE AMERICAN
   SOCIETY OF CIVIL ENGINEERS (A.S.C.E.) MANUAL.

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HYDRAULIC ELEMENTS GRAPH FOR CIRCULAR SEWERS

Note: Refer to Section 18 regarding additional design information for new subdivisions.
### Design Specifications & Requirements Manual

**Note:** Refer to Section 18 regarding additional design information for new subdivisions.

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### Maximum Pipe Sizes for Precast Maintenance Holes

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<tr>
<th>Maintenance Hole Inside Diameter (mm)</th>
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<th>Max. Pipe Size for Right Angle Installation (mm)</th>
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<tr>
<td>1200</td>
<td>600</td>
<td>450</td>
</tr>
<tr>
<td>1500</td>
<td>825</td>
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</tr>
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<td>2400</td>
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<td>3000</td>
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<td>1500</td>
</tr>
<tr>
<td>3600</td>
<td>2400</td>
<td>1650</td>
</tr>
<tr>
<td>3000 x 2400</td>
<td>1950</td>
<td>1500</td>
</tr>
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</table>

**Notes**

1. All dimensions are for concrete pipe.
2. All dimensions are in millimetres.
3. Knockouts for small diameter catch basins lead sizes 300mm or less could be provided in addition to what is shown.
4. Information taken from the Ontario Concrete Pipe Association (O.C.P.A.)

**City of London**

**Maximum Pipe Sizes for Precast Maintenance Holes**

| DWG | FIG 55 | DATE 2002 12 17 |
Note: Refer to Section 18 regarding additional design information for new subdivisions.
Note: Refer to Section 18 regarding additional design information for new subdivisions.
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Minimum Easement Width - from Oil of Sewer - Meters

Depth to Invert - Meters

Minimum Width

Notes:
1. Minimum easement width
   Measured from Oil of Sewer Pipe
   Keep not less than 500 mm below ground level
   Width of easement required = 4.0 m
   Each side or a total width of 7.2 m

2. Through fields, open space, etc., at 4.5 m
   4.5 m on one side of Sewer Oil and 4.5 m on the other or at least 6.0 if wider
   Than the minimum width obtained from this chart, as required by the City Engineer.

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MINIMUM EASEMENT WIDTH

Dwg 6.8 Date 2012. 01 26

Note: Refer to Section 18 regarding additional design information for new subdivisions.
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ABT SERIES 900 MINI CATCH BASINS

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Updated: September 2012

Note: Refer to Section 18 regarding additional design information for new subdivisions.
CITY OF LONDON STANDARD DRAWING

SAMPLING MAINTENANCE HOLE SANITARY & STORM SEWERS

NOTES:
1) DETAILS NOT INDICATED SHALL BE IN ACCORDANCE WITH CITY OF LONDON STANDARDS FOR MAINTENANCE HOLE CONSTRUCTION
2) MAINTENANCE HOLE SHALL BE LOCATED ON PRIVATE PROPERTY AS CLOSE AS POSSIBLE TO THE PROPERTY LINE OR AS APPROVED BY THE CITY ENGINEER.
3) 1200mm DIAMETER OR LARGER, PREFAB MAINTENANCE HOLE TO THE CITY OF LONDON STANDARDS IS ACCEPTABLE.
4) LARGER MAINTENANCE HOLE SIZE WILL BE REQUIRED IF NOTED ON BUILDING PERMIT APPLICATION DRAWINGS.
5) MAINTENANCE HOLES THAT HAVE MORE THAN ONE INLET SEWER WILL BE INCREASED IN SIZE TO ENSURE A MINIMUM OF 900mm RACHING LENGTH DOWNSTREAM OF ALL INLET SEWERS (SEE DETAILS ABOVE)
6) MAINTENANCE HOLE STEPS TO BE IN ACCORDANCE WITH DPSD-405.010 & DPSD-405.020
7) CLASS OF CONCRETE ±1000PA AT 28 DAYS

NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

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Note: Refer to Section 18 regarding additional design information for new subdivisions.
6 STORMWATER MANAGEMENT POND REQUIREMENTS

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6 **STORMWATER MANAGEMENT POND REQUIREMENTS**

6.1 **BACKGROUND INFORMATION**

Based on the initiatives adapted by the Province related to Best Management Practice (BMP) guidelines and the Stormwater Management Planning and Design Manual developed by the Ministry of Environment in 1994 and completion and acceptance of the subwatershed studies by City Council, the City of London developed and adapted the Stormwater Management (SWM) Pond Guidelines Requirements in 1994. In 1998, this document was updated to incorporate the Community Plan Area approach and again in 2002 to reflect changes that have been approved by the City Council in 2002.

These requirements focus on water resources management and an ecologically (holistic) based approach that treats stormwater as a resource to be used, not as waste to be shunted away downstream as quickly as possible. These stormwater management facilities must be based on a system approach to achieve (regional solutions) and need to be developed as an amenity and manage water resources incorporating an ecological approach.

Prior to 1994, the City of London had fenced virtually all constructed stormwater detention or retention facilities within its urban area, especially near residential developments. Fencing, deemed an unsightly and unnecessary requirement, has been abandoned by the City of London, following the combined efforts of staff from Environmental Services, Planning, Parks, Legal and Insurance Risk Administration.

The SWM issues evaluated as part of this update include:

- Updated provincial and municipal requirements;
- Legal considerations related to public safety and liability;
- Design considerations related to safety performance, ecology and aesthetics;
- Internal municipal cooperation as a basis for implementation; and
- The potential for public stewardship.

The SWM facility requirements included in this document were developed in a comprehensive manner by reviewing the SWM practices in other Ontario municipalities, including Cambridge, Oakville, Markham, Ottawa, Waterloo, Scarborough, Mississauga, Kitchener, Guelph and past applications in the City of London. The following sections discuss the goals/aims and purposes of these SWM requirements and identify specific design requirements for SWM facilities to be constructed in the City of London.
Where stormwater management ponds are to be implemented, they shall incorporate a water resources management approach, be consistent with the ecosystem and shall be created in a manner that is technically sound, aesthetically pleasing, ecologically diverse and where passive and active pursuits may be realized in a generally safe environment. Creatively designed and developed, these ponds will comply with and satisfy the required stormwater management functions while providing as a significant asset to the open space system within the community.

6.2 AIMS/PURPOSES

The proposed SWM Pond Requirements have six aims/purposes:

1) to minimize the risk of threat to life and health of the public while avoiding fencing of the stormwater management ponds;

2) to ensure compliance with all applicable municipal requirements and provincial legislation;

3) to provide requirements for use by developers on new projects (temporary and/or permanent) and the City for retrofit applications;

4) to expedite the development of safety-oriented and naturalized stormwater management ponds that present an aesthetically pleasing amenity to the community and reduce the reliance on heavily engineered designs;

5) to provide opportunities to integrate stormwater management systems into neighborhood open space systems; and

6) to implement a stormwater management system that has due regard for the Ecosystem and watershed as dynamic and living systems and is integrated with the urbanized human community while managing conveyance, erosion, flooding and quality of the stormwater flows.

6.3 GENERAL PROVISIONS FOR APPROVALS

Concurrence with the requirements will be determined by the City Engineer, in consultation with Parks Planning. The SWM Pond requirements are:

- ensuring compliance with all applicable municipal requirements, standards, policies and provincial legislation, thus ensuring that the life and health of the public will be adequately protected;

- maintaining and promoting the enhancement of urban ecosystems, including integration of SWM facilities within open space in a manner that is consistent with the City’s Natural Heritage System; and
• ensuring an implementation of safe, well engineered, and cost-effective stormwater management sites

Based on Ontario Water Resources Act (OWRA), Section 53, SWM works are subject to Certificate of the Approvals for this work and must be in compliance with the MOE requirements associated with the Storm/drainage and SWM servicing works, as well as be in compliance the City’s SWM design requirements as follows:

a) i) Permanent stormwater management (SWM) facilities are required to be located on lands that the proponent shall dedicate to the City of London.

ii) Temporary Stormwater management (SWM) facilities are required to be located on lands that are dedicated to the City as an easement by the proponent to ensure that the City will be able to comply with the emergency requirements in accordance with the Environmental Protection Act and Ontario Water Resources Acts.

iii) Temporary Stormwater management (SWM) facilities that become permanent SWM facilities based on the Master Plan and/or Municipal Class Environmental Assessment (EA) recommendations will be required to be located on lands that the proponent shall dedicate to the City of London.

b) Designs shall have due regard for appropriate provincial legislation and the City’s design standards, policies, guidelines including but not limited to:

• relevant SWM criteria and environmental targets of subwatershed studies adopted by City Council on September 18, 1995;

• the Dingman Creek Subwatershed Study Update accepted by City Council on August 29, 2005;

• the Conceptual and/or Functional Storm/Drainage SWM Master Plans for Community Areas, approved by City Council; and,

• the City of London Design Specifications and consistency with the London Official Plan.

c) The City of London, SWM Unit has developed the checklists which itemizes the general requirements for SWM Facilities for the various stages of design as well as the Erosion and Sediment Control Plan during construction as follows:

• Master Plan and Subwatershed Study Updates – Table 1;

• Municipal Class Environmental Assessments, Secondary Plans and Conceptual Plan for Subdivision Applications – Table 2;
• Functional Design for Municipal Regional Stormwater Management Facilities and Functional Plan for Subdivision Applications – Table 3;
• Functional storm/drainage and SWM Letter Report for Subdivision Applications Table 4;
• Detail Design for Subdivision Applications – Table 5; and
• General Requirements for Erosion and Sediment Control Plan Table 6.

The checklist encompass the requirements relating to: Water Resources, Stormwater Management Design, Geotechnical Conditions, Hydrogeological conditions, Hydraulic conditions, Hydrological conditions, with due regard for the Ecological and Natural Heritage Systems as defined by the Official Plan.

All proposed SWM Facilities must be designed in accordance with the checklist for the appropriate stage of the design, and a copy of the completed SWM Requirement Checklists checklist must be submitted with the design package.

In accordance with the Professional Engineers Ontario Use of the Professional Engineer’s Seal Guideline storm/drainage and SWM reports must be signed and sealed by a Professional Engineer.

SWM Designs may incorporate innovative approaches, provided the intent of the SWM Pond requirements, goals, aims and purposes derived for public benefit are achievable.

A hydrogeological evaluation including a water balance may be required to support the development depending on the specific characteristics of the site. The hydrogeological report should be supported by monitoring data.

The water balance evaluation and calculations are required to include an assessment of existing conditions and recommended measures to mitigate the impact to the water balance under post development conditions.

Cost effectiveness shall depend on capital, operational and maintenance cost requirements, as well as a cost/benefit analysis of those factors which are more difficult to define from an economic perspective (i.e. safety, environmental/social benefits). Such determination and approval of intent will be at the discretion of the SWM Unit in consultation with Parks Planning, the Legal Department and Insurance/Risk Administration. The SWM Unit is designated to coordinate comments and approvals for SWM Ponds from all these parties.

6.4 SWM MODELING PARAMETERS AND DESIGN CRITERIA

6.4.1 Introduction
The London Development Institute (LDI) has identified a number of comments related to the selection and implementation of the Stormwater Management (SWM) criteria in hydrologic modeling, as well as the present City general practices, standards and requirements.

In response to LDI’s request, the Environment Services Department (ESD) undertook a review of the SWM modeling criteria and parameters. A number of Water Resources Engineers- Practitioners were consulted for this review that confirmed, similar to the city of London, the majority of Ontario municipalities apply standard provincial practices for the selection of these parameters.

A Professional Water Resources Engineer (Subdivider’s Consulting Engineer) is responsible for recommending all SWM modeling parameters to ensure the application of adequate engineering knowledge is applied. At the same time, ESD is required to review the proposed SWM systems and selection of the SWM modeling parameters/criteria to ensure compliance with City and Provincial standards, requirements and practices, and also ensure the adequate protection of the people and properties of the City of London.

6.4.2 **SWM Design Criteria**

6.4.2.1 **Water Quality Storage**

Impervious percentage is described by two parameters, Total Impervious Percentage (TIMP) and Directly Connected Impervious Percentage (XIMP) values. The required storage is to be determined using the TIMP value in accordance with Table 3.2 of the Ministry of the Environment’s Stormwater Management Planning and Design Manual (2003).

The water quality storage volumes per hectare are established in Table 3.2 of the MOE Manual and consist of two components: 40 $\text{m}^3/\text{ha}$ of extended detention quality control storage (live storage) and the remaining portion represents permanent pool quality storage (dead storage). The required 40 $\text{m}^3/\text{ha}$ of quality extended detention storage is constant and required in all cases. The remaining permanent pool component of water quality storage is dependent upon the three following factors:

i) impervious percentage (discussed in Section 6.4.3.1);

ii) Protection Level of the Receiving Watercourses (the protection level of receiving watercourses will be revisited in the subwatershed studies updates); and

iii) proposed type of SWM facility (i.e. wet pond, dry pond, wetland, infiltration).

Additional extended detention storage may be required for erosion/stream morphology and attenuation control to comply with the Council accepted Subwatershed Study.
requirements and/or to address lack of conveyance capacity in the outlet system. These parameters are to be established by the Subdivider’s Consulting Engineer all to the satisfaction of the City Engineer.

6.4.2.2 Erosion Control Storage

Erosion control storage volumes reflect the need to maintain existing fluvial geomorphology, protect watercourses from further deterioration and ensure protection of public safety and property. The City of London completed 13 Subwatershed Studies all of which were adopted by City Council in 1995 and the Dingman Creek Subwatershed Study Update which was adopted by City Council in 2005. The Subwatershed Studies identified SWM erosion control criteria on an individual basis, in some cases even establishing requirements for each tributary of subwatershed (ie: Dingman Creek Subwatershed).

All facilities require a minimum of 40 m³/ha of extended detention storage. Additional erosion control protection may be required if the facility is to be located within a subwatershed that identifies specific erosion control requirements on top of the quality control extended detention. Should the consulting engineer complete a site specific geomorphological/fluvial assessment, alteration to the erosion control requirements may be considered.

6.4.3 Hydrologic Modeling

This section provides guidance in the selection and implementation of hydrologic modeling parameters. Consultants may make use of available water resources management manuals and texts as a reference to aid in the selection of hydrologic modeling parameters. Any externally referenced material employed in parameter selection should be properly referenced in the Functional SWM Report and included in the document appendices.

6.4.3.1 Imperviousness

Current City of London practices for determining site runoff for Conceptual and/or Preliminary SWM plans use the values for Total Impervious Percentage (TIMP) and Directly Connected Impervious Percentage (XIMP).

TIMP represents the ratio of area covered by an impervious surface (e.g. asphalt, concrete) to the entire area. XIMP represents the ratio of impervious areas directly connected to the conveyance system. An example of a directly connected impervious area would be a parking lot, a portion of roof areas, driveways, or roads that contain catchbasins draining to the storm sewer. An example of a non-directly connected impervious area is an outdoor basketball court surrounded by park land or roof area draining to a rear yard.

In order to ensure that the proposed SWM volumes, land requirements and the size of the SWM block are estimated correctly, impervious percentage selection is extremely
important. If the SWM block is oversized, there may be adverse effects on the economic viability of the proposed development, and if undersized, there could be negative impacts on adjacent existing properties and homeowners.

The table below lists current City of London preferred TIMP and XIMP values based on land use. These allowable ranges for TIMP and XIMP should be applied at the conceptual/preliminary design stage to ensure sufficient land is allocated for the proposed facility. Adjustment of Impervious Percentage values at the functional/detailed design stage will always be considered and accepted, subject to the consulting engineer providing engineering calculations to justify the revision of these parameters.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>TIMP</th>
<th>XIMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td></td>
<td>51% - 60%</td>
<td>43% - 48%</td>
</tr>
<tr>
<td>Medium and High</td>
<td>70%</td>
<td>55%</td>
</tr>
<tr>
<td>Density Residential</td>
<td>65% - 75%</td>
<td>45% - 55%</td>
</tr>
<tr>
<td>Commercial/Industrial</td>
<td>75% - 90%</td>
<td>70% - 80%</td>
</tr>
</tbody>
</table>

In 2001, ESD conducted a cursory evaluation of three new residential subdivisions to assess imperviousness and the results were consistent with the City's accepted TIMP and XIMP values. This issue has been discussed with a number of the Consultants, LDI and the City will accept the following two step approach:

iv) At the Master Plan level, TIMP and XIMP should be assigned the MAXIMUM (not average) imperviousness allowed by the City.

ii) At the detail design level, TIMP and XIMP can be assigned the “actual” imperviousness.

6.4.3.2 Models for Determining Site Runoff

Site runoff for both pre-development and post-development conditions is determined by subtracting the predicted infiltration volume from the estimated total rainfall volume. There are multiple models and methods for determining infiltration and thus total runoff. The City of London will consider all accepted methods/models for determining infiltration and runoff provided they are applicable and appropriate to the proposed development.

The majority of water resources submissions received by the City of London apply the SCS Method, fewer submissions apply the Horton Method and there have been no submission to date that applies the Green-Ampt Method of quantifying runoff. SCS, Horton or Green-Ampt methods are all acceptable modeling techniques. "The best model is the one you know best". This is true, the more you know the model, the better you will able to model a particular phenomenon.”
The LDI recommendation of applying the Horton Method is already practiced by the City of London.

The N parameter in the SWMHYMO model representing the number of linear reservoirs used for the derivation of the Nash unit hydrograph must be 3.

6.4.3.3 Initial Abstraction

Initial abstraction (Ia) represents the interception, infiltration, and surface depression storage of rainfall at the beginning of storm events. Current City of London modeling practices recommend the Ia values summarized below. These values are applied by the majority of Water Resources Engineering practitioners across the Province.

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>Ia Typical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impervious</td>
<td>2 mm</td>
</tr>
<tr>
<td>Pervious – lawns</td>
<td>5 mm</td>
</tr>
<tr>
<td>Pervious – meadows</td>
<td>8 mm</td>
</tr>
<tr>
<td>Pervious – woods</td>
<td>10 mm</td>
</tr>
</tbody>
</table>

In order to consider any deviation from these recommended Ia values, the proposed SWM modeling will need to be tested in the field and technical data presented to confirm the suitability of the calibrated parameters.

Without such confirmation, this request is not consistent with either the general SWM modeling selection practices, nor is it justifiable beyond an academic exercise. The City’s main concern is that the facilities may potentially be undersized due to overestimation of initial abstractions values, resulting in overtopping of the facility during storm events.

6.4.3.4 Curve Number

The curve number (CN) is a parameter used to determine the extent of rainfall that infiltrates, rather than becoming surface runoff. It is a measure of a watershed’s hydrologic response potential and is usually selected from available government documents and handbooks (See attached). Currently, the City of London does not have a specific table of CN values to be used in modeling practices. However, CN values must be consistent with provincial guidelines and standard water resources management practices and correspond with the specific geotechnical conditions of proposed developments.

Selection of CN should be correlated with the applied Initial Abstraction (Ia) OTTHYMO model recommends the use of CN*. The CN* procedures account for recalculating CN when an initial abstraction of less than 0.2*S is used. OTTHYMO does not recommend the use of 0.2*S as initial abstraction, requiring the use of CN*.”
6.4.3.5 Design Storm Selection

In the design of individual SWMF’s a 3-hour Chicago Rainfall Distribution should be applied as recommended in the subwatershed studies. The City of London presently applies this standard. With respect to larger subwatershed and community area plans, the application of AES storms is standard and the City is planning to continue in this practice. The Chicago distribution is widely accepted as a synthetic distribution to be used in the design of urban areas.

Also, where: Rainfall intensity (mm/hr) = A/(t+B)^C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2 yr</th>
<th>5yr</th>
<th>10yr</th>
<th>25yr</th>
<th>50yr</th>
<th>100yr</th>
<th>250yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>724.69</td>
<td>1330.31</td>
<td>1497.19</td>
<td>1455.00</td>
<td>1499.06</td>
<td>1499.53</td>
<td>3048.22</td>
</tr>
<tr>
<td>B</td>
<td>5.500</td>
<td>7.938</td>
<td>7.188</td>
<td>5.000</td>
<td>4.188</td>
<td>3.297</td>
<td>10.03</td>
</tr>
<tr>
<td>C</td>
<td>0.800</td>
<td>0.855</td>
<td>0.850</td>
<td>0.820</td>
<td>0.809</td>
<td>0.794</td>
<td>0.888</td>
</tr>
</tbody>
</table>

The developer’s consulting engineer is required to evaluate all applicable storms and recommend the most appropriate on a case-by-case basis. For each problem (i.e. Water Quality, Flood Control, Erosion Control), a "critical" storm should be selected for design purposes.

6.4.4 SWMF Inlet Pipe Design Criteria

According to the MOE Guidelines for the Design of Storm Drainage Systems, the SWM facility inlet pipe should represent a free outlet. Therefore, the inlet pipe invert is to be above the projected 2-year storm ponding elevation. Non-compliance with this standard may create surcharge conditions within the new storm sewer system requiring additional maintenance associated with the potential sediment accumulation, as well as create potential liabilities under the Ontario Highways Act should surface ponding occur on streets.

Should, in rare cases, we need to consider deviation on the above noted design criteria, the subdivider’s consulting engineer will be required to undertake an engineering analysis to demonstrate that the proposed deviation will have a minimum effect on the proposed sewer Hydraulic Grade Line and will not create an adverse effect on the system.

The storm sewer systems are generally designed for minor system and based on current City of London practices it is a 2-year storm event. Special cases representing exceptions to this general rule will be evaluated on a site-by-site basis. Surcharging is expected during major storm events and a major flow route must be established to accommodate these flows up to the 250 year storm event.
6.4.5 CONCLUSION

The SWM modeling criteria and parameters should be established at the conceptual design stage and approval of this plan must be received prior to proceeding with functional detailed design, as is current City practice. The intention of the Functional SWM Plan is to refine the findings of the conceptual SWM Master Plan. Major deviations from preliminary design information occur only in rare events, when detailed design has proceeded without final acceptance of the Conceptual SWM Master Plan (i.e. Stoney Creek).

Flooding has not been observed at any of the recently constructed SWMF’s, all of which applied MOE and MTO standard parameter values. However, the City of London has received a number of homeowner inquiries regarding SWMF water levels and expressing concern that the facilities be adequately designed to protect their properties. This illustrates a growing public awareness of SWM issues related to the location and size of proposed facilities and demonstrates the importance carefully selecting parameters and methods to protect public safety and properties.

We trust the information clarifies the SWM modeling design practices used by the City of London. Research of modeling parameters and SWM practices employed by other Municipalities, Conservation Authorities and water resources management practitioners reveal that City of London practices are consistent with current province-wide practices. The City met with LDI representatives and consultants on January 27, 2003 to discuss a draft of this document and which was modified to incorporate comments provided at this meeting.

Should the parameters of the SWM Modeling Parameters and Design Criteria Section require further clarification, please contact the Stormwater Management Unit.

6.5 DESIGN REQUIREMENTS

6.5.1 General

SWM facilities (temporary and/or permanent) shall meet engineering, maintenance, safety, planning, environmental, aesthetic and economic requirements, while avoiding fencing.

SWM Pond requirements for private property/developments are to generally conform to the design criteria in this manual, all to the satisfaction of the City Engineer.
6.5.2 References

The basis for implementing these requirements will be a design criteria that includes but is not limited to the following and subject to approval by the applicable SWM agencies:

- The City’s Subdivision and Development Guide Manual: (Guidelines & Procedures);
- The SWM criteria and environmental targets identified in the Subwatershed studies or Subwatershed Study Update accepted by City Council;
- Conceptual/Functional Storm/Drainage SWM Master Plans for Community Area plans;
- City of London Official Plan
- UTRCA Guidelines for the SWMFs located in Flood Plains;
- Best Management Practices (BMPs) issued by the MOE and successfully implemented by various municipalities in southern Ontario; and
- All applicable municipal requirements and provincial legislation.

6.5.3 Figures

Attached, Figures 1, 2 and 3, which accompany these requirements, incorporate generalized design features as published in recognized manuals or guidelines, as adapted and modified to reflect accepted practice in southern Ontario municipalities.

The figures are based on the use of Attenuation/Extended Detention and/or Wet/Hybrid Wet Facilities. However, they can also apply to dry facilities if the wet pond and sediment forebay components are removed. These figures provide conceptual sketches that may be used to guide design, while respecting individual SWM needs and site features, and should not be viewed as criteria for design purposes. Design criteria information should be obtained from the source(s) identified above.
6.5.4 Parks, Open Spaces and Pathways

Where stormwater management facilities are designed to be integrated with adjacent parks, open spaces or pathway systems, greater setbacks may be required subject to Planning Division Requirements and Approvals.

Since SWM Facility land is claimable under the rules of the Urban Works Reserve Fund (UWRF), where additional land, beyond the technical requirements of the SWM Facility is required, these lands will be identified as a separate Park/Open Space Block on the registered plan.

6.5.5 Specific Design Features

Fifteen key SWM Pond design features have been identified to reduce the risk of injury to children (aged 1 to 8 years), while maintaining facility function. These biophysical safety features are intended to restrain access to deep standing water through a series of spatial, physical, natural and aesthetic barriers or through alternatives to direct access. This is not intended as a replacement for adult supervision but rather as a deterrent to casual accidents. The intent is to replace fencing with an appropriate alternative, while maintaining SWM function and public safety. The 15 key SWM Pond design features include:

1. A sediment forebay is incorporated to induce treatment and improve pollutant removal by trapping larger particles near the outlet of the pond:
   a) the sediment forebay must be 1.0-1.5m deep to minimize a potential re-suspension and ecological conditions for West Nile Virus,
   b) the sediment forebay sizing must be done in accordance with the MOE’s SWM Practices Planning and Design Manual, and
   c) the sediment forebay should be constructed with a maintenance access route to permit future monitoring and maintenance as well as provide access in the event of an emergency;

2. A pond depth of 1.5-2.0m is preferred. Shallow ponds of less than 1.0m are likely to be ineffective, and should be discouraged due to the possible re-suspension of sediment and greater land requirements. The maximum SWM facility depth shall not exceed 3.0m with a maximum 0.3m freeboard. A positive overland flow path must be provided at the 3.3m water level. The permanent pool depth in wet SWM facilities must be 1.0-1.5m deep.
3. A naturalized low flow channel with a shallow channel depth (0.3 to 0.6m preferred) leading to the area of pond draw down; SWM facility inlet sewers must be designed to enter the facility as free outlet systems during 1:2-year storm events. This standard is in accordance with the Ministry of the Environment Guidelines for the Design of Storm Sewer Systems.

4. For extended detention/hybrid and wet facilities 5:1 side slopes maximum or flatter, for dry facilities 4:1 side slopes maximum must be applied around the perimeter of the sediment forebay and upper and lower cell; slopes may vary around a facility to create a natural appearance with the preferred slopes being maximums;

5. Steeper slopes (maximum 3:1) may be allowed to be used when these slopes are:
   - representing only 15-20 % from the total perimeter at the 0.3 m above the 100 year storm event elevation;
   - combined with a minimum buffer of 5.0m from 0.3 m above the 100 year storm event elevation to the property line; and
   - combined with unfriendly vegetation.

6. The two year storm event extended detention and storage component of wet facilities should discharge over a 24 to 48 hour period and the quality control ponds are not allowed to be located in line. Dry facilities should be used mostly as an attenuation/flood control system and ponding will be of relatively short duration and infrequent in occurrence; the permissible discharge for all facilities is based on detailed engineering analysis;

   All maintenance holes located within stormwater management ponds require hard surface access. Access roads below the 100 year flood line will require a turfstone surface on a granular base. The turfstone voids shall be filled with granular A. For all other requirements, refer to Section 3.15.15 for hard surface details.

7. Stormwater from the forebay shall be held in a permanent wet retention pond and should be located in the facilities lower cell (assuming the general main cell design reflects an overall safety criteria of gentle slopes and aquatic safety benches or suitable barriers);

8. Any SWM facility proposed to be located within Flood Plain lands are subject to:
   a) UTRCA guidelines and approvals;
   b) forebays being located above the 50 year storm line with any deviation from this requirement being subject to specific technical justifications approved by the City;
   c) main facilities being located above the 25 year flood line;

Note: Refer to Section 18 regarding additional design information for new subdivisions.
9. A naturalized landscape plan, approved by Parks Planning in consultation with the City Engineer, is required for all stormwater retention and detention facilities.

Seeding of exposed soil surfaces should be done as soon as possible after fine grading is complete. All landscape treatments specified in the approved plan should be installed after seed has established, but within two years of registration of a subdivision plan or development agreement.

10. In lieu of fencing, unmowed vegetated buffers will be required around the perimeter. This buffer should be comprised of tall grasses and wild flowers, followed by trees and densely planted shrubs. A densely vegetated margin on the aquatic safety bench would serve as an aesthetic amenity and an additional natural barrier.

This dense unfriendly vegetation should act as a natural barrier to all but the most determined individuals. Openings can be provided if warnings are posted advising those who approach the facility of its purpose, operation and potential safety hazards; posted warnings should be visible as emergency access points in the event that the barrier is penetrated;

The requirements for fencing stipulated in Section 11.5, Parks & Open Spaces, Fencing, are not applicable to SWM Facilities.

11. An aquatic safety bench must be constructed around the forebay and the main treatment cells with the lower edge to be located 0.9 m above the pond bottom with a minimum 2 m width and incorporate a minimum slope of 10:1 or flatter.

12. Pedestrian and cycle paths must always be located no lower than the 5 year storm event water elevation and used in conjunction with the preferred slopes discussed in item (4) to further maximize recreational user safety and minimize public risk and liability. Paths below this point and leading to the lower portions of a facility should be posted to warn the public of potential safety hazards during pond operation; and

13. Restricted area signage will be necessary to warn the adult public to avoid areas or activities under certain conditions if a number of these features are modified extensively and/or not included.

14. The minimum buffer width (separation area between the SWMF and land features such as ESA, main watercourses, significant ecological features and open space designation, etc.), is subject to City Official Plan requirements, policies, Provincial and Federal Acts, Policies and Requirements.

15. A Sediment and Erosion Control Plan during the construction activities must be developed and included in the Functional SWM Report for the proposed SWM Facility, to be reviewed and accepted by the City. Specific requirements for the protection of adjacent natural areas may be required as outlined in the relevant
Environmental Impact Statement for the development.

These requirements must be applied to all SWM applications. It is recognized that in some instances, unique circumstances may arise where some requirements cannot be accommodated. In these cases, the onus is on the proponent to demonstrate how the proposed design deviates from the requirements, yet still meets the spirit and intent of this overall document. Deviations must be approved by City Council. Additional design guidelines for inlet structures, outlet structures, maintenance access, pathways, etc. is available in the City of London Subdivision and Development Guide Manual, Section E: Guidelines and Procedures. All SWM Facility design standards identified in this document, Environmental Services Design Specifications and Requirements, are based on the revised standards approved by City Council in July 2002 and supersede any similar requirements listed in the Subdivision and Development Guide Manual.

6.5.6 Maintenance Hole Access

All maintenance holes located within stormwater management ponds require hard surface access. Access roads below the 100 year flood line will require a turfstone surface on a granular base. The turfstone voids shall be filled with Granular ‘A’. For all other requirements, refer to Section 3.15.15 for hard surface details.

6.5.7 Emergency Sanitary Sewer Overflow

Emergency sanitary sewer overflow (SSO) outletting upstream of the SWM facility or directly to SWM facilities is not permitted.

6.6 COMMISSIONING CONSIDERATIONS

6.6.1 Maintenance and Monitoring Prior to Assumption

Maintenance and monitoring of the SWM facility prior to City’s assumption, must be:

- carried out by the Subdivider/Developer to demonstrate the effectiveness of the performance of these facilities in accordance with the approved design construction practices;
- in compliance with the City and MOE’s “Monitoring and Operational Procedure for the SWM Facilities Prior to the City’s Assumption”, October 1996;
- carried out by the Subdivider, prior to the City’s assumption, at no cost to the City;
- In compliance with Planning Division’s Landscape Monitoring Guidelines. There may be other site specific monitoring requirements as a result of an EA or EIS for the facility or development; and
• All landscape materials are to be maintained in a healthy state in accordance with the approved landscape plan until the time of assumption. A final inspection is required by the Planning Division, prior to assumption of the facility.

6.6.2 Proportional Cost Sharing

Proportional Cost Sharing for maintenance and monitoring of the SWM facility amongst benefiting developers will be required.

The Subdivider/Developer constructing a SWM Pond which services other subdivisions and that carry out maintenance, operations and monitoring of SWMF’s prior to the City’s assumption, should be allowed proportional cost sharing by others serviced by these SWMF’s. The above noted proportional cost sharing shall be based on contributing storage volume of a SWM facility. Contributing Subdivider/Developer’s payments to third parties shall:

• commence upon completion of the subdivider’s service work connections to the existing unassumed SWM services; and

• continue until the time of assumption of the affected services by the City.

6.6.3 Operation Prior to Assumption

Operation of the SWM facility, prior to the City’s assumption, shall be in compliance with the Operational and Maintenance Manual developed by the subdivider’s Consulting Engineer and approved by the City’s Environmental Services Department.

6.6.4 Maintenance After Assumption

Maintenance of the SWM facility site, replacement of biophysical components such as dead trees and shrubs or soil erosion, after the City’s assumption, will be the responsibility of the City’s Planning, Environmental and Engineering Services Department.

6.6.5 Operation After Assumption

Operation of the SWM facility after the City’s assumption, will be carried out by the City’s Planning, Environmental and Engineering Department and will include periodic dredging of silt deposits from the sediment forebay of the SWM pond. Removal of potentially contaminated sediments may require compliance with regulations under the Environmental Protection Act. Lawn mowing, litter removal, trail maintenance and vegetation inspection (especially where a SWM facility is part of an open space scenario) will be subject to the Planning, Environmental and Engineering Department’s maintenance and operations budget.
6.7 **INTERIM CONDITIONS**

In situations where storm water from a road widening or development will be designed prior to the ultimate storm/drainage flow path being established the interim conditions must be designed to the same degree as the ultimate design in accordance with City Standards and Requirements.

6.8 **SEDIMENT & EROSION CONTROLS**

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha inland area within existing urbanized areas, that are not in proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area, an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.

6.9 **PERMANENT PRIVATE SYSTEMS**

Effective January 1, 2012 the Design Requirements for Permanent Private Stormwater Systems are a mandatory part of a regional stormwater servicing strategy for all Medium and High Density Residential, Institutional, Commercial and Industrial (ICI) subdivisions and site plan developments. This condition was stipulated by City Council resolution, at its session held on January 18, 2010.

The Design Requirements for Permanent Private Stormwater Systems will apply to all locations for subdivision and site plan and condominium development applications with the following land uses:

- Medium and high density residential,
- Institutional,
- Commercial, and
- Industrial
**Case 1: A SWM Facility exists downstream, addressing subwatershed quality, erosion, and peak flow control targets:**

- On-site private stormwater systems are not required.

**Case 2: An EA and/or SWM study have been completed and a SWM Facility has been constructed or will be constructed in a timely manner:**

- The on-site private stormwater system must be integrated with the permanent regional storm/drainage and SWM solution within the drainage/watershed area (if the permanent regional system has been proposed for this drainage area) and attempt to maximize stormwater retention and quality control on site subject to site constraints.

- The on-site private stormwater system must be designed and constructed in accordance with the SWM criteria and the environmental targets, identified in the Subwatershed studies accepted by City Council and be consistent with the City’s Design Standards and Requirements. In most cases, the water quality component should be implemented by oil-grit-separators or other applicable measures for sites less than 10 hectares. SWM facilities with a water quality component may be considered if the land development (under the site application) exceeds approximately 10 hectares.

- For development areas less than 10 hectares, the water quantity component should ensure that peak flow from the site does not exceed pre-development conditions and shall comply with riparian right (common) law. For sites larger than 10 hectares, it must be designed to meet the discharge requirements (flow targets) outlined in the applicable subwatershed study;

- Control manholes must be located within the site plan prior to discharging to the municipal storm/drainage system in order to monitor private side discharges to the allowable flow rate and/or velocities;

- Monitoring may be required if the outlet from the site discharges to an open watercourse and/or Natural Heritage System in accordance with the City’s Official Plan.

- A private permanent stormwater system will not be considered for site plans which are located on lands required for the construction of the conveyance and/or the regional permanent SWM system.

**Case 3: Where a municipal SWM facility is unlikely to be constructed in a timely manner:**

- The on-site private stormwater system must be provided completely within the area to be developed and serve the entire area to be developed;

- The on-site private stormwater system must provide 100% of the quality, erosion and quantity control for the lands to be developed as per the applicable Subwatershed Study;

- The on-site private stormwater system must be designed and constructed in accordance with the SWM criteria and the environmental targets, identified in the Subwatershed studies accepted by City Council and be consistent with the City’s Design Standards and Requirements.
Requirements. In most cases, the water quality component should be implemented by oil-grit-separators or other applicable measures;

- The on-site private stormwater system must be designed to meet the discharge requirements (flow targets) outlined in the applicable subwatershed study;
- A control manhole must be located within the site plan prior to discharging to the municipal storm/drainage system in order to inspect private site discharges to the allowable flow rate and/or velocities;
- Monitoring may be required if the outlet from the site discharges to an open watercourse and/or Natural Heritage System in accordance with the City’s Official Plan.
- A private permanent stormwater system will not be considered for site plans which are located on lands required for the construction of the conveyance and/or the regional permanent SWM system.

**Case 4: Where the land to be developed is located in the Central Thames Subwatershed:**

- On-site private stormwater systems located in the Central Thames Subwatershed must be designed and constructed based on the following design criteria:
  - the flow from the site must be discharged at a rate equal to or less than the existing condition flow,
  - the discharge flow from the site must not exceed the capacity of the stormwater conveyance system,
  - the design must account the sites unique discharge conditions (velocities and fluvial geomorphological requirements),
  - “normal” level water quality is required as per the MOE guidelines and/or as per the EIS field information; and
  - shall comply with riparian right (common) law.

**Design Standards and Requirements Implementation:**

In conformance with these Design Standards and Requirements a variety of requirements must be incorporated into Development Agreements associated with these developments. The following conditions must be included:

- The Developer must obtain an Environmental Compliance Approval for the Private Permanent Stormwater Servicing works;
- The Developer must develop a maintenance and operational program in compliance with the flow rates, and erosion control requirements for implementation by the Owner;
- The Developer must provide the adequate site plan security allocations for the identified works (until 2 years of operation); and
- The Private Permanent Stormwater Servicing design must meet all of the standards and specifications of the City Engineer.
6.10 REFERENCES

It should be noted that in creating the SWM Pond requirements, available literature and case study information was reviewed, incorporating the intent and objectives of the City of London’s Official Plan subwatershed studies/update, Natural Heritage System environmental targets and criteria, as well as provincial guidelines in regards to Best Management Practices and the MOE’s SWM Practices Planning and Design Manual.

The requirements promoting the integration of SWM ponds into a community as part of open space systems, rely on design and risk reducing safety measures and ecological features as replacements for fencing. The advantages that they provide to the City of London include an enhanced urban environment, water resources management, a greater sense of social well being, community pride, increased opportunities to enjoy recreation close to home and potential neighbourhood "stewardship" of a facility when implemented in an ecologically sound manner.
Stormwater Management

LIST OF TABLES

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Table 2  Stormwater Management Municipal Class EA, Secondary Plan and Conceptual Plan (CP) for Subdivision Applications
Table 3  Functional Design for Municipal Regional Stormwater Management Facilities and Functional Plan (FP) for Subdivision Applications
Table 4  Functional Letter Report for Subdivision Applications
Table 5  Detailed Design (DD) for Subdivision Applications
Table 6  General Requirements for Erosion Sediment Control Plan (ESCP)
### TABLE 1  
A. Master Plan (MP) and Subwatershed Study Updates

**Requirements Checklist**

<table>
<thead>
<tr>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify preliminary updated land use and planning requirements</td>
</tr>
<tr>
<td>Review of all relevant studies and integrate this information appropriately</td>
</tr>
<tr>
<td>Identify Subwatershed Study requirements related to Natural Heritage System (NHS), preservation of functions and features of the system (identify deviation and assess impacts)</td>
</tr>
<tr>
<td>Identify constraints and opportunities of NHS and Water Resources Management (WRM)</td>
</tr>
<tr>
<td>Identify existing erosion and/or flooding complaints/deficiencies</td>
</tr>
<tr>
<td>Identify all drainage/subcatchment areas</td>
</tr>
<tr>
<td>Identify potential utilization &amp; enhancement of open watercourses</td>
</tr>
<tr>
<td>Develop preliminary hydrological evaluation &amp; modeling (app. 80%)</td>
</tr>
<tr>
<td>Provide preliminary hydraulic evaluation &amp; modeling (app. 80%)</td>
</tr>
<tr>
<td>Develop preliminary fluvial geomorphologic assessment and erosion control modeling (to provide erosion control assessment and the required modeling in relation to open watercourses/tributaries)</td>
</tr>
<tr>
<td>Develop preliminary geotechnical assessment (app. 50%)</td>
</tr>
<tr>
<td>Develop preliminary aquatic/fishery biology evaluation (app. 50%)</td>
</tr>
<tr>
<td>Provide the preliminary hydrogeological assessment that incorporates a Water Balance/baseflow evaluation and address the augmentation requirements if applicable</td>
</tr>
<tr>
<td>Identify recharge/discharge areas if it is applicable to the subject lands (app. 70%)</td>
</tr>
<tr>
<td>Preliminary review of Flood Plains/Lines and watercourse capacity and outlet requirements (app. 70%)</td>
</tr>
</tbody>
</table>
TABLE 1

<table>
<thead>
<tr>
<th>A. Master Plan (MP) and Subwatershed Study Updates Requirements Checklist*</th>
<th>pg 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary review of the terrestrial biology in relation to the integration requirements with WRM/engineering/environmental buffers</td>
<td></td>
</tr>
<tr>
<td>Preliminary review of the potential optimization of the performance of WR system (app. 70%)</td>
<td></td>
</tr>
<tr>
<td>Developing Conceptual EIS, provide the environmental benefits evaluation and identify potential requirements of mitigation/compensation in relation to NHS &amp; EIS</td>
<td></td>
</tr>
<tr>
<td>Provide the required justifications of the integration of the proposed land use/NHS in MP (if applicable)</td>
<td></td>
</tr>
<tr>
<td>Identify compliance with all applicable acts, standards, polices and requirements of approval agencies</td>
<td></td>
</tr>
<tr>
<td>Review of applicable viable servicing options</td>
<td></td>
</tr>
<tr>
<td>Develop rating criteria for these options</td>
<td></td>
</tr>
<tr>
<td>Incorporate the most applicable innovative/creative approaches/techniques</td>
<td></td>
</tr>
<tr>
<td>Identify minor/major system &amp; BMPs</td>
<td></td>
</tr>
<tr>
<td>Select the preferred servicing option and provide all required justification of the recommended option</td>
<td></td>
</tr>
<tr>
<td>Provide the preliminary/conceptual design of these components - Location - size - land requirements/landscaping - costs</td>
<td></td>
</tr>
<tr>
<td>Identify implementation triggers and financial frame works</td>
<td></td>
</tr>
<tr>
<td>Obtain the public consultations and seek the public input in accordance with provincial legislation requirements</td>
<td></td>
</tr>
<tr>
<td>Finalize MP with implementation triggers and financial frame works</td>
<td></td>
</tr>
<tr>
<td>Identify critical design storm, quantity, erosion and water quality criteria by subcatchment in a georeferenced shapefile</td>
<td></td>
</tr>
<tr>
<td>Provide a georeference shapefiles identifying the minor system subcatchments</td>
<td></td>
</tr>
<tr>
<td>Provide a georeference shapefiles identifying the major system subcatchments</td>
<td></td>
</tr>
<tr>
<td>Provide georeferenced shapefile showing major system flow route</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 2

#### B. Stormwater Management Municipal Class Environmental Assessment, Secondary Plan and Conceptual Plan (CP) for Subdivision Applications*  

<table>
<thead>
<tr>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm components of the proposed s/d and SWM servicing option for the subject lands</td>
</tr>
<tr>
<td>Confirm that the proposed servicing option is consistent with Subwatershed Study's objectives and requirements</td>
</tr>
<tr>
<td>Confirm that the proposed servicing option is consistent with the City's NHS, the Area/Community's Servicing MP and/or the Municipal Class EA's preferred option recommended for the subject lands (identify any deviations and assess impacts on the system)</td>
</tr>
<tr>
<td>Confirm system constraints and opportunities</td>
</tr>
<tr>
<td>Confirm drainage, subcatchment area boundaries, the preliminary buffers and setbacks, as well as identify the existing and proposed drainage pattern in order to ensure that the functionality of the system would not be compromised</td>
</tr>
<tr>
<td>Confirm SWM criteria, environmental targets, policies, acts, standards of all applicable agencies</td>
</tr>
<tr>
<td>Confirm applicability of the recommended servicing option</td>
</tr>
<tr>
<td>Confirm minor/major system &amp; BMPs</td>
</tr>
<tr>
<td>Develop a conceptual design for all components of storm/drainage and SWM servicing work</td>
</tr>
<tr>
<td>Confirm the hydrological evaluation &amp; modeling (app. 80%)</td>
</tr>
<tr>
<td>Confirm hydraulic evaluation &amp; modeling that should include a summary of the pre and post development modeling results including submission of the modeling files in the hard and digital forms. (app. 80%)</td>
</tr>
<tr>
<td>Develop fluvial geomorphologic and erosion control modeling including the augmentation requirements and update land use conditions (app. 80%) (to confirm erosion control storages in relation to open watercourses/tributaries)</td>
</tr>
<tr>
<td>Provide the geotechnical study with specific recommendations regarding ground water and soil conditions in relation to the proposed s/d and SWM system including the storm outlet (app. 80%)</td>
</tr>
</tbody>
</table>
## TABLE 2

**B. Stormwater Management Municipal Class Environmental Assessment, Secondary Plan and Conceptual Plan (CP) for Subdivision Applications***  

<table>
<thead>
<tr>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm aquatic/fishery requirements (app 70%)</td>
</tr>
<tr>
<td>Provide the hydrogeological assessment (app 80%) that incorporates a Water Balance/baseflow evaluation and address the augmentation requirements if applicable</td>
</tr>
<tr>
<td>Provide the preliminary evaluation of Private Water Wells related to the water quality and quantity (if they may be affected by the proposed system)</td>
</tr>
<tr>
<td>Confirm the Flood Plains Management and the proposed/existing outlet requirements (60-80%)</td>
</tr>
<tr>
<td>Terrestrial biology integration with WR/buffers</td>
</tr>
<tr>
<td>Provide design and calculations for considerations regarding specific engineering/ecological challenges (energy dissipation system, assessment of the discharge impacts into the environmentally sensitive areas from the terrestrial and/or fishery/aquatic perspectives)</td>
</tr>
<tr>
<td>Review and ensure compliance with all applicable acts, standards, polices and requirements of the DFO, MOE, UTRCA and City</td>
</tr>
<tr>
<td>Provide the conceptual design that will be consistent with the City’s s/d and SWM Specification and Standards for the proposed design components:</td>
</tr>
<tr>
<td>- Location/size</td>
</tr>
<tr>
<td>- Conceptual design of the inlet, outlet, forebay, and main cell</td>
</tr>
<tr>
<td>- Land</td>
</tr>
<tr>
<td>Finalize CP with implementation triggers and financial frame works</td>
</tr>
<tr>
<td>Finalize Draft Plan Conditions</td>
</tr>
<tr>
<td>Provide a georeference shapefiles identifying the minor system subcatchments</td>
</tr>
<tr>
<td>Provide a georeference shapefiles identifying the major system subcatchments</td>
</tr>
<tr>
<td>Provide georeferenced shapefile showing major system flow route</td>
</tr>
</tbody>
</table>
### TABLE 3

<table>
<thead>
<tr>
<th><strong>C. Functional Design for Municipal Regional Stormwater Management Facilities and Functional Plan (FP) for Subdivision Applications</strong></th>
<th>pg 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review of all available studies (CP, MP, Municipal class EA, Area/Community Plan, Geotechnical, Hydrogeological, Hydrological, EIS, drawings ant etc..) to ensure all relevant information was incorporated</td>
<td></td>
</tr>
<tr>
<td>Confirm SWM quality, quantity/flood, steam morphology control, baseflow augmentation, infiltration, groundwater recharge/discharge and NHS requirements</td>
<td></td>
</tr>
<tr>
<td>Finalize system constraints and opportunities (outlet pipe capacity, outlet watercourse conveyance capacity, review any downstream culvert restrictions/capacity, existing erosion problems, previous flooding complaints, special fishery/aquatic protection requirements)</td>
<td></td>
</tr>
<tr>
<td>Finalize drainage, catchment areas boundaries including all external areas (identify any drainage/subcatchment area deviations compared to the Subwatershed MP, Municipal Class EA or CP)</td>
<td></td>
</tr>
<tr>
<td>Finalize all applicable SWM modeling (SWM modeling parameters, assumed conditions, model set-up for the pre and post development conditions, storage volumes, predicted peak flows for the required storm events, the critical storms identification, the outlet)</td>
<td></td>
</tr>
<tr>
<td>Identify any deviation from the previously recommended preferred option and assess the impact of deviation (s) on the system</td>
<td></td>
</tr>
<tr>
<td>Finalize review of the proposed minor/major system &amp; BMPs</td>
<td></td>
</tr>
<tr>
<td>Finalize the functional design for all components of storm/drainage and SWM servicing work (compliance with SWM facility standards, inlet structure, dissipation and settling velocities within the forebay and main cell, outlet structure, free outlet system</td>
<td></td>
</tr>
<tr>
<td>Finalize the acceptance of the proposed landscaping and compliance with the EIS requirements</td>
<td></td>
</tr>
<tr>
<td>Finalize the emergency overflow requirements</td>
<td></td>
</tr>
<tr>
<td>Finalize review of the outlet impacts on the receiving system (discharge velocities, the final outlet rating curve, energy dissipation requirements and the applicable design)</td>
<td></td>
</tr>
<tr>
<td>Finalize the impacts of the completed hydrogeological and water balance assessment and confirm with the compensation/mitigation measures in the proposed design</td>
<td></td>
</tr>
<tr>
<td>Finalize applicable aquatic/fishery requirements (app 100%)</td>
<td></td>
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</tbody>
</table>
**TABLE 3**

<table>
<thead>
<tr>
<th>C. Functional Design for Municipal Regional Stormwater Management Facilities and Functional Plan (FP) for Subdivision Applications* pg 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finalize assessment of the proposed servicing on the interaction with the Private Water Wells evaluation (if they are affected by the proposed system)</td>
</tr>
<tr>
<td>Finalize if the Municipal Drain re-designation/abandonment will be finalized prior to contracting the proposed servicing (if the above noted abandonment is needed)</td>
</tr>
<tr>
<td>Develop and finalize the Sediment Erosion Control Plan (ESCP) in accordance with the DFO, City and provincial requirements (this plan must be finalized and accepted by the City prior to any development activity being approved on the subject lands)</td>
</tr>
<tr>
<td>Review and ensure compliance with Flood Plain Lines, storages, hazardous slope lines, fill regulations and new storm outlet requirements associated with the UTRCA approvals.</td>
</tr>
<tr>
<td>Develop the s/d and SWM servicing works subdivision conditions in accordance with the accepted FP</td>
</tr>
<tr>
<td>Review and ensure compliance with all applicable acts, standards, policies and requirements of the DFO, MOE, UTRCA and City</td>
</tr>
<tr>
<td>Finalize FP with implementation triggers and financial frameworks and provide sign off</td>
</tr>
<tr>
<td>Provide a georeference shapefiles identifying the minor system subcatchments</td>
</tr>
<tr>
<td>Provide a georeference shapefiles identifying the major system subcatchments</td>
</tr>
<tr>
<td>Provide georeferenced shapefile showing major system flow route</td>
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TABLE 5

<table>
<thead>
<tr>
<th>D. Detailed Design (DD) for Subdivision Applications*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm compliance with the accepted functional design for storm/drainage and SWM servicing works (identify any deviation with the above-noted design and assess impacts)</td>
</tr>
<tr>
<td>Confirm compliance with the accepted and approved ESC plan and ensure the implementation of the ESC measures on the detailed design drawings</td>
</tr>
<tr>
<td>Confirm and finalize operational and maintenance requirements for all proposed SWM systems</td>
</tr>
<tr>
<td>Confirm and finalize monitoring requirements (if applicable) for all proposed SWM systems</td>
</tr>
<tr>
<td>Confirm and finalize acceptance of landscape plan integration (parks/open space) with the proposed storm/drainage and SWM system</td>
</tr>
<tr>
<td>Confirm acceptance of Storm drainage and SWM Servicing and storm outlet by UTRCA</td>
</tr>
<tr>
<td>Finalize sign-off for submission to the MOE for the proposed work</td>
</tr>
</tbody>
</table>
# GENERAL

## REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (ESCP)

<table>
<thead>
<tr>
<th>No.</th>
<th>Proposed Measures and Site Conditions</th>
<th>Timing</th>
<th>Comments</th>
</tr>
</thead>
</table>
| 1   | (1st bullet identified in ETC report on June 28, 2006) Identify all types of "erosion/sediment control (ESC) devices" that are selected for the proposed construction activities. | Included in ESCP as part of the Functional SWM Servicing Works Report | ESC devices/measures have to be listed and identified in detail including, but not be limited to:  
- the type of sill fences and/or link sill fences (all/robust/heavy duty or others).  
- the proposed berms in relation to the identified areas.  
All this information is required to be identified on the ESC's attached plan of the section of the storm/drainage and SWM Functional Design Report. |
| 2   | (3rd bullet identified in ETC report on June 20, 2006) Identify the land slopes and proposed land alterations. | same | The relation of these recommended control devices to the proposed storm/drainage flow routes and grading on the attached plan shall be clearly established. All temporary fencing, rock check dams, and swales, where applicable, are intended to alter flow lines and to provide sediment depositing. All these measures should be identified and attached to the ESCP in order to ensure that the ecological health of the system will be well protected and not compromised. During construction activities, any proposed diversion swales/channels, berms or sill fencing must direct all surface runoffs to the temporary sedimentation/settling basins or perimeter ditches in order to minimize sediment loading to the open watercourses or municipal system. |
| 3   | (2nd bullet identified in ETC report on June 20, 2006) Identify when and where these devices are to be installed. | same | The relation of these identified control devices to the proposed storm/drainage flow routes and grading on the attached plan shall be clearly established. All recommended temporary swales shall be identified on the plan and the detailed information should be included in the report (locations, elevations, geotechnical conditions and separation distances should be identified). |
| 4   | (5th bullet identified in ETC report on June 20, 2006) Identify the potential downstream sensitivity of water resources. | same | All applicable and relevant background information related to the Official Plan (OP) Natural Heritage System requirements (NHS), the Subwatershed Study, Environmental Impact Studies, the City's Design Standards and Requirements and the MOE and the UTRCA's requirements must be identified. |
| 5   | (6th bullet identified in ETC report on June 20, 2006) Identify the proximity to Environmental Significant/Sensitive Areas. | same | All applicable and relevant background information related to the Official Plan (OP) Natural Heritage System requirements (NHS), the Subwatershed Study, Environmental Impact Studies, the Subwatershed Study, Environmental Impact Studies, the... |
### TABLE 6

<table>
<thead>
<tr>
<th>Table Row</th>
<th>Description</th>
<th>City's Design Standards and Requirements and the UTRCA requirements must be identified.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>(4th bullet identified in ETC report on June 26, 2005) Identify the proposed infiltration measures and the existing groundwater levels, the relation to the surface flows, flood plains, base flows and provide all required calculations to support the recommended approach if it is warranted.</td>
<td>same</td>
</tr>
<tr>
<td>7</td>
<td>(4th bullet identified in ETC report on July 18, 2007) Identify disconnection requirements, the type of permits and existing groundwater and open watercourse levels.</td>
<td>Compliance with the Hydrogeotechnical report recommendations for the subject lands.</td>
</tr>
<tr>
<td>8</td>
<td>(4th bullet identified in ETC report on July 18, 2007) Identify the types (i.e. predominant characteristics of the soils in the area (e.g. particle size distribution, moisture content and compositeness)).</td>
<td>same</td>
</tr>
<tr>
<td>9</td>
<td>(4th bullet identified in ETC report on July 18, 2007) Provide specific provisions for all disturbed areas that are left inactive for 30 days or more. These areas must be re-vegetated in order to minimize the soil to be exposed and washed out by the storm flows.</td>
<td>same</td>
</tr>
<tr>
<td>10</td>
<td>(4th bullet identified in ETC report on June 26, 2005 and 3rd bullet identified in ETC report) Identify the need for advanced EBC measures that may be warranted by the site conditions and/or the proximity to Environmental Sensitive Areas and/or open watercourses.</td>
<td>The requirement to provide various levels of the advanced EBC measures that encompass:</td>
</tr>
</tbody>
</table>

- Multi-barrier approaches that will collect the sediment at the source first rather than through conveyance; and
- End-of-pipe controls that will contain the sediment within the proposed perimeter detention and sedimentation detention basins to protect ecological health of the system. |

|
A Contingency Plan must be included in the ESCP and is required to address potential non-typical site and weather conditions, the efficient reporting system and the emergency contacts list including all applicable agencies.

The Owner's Engineer will be responsible to develop and obtain all approvals for the proposed ESC Plan (including a Contingency Plan) for any construction sites/subdivisions.

A cost estimate for the ESCP's security allocations for potential remediation works is required to be calculated based on approximately 15% of the total projected cost for the Storm/Drainage and SWM Servicing Works.

The Owner's Engineer will be required to obtain all required approvals for any proposed modifications that will compromise the effectiveness of the originality of the approved ESCP and obtain the acceptance by the Contractor.

The need for enhanced and sustainable ESC measures using the multi-barrier approach should be implemented. The main objectives of these measures are to provide the required control and containment of the sediment at the source within the proposed perimeter ditches and settling/contingency detention basins. The by-pass channels must be designed for a minimum of the 10 year storm event unless otherwise agreed to in writing.

The commencing of any construction activity on the subject lands is not allowed to proceed without all approvals being in place including the ESC Plan and the dewatering permits.

It is required that the ESCP's security allocations for potential remediation works be collected independently from the Subdivision security and should be owned by the Owner for the adequate implementation of the approved ESC Plan, the City would undertake remedial works.

The Owner's Engineer will be required to discuss the recommended modifications and obtain approval from EESC staff. These suggested changes must be supported by the presented justification merits and required to include, but not be limited to; the existing site conditions, sensitivity and proximity to watercourses and/or Environmental Significant Areas (ESA) and the acceptance of by Contractor to implement the suggested modifications.

Should these recommended modifications be considered:

- Minor changes: Upon discussing the presented justifications, and if the City agrees with the Engineer’s direction, the ESCP’s recommended modifications may be implemented by Contractor;
- Major Changes: The Owner’s Engineer must submit the ESCP’s recommended modifications for review and acceptance by the City Engineer and implemented by the Contractor, all to the specification of the City Engineer.

<table>
<thead>
<tr>
<th>TABLE 6</th>
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<tbody>
<tr>
<td>11</td>
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<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
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<tr>
<td>14</td>
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</tbody>
</table>

- Minor changes: Upon discussing the presented justifications, and if the City agrees with the Engineer’s direction, the ESCP’s recommended modifications may be implemented by Contractor;
- Major Changes: The Owner’s Engineer must submit the ESCP’s recommended modifications for review and acceptance by the City Engineer and implemented by the Contractor, all to the specification of the City Engineer.
| 10 | The Owner's Engineer will be required to ensure the implementation of the ESCP and to assign inspection throughout all construction stages, as well as to undertake decommmissioning of these ESC measures upon completion of construction activities on these sites. |

| same | Control features that fail should be repaired and evaluated as to whether or not additional measures are rerequired, and prior to removal of ESC measures, joint inspection is required to be conducted with the City's staff. |

| 10 | The Owner's Engineer will be required to incorporate the following main components of the ESCP's reporting system: |

| same | The Owner/Subdivision is responsible and ultimately determines on the ESC measures contained in the approved ESC Plan, and their consulting engineers will be required to comply with the following requirements: |

| 10 | - Inspection on all days of the construction (failure of any ESCP shall be reported immediately within a period of 2-3 hours). |
| 10 | - Inspect if the precipitation exceeds the 35 mm stem event. |
| 10 | - Inspection log must be reviewed on a regular monthly basis. |
| 10 | - The semi-annual summary status reports are required to be provided to the City, and the inspection reports shall be submitted to the City every three months. |

| same | The Owner/Subdivision is responsible and ultimately determines on the ESC measures contained in the approved ESC Plan, and their consulting engineers will be required to comply with the following requirements: |

| same | - "Certify" that all ESC measures are being maintained and operating as intended; |
| same | - Submit ESC monitoring reports. They are to be submitted by April 1, July 1, and November 1 of each year until all works and services of the plan are assumed; |
| same | - Submit semi-annual SWW monitoring reports for a minimum period of two years (implemented in 1995 and updated in February 2002) and ensure that ESC measures are decommissioned at the various stages of the project. |

EECD suggests that the Site Alteration agreement for new subdivisions/developments to be used only for a limited number of site-specific use and only in emergency cases. At the site alteration agreement stage, the site alteration agreement shall include:

- A proposed temporary site grading and drainage design that identifies site alteration parameters and any impacts on the adjacent lands and must be reviewed and accepted by EECD, prior to the agreement being finalized.
- The proposed site grading and drainage design that will incorporate the hydrogeotechnical study recommendations;
- The proposed site alteration activities that will be in compliance with hydrogeotechnical study recommendations; and
- The consulting engineer provides formal "certification" that ESC measures were properly installed and were regularly maintained.

At the final servicing stage/ review stage for various and development applications, all required ESC measures and procedures are identified on these drawings, and are to be in compliance with the approved ESCP and applicable standards, all to the specifications and satisfaction of the City Engineer.
# Stormwater Management

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<th>Description</th>
</tr>
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</tr>
<tr>
<td>2</td>
<td>Sectional Views of Typical Conceptual Pond Design Wet/Dry/Hybrid</td>
</tr>
<tr>
<td>3</td>
<td>Basin Cross-Section Based on Modification of the Proposed SWM Requirements</td>
</tr>
</tbody>
</table>
FIGURE 1

PLAN VIEW – TYPICAL CONCEPTUAL POND DESIGN

Note: Refer to Section 18 regarding additional design information for new subdivisions.
FIGURE 2

SECTIONAL VIEWS OF TYPICAL CONCEPTUAL POND DESIGN

Note: Refer to Section 18 regarding additional design information for new subdivisions.
FIGURE 3

BASIN CROSS-SECTION BASED ON MODIFICATIONS OF THE PROPOSED SWM REQUIREMENTS

NOT TO SCALE
## 7 WATER DESIGN STANDARDS

### 7.1 DEFINITION AND PURPOSE

### 7.2 PERMITTED USES

### 7.3 WATERMAIN DESIGN

- **7.3.1** Pressure and Flow Requirements
- **7.3.2** Design Water Demands
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- **7.3.2.2** Domestic Water Demands
- **7.3.2.3** Commercial, Institutional and Industrial Water Demand
- **7.3.2.4** Friction Factors
- **7.3.3** Fire Demands
- **7.3.4** Minimum Pipe Sizes/Acceptable Pipe Sizes
- **7.3.5** Water Quality
- **7.3.6** Maximum Velocities
- **7.3.7** Boundary Conditions

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- **7.4.1** Watermain Location within Road Allowance
- **7.4.2** Watermain Pipe Depth
- **7.4.2.1** Pipe Insulation
- **7.4.3** Pipe Offsets/Bends/Deflection
- **7.4.4** Termination of Watermains
- **7.4.5** Blow-Offs at Dead Ends of Watermains
- **7.4.7** Watermain and Other Utilities Separation

#### 7.4.7.1 Parallel Installations of Watermains and Sewers

#### 7.4.7.2 Crossings of Watermains and Sewers

#### 7.4.7.3 Utility Crossings of Existing Watermains larger than 450 mm Diameter

#### 7.4.8 Looping of Watermain/Supply Redundancy

### 7.5 WATERMAIN PIPE MATERIAL

- **7.5.1** Reference Specifications
- **7.5.2** Transitions in Pipe Material - Watermains

### 7.6 SWABBING, FLUSHING, DISINFECTING AND BACTERIOLOGICAL

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7 WATER DISTRIBUTION SYSTEM DESIGN AND LAYOUT OF WATERMAINs AND WATER SERVICES

7.1 DEFINITION AND PURPOSE

These specifications shall apply to all water services and to all water mains up to 450 mm diameter including appurtenances which are located within the City road allowance, or on property which will be transferred to City ownership. These specifications shall also apply to all water meter placements.

The designer shall design to City Specifications and also make reference to the Ministry of the Environment “Design Guidelines for Drinking-Water Systems” and to the Ministry of the Environment “Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit”. If there is a discrepancy between the City Specifications and the MOE Guidelines then the Water Engineering Division shall be contacted to resolve the issue.

Any deviation from these specifications must be submitted in writing to the Water Engineering Division, Environmental Services Engineer for approval.

For water mains larger than 450 mm diameter and for any other water system installation, special specifications must be prepared for and approved by the Water Engineering Division, Environmental Services Engineer. These specifications are to be used as a supplement to all other specifications approved by the Water Engineering Division, Environmental Services Engineer for water system installation.

The water distribution system is for the purpose of supplying and distributing water, but does not include plumbing or other works to which the Ontario Building Code applies.

“Water Distribution System” means watermains with connections to feeder watermains, feed watermains within subdivision lands, private watermains, water services, fire hydrants, and shut-off valves and all other appurtenances thereto.

A water distribution system may exist for the purpose of distributing potable or non-potable water, however water distribution systems for potable and non-potable water may not be intermixed or cross-connected. Private supplies of potable water may not be cross-connected to the municipal or public water distribution system.

Watermain Classifications

- Trunk Main - Large diameter watermain (over 600mm diameter)
- Feeder Main - Large diameter watermain (400mm, 450mm and 600mm)
- Distribution Main – Watermain diameters of 300m and smaller

7.2 PERMITTED USES

Permitted and non-permitted uses of water are identified by By-law W-1 - A by-law to provide for the REGULATION OF WATER SUPPLY IN THE CITY OF LONDON.
7.3 WATERMAIN DESIGN

7.3.1 Pressure and Flow Requirements

Watermains shall be sized to maintain the greater of:

i) maximum day demand plus fire flow at a pressure not less than 140 kPa (20 psi) at any hydrant lateral or potential fire service connection. Pressures to be taken at the most critical locations.

ii) maximum hourly demand at a pressure not less than 275 kPa (40 psi).

iii) average day demand at a pressure not less than 275 kPa (40 psi).

iv) maximum residual pressure should not exceed 550 kPa (80 psi) and a minimum residual pressure shall not be below 275 kPa (40 psi).

v) All pressures shall be calculated/determined assuming minimum hydraulic grade line conditions apply. Refer to section 7.3.7 of this document and confirm with the Water Engineering Division, Environmental Services Engineer.

7.3.2 Design Water Demands

7.3.2.1 Total Water Demands

Gross water consumption rate recorded for the City is 470 to 600 L/d (121 IGPD to 132 IGPD) average per capita.

7.3.2.2 Domestic Water Demands

Average day domestic (residential) unit demand for design shall be 270 L/D (60 IGPD) per capita.

Peaking factors of 3.5 for maximum day and 7.8 for maximum hour are to be used for design for the purposes of subdivisions and site plans unless written authorization from the Water Engineering Division, Environmental Services Engineer is received.

For design purposes, the following densities shall be used:

<table>
<thead>
<tr>
<th>Type Of Use</th>
<th>People / Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low density residential</td>
<td>3 people per unit</td>
</tr>
<tr>
<td>Medium density residential</td>
<td>2.4 people per unit</td>
</tr>
<tr>
<td>High density residential</td>
<td>1.6 people per unit</td>
</tr>
</tbody>
</table>

Note: Refer to Section 18 regarding additional design information for new subdivisions.
7.3.2.3 Commercial, Institutional and Industrial Water Demands

These demands vary greatly with the type of water using facilities or process present in the development. If the Owner (designer) does not know the required demand they should refer to Ontario Ministry of the Environment “Guidelines for the Design of Water Distribution Systems” or find other suitable references and justification for selecting water demands. The designer can also provide typical demand and peaking factor data. For industrial demands the Owner (designer) shall discuss water requirements with the Water Engineering Division, Environmental Services Engineer.

7.3.2.4 Friction Factors

The following Hazen-Williams “C” values shall be used for design, regardless of material:

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>C-Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 and 150 mm</td>
<td>100</td>
</tr>
<tr>
<td>200 and 250 mm</td>
<td>110</td>
</tr>
<tr>
<td>300 to 600 mm</td>
<td>120</td>
</tr>
<tr>
<td>Over 600 mm</td>
<td>130</td>
</tr>
</tbody>
</table>

7.3.3 Fire Demands

To estimate the fire flow requirements for an area of the Municipality, the designer should refer to the guide “Water Supply for Public Fire Protection - A Guide to Recommended Practice” (latest revision) prepared by Fire Underwriters Survey, Insurers’ Advisory Organization.

On private property, adequate water for fire fighting shall be determined in accordance with the Ontario Building Code.

7.3.4 Minimum Pipe Sizes/Acceptable Pipe Sizes

The minimum size for watermains shall be 150 mm diameter except beyond the last hydrant on cul-de-sacs where smaller diameter pipe shall be used which is designed for domestic and maximum hour demands only.

Accepted pipe sizes are 50mm and 100 mm (see above), 150mm, 200mm, 250mm, 300mm, 400mm, 450mm, 600 mm. For larger pipe sizes, the designer should consult with the Water Engineering Division, Environmental Services Engineer.

7.3.5 Water Quality

Watermains and watermain networks shall be designed so that water shall not remain unused in the watermain for more than three (3) days under average day demand.

To demonstrate a three (3) day turnover, the designer shall provide a hydraulic analysis as outlined in 7.14 of this document.

The City of London has primary responsibility to ensure that the minimum chlorine
residuals are maintained in the distribution system and therefore reserves the right to require watermain looping and/or automatic flushing devices and/or blow-offs to facilitate the maintenance of the chlorine residual. Refer to W-CS-5 sht.1 and W-CS-5 sht.2.

On private property, where there is concern (When a (3) day water turn-over cannot be achieved) that there may be degradation of the water quality in the private service, that has the potential to re-enter the municipal water system, the City reserves the right to require premise isolation. This shall consist of appropriate backflow protection to the risk posed and shall be installed at the property line and at the owners expense.

7.3.6 Maximum Velocities

The watermain shall be sized so that the maximum velocity in the pipe shall not exceed 1.5 meters per second during maximum hour domestic flow conditions or 2.4 meters per second during fire flow conditions unless otherwise approved by the Engineer.

7.3.7 Boundary Conditions

For the purposes of hydraulic analysis the designer shall contact the Water Engineering Division, Environmental Services Engineer for appropriate boundary conditions rather than using information from fire flow test directly. This is because operating pressures and flows are subject to fluctuation.

In general, the minimum hydraulic grade lines (HGL) for each of the various service areas of the City are:

- 301.8m for the low level system
- 335.0m for the Springbank / Westmount / Pond Mills / Wickerson Pumping Station high level system
- 317.0m for Hyde Park Pumping Station and Uplands Pumping Station
- 322.0m for the Southeast Pumping Station System

The designer shall assume a reservoir with the appropriate HGL for water supply to the area being designed.

7.4 LAYOUT OF WATERMAIN

7.4.1 Watermain Location within Road Allowance

a) Watermains are to be located in standard location as indicated on the City of London Standard Utility Locations for all streets, U.C.C.-1M (UCC1), on straight streets, unless otherwise approved. Deviation from the standard location must be approved by the Utilities Coordinating Committee.

b) Window Street Right-of-ways - all watermains to be located in a window street right-of-way are to be located in accordance with UCC-2M. Refer to Section
1.1.3 b) for additional details.

On watermain bends, the watermain may deviate from the standard location by up to 1.0 m, provided that the deviation towards, or closer to the street line.

7.4.2 Watermain Pipe Depth

Curb and Gutter Roads - Watermains shall have no less than 1.7m nor more than 1.9m of cover from final surface grade. Variations from this cover may be made only if approved on plans or in writing by the Engineer.

Open ditch and unimproved roads - Watermains shall be laid 2.1m minimum below road grade or 1.1m below the bottom of the ditch, whichever is greater. On unimproved roads within the City, the designer should also review the vertical alignment of the road so that, where possible, future road improvements will not result in an unacceptable watermain depth, as defined in this specification.

7.4.2.1 Pipe Insulation

Where joint deflections or offsets require the pipe to be laid with less than 1.5 m of cover, insulation shall be placed to prevent freezing. Refer to City of London W-CS-68 for insulation requirements.

Where storm drains or culverts cross over or under a watermain, insulation is required per City of London W-CS-68 unless there is a minimum 1.5m separation.

7.4.3 Pipe Offsets/Bends/Deflection

Offsets must be made according to City of London W-CS-12. Use of offsets must be indicated on the approved plans or in the case of unforeseen obstructions found after approval of the watermain design, written approval of the Engineer must be obtained.

For watermain diameter up to 400 mm, a maximum bury depth of 2.3 m should be utilized. Situations deviating from this should be approved by the Engineer.

If using joint deflection, full lengths of pipe must be used. Maximum deflection for various pipe materials to be in accordance with half (1/2) the pipe manufactures specifications. Where it is not possible to lay pipes to the required radius to utilize allowable joint deflection, manufactured pipe bends must be used. Axial deflection (bending of the pipe barrel) is prohibited for P.V.C. pipe. Any change in the direction of the watermain in excess of the pipe joint deflection tolerance shall be made using an appropriate fitting. Thrust or joint restraint shall be provided as in 7.4.6.

7.4.4 Termination of Watermains

Watermains shall be terminated opposite street lines or property lines.

Where caps and plugs are installed without a blow-off to provide for future watermain extension, a 20 mm watermain stop shall be tapped into the watermain no further than 0.5 m from the cap or plug to release trapped air/pressure from the watermain.
prior to removal of the cap or plug.

7.4.5 Blow-Offs at Dead Ends of Watermains

1. The design of the watermain shall be undertaken to ensure adequate water quality requirements are met.

2. Dead end watermain which are part of an interim phase of a subdivision build-out shall meet water quality requirements by:
   i) demonstrating adequate turnover by use; or
   ii) strategic valve location; or
   iii) installation of an automatic flushing device.

3. Where an automatic flushing device is used to maintain water quality, a water meter (in a meter pit) shall be installed to measure the volume of water discharge. The owner will be charged for the water used.

4. Where an automatic flushing device is not required to maintain water quality a standard blow-off will be required to allow flushing to take place.

5. On cul-de-sac or similar streets, blow-offs, when required, shall terminate in the boulevard. Blow-offs must be operable without the necessity of excavating.

7.4.6 Thrust Restraint

Refer to section 441.07.23 Thrust Restraints of the City of London Standard Contract Documents

7.4.7 Watermain and Other Utilities Separation

Designers should refer to Ontario Ministry of the Environment Guidelines for the Design of Water Distribution Systems (latest revision) and the Ontario Plumbing Code (latest revision) regarding the location of watermains and water services relative to sewers and to the Public Utilities Act of Ontario regarding the location of watermains relative to other utilities.

Encroachment of utilities, structures, sewers and/or any utility appurtenances, which may impact the watermain, the integrity of its bedding, and/or structural capabilities, shall have design consideration(s) applied to adequately protect the watermain.

7.4.7.1 Parallel Installations of Watermains and Sewers

Sewers and watermains located parallel to each other should be constructed in separate trenches maintaining the maximum practical horizontal separation.

Under Normal conditions, watermains shall be laid with at least 2.5m horizontal separation from any sewer, sewer manhole, catch basin, or other sewer appurtenances.
7.4.7.2 Crossings of Watermains and Sewers

The designer shall refer to the Ministry of the Environment Procedure F-6-1, Procedures to Govern the Separation of Sewers and Watermains.

Watermain up to and including 450 mm diameter (New Construction)

Watermains shall cross above sewers and Private Drain Connections (PDC’s) with sufficient vertical separation to allow for proper bedding and structural support of the watermain, sewer or PDC. If the watermain is less than 1.5 meters below grade at the crossing, the watermain shall be insulated as per section 441.07.14 of the City of London Standard Contract Documents for Municipal Construction Projects.

Where it is not possible for the watermain to cross above the sewer or PDC, the watermain shall pass under a sewer or PDC and shall be protected by providing:

a) A vertical separation of at least 0.5 meters between the invert of the sewer or PDC and the crown of the watermain.

b) That a minimum 5.0 meter length of water pipe shall be centred at the point of crossing so that the watermain joints will be equidistant and as far as possible from the sewer or PDC.

c) Adequate structural support for the sewers to prevent excessive deflection of joints and settling.

Watermain Greater than 450 mm Diameter (New Construction)

Watermains shall cross above sewers and Private Drain Connections (PDC’s) with a minimum vertical separation of 0.60 meters to allow for proper bedding and structural support of the watermain, sewer or PDC. Joints for the watermain shall be located a minimum horizontal distance of 2.0 meters from the crown of the sewer pipe or PDC. If the watermain is less than 1.5 meters below grade at the crossing, the watermain shall be insulated as per section 441.07.14 of the City of London Standard Contract Documents for Municipal Construction Projects. Where it is not possible for the watermain to cross above the sewer or PDC, the watermain shall pass under a sewer or PDC and shall be protected by providing:

- a vertical separation of at least 0.60 meters between the invert of the sewer or PDC and the crown of the watermain; and adequate structural support for the sewers to prevent excessive deflection of joints or settling, and

- that a minimum 5.0 meter length of water pipe shall be centred at the point of crossing so that the watermain joints will be equidistant and as far as possible from the sewer or PDC.

7.4.7.3 Utility Crossings of Existing Watermains larger than 450 mm Diameter

It is desirable for new servicing, sewers or PDC to cross above existing trunk watermains wherever possible. The watermain shall be protected by providing:
i) vertical separation of at least 0.60 meters between the invert of the sewer or PDC and the crown of the watermain; and

ii) adequate structural support for the sewers to prevent excessive deflection of joints or settling, and

iii) that the crossing is not within 2.0 m of a joint in the watermain.

Where it is not possible to cross above the watermain, the sewer or PDC shall pass under the watermain, and the watermain shall be protected by providing:

i) a vertical separation of at least 0.60 meters between the crown of the sewer or PDC and the invert of the watermain; and

ii) adequate structural support for the watermain must be provided during construction, and post construction to support the structure and prevent excessive deflecting of the watermain or joints.

For either situation (crossing over or under an existing watermain) details of the crossing proposed and the method of reinstatement to be used must be approved prior to construction. Refer to W-CS-69.

7.4.8 Looping of Watermain/Supply Redundancy

Water distribution systems shall be designed to exclude any dead-ended pipe, unless meeting the requirements in 7.4.5. Water distribution systems shall be designed so that no more than eighty (80) units with individual water services and meters shall be serviced from a single source of supply. If the looped watermain is connected to a single watermain, a valve must be installed in the watermain to permit isolation of supplies.

For requirements for looping for private property, see section 7.9.3.

7.5 WATERMAIN PIPE MATERIAL

7.5.1 Reference Specifications

All waterworks material used shall be new and shall conform to those listed in the City of London Standard Contract Documents for Municipal Construction Projects and the latest revision of the Standards of the American Waterworks Association (AWWA).

Material other than that listed in the City of London Standard Contract Documents for Municipal Construction Projects may be used if it is approved in writing by the Water Engineering Division. The Water Engineering Division will designate the AWWA Standard and/or other specifications and conditions applicable for use of such approved material.
The City reserves the right to select any materials or product it deems appropriate for the application. The City also reserves the right to remove from the specifications any product previously approved but found inappropriate for the application. This includes but is not limited to pipe material, valves, or fittings. The designer shall clearly indicate on drawings and contract documents the materials which are acceptable for use in a particular application where the use of one or more of the approved materials list is not acceptable.

7.5.2 Transitions in Pipe Material - Watermains

Transitions from one pipe material to another must be made at a valve or tee. Where PVC pipe is used, a tracer wire must be provided along the entire pipe and CAD welded to the valve and terminated at grade elevation as per the Standard Contract Documents for Municipal Construction Projects Section SW 441.05.04 Polyvinyl Chloride Plastic Pipe Products.

7.6 SWABBING, FLUSHING, DISINFECTING AND BACTERIOLOGICAL TESTING OF WATERMAINS

For requirements regarding swabbing, flushing and disinfecting and bacteriological testing of watermains see section 441.07.25 of the City of London Standard Contract Documents for Municipal Construction Projects. The usual test pressure in the London water system is 1035 kPa (150 psi).

7.7 LOCATION AND SPACING OF VALVES

7.7.1 Location and Spacing of Watermain Valves

In accordance with the Ministry of the Environment, Watermain Design Criteria for Future Alterations Authorized Under a Drinking Watermain Works Permit, Table 2: Shut-Off Valves.

7.7.1.1 Residential Developments

In residential developments, valves shall be located so that any section of watermain serving up to a maximum of sixty (60) residential water services can be isolated by operating not more than four (4) valves. Phasing of developments should be considered and valving should be logical (i.e. at intersections). In residential areas, valves shall be spaced no more than 250 m apart.

7.7.1.2 High Density Residential, Commercial and Industrial Developments

In high density residential, industrial and commercial areas, valves shall be located to be no more than 150 m apart.

7.7.1.3 Feeder Watermains

Feeder watermains (400mm, 450mm and 600mm) should have valves at 400 m intervals.
7.7.1.4 **Intersections of Watermains**

At intersections where smaller watermains connect to larger feeder watermains, each smaller watermain shall be valved with an isolation valve whereas the larger watermain shall be valved as required above.

7.7.1.5 **Valves for Looped Services/Private Watermains**

Valves shall be installed on looped services or private watermains to isolate buildings or groups of buildings so that no more than eighty (80) individual water services or apartment complex containing 300 dwelling units or more are on any one valved section. The Owner shall install a valve on the street watermain between connections to a looped private watermain if there is not an existing valve, at no expense to the City.

7.7.1.6 **Crossings of Watermain, Rivers, Railway, Controlled Access Highways, Bridges**

Watermains crossing rivers, railways and controlled access highways shall be valved on each side of the crossing.

7.7.1.7 **Hydrant Laterals**

Valves shall be located on all hydrant laterals according to City of London W-CS-1.

7.7.1.8 **Location of Valves at Street Intersections**

Valves shall be located on the extension of street lines or according to City of London W-CS-45.

7.7.1.9 **Location of Valves at Intersections with Roundabouts**

Water valves may be placed within the raised roundabout island where possible. However, if placement of the valves creates a potential conflict with the curb & gutter of the island, than the valves are to be placed in the boulevard clear of the curb and gutter of the approaching streets.

7.7.1.10 **Valve Boxes and Extensions Rods Required**

All valves shall be provided with valve boxes. Valve extension rods as detailed on City of London W-CS-6 shall be installed on every valve and are to be purchased from the City of London Purchasing & Supply Division.

7.7.2 **Valve Locations - Phasing of Subdivision Developments**

Valves shall be located to meet the requirements of 7.7.1. As well, location and number of valves shall take into consideration reducing shutdowns and inconvenience to customers during the construction of additional phases. Valves may be installed on a temporary basis and relocated in order to accomplish this.
FIRE HYDRANTS AND FIRE DEPARTMENT CONNECTIONS

All fire hydrants situated within the road allowance and on private property are the sole property of the City of London and shall be installed in accordance with The City of London Standard Contract Documents for Municipal Construction Projects, and shall be maintained by and operated only by the City of London.

The detail of hydrant and valve installations shall be according to The City of London Standard Contract Documents for Municipal Construction Projects (441.05.10) and drawing W-CS-1

7.8.1 Location/Spacing of Hydrants on Public Streets

The location of hydrants is subject to the requirements and approval of the City Fire Department in accordance with the Ontario Building Code. As a general guide, hydrants must be located not more than 170 m apart along the length of the watermain and should be located at intersections where possible.


7.8.1.2 Location of Hydrants to Sprinkler or Standpipe Systems

For use with sprinkler or standpipe systems the hydrant must be located not more than 45 m from the Fire Department connection.

7.8.1.3 Hydrants on Dead-end Streets

Hydrants shall not be located on dead-end streets unless such streets exceed 90 m in length. Where located on dead-end street the hydrant shall be located at 90 m from the end and a smaller size watermain (minimum 50mm) shall be used beyond the hydrant so that water quality is maintained.

7.8.2 Addition or Relocation of Hydrants

Regardless of hydrant location shown on accepted subdivision plans, additional hydrants may be required or existing hydrants may have to be relocated due to circumstances unknown at the time of plan acceptance such as the position of a structure, Fire Department connection, driveway or landscaping feature.

Such addition and/or relocation shall be requested when the City approves the service plan and must be done at the expense of the Owner of the subdivision or, if the subdivision has been assumed, at the expense of the Owner of the property for which the additional or relocated hydrant is required.

7.8.3 Hydrants on Private Property

Hydrants shall be located on private property where required to meet spacing in accordance with the Ontario Building Code, subject to the approval of the Building
Division.

Fire hydrants shall be installed at grades such that they are readily accessible to the fire department.

For average conditions, fire hydrants shall be placed at least 12.2m from the buildings being protected, in accordance with NFPA 24.

Exception: When hydrants cannot be placed at this distance, they shall be permitted to be located closer, or wall hydrants used, provided they are set in locations by blank walls where the possibility of injury by falling walls is unlikely and from which people are not likely to be driven by smoke or heat. Usually, in crowded plant yards, they can be placed beside low buildings, near brick stair towers or at angles formed by substantial brick walls that are not likely to fall.

Fire hydrants shall be located a minimum distance of 3.0m from a fence or other such obstruction.

Fire hydrants shall not be placed near retaining walls where there is danger of frost through the wall, in accordance with NFPA 24.

Where municipal water is not available, and an on-site water supply is utilized for firefighting purposes, a fire hydrant shall not be installed, but instead a standpipe connection, meeting the requirements of the Building Division, Standard Practice Sheet B2.2, On-Site Water Supply for Fire Fighting shall be provided.

The cost for the supply and installation of hydrants located on private property must be paid by the Property Owner. The fire hydrant must meet the specification set out in section 441.05.10 Hydrants, of The City of London Standard Contract Documents for Municipal Construction Projects and drawing W-CS-1 since they become the property of the City of London and are maintained by the City.

7.8.4 Hydrants for Fire Department Connections

Requirements are given in the Ontario Building Code.

7.8.5 Protection of Hydrants

If the placement of a hydrant on public or private property is such that it will be susceptible to damage by vehicular traffic, bollards are to be installed, at the owners cost, in sufficient number to protect the hydrant. Minimum spacing between any bollard and a hydrant shall be 1.0 meter, and bollards shall be a minimum of 1.0 meter in height. Bollards shall be painted hydrant yellow as per section 441.05.10 of the Standard Contract Documents for Municipal Construction Projects. Bollard construction to be steel with concrete fill.

7.9 WATER SERVICES, FIRE SERVICES AND PRIVATE WATERMAINS

For the design and materials requirements all water service pipe and fire service mains on private property, the Ontario Building Code shall apply. It shall be noted
that water quality requirements are not addressed in the Ontario Building Code. Where there is a concern that there may be a degradation of water quality in the private servicing that has the potential to enter the municipal water supply system, the Water Engineering Division reserves the right to require premise isolation. Premise isolation shall consist of appropriate backflow prevention measures to the risk posed, and shall be installed at the property line at the owners expense.

The following apply to the water services on public property up to the property line.

7.9.1.1 Water Service Size and Design

The Owner will be responsible for water service sizing. The Water Engineering Division, Environmental Services Engineer shall be consulted for available pressures and flows at the watermain under design conditions given in Section 7.3.1. If the results of hydrant flow tests are to be used, the Water Engineering Division, Environmental Services Engineer shall be consulted for necessary adjustments since flow tests are not usually done at design conditions.

On private property, adequate water required for fire protection shall be determined in accordance with the Ontario Building Code. Fire flow and hydraulic calculations shall be reviewed by the Building Division.

7.9.1.1.1 Minimum Service Size

The minimum size permitted for copper water services is 20 mm diameter except in certain pressure areas designated by the Water Engineering Division where the minimum water service size allowed is 25 mm diameter. In general, these pressure areas are where water pressures are between 275m (40psi) and 345kpa (50psi). Location of pressure areas can be obtained from the Water Engineering Division, Environmental Services Engineer.

<table>
<thead>
<tr>
<th>Pressure Area</th>
<th>Ground Elevation</th>
<th>Minimum Water Service Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Copper</td>
</tr>
<tr>
<td>Low level</td>
<td>Above 267m</td>
<td>25mm</td>
</tr>
<tr>
<td>Upland / Hyde Park</td>
<td>Above 278m</td>
<td>25mm</td>
</tr>
<tr>
<td>Springbank / Westmount / Pondmills / Wickerson</td>
<td>Above 300m</td>
<td>25mm</td>
</tr>
<tr>
<td>Southeast</td>
<td>Above 286m</td>
<td>25mm</td>
</tr>
</tbody>
</table>

The minimum size permitted for PEX water services is 25mm diameter regardless of pressure area.

25 mm diameter or larger water services should be installed for estate lots, larger homes, deep setbacks or where automatic lawn sprinkler systems or fire sprinkler systems are to be used.

As required by the Ontario Building Code on private property, the minimum size for fire service mains and water service pipes, combined with fire service mains, shall be 150mm, in accordance with NFPA 24.
Exception: For mains that do not supply hydrants, sizes smaller that 150mm may be used, subject to:

- the main supplies only automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems or Class II standpipe systems;
- hydraulic calculations show that the main will supply the total demand at the appropriate pressure. Systems that are not hydraulically calculated shall have a main at least as large as the riser.

7.9.1.1.2 Accepted Water Service Sizes

Acceptable water service sizes are 20 mm, 25 mm, 40 mm, 50 mm, 100 mm, 150 mm, 200 mm, 250 mm, and 300 mm diameter.

7.9.1.1.3 Pressure Reducing Valves Recommended Where Water Pressure Exceeds 550 kpa (80 PSI)

In some lower elevation areas of the City, water distribution pressures may exceed 690 kPa (100 psi) and it is recommended that when pressures in the municipal water distribution system exceed 550 kPa (80 psi) that owners provide pressure reducing valves, at no cost to the City. System pressures available at points of supply should be obtained from the Water Engineering, Environmental Services Engineer.

7.9.1.1.4 Cathodic Protection

Cathodic protection to be provided where connection made to steel mains in accordance with W-CS-24 or W-CS-25.

All copper water services to be installed with a 5.5kg (12lb) zinc anode as set out in section 441.05.07 Copper Pipe, of the City of London Standard Contract Documents.

7.9.2 General Requirements - Water Services

Water service shall mean the pipe, fittings and shut off valve that convey potable water from a connection on a watermain or private watermain to the meter location.

a) Water Services to Residential Dwelling Units  
(Detached, Semi-detached, Townhouses, Row-housing).

Each dwelling unit in a detached, semi-detached, townhouse or row house block, must be serviced with a separate water service connected to a watermain or private watermain. Water services must front the dwelling unit they service unless otherwise approved in writing by the Water Engineering Division.

b) Water Services to Commercial/Industrial Malls

Each structure in a commercial or industrial mall shall have one water service connected to a watermain or private watermain. Units in such a mall may...
have an individual water service connected to a watermain or private watermain outside the unit.

c) **Water Services to Swimming Pools/Lawn Sprinkler Systems**

Swimming pool facilities and lawn sprinkler systems must be serviced by connecting to the metered side of a water service that is within a heated structure.

d) **Water Services to Other Structures**

Unless otherwise approved in writing by the Water Engineering Division, all structures not covered in (a), (b), and (c) including commercial, industrial and institutional shall have one water service connected to a watermain or private watermain.

e) **Water Engineering Division to Designate Watermain to Provide Service**

When there are two (2) watermains on a road allowance, the water service shall be laid from the structure to the watermain which, in the opinion of the Water Engineering Division, Environmental Services Engineer, provides adequate flow and/or pressure. Water services shall not be tapped off transmission Watermains 24” (600 mm) and larger where an alternate source is available.

f) **Water Services to Residential Apartment Buildings (5 dwelling units or more)**

Apartment buildings (5 dwelling units or more), shall have one water service connected to a watermain or private watermain. Alternately, if individual metering of each unit is to be provided, the meters shall be placed in a common utility room which is located immediately inside the building exterior face and is accessible to the Water Engineering Division, Environmental Services Engineer and their designates for meter reading and maintenance. Each service shall be:

- clearly marked to indicate the unit served, and
- equipped with a lock-out type shut off valve.

The servicing configuration shall be as indicated in City of London W-CS-7, with the appropriate number of services/meters. The plumbing to service each unit beyond the water meter shall meet with the requirements of the Ontario Building Code.

7.9.3 **Looped Water Servicing Required**

A looped water service connected to a public or private watermain or watermains must be installed:

a) when one water service will not supply the required flow for domestic use and fire protection or,
b) for an apartment complex containing one or more structure and more than 300 dwelling units or,

c) for a townhouse, condominium or similar complex having more than eighty (80) units with individual water services and meters.

The looped water servicing must be installed to service the private development from two sources. If the looped watermain is connected to one public watermain, an isolating splitter valve must be installed in the public watermain to permit isolation of supplies, at no cost to the City.

7.9.4 Material Type

Material type shall be an approved material type as indicated in the City of London Standard Contract Documents for Municipal Construction Projects to the property line. On private property, material for water service pipes and fire service mains shall comply with Part 7 of the Ontario Building Code.

7.9.5 Location and Layout of Water Services

Single Family and Semi-Detached Lots:
The standard residential water service will be located as per City of London SW-7.0, and W-CS-8.

Street Townhouse Blocks;
At this time no standards exist. Approval will be on a case by case basis. Approval is to be given by the Water Engineering Division.

The water service pipe must be installed at right angles to the watermain and in a straight line from the watermain to the water meter.

Water services connected to a private watermain are subject to the same requirements as water services connected to a public watermain.

7.9.5.1 Water Service Pipe Depth

Water services shall have no less than 1.7m nor more than 1.9m of cover from final surface grade. Variations from this cover may be made only if approved on plans or in writing by the Water Engineering Division.

The Owner must ensure that water services and private water mains are located so that “berm” or “mound” type landscaping will not cause excessive cover over water services.

7.9.6 Approved Deviations in Location of Water Services

Deviations from the above may be approved by the Water Engineering Division for the following conditions:

a) Cul-de-sacs, Street Curves and Bends

On cul-de-sac streets and on street curves and bends the water service stubs may be installed at other than right angles to the watermain and not necessarily
through the midpoint of the lot frontage. The water service must be in a straight line from the watermain to the meter.

b) Water Service Cannot be Located in Accordance with SW-7.0

Where the water service cannot be located in line with the centre of the lot, the water service stub may be installed at any point on the front of the lot but must be at right angles to the watermain and in a straight line from the watermain to the meter and must maintain the appropriate separation distances from other utilities.

c) Water Service Cannot Extend in a Straight Line from the Watermain to the Water Meter

In (a) and (b), if the water service stub has been installed on the lot frontage but the water service cannot be in a straight line from watermain to water meter then the water service extension may be installed in a straight line from the curb stop to the meter provided the meter is inside the front wall of the structure.

d) Water Meter to be Located at the Side of a Structure

Where the water service entrance must be located at the side of a structure, the water service stub must be located on the front of the lot such that the water service extension can be installed in a straight line from the watermain to a point outside the structure adjacent to the meter. Such a water service shall be a minimum of 1.5 m from the structure and centered about a 3.0 m clear space.

e) Porch or Cold Cellar on Front of Building

Where there exists a porch or cold cellar on the front of the building and the water service stub has been installed in the standard location on the lot frontage, the water service extension may be installed under the porch or cold cellar in a straight line from the watermain to inside of the first heated wall. A maximum distance of 2 meters of water service pipe may be located under the porch or cold cellar floor slab.

7.9.7 Nonconforming Installation of Water Service or Private Watermain

a) Water Service does not Conform with Location Requirements

If the water service stub is to be extended and it is found that the water service will not conform to the above location requirements in Section 7.9, the water service stub shall be disconnected from the watermain and a new stub installed which will conform with the requirements.

b) Water Service or Private Watermain not in Accordance with Specifications or with Approved Service Drawing

If a water service stub, a water service or a private watermain is installed that
is not in accordance with these specifications or with the service drawing approved by the City, such installation will be required to be removed and relocated to conform with the specifications or approved drawings.

c) Existing Water Service to Relocated, Rebuilt or Replaced Structures

If an existing water service cannot conform to the above location requirements, or is of lead or other unsuitable material, a new water service must be installed which will conform to the requirements. If a Demolition Permit was issued for an existing structure on the lot, then the existing water service must be abandoned at the watermain and a new water service installed to service the structure.

d) Relocation to be at Owner or Contractor's Expense

All relocation work required in (a), (b) or (c) shall be at the expense of the Owner or Contractor. The Owner will be responsible, upon approval of the demolition permit, to cut and cap the existing water service(s) at the watermain to City of London standards and at no cost to the City of London.

7.9.8 Fire Service Design

The determination of fire service requirements and the sizing of supply piping shall be the responsibility of the Owner. If a domestic water service is combined with a fire supply service, the Owner is responsible to ensure that the supply pipe is large enough to carry the combined demand. Design and installation of sprinkler and standpipe systems and their supply services shall conform to the requirements of the Ontario Building Code, Section 3.2, and the Fire Code. The design of Fire Services must be approved by the Chief Official (Fire Prevention Office) of the City. The designer should obtain information from the Engineer regarding flows and pressures available for fire systems. If the flows and pressures required are in excess of the minimum design standards given in Section 7.3.1 and in excess of the actual capacity of the system the Owner shall install booster pumps and/or storage to satisfy the required demand.

7.9.8.1 Separated Water and Fire Services

Domestic water, sprinkler and standpipe services may be installed as a separated services from the watermain to the structure. Sprinkler and standpipe services may be combined. The Owner is advised to consult with the Insurance Underwriter before combining these services.

7.9.8.2 Combined Water and Fire Services

A domestic water service may be combined with a sprinkler or standpipe service or with a combined sprinkler/standpipe service. The Owner is advised to consult with the Insurance Underwriter before combining these services.

The owner/designer is advised that water quality should be considered; domestic water demands may not achieve a sufficient turnover rate (see 7.3.5) to prevent poor water quality.
7.9.9 **Water Service Size or Location not Determined**

Where water service stub size and/or location for any block cannot be determined prior to street construction the Water Engineering Division will not approve installation of the water service stub.

7.9.10 **Water Services Valves**

All water services shall be equipped with a corporation stop and a curb stop. The curb stop shall be provided with a curb box.

All water service valves and curb stops shall be installed with valve boxes and operating rods. All in accordance with the City of London Standard Contract Documents for Municipal Construction Projects.

7.9.10.1 **Location of Water Service Valves**

7.9.10.1.1 **Valves for Water Services up to 50 mm Diameter**

On water services of 50 mm diameter and smaller, a main stop or corporation stop shall be installed at the watermain and a curb stop shall be installed 0.3 m from, and on the street side of, the property line in accordance with City of London W-CS-8 and W-CS-22.

7.9.10.1.2 **Valves for Water Services 100 mm Diameter and Larger**

For water services of 100 mm diameter and larger, water service valves shall be placed in accordance with City of London W-CS-31.

Where the watermain cannot be closed off for the water service connection, a tapping sleeve and valve will be required at the watermain. It should be noted that size on size taps (eg; 150mm x 150mm tap) is not allowed and a tee will have to be cut in.

Where the watermain can be closed and a tee cut into it, or where a new watermain is being installed, a valve shall be installed 0.3 m from and on the street side of the property line.

The requirement to use a tapping sleeve and valve or to cut in a tee to make the service connection will be made at the discretion of the Water Engineering Division.

7.9.10.1.3 **Valves for Water Services to be Connected to a Private Watermain**

Water services to structures in a complex that are to be connected to a private watermain shall have the curb stop or valve placed 3 meters (10 feet) from the face of the building. If this distance locates the curb stop in the paved portion of the complex, a deviation in the curb box location may be requested. All deviations from standard location to be approved by the Water Engineering Division.
7.9.10.2 **Locates for Curb Stops or Valves**

The layout for water services must be such that the curb stop or valve can be easily found by referring to two directional dimensions from a plaque located on the building where the water service enters.

7.9.10.3 **Water Service Control Valves Not to be Covered**

The Owner shall ensure that water service control valves on his property are not covered by “mound” or “berm” type landscaping.

7.9.11 **Water Service Entrances**

Water services of all sizes shall enter through the building wall or under the wall footing into a heated area, leaving sufficient pipe and working space for meter installation.

A length of between 0.3 and 0.45 metres shall be exposed above the finished floor. The pipe shall enter the building not less than 0.15m and not more than 0.3m from the wall.

7.9.12 **Protection from Contamination**

Connections to the municipal potable water system shall be designed and installed so that non-potable water or substances that may render the water non-potable cannot enter the system. This shall be in accordance with the requirements of the Ontario Building Code, Part 7 Plumbing.

7.9.12.1 **Backflow Prevention Devices Required on Water Services In High Elevation Areas of the City**

In some high elevation areas of the City, the Owner may be required to install a check valve on the water service to prevent backflow into the watermain in the event of a loss of pressure in the system.

The Owner will be responsible for the supply, installation and maintenance of all check valves and protective devices, at no cost to the City.

7.9.13 **Electrical Grounding**

7.9.13.1 **New Installations**

Effective June 30, 1993 electrical systems of all new developments shall not be grounded to the water system. Refer to Ontario Hydro Electrical Safety Code (Section 10) for grounding requirements.

7.9.13.2 **Upgrade of Existing Plant**

Where an existing watermain is replaced or upgraded, the grounding of electrical systems to the water service may not be adequate. It will be the Owner’s responsibility to ensure grounding is adequate after the watermain is installed.
7.10  CORROSION PROTECTION

Soil samples shall be taken on each street to identify soil class and resistivity for pipe design. Obtain corrosion protection and pipe class selection information from the Engineer. Refer to the Standard Contract Documents for Municipal Construction Projects for installation requirements. Sections for note include: 441.05.02 - Ductile Iron Products, 441.05.04 - Polyvinyl Chloride PlasticPipe Products.

7.11  EASEMENTS

Easements are required for any publicly/City owned watermain which is located outside a road allowance on privately owned property.

The minimum width of easement shall be 6.0 m for a single watermain only. When the easement is 6.0m, the watermain will be installed 2.0m from one side of the easement to provide an adequate working area to access and repair infrastructure placed within the easement. Where there is more than one utility, adequate width of easement and separation of utilities for both construction and future access and maintenance shall be provided.

7.12  INSTRUMENTATION

For design and installation standards related to instrumentation and control equipment, refer to “Scada and Instrumentation Standards”, (latest version from the City of London website: http://www.london.ca/d.aspx?s=/Consultant_Resources/SCADA_index.htm

7.13  WATER METERS

7.13.1  General Requirements

Refer to Section 7.9.2 for acceptable servicing configurations.

a)  All Domestic Services to be Metered
    All domestic water services must be metered.

b)  Fire Services Not Metered, Exception
    Fire services are not metered with the exception of sprinkler systems located in individually metered dwelling units.

7.13.2  Supply of Water Meters and Water Meter Remote Read Registers and Meter Strainers for Services 150 mm and Larger

The City will supply and install all water consumption meters that are used for billing process. Water meters up to 20 mm size will be supplied at no charge.

Strainers for 75 mm and larger installations where required shall be supplied by the City.
7.13.3 **Location of Water Meter**

The water meter shall be installed on the water service immediately inside the point of entry of the water service into the building (see Section 7.9.11 Water Service Entrance). Any variation from this location must be approved in writing by the Engineer.

The Owner shall provide sufficient space for installation and maintenance of the meter. The meter must be accessible for reading and maintenance and must be protected from freezing and other damage.

The meter or piping shall be no closer than 1 m to any electrical panel or above or below any electrical panel unless provided with a meter enclosure as outlined in 7.13.3.2.

7.13.3.1 **Meter Pits will be Required**

Meter pits will be allowed only with approval of the Water Engineering Division when no other suitable location is feasible. Meter pit design and installation must be submitted for approval as per section 7.13. All costs associated with the supply and installation of the meter pit will be the responsibility of the Owner.

The Owner will be required to provide a conduit for the wiring from the meter pit to the location of the remote transmitter.

7.13.3.2 **Water Meter Enclosures**

Water meters may be installed in electrical rooms provided a shield is installed between the water meter and any electrical panel located within one (1) meter. The shield must be of metal construction (or approved alternative) and affixed securely to the wall and must be of sufficient width to isolate the water meter from the electrical panel. It must not impede the maintenance of the water meter.

7.13.4 **Installation of Water Meters**

Water meters up to 20 mm size - single family residential units with individual water services. This applies to single family residential, semi-detached dwelling units and townhouses with individual services (constructed after 1985). Water meters up to 20 mm size shall be installed in accordance with City of London W-CS-7. Water meters larger than 20 mm in size shall be installed in accordance with AWWA C700, C701 or C702.

7.13.4.1 **Water Meter Valving**

All new and replacement installations shall require a valve on each side at the meter. The City will supply, install and maintain the valve on the inlet side of the meter for 16 mm and 20 mm meters for water service sizes up to and including 25 mm diameter.

The Owner must supply and install the outlet valving and bypass valve (when required) for all sizes of meters and the inlet valve when the water service piping is
over 25mm diameter. The Owner will be responsible for maintaining and keeping the
meter inlet and outlet valving operational and in good working order.

All meter setting valves must open left (counter clockwise).

7.13.4.2 Meter Strainers

Meter strainers shall be supplied and installed by the City on 75 mm size and larger
meter installations in accordance with City of London W-CS-30. The Owner shall
consult the Engineer regarding dimensions of supports required for the meter and
strainer.

7.13.4.3 Water Meter-by-pass Required

The Owner shall install, at his expense, a meter bypass when any of the following
conditions exist:

i) the water meter is 40 mm or larger in size.

ii) shutting the water supply off for approximately thirty (30) minutes during
normal working hours of the City would create a production or other
problem to the Owner.

iii) any water service which supplies coin-operated equipment cannot be
shut down for thirty (30) minutes or longer during the normal working
hours of the City.

Meter bypasses shall be installed according to City of London W-CS-30. Bypass
valves shall be closed and sealed for use by the City only.
7.13.5 Meter Sizing

The size of meters will generally be one size smaller than the water service. Owners should obtain advice from the Engineer on meter sizing. Meter ratings are as follows:

<table>
<thead>
<tr>
<th>METER SIZE</th>
<th>MAXIMUM RATING</th>
<th>CONTINUOUS RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 mm</td>
<td>76 L/min</td>
<td>38 L/min</td>
</tr>
<tr>
<td>20 mm</td>
<td>114 L/min</td>
<td>57 L/min</td>
</tr>
<tr>
<td>25 mm</td>
<td>189 L/min</td>
<td>95 L/min</td>
</tr>
<tr>
<td>40 mm</td>
<td>378 L/min</td>
<td>189 L/min</td>
</tr>
<tr>
<td>50 mm</td>
<td>606 L/min</td>
<td>303 L/min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPOUND METERS</th>
<th>MAXIMUM RATING</th>
<th>CONTINUOUS RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 mm</td>
<td>1136 L/min</td>
<td>568 L/min</td>
</tr>
<tr>
<td>100 mm</td>
<td>1893 L/min</td>
<td>946 L/min</td>
</tr>
<tr>
<td>150 mm</td>
<td>3785 L/min</td>
<td>1893 L/min</td>
</tr>
</tbody>
</table>

7.14 HYDRAULIC MODELING

7.14.1 General

Hydraulically model water distribution systems for all new developments, or as otherwise exempted by the City Engineer. Submit the results of the analyses to the City for review and provide an electronic version of the hydraulic model for incorporation in the City's overall hydraulic model.

Include all watermains 50mm diameter and larger, control valves (pressure reducing valves and flow regulating valves), reservoirs and pumping stations.

For phased developments, submit updated hydraulic models incorporating the distribution system for all phases at the first phase stage. The City may require hydraulic analyses beyond the development boundaries in situations where the operation of water system facilities such as control valves, reservoirs and pumping stations, are influenced by changing demands in the new development.

The model shall also include calculations to ensure water quality in any dead end watermain at the end of a phase and specify the installation of automatic blow-offs, as required.

The City has adopted H2ONET as its standard for hydraulic modelling. Other software packages may be used for analysis and reporting but all model input files provided to the City must be directly readable by H2ONET or EPANET without modification. The accuracy and readability of the input files are the sole responsibility...
of the developer.

As a minimum, conduct steady-state hydraulic analyses for each proposed development phase under the following demand conditions:

- average day
- peak hour
- maximum day plus fire flow
- water quality detention time

All Hydraulic reports shall include detailed maps/ layouts of the watermain system (valves, hydrants, etc.) and shall clearly show the pipe and node numbering.

Extended period simulations are not required unless specifically requested by the Water Engineering Division.

7.14.2 Information Provided by the City

The City of London Water Engineering Division will provide minimum steady-state pressures at the connection node(s). The designer is cautioned that only the pressures provided by the City will be acceptable for the model and that flow tests cannot be used for boundary conditions as they are not representative of design flow conditions.

7.14.3 Design Criteria

In accordance with Section 7.3 Watermain Design.

7.14.4 Hydraulic Model Input Standards

7.14.4.1 Units

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>elevation</td>
<td>metres</td>
<td>x.xx</td>
</tr>
<tr>
<td>length</td>
<td>metres</td>
<td>x.x</td>
</tr>
<tr>
<td>diameter</td>
<td>millimetres</td>
<td>x (hard conversion)</td>
</tr>
<tr>
<td>demand</td>
<td>litres per second</td>
<td>x.xxx</td>
</tr>
<tr>
<td>tank diameter</td>
<td>metres</td>
<td>x.</td>
</tr>
<tr>
<td>tank volume</td>
<td>cubic metres</td>
<td>x.xx</td>
</tr>
<tr>
<td>pressure</td>
<td>metres (of water)</td>
<td>x.xx</td>
</tr>
<tr>
<td>Power</td>
<td>kilowatts</td>
<td>x.xx</td>
</tr>
<tr>
<td>Time</td>
<td>hours</td>
<td>x.x</td>
</tr>
</tbody>
</table>

7.14.4.2 Node Elevations

In metres to geodetic datum and estimated final grading contours.

7.14.4.3 Node and Link Identification

Nodes and links are to be graphically identified on a map.
7.14.4 Demands

Use average day demands and global demand multipliers for demand patterns.

7.14.5 Submission Requirements

Submit electronic versions of the following files in H2ONET or EPANET format:

- model input file
- model input file in text format with tab separation
- map or shape file

Submit a report, sealed by an Ontario Professional Engineer, including:

- summary of demand scenarios and points of connection to the City system
- network map (in colour) for each scenario which identifies node and link numbers
- node tables for all scenarios listing node numbers, elevation, demands, and pressures
- link tables for all scenarios listing link numbers (with up and downstream nodes indicated), diameters, lengths, roughness, velocities, flows, headlosses, and age of water calculations
- for multi-phase developments, provide model data and summaries for all phases as part of the first phase submission.

Reports containing results that indicate operating parameters outside the acceptable Design Criteria will be automatically rejected without further review and returned to the Owner for correction.

7.14.6 Review by the Water Engineering Division

The Water Engineering Division will review the report and advise on the need for any further analysis to be carried out at the Owner’s cost.

7.15 Sediment & Erosion Control

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area, an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.
WATER DISTRIBUTION SYSTEM REFERENCES

Fire Underwriters Survey

Ontario Water Resources Act

Public Utilities Act

Ontario Building Code

Corporation of the City of London
Zoning By-Law, No. Z. - 1, March 1995

Water By-Law W-1
Regulation of Water Supply In The City of London

Ministry of the Environment

Design Guidelines for Drinking-Water Systems (Latest Revision)
http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079818.pdf

Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit

Form 1 – Record of Watermains Authorized as a Future Alteration
8 WATER PUMPING STATIONS

This section not available at this time.
# 9 GRADING

## 9.1 GRADING REQUIREMENTS FOR VARIOUS SITUATIONS

- **9.1.1 Subdivisions**
- **9.1.2 Site Plans**
- **9.1.3. Severances, Lifting of Part Lot Control & Infill Lots**
- **9.1.4 Blocks**
- **9.1.5 Capital Projects**
- **9.1.6 Parks and Open Space**
- **9.1.7 Variations / Modifications**

## 9.2 MAJOR / MINOR STORM DESIGN

## 9.3 GRADING REQUIREMENTS ALONG PROPOSED/EXISTING ROADS

- **9.3.1 Arterial & Primary Collector Roads**
- **9.3.2. Other Situations**
- **9.4.1. Drainage**
- **9.4.2. Elevations**
- **9.4.3 Slopes**
- **9.4.4 Swales**
- **9.4.5 Catch Basins**

## 9.5 ADDITIONAL INFORMATION TO BE SHOWN ON PLAN

## 9.6 GRADING NOTES

## 9.7 SEDIMENT & EROSION CONTROL
9  GRADING

9.1  GRADING REQUIREMENTS FOR VARIOUS SITUATIONS

Grading in a plan of subdivision, site plan (guidelines where applicable) and infill lots are to be designed by a Professional Engineer and certified by a designated professional (as per the Subdivision Agreement clauses, Drainage By-Law (WM-4) and Building By-Law (B-4)) and are to be in accordance with the following standards:

9.1.1  Subdivisions

Developments created by a draft plan of subdivision shall conform to the following lot grading standards and will not adversely affect the abutting or adjacent properties.

9.1.2  Site Plans

Developments subject to site plan approval are to be graded and drained internally in compliance with the Drainage By-Law and should not adversely affect adjacent properties. The sites grading and drainage shall conform to the overall drainage pattern of the adjacent lands as certified by the design engineer at the time of the permit for each building. On site grading will also be subject to the Site Plan Design Manual Guidelines.

9.1.3.  Severances, Lifting of Part Lot Control & Infill Lots

Developments created by severance, lifting of Part Lot Control and infill lots for residential lots shall conform to the lot grading standards in a plan of subdivision and are not to adversely affect the abutting and/or adjacent properties.

9.1.4  Blocks

Development on blocks within registered plans of subdivision are subject to site plan approval (as above). Drainage and grading of such blocks shall conform to the accepted overall subdivision design and shall be certified by the site design engineer.

9.1.5  Capital Projects

When grading is required, the designer shall determine match points that appear to naturally blend proposed design grades with existing topography. Consideration shall be given to transitions with intersecting streets, driveway profiles, drainage, utilities, existing retaining walls, potential impacts on trees and other landscaping features. Wherever possible, the designer shall take every opportunity to eliminate or reduce the size of existing retaining wall owned and maintained by the City. Consideration should also be given to maintenance and aesthetics of grassed areas such as lawns and boulevard areas.

Grades should not be altered around trees on the basis of 30cm of distance from the stem for each 3cm of trunk diameter at breast height C1.5m above ground.
While a 4:1 slope or greater is desirable from a maintenance perspective, a maximum 3:1 slope is acceptable.

Proposed driveway grades shall not exceed 10% unless approved by the City’s Contract Administrator.

9.1.6 Parks and Open Space

Overall grading of Park and Open Space Blocks within new plans of subdivision shall conform to the master grading plan for the subdivision and must accommodate overland flow routes, etc. Detailed grading within Parks and Open Space areas will be according to Section 11. Technical servicing requirements will be subject to the provisions of Section 5.

9.1.7 Variations / Modifications

There will be site specific situations where all the criteria may not apply. Proposed grading that does not conform to the appropriate grading requirements standards will be reviewed taking into account the mitigating circumstances that require the proposed variations or modifications.

9.2 MAJOR / MINOR STORM DESIGN

As Storm sewer systems (referred to as the minor system) are designed to accommodate storm runoff from a 2 year storm event, the lot grading design (referred to as the major storm system), must be designed to accommodate runoff from storm events that exceed the design capacity of the storm sewer system. These allowances, in the form of major overland flow routes, shall provide for the effective routing of major overland storm flow from residential areas to an acceptable overland flow outlet location.

When designing overland flow routes, the following criteria shall apply:

- The Major overland flow routes are generally to follow low areas in subdivision grading, and be in compliance with an accepted SWM report.

- In order of preference, overland flow routes should be directed along:
  - arterial and primary collector roads;
  - secondary collector roads;
  - local streets;
  - parks, open spaces; and
  - rear yards

- The maximum allowable ponding at gutters on roads is 300mm.

- Building opening elevations adjacent to overland flow routes on roadways shall be at least 300mm above the road centreline elevation.
• Building opening elevations adjacent to overland flow routes through lots or blocks in a subdivision shall be at least 450mm above the overland flow route elevation (no window wells, or other openings).

Ground elevations at buildings abutting overland flow routes are to be 225mm above the elevation of the overland flow route.

• The maximum ponding permitted at rear yards catch basins is 450mm.

• The maximum ponding permitted at parking areas in Multi-family, commercial and institutional blocks is 300mm.

• Accommodate all overland flow routes into a stormwater management pond (if applicable).

• Show existing and proposed major overland flow route directional arrows on all grading drawings.

9.3 GRADING REQUIREMENTS ALONG PROPOSED/EXISTING ROADS

9.3.1 Arterial & Primary Collector Roads

The property line (including the adjacent boulevards) abutting road allowances of arterial and primary collectors shall be graded to blend with the future road grades proposed for the street. City of London Standard “Subdivision Grading along Arterial Roads”. See Figure 9.1, shall be used to establish these grades. Where these future grades have not yet been established and approved by the City of London Environmental Services Department, Transportation Division, the owner, shall at no expense to the City, retain a Consulting Engineer to obtain the necessary information to establish the future centreline road profile and property line grades, and have such approved by the City Engineer.

9.3.2 Other Situations

On all other streets not mentioned in 9.3.1 above, the owner shall grade the property line and adjacent boulevards so that they blend with the proposed or existing street grades in accordance with the City of London Standard “Utility Coordinating Committee Standard Utility Locations, U.C.C.-1M and U.C.C.-2M, and to the specifications of the City Engineer. Refer to Section 1.1.3 a) for further UCC-1M design criteria and Section 1.1.3 b) for further UCC-2M design criteria.

9.4 GRADING STANDARDS

The following standards are to be considered when designing lot and adjacent boulevard grading:
9.4.1. **Drainage**

- The **boulevard** and a minimum 6.0m at the front of any residential lot must drain towards the abutting road.

- Show the location and direction of drainage along the rear and side lot lines. Show one drainage direction arrow for each change in grade for all lots.

- The drainage from single-family lots in the same subdivision may be drained between other single-family lots (from back to front).

- The drainage from impervious areas on lots in a new subdivision is not to flow across existing lots abutting the new subdivision.

- The drainage from single-family and semi-detached lots is not to drain onto Multi-family, Commercial or Institutional blocks (with the exception of the overland flow routes).

- All multi-family, commercial and institutional block drainage is to be self-contained.

- Where a new subdivision abuts an existing development or undeveloped land, the existing ground elevations at the common property line are to remain unchanged and existing drainage of abutting lands is not to be disturbed, or obstructed, unless written permission is granted by the affected land owner.

- Localized surface drainage from abutting properties, to be developed in future, may be discharged onto the proposed lots in a subdivision.

- Identify existing vegetation and set grades to retain where possible.

9.4.2. **Elevations**

- Show existing elevations by contours. Contours are to extend a minimum of 30m beyond the limit of the site plan, or subdivision.

- Show existing spot elevations at all lot/block corners along the boundary of the development, and along all major overland flow routes.

- Show existing centreline of road elevations every 30m for existing, abutting and connecting streets.

- Show existing spot elevations around existing house/units and at house/unit openings for new proposed major overland flow routes through existing developments.

- Show proposed elevations on ALL corners of the proposed lots.

- Show finished ground elevations around house/unit.
• Show final centreline road elevations, every 30m as well as at break points and high and low points in the road profile. Identify (label) the break points, high/low points.

• Show proposed elevations at all high points or break points where the direction of drainage along rear and side lot lines changes.

• Show proposed bottom of swale elevations at pertinent intervals, and at property lines.

• Show proposed elevations at the top and bottom of all steep slopes (3H: 1V, max.).

• Show proposed top and bottom retaining wall elevations.

• Show proposed top and bottom noise barrier wall elevations.

9.4.3 Slopes

• Yard surfaces shall have a minimum slope of 2%.

• Front yard surfaces shall have a maximum slope of 10%.

• Rear yard/side yard (walkouts/back splits) surfaces including swale cross-falls shall have a maximum slope of 3H: 1V.

• Berms shall have a maximum slope of 3H: 1V.

• Road and boulevard surfaces shall have a minimum cross-fall grade of 2% and a maximum cross-fall grade of 4% in new subdivisions.

• Driveway surfaces shall have a minimum grade of 2% and a maximum grade of 10%.

• Specify stepped foundations, side to side for lots fronting streets with a road grade of more than 3%.

9.4.4 Swales

• Drainage flows which are carried around houses are to be confined in defined swales, located as far from the house as possible.

• Minimum swale grade is 2%.

• Maximum of 16 lots draining to a rear yard swale, outletting to a rear yard catch basin.
• Maximum length of swales permitted is 76m, outletting to a rear yard catch basin.

• The maximum flow allowable in a side yard swale or a swale discharging across a boulevard onto a City Right-of-Way shall be that from 4 backyards.

• The side yard swale is to be a minimum of 150mm lower than the finished ground elevation at the house.

• The average rear yard swale depth is 225mm. The minimum swale depth allowed is 150mm. The maximum swale depth is variable, but is dependent on location and safety considerations.

• Show the location and direction of flow in swales by means of arrows. Show at least one arrow at the rear of each lot.

9.4.5 Catch Basins

• The maximum length of swales permitted to drain to a catch basin is 76m.

• A maximum of 16 lots draining to a rear yard catch basin is allowed.

• Front yard catch basins are not permitted, except in unusual circumstances where a rear-yard catch basin cannot be provided.

• No surface ponding is allowed during a two year design storm event.

• Under a 100 year design storm event, 300mm surface ponding is allowed at catchbasins on roads, and 450mm surface ponding is allowed at rear yard catchbasins.

• Flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.

• In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.

• See Catchbasin Section 5.16, for additional catch basin design requirements.
9.5 ADDITIONAL INFORMATION TO BE SHOWN ON PLAN

Grading Plans shall be designed in accordance with the standards listed above, and will contain the following information where applicable:

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<tr>
<th>REQUIRED INFORMATION</th>
<th>WHERE APPLICABLE INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard City of London title block</td>
<td>Sidewalk ramps</td>
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<tr>
<td>North arrow</td>
<td>Sewer easements and widths</td>
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<tr>
<td>P. Eng. stamp</td>
<td>Building setbacks for rear yard catch basin leads</td>
</tr>
<tr>
<td>Street Names</td>
<td>Steep slope lines (3:1 desirable)</td>
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<tr>
<td>Lot and Block frontages</td>
<td>Sidewalks to be constructed</td>
</tr>
<tr>
<td>Lot and Block Numbers</td>
<td>Headwalls (inlets/outlets)</td>
</tr>
<tr>
<td>0.3m reserves</td>
<td>Channels</td>
</tr>
<tr>
<td>existing features (trees, fences, houses, etc.)</td>
<td>Pedestrian walkways (fencing, posts, width and driveways)</td>
</tr>
<tr>
<td>Sediment and Erosion Control Measures</td>
<td>Noise barrier walls and details</td>
</tr>
<tr>
<td>Delineation of proposed unit/house</td>
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</tr>
<tr>
<td>Manholes and Fire Hydrants</td>
<td></td>
</tr>
<tr>
<td>Catch basins</td>
<td></td>
</tr>
</tbody>
</table>

9.6 GRADING NOTES

The following notes are to be included on the Grading Drawings:

- Existing drainage of abutting lands is not to be disturbed

- Localized surface drainage from abutting properties to be developed in future may be discharged onto the proposed lots in this subdivision.

- Basement openings to be minimum 300mm above the centreline of road unless otherwise approved by the City Engineer.

- Ground elevations at houses abutting overland flow routes are to be 225mm above overland flow route elevations.

- Retaining walls, 1.0m high or greater, are to be designed by and constructed to the specifications of a registered professional engineer in accordance with the Ontario Building Code.

- For Subdivisions: Sump pump discharge must be directed to the storm sewer via the storm PDC.

  - OR -

- For Other Cases: Sump pump discharge must be directed away from driveways and sidewalks.
9.7 SEDIMENT & EROSION CONTROL

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESPC is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area; an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.
10 SEDIMENT AND EROSION CONTROL

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10 SEDIMENT AND EROSION CONTROL

10.1 INTRODUCTION

Construction Sites by their nature result in the disturbance of the on site natural materials as well as impacting on the surrounding areas. Sediment and erosion control measures are to be used on ALL construction sites to limit the effect of the proposed construction on the surrounding areas and infrastructure. The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for all Development, Capital Works and Operational Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

10.2 REFERENCE

The following guidelines rely on the Ministry of Natural Resources Guidelines on erosion and sediment control for urban construction sites, unless otherwise noted.

Erosion Sediment Control Plan (ESCP)
The requirement for an ESCP within the City of London has developed through the City’s ongoing commitment to ensure adequate protection of water quality in open watercourses within the City’s boundaries. More background information relating to the ESCP can be found in:

i) Planning Committee Report, June 20, 2005, Agenda Item # 3; and
ii) Joint ETC/Planning Committee Report, June 18, 2007, Agenda Item # 12.

10.3 GENERAL INFORMATION REQUIREMENTS

10.3.1 ESC Plan

a) An ESC Plan for all Capital Works, Operational and Development Projects is to be designed, addressing all the requirements identified in the General Requirements for Erosion Sediment Control Plan (ESCP) chart (See Figure 10.1).

i) For Development related projects, the ESCP is to form part of the Functional SWM Servicing Report or the Servicing Report for the project.

ii) For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area, an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

iii) For Capital Works and Operational Projects, the ESCP is to be submitted during detailed design.
The ESCP should address all potential issues on any given project, including, but not limited to:
- close proximity to an open watercourse;
- close proximity to woodlands, ESA’s and other natural areas;
- steep slopes; and
- high groundwater levels

The complexity of the project will determine the required complexity of the ESCP.

b) Servicing Drawings

Sediment and Erosion Control measures are to be identified on all lot grading plans, stormwater management ponds, channels and, where applicable, plan and profile drawings, and on detailed drawings. If extensive measures are required, or the scale of the drawing is such that the measures are not clear, then the sediment and erosion control measures must be identified on a separate plan. The measures shown on the servicing drawings are to reflect the requirements identified in the ESCP.

The complexity of the project will determine the required complexity of the ESCP.

The City of London, Wastewater & Drainage Engineering Division, SWM Unit is responsible for reviewing and accepting the ESCP. As required, they will consult with the UTRCA and Parks Planning and Design.

For Development Projects: Engineering Review Division reviews the detailed design servicing drawings to ensure that the measures identified in the Accepted ESCP are implemented, and that the ESCP addresses all the necessary areas of concern with respect to sediment and erosion control measures.

10.4 REVIEW AND ACCEPTANCE

The City of London, Wastewater & Drainage Engineering Division, SWM Unit is responsible for reviewing and accepting the ESCP. As required, they will consult with the UTRCA and Parks Planning and Design.

For development projects, Engineering Review Division reviews the detailed design servicing drawings to ensure that the measures identified in the Accepted ESCP are implemented, and that the ESCP addresses all the Necessary areas of concern with respect to sediment and erosion control measures.

10.5 UTRCA

Approvals are to be obtained from the UTRCA for works which are in or adjacent to flood lines, fill lines and hazardous slopes, prior to the construction of services and approval of the engineering plan.

10.6 PARKS AND OPEN SPACES

Approvals are to be obtained from the Planning Division for sediment and erosion control measures adjacent to any open space areas – flood plain, Environmentally
10.7 **SEDIMENT CONTROL MEASURE NOTES**

The following sediment control measure notes are to be shown on the construction drawings, either on the plan that details the sediment and erosion control measures, or on the notes and details drawing.

Please note that the following sediment control measure notes are examples only, and may vary to suit the individual project:

   a) Protect all exposed surfaces and control all runoff during construction.
   
   b) All erosion control measures are to be in place before starting construction and remain in place until restoration is complete.
   
   c) Maintain erosion control measures during construction.
   
   d) All collected sediment must be disposed of at an approved location.
   
   e) Minimize area disturbed during construction. All dewatering must be disposed of in an approved sedimentation basin.
   
   f) Protect all catch basins, maintenance holes and pipe ends from sediment intrusion with geotextile (Terrafix 270R).
   
   g) Keep all sumps clean during construction.
   
   h) Prevent wind-blown dust.
   
   i) Straw bales to be used in localized areas as shown and as directed by the engineer during construction for works which are in or adjacent to floodlines, fill lines and hazardous slopes.
   
   j) Straw bales to be terminated by rounding bales to contain and filter runoff.
   
   k) Obtain approval from UTRCA prior to construction for works which are in, or adjacent to floodlines, fill lines and hazardous slopes.
   
   l) All silt fencing and details are at the minimum to be constructed in accordance with the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.
   
   m) All of the above notes and any sediment & erosion control measures are at the minimum to be in accordance with the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.
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<th>No.</th>
<th>Proposed Measures and Site Conditions</th>
<th>Timing</th>
<th>Comments</th>
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</table>
| 1   | Identify all types of “erosion/sediment control (ESC) devices” that are selected for the proposed construction activities. | - For Development Projects with a Functional SWM Report – the ESCP is to be included in the Functional SWM Servicing Works Report.  
- For Development Projects with no Functional SWM Report component – the ESCP is to be included in the Servicing Report for the Project  
- For Operational & Capital Works Projects – the ESCP is to be submitted prior to detailed design. | ESC devices/ measures have to be listed and identified in detail including, but not limited to:  
- the type of silt fences and/or link silt fences (silt/ robust/heavy duty or others),  
- the proposed berms in relation to the identified areas  
All this information is required to be identified on the ESC’s attached plan of the section of the storm/drainage and SWM Functional Design Report. |
<p>| 2   | Identify the land slopes and proposed land alterations. | same | The relation of these recommended control devices to the proposed storm/drainage flow routes and grading on the attached plan shall be clearly established. All temporary fencing, rock check dams, and swales, where appropriate, are intended to attenuate flows and to provide sediment depositing. All these measures should be identified and attached to the ESCP in order to ensure that the ecological health of the system will be well protected and not compromised. During construction activities, any proposed diversion swales/channels, berms or silt fencing must direct all surface runoffs to the temporary sedimentation/settling basins or perimeter ditches in order to minimize sediment loading to the open watercourses or municipal system. |
| 3   | Identify when and where these devices are to be installed. | same | The relation of these identified control devices to the proposed storm/drainage flow routes and grading on the attached plan shall be clearly established. All recommended temporary swales shall be identified on the plan and the detailed information should be included in the report (locations, elevations, geotechnical conditions and separation distances should be identified). |</p>
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<th>No.</th>
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<th>Timing</th>
<th>Comments</th>
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<tbody>
<tr>
<td>4</td>
<td>Identify the potential downstream sensitivity of water resources.</td>
<td>same</td>
<td>All applicable and relevant background information related to the Official Plan (OP) Natural Heritage System (NHS) requirements, the Subwatershed Studies, Environmental Impact Studies, the City’s Design Standards and Requirements and the MOE and the UTRCA’s requirements must be identified.</td>
</tr>
<tr>
<td>5</td>
<td>Identify the proximity to Environmental Significant/Sensitive Areas.</td>
<td>same</td>
<td>All applicable and relevant background information related to the Official Plan (OP) Natural Heritage System (NHS), the Subwatershed Studies, Environmental Impact Studies, the City’s Design Standards and Requirements and the UTRCA requirements must be identified.</td>
</tr>
<tr>
<td>6</td>
<td>Identify the proposed infiltration measures and the existing groundwater levels, the relation to the surface flows, flood lines, base flows and provide all required calculations to support the recommended approach if it is warranted.</td>
<td>same</td>
<td>Compliance with the Hydrogeotechnical report recommendations for the subject lands.</td>
</tr>
<tr>
<td>7</td>
<td>Identify dewatering requirements, the type of permits and existing groundwater and open watercourses levels.</td>
<td>same</td>
<td>Compliance with the Hydrogeotechnical report recommendations for the subject lands and the MOE’s CofA for the Permit to Take Water (if it is applicable).</td>
</tr>
<tr>
<td>8</td>
<td>Identify the type(s) and predominant characteristics of the soils within the area (e.g. particle size/structure, moisture content and compactness).</td>
<td>same</td>
<td>Compliance with the Geotechnical report recommendations for the subject lands.</td>
</tr>
<tr>
<td>No.</td>
<td>Proposed Measures and Site Conditions</td>
<td>Timing</td>
<td>Comments</td>
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<tr>
<td>9</td>
<td>(1st bullet identified in ETC report on July 18/07) Provide specific provisions for all disturbed areas that are left inactive for 30 days or more. These areas must be re-vegetated in order to minimize the soil to be exposed and washed out by the storm flows.</td>
<td>same</td>
<td>The areas where the vegetation was removed for the proposed construction activities should be minimized and the phasing approach should be considered and discussed. The time period between the initial vegetation removal and final grading/seeding should be kept to a minimum.</td>
</tr>
<tr>
<td>10</td>
<td>(4th bullet identified in ETC report on June 20, 2005 and 3rd bullet identified in ETC report on July 18/07) Identify the need for enhanced ESC measures that may be warranted by the site conditions and/or the proximity to Environmental Significant/Sensitive Areas and/or open watercourses.</td>
<td>same</td>
<td>The requirement to provide various levels of the enhanced ESC measures that encompass: a multi-barrier approach that will collect the sediment at the source first rather than through conveyance; and end-of-pipe controls that will collect the sediment within the proposed perimeter ditches and settling/contingency detention basins to protect ecological health of the system.</td>
</tr>
<tr>
<td>11</td>
<td>(8th bullet identified in ETC report on July 18/07) A Contingency Plan must be included in the ESCP and is required to address potential non-typical site and weather conditions, the efficient reporting system and the emergency contact list including all applicable agencies.</td>
<td>same</td>
<td>The need for enhanced and sustainable ESC measures using the multi-barrier approach should be implemented. The main objectives of these measures are to provide the required control and containment of the sediment at the source within the proposed perimeter ditches and settling/contingency detention basins. The by-pass channels must be designed for a minimum of the 10 year storm event unless otherwise agreed to in writing.</td>
</tr>
<tr>
<td>12</td>
<td>(5th bullet identified in ETC report on July 18/07) The Owner’s Engineer will be responsible to develop and obtain all approvals for the proposed ESC Plan (including a Contingency Plan) for any construction sites/subdivisions.</td>
<td>same</td>
<td>The commencing of any construction activity at the subject lands is not allowed to proceed without all approvals being in place including the ESC Plan and the dewatering permits.</td>
</tr>
<tr>
<td>No.</td>
<td>Proposed Measures and Site Conditions</td>
<td>Timing</td>
<td>Comments</td>
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<tr>
<td>13</td>
<td>A cost estimate for the ESCP’s security allocations for potential remediation works is required to be calculated based on approximately 15% of the total projected cost for the Storm/Drainage and SWM Servicing Works.</td>
<td>same</td>
<td>It is required that the ESCP’s security allocations for potential restoration works be collected independently from the Subdivision security and should the Owner fail to provide the adequate implementation of the approved ESC Plan, the City would undertake remediation works.</td>
</tr>
<tr>
<td>14</td>
<td>The Owner’s Engineer will be required to obtain all required approvals for any proposed modifications that will compromise the effectiveness of the originally of the approved ESCP and obtain the acceptance by the Contractor.</td>
<td>same</td>
<td>The Owner’s Engineer will be required to discuss the recommended modifications and obtain approval from EESD staff. These suggested changes must be supported by the presented justification merits and required to include, but not be limited to: the subject site conditions, sensitivity and proximity to watercourses and/or Environmental Significant Areas (ESA) well the acceptance of by Contractor to implement the suggested modifications. Should these recommended modifications be considered: Minor changes- Upon discussing the presented justifications, and if the City agrees with the Engineer’s definition, the ESCP’s recommended modifications may be implemented by Contractor; Major changes-The Owner’s Engineer must submit the ESCP’s recommended modifications for review and acceptance by the City Engineer and implemented by the Contractor, all to the specification of the City Engineer.</td>
</tr>
<tr>
<td>15</td>
<td>The Owner’s Engineer will be required to ensure the implementation of the ESCP and to assign inspection throughout all construction</td>
<td>same</td>
<td>Control features that fail should be repaired and evaluated as to whether or not additional measures are required, and prior to removal of ESC measures, joint inspection is required to be conducted with the City’s staff.</td>
</tr>
<tr>
<td>No.</td>
<td>Proposed Measures and Site Conditions</td>
<td>Timing</td>
<td>Comments</td>
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<td>stages, as well as to undertake decommissioning of these ESC measures upon completion of construction activities on these sites.</td>
<td></td>
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<tr>
<td>16</td>
<td>The Owner's Engineer will be required to incorporate the following main components of the ESCP’s reporting system: Inspection on all days of the construction (failure of any ESCP shall be reported immediately within a period of 2-3 hours), Inspect if the precipitation exceeds the 25 mm storm event; Inspection logs must be reviewed on a regular monthly basis; The semi-annual summary status reports are required to be provided to the City; and The inspection reports shall be submitted to the City every three months.</td>
<td>same</td>
<td>The Owner/Subdivider to implement, maintain and ultimately decommission the ESC measures contained in the approved ESC Plan and their Consulting Engineer will be required to comply with the following requirements: “Certify” that all ESC measures were installed prior to construction; “Certify” that all ESC measures are being maintained and operating as intended; Submit ESC monitoring reports. They are to be submitted by April 1, July 1, and November 1 of each year until all works and services of the plan are assumed; Submit semi-annual SWM monitoring reports for a minimum period of two years (implemented in 1996 and updated in February of 2002) and ensure that ESC measures are decommissioned at the various stages of the project.</td>
</tr>
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</table>

EESD suggests that the Site Alteration agreement for new subdivisions/developments to be used only for a limited number of site applications and only in emergency cases.
At the site alteration agreement stage, the site alteration agreement shall include:

A proposed temporary site grading and drainage design that identifies site alteration parameters and any impacts on the adjacent lands and must be reviewed and accepted by EESD, prior to the agreement being finalized.

The proposed site grading and drainage design that will incorporate the hydrogeotechnical study recommendations; The proposed site alteration activities that will be in compliance with hydrogeotechnical study recommendations; and The Consulting Engineer provides formal “certification” that ESC measures were properly installed and were regularly maintained.

At the final servicing drawings review stage for various land development applications, all required ESC measures and procedures are identified on these drawings, and are to be in compliance with the approved ESCP and applicable standards, all to the specifications and satisfaction of the City Engineer.
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11 PARKS & OPEN SPACE

11.1 DEFINITIONS

11.1.1 Neighbourhood Parks

Neighbourhood parks are intended to serve a local neighbourhood population and should be designed to support unorganized activity along with some organized youth activities and programs. Typical features include: play structures, pathways, unlit sports fields, multi-use pads, and basketball courts.

11.1.2 District Parks

District parks are intended to serve groups of neighbourhoods and are designed with an emphasis on facilities for organized sports and unorganized activities. Facilities may include lit sports fields, spray pads, tennis courts, skateboard parks, parking lots, community centers, arenas, pools, and major play structures.

11.1.3 Community Linkages

Community linkages provide physical connections between parks, the larger open space system and community facilities such as schools, libraries, community centers and local shopping areas. They typically have asphalt pathways and maintain significant natural features and are designed to create convenient links in conjunction with local roads, storm water management blocks and school blocks.

11.1.4 Natural Areas

Natural areas can include Open Space Blocks, Woodlands, portions of larger Park Blocks and Environmentally Significant Areas (ESA). Generally, they have been set aside for their environmental significance and may have been identified by the City through a previous study or have a development-related Environmental Impact Statement (EIS) with recommendations for their protection, management and enhancement.

11.1.4 Thames Valley Parkway

Thames Valley Parkway is the City’s multi-use pathway system which generally follows the Thames River corridor. Future extensions of the Thames Valley Parkway (TVP) will occur as lands along the branches of the Thames River come under urban development. The TVP is asphalt and typically 3-4m wide with convenient connections to adjacent neighbourhoods.

11.1.5 Water Management Ponds

Stormwater management ponds are facilities constructed as part of the servicing requirements for development. Often located adjacent to Open Space uses, they are to be integrated with the park design or natural landscape feature.

Note: Refer to Section 18 regarding additional design information for new subdivisions.
11.2 **LAYOUT**

11.2.1 **Neighbourhood Parks**

Neighbourhood parks should be centrally located within the service area radius of 0.8km and serve a population of up to 5,000 people. Parks should be located to be within a convenient and safe walking distance to the majority of residents and users should not have to cross arterial roads to access their neighbourhood park. Wherever practical, neighbourhood parks should be coordinated with school sites to maximize outdoor space for school use and hard surface/parking for park users.

The parks should be from 1.5 – 4.0 ha in size and roughly rectangular to accommodate facilities with a minimum 15m setback to adjacent houses and to reduce “blind” corners. Typically, a 30-60m minimum frontage to suit block configuration is required, with at least one secondary entrance to the park. Generally, a flat site is desirable for facility development, but some topography may provide for tobogganing, etc. Stands of vegetation should be retained where possible.

Park facilities should be separated by suitable buffers and designed to be visible from the street. Pathways should connect all points of entry into the park. All layout of pathways and facilities is to be reviewed and approved on site by the City prior to proceeding with construction.

11.2.2 **District Parks**

District Parks should be centrally located within the service area of the District, and serve typically a 2km radius. They serve a population of up to 20,000 people, but can have more regional facilities such as indoor pools. They can be integrated with schools and should be located on primary collector or arterial roads for access by public transit. The City’s districts and existing district and neighbourhood parks are shown on the Planning Division’s Parks and Open Spaces map.

Some degree of topography is an asset to the park as it can provide buffers between facilities and adjacent houses. Stands of vegetation are desirable features and pathways are to connect all park facilities and park entrances. All layout of pathways and facilities is to be reviewed and approved on site by the City prior to proceeding with construction.

11.2.3 **Pathways and Facilities**

The design and layout of pathways and facilities is to be reviewed and approved on site by the City prior to proceeding with construction in Community Linkages and Natural Areas.

11.2.4 **Thames Valley Parkway**

The design and layout of the TVP will be done through City capital projects and through the development process where the TVP crosses developing lands. Typically, layout, design and construction of the TVP is subject detailed
environmental analyses as it is sometimes routed through valley lands and ESAs. In general, convenient access points that provide visibility from an adjacent street are required every 500m maximum.

11.2.5 Storm Water Management Facilities

The technical requirements and design of storm water management facilities is approved under Section 6 of this manual. Through that process, integration with adjacent parks or open spaces may be desirable. Where storm facilities are located and designed to integrate with parks and open spaces, additional land around the pond may be required beyond the minimum technical setbacks to property lines to permit suitable pathway systems and/or EIS requirements that meet park planning & design approval. Appropriate compensation will be provided for additional land requirements.

Facilities located away from parks and open spaces and not intended to be used as a community amenity are not subject to these additional setback requirements.

11.3 GRADING

Park grading for neighbourhood and district parks and community linkages shall integrate with the surrounding lands and provide positive flow from all facilities and adjacent private lands. Drainage from private lands may be directed to parkland if it can be accommodated within the park drainage design.

Pathways shall be set as high points through the park with positive drainage away from them. Limited amounts of sheet flow may be permitted to cross pathways in certain circumstances.

Park grading shall be smooth flowing and shown with contours, with spot elevations as required to demonstrate desired slopes, top-of-bank, field corners, and hard surface grades. Swales are to curve to suit facility layout, pathway alignments and natural topographical design.

Specific grading standards are:

1) Sports fields – 1.5%, directed to suit field layout and site conditions
2) Pathways – 1 – 2% cross slope, up to 8% linear (4% preferred)
3) Swales – 1.5 – 4%, for a maximum length of 150m
4) Topography – 3:1 maximum with undulating surfaces. 2:1 is permitted if an area is to be naturalized

Retaining walls are generally unacceptable within a park block unless they are required to maintain existing grades of adjacent facilities or for the protection of significant vegetation.

Grading plans for new subdivisions are to be included in engineering packages and meet all applicable requirements from the Engineering Review Division. The
completion of grading, servicing and seeding of park blocks is typically required prior to the issuance of building permits within the subdivision.

Grading for “natural areas” (may include some community linkages) is to be kept to a minimum and subject to review on a case by case basis. There may be requirements to grade within “natural areas” to suit future pathways. Grading of parks and open spaces adjacent to natural areas and ESAs to be delimited by upgraded silt fencing and/or as directed by a site specific Environmental Impact Statement (EIS). There may be requirements to grade within “natural areas” to suit future pathways.

Grading within storm water management ponds is approved by EESD. If ponds are to be integrated with parks and open space areas, pathway grades (as above) and pond side-slope grades should mesh and compliment adjacent landforms.

All rough grading for parks and open spaces is to be reviewed and approved on site by the City prior to proceeding with fine grading.

11.4 SERVICING

Park and open space blocks generally require storm sewer systems and occasionally sanitary sewers and water lines to service community facilities such as field houses and pools. For specific sewer design requirements, refer to Section 3 - Sanitary Sewer Collection System, Section 5 - Storm Sewer Collection System and Section 7 – Water Distribution System.

11.5 FENCING

All Parks and Open Space blocks shall require fencing adjacent to private owned lands. Fencing shall always be located on a common property line. Fencing shall be constructed in accordance with the specifications in the Standard Contract Documents for Municipal Projects, SP0-4.8. Fencing shall conform to the current City of London fence by-law. Fencing shall not be located adjacent to a public right of way, School Block and any other City Facility, except where fencing is required under another section of this document.

Fencing that is an integral part of a park recreational facility (ie: baseball diamonds, batting cages, etc…) are not subject to the above.

11.6 BOUNDARY MONUMENTS

Boundary Monuments shall only be used in substitution for fencing where it can be demonstrated that fencing will have a significant adverse impact on the site or fencing is not physically possible. Boundary Monuments shall always be located on a common property line and shall be constructed in accordance with the specifications in the Standard Contract Documents for Municipal Projects, SP0-4.7. At minimum Boundary Monuments shall be located at every change in direction of the property line and at 30 metre intervals. Where site topography is such that the...
line-of-sight between the Boundary Monuments is obscured at above intervals, additional Boundary Monuments are required at these locations to the satisfaction of the City.

11.7 SEEDING

Seeding of park blocks is carried out in accordance with the specifications in the Standard Contract Documents for Municipal Construction Projects.

Maintenance of the turf is the responsibility of the developer up to assumption. This includes mowing to maintain a height of no more than 63mm, weed control and over-seeding, if required. Inspections for assumption will only take place between May 30 and October 15. At assumption, the turf must be healthy and vigorous, cut to 50mm height with very few bare patches or weeds.

11.8 FACILITIES

With the exception of soccer fields, park facilities as described in Section 9.1 are not generally installed by a developer as part of park development. Occasionally, developers will proceed with a certain level of facility development to provide an amenity within their subdivision. Requirements for these facilities are outlined in the Standard Contract Documents for Municipal Construction Projects.

11.9 TREE PRESERVATION

In many parks, community linkages and open space blocks, existing vegetation is to be maintained as an amenity feature. Where this is the case, the following requirements apply:

1. Grading alterations should be generally restricted to outside the “drip-line” of existing vegetation.
2. The limits of grading where the slope is toward existing vegetation is to be fenced with upgraded silt fencing and/or as directed by a site specific environmental impact statement. Where grades slope away from existing vegetation, 1.2m high “construction fencing” is required.
3. Hazard trees and or limbs are to be removed from the edges of woods and over existing or proposed pathway/trail locations.
4. Additional requirements may be specified through a tree preservation plan produced to fulfill the conditions of a subdivision agreement.

11.10 NATURAL AREAS

Natural areas, open space blocks, woodlands or environmentally significant areas have stringent design requirements, often specific to the area. Generally, through the land development process they have been set aside for their environmental/ecological significance and through the preparation of an EIS will have recommendations for their protection, management and enhancement that are to be accommodated in engineering plans. Some of the City’s ESAs have conservation master plans that would also outline specific requirements.
Typically, standard grading, servicing and development requirements do not apply, but pathway/trail development is usually required and will require some level of design and construction as directed by the City.

Prior to assumption of natural areas, all hazards such as tree forts, old fencing, construction materials and general debris must be removed from the block. Hazard trees along existing or proposed trails and pathways and abutting adjacent lands should be removed.

11.11 BIO-ENGINEERING

Within parks, open spaces, natural areas and ESAs, bio-engineering is to be used as the preferred approach for slope stabilization, channel creation or restoration, storm outlet design and any other “engineered” feature. Limited use of rip-rap or other erosion control materials is permitted where the situation warrants if used in conjunction with other “natural” approaches.

Conveyance channels from storm water management facilities that outlet into parks and open spaces require suitable bio-engineered design to blend with the surrounding landscape.

Bio-engineering design may require specialized consultants to successfully implement parks standards and/or EIS recommendations.

11.12 TREE PLANTING

Tree planting within parks, open spaces, linkages, natural areas and stormwater management facilities is to be carried out in compliance with Section 12. More detailed planting and monitoring requirements for stormwater management ponds is found in “Guidelines for Landscape Planting & Monitoring” available from the Planning Division.

11.13 SEDIMENT & EROSION CONTROL

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA’s, steep slopes or other natural area, an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP please refer to Section 10 – Sediment & Erosion Control, within this manual.
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12 TREE PROTECTION & TREE PLANTING

12.1.1 TREE PROTECTION

This Section describes the requirements and measures required to ensure adequate protection for trees identified for retention under the contract. The requirements and measures include a tree protection plan, identification of Tree Protection Zones, installation of tree protection barriers, pruning of branches and roots and remediation measures to mitigate the impact of damage to retained trees.

The City will consider the protection of trees throughout the acceptance and construction processes and adopt reasonable precautions for the protection of trees.

All new subdivisions require an accepted Tree Protection Plan.

For site plans, the City will recommend at the site plan pre-consultation meeting whether a Tree Protection Plan is warranted for the specific site.

The City will assess each Capital Works project to determine whether a Tree Protection Plan is warranted.

12.1.2 Requirement for Approved Tree Protection Plan

12.1.3 A tree protection plan shall be completed by a certified arborist or approved professional, such as a Landscape Architect, and submitted to the Urban Forester or designate for approval prior to the start of the construction or other works.

12.1.4 No on-site construction or other works that may cause damage to trees is permitted without an accepted tree protection plan.

12.1.5 The tree protection plan shall include, but is not limited to:

a) Identification of specific trees (species, size and health) that are to be removed for safety, tree health, operational requirements or aesthetics. A detailed description of the condition of the trees and factors on which the recommendation to remove were based must be included in the report. Pictures of the trees showing pertinent condition are recommended;

b) Identification of specific trees (species, size and health) that will be retained and protected during the operations as future forest cover. Pictures of the trees showing pertinent conditions are recommended;

c) Identification of specific trees that will be dug up and relocated prior to the start of the operations and the locations where they will be replanted;

d) Foreseeable remedial actions to ensure the health of the remaining trees such as but not limited to branch pruning, deep root fertilization, tree watering, soil replacement or amelioration, planting;
e) Specification of good arboriculture practices for root and branch pruning;

f) A map showing:
   i) the location of all existing trees and the extent of their crowns;
   ii) the location of all trees to be retained, removed, replaced or relocated;
   iii) highlighted and labeled Tree Protection Zones and tree protection barriers.

12.1.6 Operational Constraints

Operational constraints as per Ontario Provincial Standards Specification (OPSS) 565.07.01 apply except during emergency situations.

12.1.7 Tree Protection Zones and Barriers

Tree Protection Zones (TPZ) shall be established surrounding all trees to be retained. The outside boundary of the TPZ shall be delineated by a tree protection barrier.

Barriers for Tree Protection Zones as per OPSS 565.07.02 apply except where:

a) The tree is flanked by curb/sidewalk and/or an asphalt road the TPZ and barrier can be limited to furthest extent of the boulevard area; and

b) A TPZ is not required or not feasible to establish beyond the main stem of the retained trees, banding boards shall be installed around the stems of the retained trees. The boards shall be installed in a vertical direction and remain in place for the duration of the project. Banding boards must not be nailed, or screwed onto the tree stem. Bark must not be broken or torn during the establishment of the banding boards. The banding boards must extend from ground level to a minimum height not of 1.2 metres.

12.1.8 Cutting and Repair

12.1.8.1 The Ontario Standard Specification (OPSS) 565.07.03 for tree cutting and repair applies except as amended as follows:

   The term “Specimen Trees” is deleted and replaced by the term “Trees to be retained”

12.1.8.2 All trees identified in the approved tree protection plan for pruning must be pruned before commencement of any on-site operations by a certified arborist.

12.1.8.3 It is recommended that when lateral services require replacement that the use of ‘no dig’ technology be used. Feasibility will be determined by the City’s Project Manager.

12.1.8.4 Roots that are exposed should be covered with wet burlap or soil as soon as possible and watered regularly to prevent them from drying out. Watering is required until such time as the topsoil and sod has been replaced satisfactorily or as otherwise directed by the City’s Project Manager.

All trees identified in the tree protection plan for relocation or removal must be
relocated or cut and removed prior to the commencement of the on-site operations.

12.1.9  **Tree Damage and Remediation**

12.1.9.1 “Damage” means to carry out any activity that may injure or kill any tree and including but not limited to:

a) the topping or removal of branches from a tree other than in accordance with accepted arboricultural practices;

b) the cutting or shattering of the roots of a tree within the drip line other than in accordance with accepted arboricultural practice;

c) the scraping, gouging or denting of a tree’s drip line

d) the compaction of the soil within the Tree Protection Zone by the placement of soil, fill, heavy equipment, vehicles, building or other materials thereon or by the movement of vehicles or equipment thereover;

e) depositing within the tree’s drip line any toxic or harmful substance;

f) the removal of soil from within a tree’s drip line.

12.1.9.2 No objects except approved tree protection barriers are permitted to be attached to trees protected by City by-laws.

12.1.9.3 Costs associated with any remediation actions required as a result of damage to retained trees, as ordered by the City, shall be borne solely by the contractor.

12.1.10  **Requirements for Post Construction Measures**

12.1.10.1 A certified arborist, or other tree professional, approved by the Urban Forester or designate, shall inspect all retained trees and their rooting area to assess if any additional remediation work is required to ensure their future health and survival.

12.1.10.2 If the inspection specified in Section 6.6.1 indicates damage to retained trees, the certified arborist or approved professional shall prepare a post construction remediation plan for approval to the City Urban Forester. The remediation plan may include but is not limited to: pruning; deep root fertilization; irrigation; aeration; tree planting either as a single activity or in combination.

12.1.10.3 A certified arborist, or other tree professional, approved by the Urban Forester or designate shall inspect the project site and certify that any and all measures specified in the tree protection plan or post construction remediation plan have been completed as per the plan. This certification is required before final acceptance and approval of the work by the City.

12.2.1  **TREE PLANTING**

**INTRODUCTION**

Tree planting on the public right-of-way is a long term initiative. What is done today can have a serious impact on street tree maintenance activities for years to come. It
is therefore imperative that tree planting be done with care and planning. Planning is critical to ensure that the final product is sustainable and aesthetically pleasing. Trees of similar shape but different species, if carefully selected, will provide the desired effect of tree arch over the street. The mix of species is essential to reduce the chances of insect epidemics, to guard against the spread of disease as trees are trimmed in efficient block treatments, to prevent widespread neighbourhood complaints and to eliminate extensive tree removal programs when single species plantings die (eg. Dutch Elm Disease on American Elm, Verticillium wilt on Norway Maples).

Designs should reflect patterns which show a use of random plantings of diversified species. Consideration should be given to adjacent lands where existing street trees may exist to ensure that continuous plantings are not created, in particular infill projects of limited frontage.

The City of London recognizes the difficulties in coordinating tree planting within the development process for new subdivisions. Trees are a living entity and, as such, cannot always be planted or inspected at convenient times. As well, difficulties with tree species availability, the seasonal nature of planting operations and administration make it more difficult to coordinate tree planting operations within the framework in place for assumption and end of warranty processes currently in place for new developments. The City of London, therefore, has instituted a ‘cash-in-lieu’ system whereby the developer will participate in providing a planting plan at the time of assumption and the City will implement the tree planting.

12.2.2 POLICY

12.2.2.1 Security (at Development Agreement Stage)

Security is required to ensure that funds are available in the event of default by the developer. Currently, this is a standard subdivision development requirement and will continue to be required in the amount of $25.00 per linear metre of street frontage (both sides) within the plan of subdivision.

12.2.2.2 Planting Plan (at time of assumption request by developer)

The developer will submit a planting plan showing actual planting locations (with all site amenities know and shown on the plan) and proposed species of trees (common and Latin names shown). **The services of an Ontario Registered Professional Forester or a member of the Ontario Association of Landscape Architects in good standing must be retained.** This will ensure that an appropriate planting plan is in place which considers species diversity, tree form location and design. The planting plan must be stamped by the R.P.F. or L.A. and be shown on the standard plan of subdivision drawing or grading plan which shows lot dimensions (particularly frontages) as prepared by the consulting engineer. The plan will be reviewed and approved by City staff. The plan is to be submitted to the Coordinator, Forestry Programs, Planning Division, City Hall for review.

12.2.2.3 Guidelines for Planting Plan Preparation

All trees are to be planted on City property.
Tree planting locations will be determined on a site specific basis. As a goal, no less than one tree should be planted for each lot. Larger lots and corner lots may have more than one tree.

Since large trees contribute more to the environment and the neighbourhood than small ones, the largest tree that is suitable for the location is to be planted, considering eventual size at maturity. Plantable space may include the boulevard in front of or rear of the sidewalk (where present). Tree locations may be staggered and/or grouped where appropriate to make the best use of available planting and growing space. The preferred location for trees will be in the boulevard between sidewalk and curb, where present. All trees are to be planted on City property.

Adjacently planted trees will be shown approximately every 3.0m – 12.0m o.c. where practical and where growing space is available, according to species. Ornamental trees will be spaced more closely than medium trees, and medium trees more closely than large trees.

The following guidelines will assist:

Figure 1. Tree size section

<table>
<thead>
<tr>
<th>Lot width</th>
<th>0.6m</th>
<th>1.5m – 2.0 m</th>
<th>&lt;1.5m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blvd width</td>
<td>Ornamental or Medium</td>
<td>Medium</td>
<td>Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone</td>
</tr>
<tr>
<td>&gt;2.0m</td>
<td>Medium or Large</td>
<td>Medium or Large</td>
<td>Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone</td>
</tr>
<tr>
<td>1.5m – 2.0 m</td>
<td>Ornamental or Medium</td>
<td>Medium</td>
<td>Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone</td>
</tr>
<tr>
<td>&lt;1.5m</td>
<td>Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone</td>
<td>Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone</td>
<td></td>
</tr>
</tbody>
</table>

**ii) Curb to Property Line Considerations**

- Where no sidewalks exist or where sidewalk construction is not planned, trees are to be shown no closer than 0.6m to the private property boundary on City property.
However this location should not be so far from the curb as to not contribute to a street canopy.

iii) **Site Considerations**

- Plant only ornamental tree varieties under or within 3m of high voltage overhead utility wires or poles. Large and medium shade trees maturing to an upright or vase shape are permitted no closer than 3m from high voltage overhead utility wires or their poles. Large and medium shade trees are not permitted immediately under but may be planted near other overhead cables including single phase and service wires and their poles.

- Trees may be planted at 0m (measured horizontally) from buried street light cable, not closer than 0.9m (measured horizontally) from other buried electric cables and not closer than 0.3m (measured horizontally) from buried telephone and/or TV service cables.

- No tree is to be shown closer than 2.0m to a driveway or 0.5m from a lead sidewalk going into a property.

- No tree is to be planted closer than 1.5m to the doors or within 1.2m from the sides of an above ground hydro vault (transformer).

- No tree is to be shown closer than 6m in line of sight to a stop sign on a residential street only (i.e. not a collector or arterial road).

- No tree is to be shown closer than 15.0m in line of sight to a stop sign or traffic signal light on any collector or arterial road.

- No tree is to be shown closer than 3m to the front and sides of a fire hydrant.

- No tree is to be shown closer than 0.3m (measured horizontally) to a water main, or 0.7m from a shutoff.

- No tree is to be shown closer than 0.2m (measured horizontally) to a gas line.

- No tree may be shown closer than 2.0m (measured horizontally) to a sanitary sewer.

- No tree may be shown closer than 3.0m to another tree.

- Trees only are required for cul-de-sac island or roundabout areas and will be shown on the planting plan. The cost for any shrub or perennial plantings will be at the expense of the developer and will be shown on the planting plan for review and approval in accordance with city guidelines and specifications. Planting of shrubs and/or perennials should coincide with City guidelines and specifications. Should this be required in advance of scheduled planting operations by City staff (i.e: for model homes, etc), the developer should discuss the scheduling of this planting with City Staff prior to work being carried out.
**Design and Species Considerations**

- Mature street trees are the most visible and desirable component of our streetscapes. However, to increase resistance to insect and disease problems, tree species must be mixed in order to avoid a continuous mono-culture situation. Where several phases make up the M-Plan, the plan should reflect the character of planting in adjacent phases.

- Use of native species over non-native species is desirable. Native means naturally occurring (indigenous) in Ontario.

- Invasive species (see Appendix 5) will be avoided except in special circumstances.

- ‘Ornamental’ tree means a tree that typically achieves a mature height of not more than 6m.
- ‘Medium’ tree means a tree that typically achieves a mature height greater than 6m and less than 16m.

- ‘Large’ tree means a tree that typically achieves a mature height greater than 16m.

- No more than five of any one species or variety is to be shown on one side of the street in a row. Trees should be matched one side of the street to the other (maximum of 10 matched trees) to provide a ‘closed canopy’ effect at maturity.

- Where several phases make up the M-Plan, the plan should reflect the landscape character of plantings in adjacent phases. It is not necessary and may not be desirable to match species on adjacent phases, but consideration should be given to a neighbourhood identity with similar tree shape and size at maturity.

- In order to integrate species diversity into each plan, the species mix shall provide no more than 15% of any one species (percentage of the entire number of trees within the plan). Individual phases may diverge from this percentage if deemed reasonable (e.g. cul-de-sac of 12 lots) so long as the overall object of 15% species mix is maintained within the plan of subdivision.

- Trees with similar shape (i.e.: vase, oval, upright) are to be selected to provide a neighborhood landscape character.

- No species other than those listed in Appendix 5 are to be shown on the planting plan without prior consultation with City of London staff. Other species may be considered for approval if it can be shown the proposed species are appropriate to the proposed planting locations and to permit trial plantings of new (to the City) species or cultivars.

- Trees with large or messy fruit may be planted only in limited situations; trees with
- large thorns are not permitted and species such as poplar and willow are banned by by-law for street tree planting.

- Coniferous needle-bearing trees will not be shown in the boulevard where they will cause sight line obstructions but may be planted rear of the sidewalk.
• Ash (*Fraxinus*) species may not be shown or planted on any City boulevard until further notice – no exceptions.

### 12.2.3 PLANTING

#### 12.2.3.1 Planting (Post Assumption)

Once the planting plan is approved at the time of assumption, the City of London will implement street tree planting before end of warranty of the subdivision through City of London tender processes and administration.

#### 12.2.3.2 Species Substitutions

The City will implement the approved tree planting plan, as accurately as possible, with the tree species specified. Once the planting plan is prepared, substitutions will be done only as necessary and should not be a common occurrence. Should substitution be required due to unforeseen circumstances, the City reserves the right to substitute with a suitable species without further consultation or approvals through the developer.

**Note:** Substitute species will endeavour to match the size and shape of the originally planned species. The overall 15% maximum by species limit shall still apply.

#### 12.2.3.3 Timely Planting

The City of London will commit to planting trees within one year of assumption. Any subdivisions assumed prior to October 1 of the current year would be incorporated into the Tender process for planting the following year. If assumptions are processed after that date, they could be planted the following year, depending upon availability of plant material specific to the planting plan, and depending upon when the Tender documents are distributed.

If assumption of the subdivision is unduly delayed, with at least 50% of homes already occupied, the City of London may work with the developer to arrange for planting of trees prior to assumption by the City, recognising the high benefit to the neighbourhood and the environment of planting trees as early as possible.

#### 12.2.3.4 Fee

There are several components which comprise the cash-in-lieu amount charged for street tree planting. The fee must cover all costs associated with implementing the program, including the cost to supply and install the tree, a two year replacement warranty policy and associated administration costs (planning, organizing and implementing of tree planting as well as surveying and compliance checks).

Once the trees are planted, the City will forward an invoice to the developer reflecting the actual cost of planting trees in that subdivision with an additional 10% administration fee (plus all applicable taxes).
12.2.4 AT END OF SUBDIVISION WARRANTY

12.2.4.1 Fee

Payment for tree planting as invoiced by the City of London is a requirement at the time of end of warranty of the subdivision. If payment is not received, end of subdivision warranty will not be granted.

12.2.4.2 Security

Once payment for street tree planting has been received (as invoiced), the developer will be released from all obligations in this regard and the City's Engineering Review Department will be authorized to release all securities held for such.

12.2.4.3 Public Relations

Should homeowners inquired about tree planting operations, the developer will explain that trees will be planted post-assumption. Further inquiries may be directed to the City of London.

12.2.4.4 PROCEDURE SUMMARY

- The developer will submit security amount at time of development agreement;
- The developer will provide a planting plan for review and approval at time of assumption;
- City Staff will plant trees between assumption and end of warranty of the subdivision;
- The City will invoice the developer for tree planting operations;
- The developer will forward payment as invoiced to the Finance Division, City Hall, Room 406;
- City staff will acknowledge receipt of payment and communicate to the Engineering Review Department that all requirements with regards to tree planting have been met for the area being assumed;
- City staff will authorize release of securities held;
- Payment for street tree planting is a requirement at end of warranty. If payment has not been received, end of warranty will not be awarded and securities will continue to be held until such time as payment is received by the consulting engineer. The plan will be reviewed and approved by City staff. The plan is to be submitted to the Coordinator, Forestry Programs, Planning Division, City Hall for review.
12.2.5 END OF TREE WARRANTY – INSPECTION PROCEDURE

Trees shall be planted under a 2-year warranty from time of planting, as prescribed in the tender documents. A tree warranty inspection shall be conducted prior to the expiry of the 2-year warranty period. This shall be conducted as per the guidance in Appendix 7 and included in the tree planting tender (contract). Trees that fail inspection shall be replaced within a suitable timeframe.
# TRANSPORTATION

## LIST OF FIGURES

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<th>Appendix</th>
<th>Description</th>
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<tr>
<td>8</td>
<td>TREE ASSESSMENT CRITERIA</td>
</tr>
</tbody>
</table>
Note: Refer to Section 18 regarding additional design information for new subdivisions.
**APPENDIX 2**

REMOVE RUBBING AND/OR BROKEN BRANCHES ONLY.
DO NOT TOP PRUNE AND DO NOT PRUNE THE LEADER.
REMOVE ALL NURSERY TAGS, PLASTIC OR METAL LABELS,
STRING, TRUNK WRAPPING AND OTHER FOREIGN MATERIAL.

*10 GALVANIZED WIRE TIES WITH
12mm 2-PLY REINFORCED RUBBER
HOSE TO PROTECT TRUNK

42mm x 40mm x 6mm x 2400mm
METAL "T" BAR STAKES.
STAKE NOT TO INTERFERE WITH
BRANCHES.

120mm DIA BLACK PLASTIC PVC
PERFORATED PIPE 450mm LONG
SET ON GRADE, SLIT ONE SIDE
INSTALLED PRIOR TO MULCHING.

100mm MIN. DEPTH OF SHREDDED
BARK OR WOOD MULCH TO COVER
ENTIRE EXCAVATED AREA.

REMOVE ROPE, BURLAP AND
WIRE FROM TOP 1/3 OF ROOT
BALL.

CONSTRUCT 180mm HIGH-SAUCER
AROUND TREE BASE AT MAX. HOLE
WIDTH.

PLANTING PIT TO BE 500mm
MIN. WIDER THAN ROOT BALL
IN ALL DIRECTIONS.

BACKFILL WITH NATIVE OR
PARENT MATERIALLY SEE NOTE *2

UNDISTURBED SOIL IF PIT IS DUG
TOO DEEP, COMPACT BACKFILL TO
PREVENT SETTLING.

---

**NOTE:**
1. TRUNK TO HAVE SAME ELEVATION RELATIVE TO FINISHED GRADE AS PREVIOUSLY OCCUPIED PRIOR TO TRANSPLANTING.
2. BACKFILL TREE-PIT WITH NATIVE SOIL AND/ OR A COMBINATION OF NATIVE SOIL AND APPROVED IMPORTED TOPSOIL.
   REMOVE FOREIGN DEBRIS AND STONES.
3. SAUCER TO BE SOAKED WITH WATER AND COMPLETELY MULCHED IMMEDIATELY FOLLOWING PLANTING.
4. ON STRING BALLS, ONLY BIODEGRADABLE ROPE IS ACCEPTABLE.
5. ALL DIMENSIONS ARE IN MILLIMETERS.

---

**BALLED AND BURLAPPED DECIDUOUS TREES**

---

**CITY OF LONDON STANDARD DRAWING**

**TREE PLANTING DETAIL**

<table>
<thead>
<tr>
<th>DWG</th>
<th>DATE</th>
<th>APPROVED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-31A</td>
<td>2002 11 14</td>
<td>CITY ENGINEER</td>
</tr>
</tbody>
</table>

Note: Refer to Section 18 regarding additional design information for new subdivisions.
TYPICAL TREE LOCATION DETAIL
ON BOULEVARD WITH SIDEWALK

TYPICAL TREE LOCATION DETAIL
WITHOUT BOULEVARD SIDEWALK
GENERAL NOTES

1. All plant materials shall be #1 nursery stock meeting Canadian standards.

2. Stake all deciduous trees.

3. Dig all tree pits 500.0 mm larger all around than the root ball and place tree centred in pit on undisturbed soil. Backfill with parent material and replace debris (eg. Brick, dry wall, etc) with screened topsoil.

4. 

5. For grading and drainage, see engineering plans.

6. Specific tree locations for each lot are to be determined by Tree Planting Guidelines set by the City of London Environmental Services Department and as shown on Lot Grading Certification Plans.

7. All dimensions are in millimetres unless otherwise noted.

8. All plant materials to be guaranteed for two growing seasons from the date of provisional acceptance.

9. Prior to the commencement of construction, all existing underground utilities within the limits of the construction site shall be located and marked. Any utilities damages or disturbed during construction shall be repaired or replaced to the satisfaction of the City of London at the Contractor’s expense.

10. Plant materials to be installed as shown; substitutions allowed only after consultation with the Landscape Consultant and the City of London.

11. Predominant soil type in the area.
The selection of trees for individual locations is a difficult process. It must give careful consideration to the neighbourhood and the existing conditions including soil type, moisture, available growing space above ground, proximity to hard physical plant (hydro wires, gas, lighting, hydrants, vaults, sidewalks) and future rooting and growing space demands.

In recommending the species in the table we recognize that they are not all suitable for all locations. Carefully select the species which possess the characteristics that most closely meet the environmental conditions of each site. As well, not all cultivars of each species are listed. The design professional may suggest species not listed and they will be reviewed by City staff through the approval process.

Other concerns include:

♦ STRESS considers the tolerance to conditions such as compacted soil, diseases, drought, insects, road salt spray

♦ TIME considers which species can be transplanted/moved at specific times in the year eg. spring only

♦ NATIVE considers the suitability of trees indigenous to this region for use in highly disturbed soils, traditionally found in streetscapes and new subdivisions

♦ FRUIT consider the size and season and abundance of fruit produced by some species making them less desirable in specific locations

♦ DISEASE consider the potential for widespread mortality and costly removal and replacement programs generating public and political complaints with trees such as Norway maple (Verticillium wilt) American Elm (Dutch Elm Disease) Austrian Pine (Diplodic Tip Blight). Avoid mass planting of single species.

Variety

In an effort to promote long term sustainability, cost effective block trimming operations and increase ability to manage street tree risk management, we encourage a variety of tree species on each and every street. We also support aesthetically pleasing street tree designs and therefore encourage the planting of tree species mixtures which have similar form.

Commonly the landscape architect or registered professional forester is responsible for proper design and species selection taking the above points into consideration.

In an attempt to assist the design and species selection process, a list of recommended street trees is included. The list has been prepared using a number of references and you are encouraged to search these out and provide input with respect to other species for consideration.
APPENDIX 5

References include:

Dirr, M.A.  1990 Manual of Woody Landscape Plants
Farrar, J.L.  1995 Trees in Canada
Gerhold, H.D. et.al.,  1989 Street Tree Factsheets
Poor, J.M.  (Editor) 1984 Plants That Merit Attention Vol. 1
Rehder, A.  1940 Manual of Cultivated Trees & Shrubs
Watson, G.W.  1992 Selecting and Planting Trees

TREE FORMS:

VASE
PYRAMIDAL
OVAL
COLUMNAR
ROUNDED
SPREADING
# APPROVED STREET TREES

*Do not use within 200m of a natural area or watercourse. Use only in highly urbanized and disturbed environments where other species may fail to thrive*

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Native or Not</th>
<th>Uses</th>
<th>Comments and Notes</th>
<th>Size</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acer campestre</strong></td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Compact form/trunk suckers require extra maintenance.</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Hedge Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer x freemanii</strong></td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Caution: Many cultivars of <em>Acer rubrum</em> and <em>A. saccharinum</em> exist under the name</td>
<td>Medium</td>
<td>Oval-Rounded</td>
</tr>
<tr>
<td><em>Hybrid Soft Maple</em></td>
<td></td>
<td></td>
<td>Freemanii, each with different characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer ginnala</strong></td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Multi-stem by prior approval only. Compact form/red &amp; yellow face colour/lots of</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Amur Maple</em></td>
<td></td>
<td></td>
<td>seeds/tends to sucker/specify single stem form</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer nigrum</strong></td>
<td>Native</td>
<td>Boulevard, Parks</td>
<td>Lots of seed for winter interest/rare/needs moist soil</td>
<td>Large</td>
<td>Oval</td>
</tr>
<tr>
<td><em>Black Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer pennsylvanicum</strong></td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Specify single stem.</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Striped Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer platanoides</strong></td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Surface roots conflict with and turf/girdling roots/aphid and wilt problems.</td>
<td>Medium</td>
<td>Various Forms</td>
</tr>
<tr>
<td><em>Norway Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer pseudoplatanus</strong></td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Very pollution and salt tolerant. Cankers cause high maintenance</td>
<td>Large</td>
<td>Oval-Rounded</td>
</tr>
<tr>
<td><em>Sycamore Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer rubrum</strong></td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Green summer foliage &amp; yellow to red fall colour/tolerates wet soil</td>
<td>Medium</td>
<td>Oval-Rounded</td>
</tr>
<tr>
<td><em>Red Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer saccharinum</strong></td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Fast growing softwood maple; Maintenance issues as tree nears maturity due to weak</td>
<td>Large</td>
<td>Oval-Rounded</td>
</tr>
<tr>
<td><em>Silver Maple</em></td>
<td></td>
<td></td>
<td>wood.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer saccharum</strong></td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Upright form/fall colour varies/prefers good drainage/shallow roots/salt sensitive</td>
<td>Large</td>
<td>Oval-Rounded</td>
</tr>
<tr>
<td><em>Sugar Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer spicatum</strong></td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Specify single stem. Shade tolerant, seldom thriving in the open. Prefer cool shade.</td>
<td>Ornamental</td>
<td>Oval-rounded</td>
</tr>
<tr>
<td><em>Mountain Maple</em></td>
<td></td>
<td></td>
<td>May spread by root shoots.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acer tataricum</strong></td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Specify single stem. Good red &amp; yellow fall colour/tends to sucker/lots of</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Tatarian Maple</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Design Specifications & Requirements Manual
The Corporation of the City of London
Updated: September 2012

Note: Refer to Section 18 regarding additional design information for new subdivisions.
### APPROVED STREET TREES

*Do not use within 200m of a natural area or watercourse. Use only in highly urbanized and disturbed environments where other species may fail to thrive*

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Native or Not</th>
<th>Uses</th>
<th>Comments and Notes</th>
<th>Size</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesculus glabra Ohio Buckeye</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Untested in London area and may suffer winter problems. Likes moist soil. <em>For use in limited circumstances</em></td>
<td>Medium</td>
<td>Oval</td>
</tr>
<tr>
<td>Aesculus hippocastanum</td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Good spring flower with no fruit/limit use due to disease susceptibility</td>
<td>Large</td>
<td>Rounded</td>
</tr>
<tr>
<td>Alnus glutinosa</td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Tolerant of wet &amp; dry soil. Invasive tendencies checked by dry sites.</td>
<td>Medium</td>
<td>Pyramidal</td>
</tr>
<tr>
<td>Amelanchier arborea Downy</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Showy flower &amp; fruit/ tolerant of wet &amp; dry soil</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td>Amelanchier canadensis Shadblow</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Difficult to maintain single stem Four-season interest Tolerates moist soil</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td>Amelanchier laevis Alleghany</td>
<td>Native</td>
<td>Boulevard, Park</td>
<td>Multi-stem specimens by prior approval only</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td>Betula alleghaniensis Yellow</td>
<td>Native</td>
<td>Parks</td>
<td>Interesting bark features and good fall colour</td>
<td>Large</td>
<td>Rounded-Spreading</td>
</tr>
<tr>
<td>Betula papyrifera White Birch</td>
<td>Native</td>
<td>Parks</td>
<td>Interesting bark features and good fall colour</td>
<td>Large</td>
<td>Rounded-Oval</td>
</tr>
<tr>
<td>Carpinus betulus European</td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Difficult to transplant Keep away from road salt &amp; spray</td>
<td>Medium</td>
<td>Pyramidal-Oval</td>
</tr>
<tr>
<td>Carpinus caroliniana Blue beech or Musclewood</td>
<td>Native</td>
<td>Boulevard Parks</td>
<td>Difficult to transplant/keep away from road salt &amp; spray/likes wet soil/thin bark and sculptured trunk</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td>Carya cordiformis Bitternut</td>
<td>Native</td>
<td>Parks</td>
<td>Difficult to transplant due to large tap root, messy fruit</td>
<td>Large</td>
<td>Oval-Vase</td>
</tr>
<tr>
<td>Carya glabra Pignut Hickory</td>
<td>Native</td>
<td>Parks</td>
<td>Difficult to transplant due to large tap root, messy fruit</td>
<td>Large</td>
<td>Oval-Vase</td>
</tr>
</tbody>
</table>
## APPROVED STREET TREES

*Do not use within 200m of a natural area or watercourse. Use only in highly urbanized and disturbed environments where other species may fail to thrive.

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<th>Uses</th>
<th>Comments and Notes</th>
<th>Size</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Carya laciniosa</em> Big Shellbark Hickory</td>
<td>Native</td>
<td>Parks</td>
<td>Difficult to transplant due to large tap root, messy fruit</td>
<td>Large</td>
<td>Oval-Vase</td>
</tr>
<tr>
<td><em>Carya ovate</em> Shagbark Hickory</td>
<td>Native</td>
<td>Parks</td>
<td>Difficult to transplant due to large tap root, messy fruit</td>
<td>Large</td>
<td>Oval-Vase</td>
</tr>
<tr>
<td><em>Celtis laevigata</em> Sugar Hackberry</td>
<td>Non-Native</td>
<td>Boulevard Park</td>
<td>Compact form/good in moist soils</td>
<td>Large</td>
<td>Vase</td>
</tr>
<tr>
<td><em>Celtis occidentalis</em> Common Hackberry</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Requires pruning for witches broom and general form. Very tolerant.</td>
<td>Large</td>
<td>Vase</td>
</tr>
<tr>
<td><em>Cercidiphyllum japonicum</em> Katsura Tree</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Multi-stem by prior approval only. Difficult to transplant. Thin bark. Needs supplemental water. For use in limited circumstances</td>
<td>Large</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Cercis canadensis</em> Redbud</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Seeds readily. Suitable for lawns but not formal boulevard due to low branching.</td>
<td>Medium</td>
<td>Vase-Rounded</td>
</tr>
<tr>
<td><em>Cladrastis kentukea (lutea)</em> Yellowwood (Single Stem Only)</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Few problems/use local seed sources or stock only/prune early</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Cornus alternifolia</em> Alternate-leaf Dogwood</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Use local winter hardy material only Specify single stem</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Cornus florida</em> Flowering dogwood</td>
<td>Native</td>
<td>Park</td>
<td>Specify single stem only. Use local winter hardy material only/good flower/specify single stem Can be very sensitive. Prefers acid soil, Limited use only.</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Corylus colurna</em> Turkish Hazal</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Good form/difficult to transplant/winter interest/needs supplemental water</td>
<td>Large</td>
<td>Pyramidal</td>
</tr>
<tr>
<td><em>Crataegus (varieties)</em> Hawthorns</td>
<td>Non-Native</td>
<td>Boulevard Park</td>
<td>thornless &amp; disease resistant varieties only. * For use in limited circumstances Crataegus monogyna is invasive*</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
</tbody>
</table>

Note: Refer to Section 18 regarding additional design information for new subdivisions.
<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Native or Not</th>
<th>Uses</th>
<th>Comments and Notes</th>
<th>Size</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Fagus grandifolia</em></td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Needs moist soil/different leaf colours with varieties/sensitive to activity within root zone/leaves persist through winter/thin bark</td>
<td>Large</td>
<td>Oval</td>
</tr>
<tr>
<td><em>Fagus sylvatica</em></td>
<td>Non-native</td>
<td>Park</td>
<td></td>
<td>Large</td>
<td>Oval-Rounded</td>
</tr>
<tr>
<td><em>Fagus orientalis</em></td>
<td>Non-native</td>
<td>Park</td>
<td></td>
<td>Large</td>
<td>Oval-Rounded</td>
</tr>
<tr>
<td><em>Ginkgo biloba</em></td>
<td>Non-native</td>
<td>Boulevard Park</td>
<td></td>
<td>Large</td>
<td>Pyramidal Spreading</td>
</tr>
<tr>
<td><em>Gleditsia triacanthos var. inermis</em></td>
<td>Non-native</td>
<td>Boulevard Park</td>
<td>Provides a filtered shade/susceptible to defoliation by leafhopper/susceptible to canker and other pests and diseases</td>
<td>Medium</td>
<td>Spreading</td>
</tr>
<tr>
<td><em>Gymnocladus dioicus</em></td>
<td>Native</td>
<td>Boulevard Park</td>
<td></td>
<td>Large</td>
<td>Oval</td>
</tr>
<tr>
<td><em>Halesia tetrapera</em></td>
<td>Native</td>
<td>Park</td>
<td>Low branched tree with narrow head/broad, rounded crown/reserve for lawn areas</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Juglans nigra</em></td>
<td>Native</td>
<td>Park</td>
<td>messy fruit/needs large area * For use in limited circumstances</td>
<td>Large</td>
<td>Oval</td>
</tr>
<tr>
<td><em>Koelreuteria paniculata</em></td>
<td>Non-native</td>
<td>Boulevard Park</td>
<td>Good yellow flower &amp; fruit/susceptible to winter damage/weak</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Laburnum (varieties)</em></td>
<td>Non-native</td>
<td>Park</td>
<td>Poisonous pea-like seeds. yellow chain like flower/winter hardy local varieties only/borderline hardiness * For use in limited circumstances</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td><em>Liriodendron tulipifera</em></td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Good flowers and yellow fall colour/local sources/moist well drained soil/very large tree most appropriate for lawn areas/somewhat weak wooded</td>
<td>Large</td>
<td>Rounded</td>
</tr>
</tbody>
</table>
### APPROVED STREET TREES

*Do not use within 200m of a natural area or watercourse. Use only in highly urbanized and disturbed environments where other species may fail to thrive*

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Native or Not</th>
<th>Uses</th>
<th>Comments and Notes</th>
<th>Size</th>
<th>Form</th>
</tr>
</thead>
</table>
| **Maackia amurensis**  
Amur Maackia                           | Invasive*     | Boulevard     | Small, round headed tree/slow growing/summer flowering/bronze coloured bark       | Ornamental | Rounded          |
| **Magnolia acuminata**  
Cucumber tree                           | Native        | Boulevard     | Maintenance problems/disease & insect problems/tolerates most soils               | Medium | Oval-Rounded     |
| **Malus (most)**  
Flowering & Domestic Crab Apple:       | Invasive*     | Boulevard     | Choose persistent fruit-holding, or poorly-fruiting types.                         | Ornamental | Rounded-Spreading |
| **Malus coronia**                     | Native        | Park          |                                                                                   | Ornamental | Rounded          |
| **Nyssa sylvatica**  
Black Gum                                | Native        | Park          | Difficult to transplant due to tap root, interesting summer and fall foliage, not for heavily polluted areas | Medium | Rounded - Oval   |
| **Ostrya virginiana**  
Hop Hornbeam or Ironwood                | Native        | Boulevard     | Mainly an understory species                                                     | Medium | Oval             |
| **Phellodendron amurense**  
Amur corktree                           | Non-native    | Boulevard     | Good winter texture in bark/lots of black berries/use in protected areas         | Medium | Spreading        |
| **Pinus strobus**  
White Pine                               | Native        | Park          | Locate with care in boulevards, due to possible sight line and access issues when immature (bushy). Avoid Ribes (alternate host for white pine blister rust) | Large  | Pyramidal        |
| **Platanus x acerifolia**  
London Planetree                         | Non-native    | Boulevard     | Frost cracks on trunk/attractive peeling bark/fruit can cause problems/very large at maturity – reserve for large lots and lawn areas | Large  | Spreading        |
| **Platanus occidentalis**  
Sycamore                                  | Native        | Boulevard     | Frost cracks on trunk/attractive peeling bark/fruit can cause problems/very large at maturity – reserve for large lots and lawn areas | Large  | Spreading        |
### APPROVED STREET TREES

*Do not use within 200m of a natural area or watercourse. Use only in highly urbanized and disturbed environments where other species may fail to thrive*

<table>
<thead>
<tr>
<th>Tree Species</th>
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<th>Uses</th>
<th>Comments and Notes</th>
<th>Size</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Populus ssp.</td>
<td>Native</td>
<td>Park. Not permitted in Boulevard</td>
<td>Wood is light, soft and weak, breaks easily in storms, drops flowers, fruit, twigs and branches</td>
<td>Large</td>
<td>Pyramidal – Vase and Spreading</td>
</tr>
<tr>
<td>Prunus Americana</td>
<td>Native</td>
<td>Park</td>
<td>Somewhat thorny. Untested in boulevard.</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td>Prunus nigra</td>
<td>Native</td>
<td>Park</td>
<td>Thorny. Untested in boulevard.</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td>Prunus pensylvanica</td>
<td>Native</td>
<td>Parks</td>
<td>excellent flowers with no fruit/single stem to be specified/weeping cankers * For use in limited circumstances</td>
<td>Ornamental</td>
<td>Oval</td>
</tr>
<tr>
<td>Prunus serotina</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Interesting bark, messy fruit; Better in lawns than in formal boulevard.</td>
<td>Large</td>
<td>Oval</td>
</tr>
<tr>
<td>Prunus (flowering varieties)</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Weeping cankers; prone to fungal infections * For use in limited circumstances*</td>
<td>Ornamental</td>
<td>Vase</td>
</tr>
<tr>
<td>Prunus virginiana</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>green spring foliage &amp; red in summer/bark tends to split</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td>Pyrus calleryana</td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Fireblight problems Graft incompatibility problems with some rootstocks</td>
<td>Ornamental</td>
<td>Pyramidal</td>
</tr>
<tr>
<td>Quercus alba</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Needs moist soil/fruit maintenance/needs large space at maturity</td>
<td>Large</td>
<td>Rounded</td>
</tr>
<tr>
<td>Quercus bicolor</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Grows in wetter conditions with acidic soils</td>
<td>Large</td>
<td>Rounded</td>
</tr>
<tr>
<td>Quercus ellipsoidalis</td>
<td>Native</td>
<td>Boulevard Park</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quercus macrocarpa</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Large size at maturity – reserve for large lots and lawn areas/fruit drop/difficult to transplant/requires good soils</td>
<td>Large</td>
<td>Rounded</td>
</tr>
</tbody>
</table>
### APPROVED STREET TREES

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<th>Comments and Notes</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Quercus muhlenbergii</strong>&lt;br&gt;Chinquapin Oak</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Attractive tree, especially in old age</td>
<td>Medium</td>
<td>Rounded</td>
</tr>
<tr>
<td><strong>Quercus robur</strong>&lt;br&gt;‘Fastigata’&lt;br&gt;Fastigate English Oak</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Needs well drained soil/holds leaves through the winter/difficult to transplant/very upright in form – reserve for sites with specific need for this form</td>
<td>Large</td>
<td>Columnar</td>
</tr>
<tr>
<td><strong>Quercus robur</strong>&lt;br&gt;English Oak</td>
<td>Non-native</td>
<td>Boulevard Park</td>
<td>Needs well drained soil/difficult to transplant/large size at maturity</td>
<td>Large</td>
<td>Rounded</td>
</tr>
<tr>
<td><strong>Quercus rubra</strong>&lt;br&gt;Red Oak</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Needs sandy loam soil/difficult to transplant/more salt tolerant and faster growing than other oaks</td>
<td>Large</td>
<td>Rounded</td>
</tr>
<tr>
<td><strong>Quercus velutina</strong>&lt;br&gt;Black Oak</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Needs well drained soil/difficult to transplant/large size at maturity</td>
<td>Large</td>
<td>Rounded</td>
</tr>
<tr>
<td><strong>Rhus ssp.</strong>&lt;br&gt;Staghorn Sumac, Smooth Sumac</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Spreads quick, freely suckers from roots creating wide spreading colonies. Tolerates dry sterile soils</td>
<td>Ornamental</td>
<td>Rounded - Spreading</td>
</tr>
<tr>
<td><strong>Sassafrass albidum</strong>&lt;br&gt;Sassafrass</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Prefers sandy soils</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sophora japonica</strong>&lt;br&gt;Japanese Pagoda Tree</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Excellent white flower/green stem when young/limit use due to messy characteristics</td>
<td>Large</td>
<td>Spreading</td>
</tr>
<tr>
<td><strong>Sorbus aria</strong>&lt;br&gt;Whitebeam Mountain Ash</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Leathery, gray-green leaves/white flowers in May/fall colour varies from pale green to golden brown to reddish</td>
<td>Medium</td>
<td>Pyramidal-Oval</td>
</tr>
<tr>
<td><strong>Sorbus aucuparia</strong>&lt;br&gt;European Mountain Ash</td>
<td>Invasive*</td>
<td>Boulevard</td>
<td>Scab disease &amp; insect problems; Limit use due to fruit and other problems.</td>
<td>Medium</td>
<td>Oval</td>
</tr>
<tr>
<td><strong>Sorbus x thuringiaca</strong>&lt;br&gt;Oakleaf Mountain Ash</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Forms a tight, rounded crown/White flowers/red fruit/Leathery dark green leaves</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
<tr>
<td><strong>Syringa reticulata</strong>&lt;br&gt;Japanese Tree Lilac&lt;br&gt;• ‘Ivory Silk’</td>
<td>Non-native</td>
<td>Boulevard</td>
<td>Good white summer flower/excellent small specimen</td>
<td>Ornamental</td>
<td>Rounded</td>
</tr>
</tbody>
</table>
# APPROVED STREET TREES

*Do not use within 200m of a natural area or watercourse. Use only in highly urbanized and disturbed environments where other species may fail to thrive.*

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Native or Not</th>
<th>Uses</th>
<th>Comments and Notes</th>
<th>Size</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tilia americana</em> Basswood</td>
<td>Native</td>
<td>Boulevard Park</td>
<td>Prefers deep moist fertile soil/will grow on drier heavier soil/needs large space</td>
<td>Large</td>
<td></td>
</tr>
</tbody>
</table>
| *Tilia cordata* Littleleaf Linden  
• ‘Glenleven’  
• ‘Greenspire’  
• ‘Greenglobe’ | Possibly invasive* | Boulevard | Aphid & borer problems; suckers from base; messy species | Medium | Pyramidal |
| *Tilia x euchlora* Crimean Linden | Non-native | Boulevard | Fruit messy/suckers from base *For use in limited circumstances* | Medium | Rounded |
| *Tilia tomentosa* Silver Linden | Non-native | Boulevard | Heat and drought tolerant. | Medium | Pyramidal-Oval |
| *Ulmus carpinifolia* Smoothleaf Elm  
• ‘Homestead’  
• ‘Pioneer’  
• ‘Sapporo Autumn Gold’  
*Ulmus x ‘Accolade’* | Non-native | Boulevard | Choose with care. Cultivars vary in resistance to Dutch elm disease and elm leaf beetle. | Large | Vase |
| *Zelkova serrata* Japanese Zelkova  
• ‘Green Vase’  
• ‘Village Green’ | Non-native | Boulevard | Rapid growth/narrow branch angles promote fork split/frost susceptibility when young | Large | Vase |
APPENDIX 6

TREE PLANTING LISTING FOR PROVINCIAL ACCEPTANCE

<table>
<thead>
<tr>
<th>ADDRESS</th>
<th>TREE SPECIES</th>
<th>DATE PLANTED</th>
<th>CONTRACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
Note: Refer to Section 18 regarding additional design information for new subdivisions.
## TREE PLANTING PROCESS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>RESPONSIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Select landscape architect/consulting forestry firm</td>
<td>Developer</td>
</tr>
<tr>
<td>2. Using plan of subdivision drawing and the list of trees in the guidelines for tree planting, select the most appropriate tree species for the lot size, conditions and soil types, and plot on the plan</td>
<td>Consultant</td>
</tr>
<tr>
<td>3. Submit the tree planting concept plan to the Forestry Division, Environmental Services Department for review and approval.</td>
<td>Consultant</td>
</tr>
<tr>
<td>4. Once plan receives final approval stamp and is signed and dated, the plan is submitted to Engineering Review for inclusion in their files.</td>
<td>Consultant</td>
</tr>
<tr>
<td>5. When subdivision final grades are established and sodding is complete, select landscape firm to plant trees according to planting plan and guidelines.</td>
<td>Developer</td>
</tr>
<tr>
<td>6. Plant Trees</td>
<td>Landscaper</td>
</tr>
<tr>
<td>7. Inspect trees for compliance with plan and guidelines (location, species, etc.) and prepare listing of trees planted by address.</td>
<td>Consultant</td>
</tr>
<tr>
<td>8. Notify Forestry Division of completion and provide listing by address of species planted.</td>
<td>Consultant</td>
</tr>
<tr>
<td>9. Acknowledge provisional acceptance.</td>
<td>Forestry Division</td>
</tr>
<tr>
<td>10. At the end of 2 year guarantee, inspect all trees for condition/survival and recommend and arrange replacements and/or assumption to Forestry Division.</td>
<td>Consultant</td>
</tr>
<tr>
<td>11. Inspect and prepare assumption letter for developer with copy to Engineering Review and authorize release of security.</td>
<td>Forestry Division</td>
</tr>
</tbody>
</table>
APPENDIX 8

TREE ASSESSMENT CRITERIA

It is critical that the inspections of trees are done in a consistent manner so that all developers and landscapers are treated fairly. We must also ensure that the City assumes a quality product that will not result in high maintenance costs.

To help facilitate this, the following tree assessment criteria are to be followed by the L.A. or R.P.F. in recommending tree assumption to the City. If these criteria are followed, City staff should be able to quickly approve trees for assumption.

Tree assessments are to be conducted from May 1 to September 1 only.

TREE CROWN

- Leaf area must be 75% or more
- Branch ratio must be 50% of total tree height and there must be 9 to 11 branches, well spaced and ascending the main trunk in a spiral fashion. The crown must be well balanced.
- Leaf size must be normal for the species
- Leaf colour must be normal for the species

TREE STEM

- The main leader must be intact – not cut
- The trunk must be single and straight
- The tree must be planted straight
- There must be 175 – 200 cm of clean stem below the branches
- There must be no major scrapes or cuts on the bark
- The tree must meet the diameter class as specified on the concept plan
- Trees must be planted as on the concept plan or an explanation provided
- Trees must be planted at the same height as in the nursery. We will accept maximum 4 inches high where necessary for survival. We will not accept trees planted deep, ie: below the level they were in the nursery.

PLANTING METHODS

- Plastic pipe may be left in place
- Stakes, ties, labels and wrap must be removed prior to acceptance
- Saucer and mulch are to be left in place
- NO mounding of soil or volcano acceptable.

A professionally stamped report by address is to be submitted with your recommendation to the Parks and Forestry Division. The following form is to be completed and submitted with your recommendation for assumption.
<table>
<thead>
<tr>
<th>M-PLAN</th>
<th>DATE OF SURVEY:</th>
<th>SURVEYOR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>STREET NAME:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TREE CROWN:</th>
<th>TREE STEM:</th>
<th>PLANTING METHODS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>House No.</td>
<td>Species Planted</td>
<td>% Leaf</td>
</tr>
<tr>
<td>-------------</td>
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<tr>
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</tbody>
</table>

- TREE HEALTH & WORKMANSHIP ACCEPTABLE - ASSUMED
- TREE HEALTH ACCEPTABLE BUT DEFICIENCIES TO CORRECT
- TREE HEALTH UNACCEPTABLE AND DEFICIENCIES TO CORRECT (Replace tree)

Note: Refer to Section 18 regarding additional design information for new subdivisions.
13 MATERIAL SUBSTITUTIONS

13.1 INTRODUCTION .................................................................................................................. 1

13.2 SPECIFICATIONS ............................................................................................................... 1

13.3 LISTS OF MATERIALS ...................................................................................................... 1
   13.3.1 Lists of Acceptable Products ....................................................................................... 1
   13.3.2 Utilization of the Lists ............................................................................................... 1

13.4 PRODUCT APPROVALS ..................................................................................................... 2
   13.4.1 Product Approval Committee .................................................................................... 2
   13.4.2 Materials Not Subject to Product Approval Committee Review ................................ 2

13.5 DRAWING APPROVAL ...................................................................................................... 2

13.6 HOW TO PROPOSE A SUBSTITUTION ............................................................................. 3
13 MATERIAL SUBSTITUTIONS FOR CITY OF LONDON PROJECTS

13.1 INTRODUCTION

There is a history of confusion surrounding the substitution of a material during construction projects, for example, using PVC pipe instead of HDPE pipe. This chapter is intended to clarify the City’s position on the matter of substitution of a material specified on an approved set of drawings with an alternative material. In no case can a substitution occur without the consent of the City.

13.2 SPECIFICATIONS

In the most simple of terms, the City of London has, at the minimum, two basic needs:
- the material must work for its intended use and life.
- the City must be able to maintain the works.

The City applies two decision-making tools to meet these needs:
- general acceptance of a material through the Product Approval Committee.
- specific acceptance, through the detailed design and drawing review process of a material based on the site specific design criteria.

13.3 LISTS OF MATERIALS

13.3.1 Lists of Acceptable Products

- The City of London Standard Contract Documents for Municipal Construction Projects has partial lists of acceptable products for use on construction projects where the City will ultimately be assuming the works.

- There is also a list of products that have been previously approved for use in the City of London, by the Products Approval Committee.

13.3.2 Utilization of the Lists

The materials listings have been developed to meet a multitude of general City needs such as durability and future maintenance, spare parts inventories, etc. The lists are not tailored to site specific needs.

Selecting from the pre-approved list allows the designer to avoid the additional process of having a material approved for use through the Product Approval Committee. The designer may choose to offer options of all acceptable materials for a given application, or may specify one product only, depending on site specific design constraints. If for example the designer chooses to allow either PVC, or Concrete Pipe, then the design...
drawings and related contract tender items must specify both, with full details for each with respect to class of pipe, and bedding requirements for type of material, taking into account depth of cover, soil conditions, etc. If the designer only specifies one material type for site specific reasons, then no substitutions may be allowed.

13.4 PRODUCT APPROVALS

13.4.1 Product Approval Committee

a) The Product Approval Committee is a committee comprised of City of London Environmental Services Department staff. If a new product is being proposed for future routine use in the City of London, the material must be reviewed, evaluated and approved by the Product Approval Committee, prior to its being used. The review, evaluation and approval of a new product takes, on average, six months to one year, depending on the product.

b) The designer is expected to select materials approved by the Product Approval Committee if any are available that are suitable for the use.

13.4.2 Materials Not Subject to Product Approval Committee Review

On occasion, the Product Approval Committee (PAC) excludes materials from the review process which they do not consider to be ‘products’. Examples include recycled asphalt as a granular base or painted glue. In these cases the City relies on acceptance of detailing drawings and/or contract specifications and/or manufacturer’s specifications. In all cases, the City has the final say as to whether a material may be used.

If the designer is unsure as to whether the material should be reviewed by the PAC, they should contact the PAC for confirmation.

13.5 DRAWING APPROVAL

The City requires all substitutions for items that are specified on an approved set of drawings, be approved by the City Engineer before use on that project. A note to this effect is included on all sets of servicing plans, as part of the City’s standard “Construction Notes for Engineering Drawings”. Consequently, after the design drawings have been accepted by the City, the designer MUST discuss and receive approval from the appropriate City of London staff, for any proposed changes of material prior to its being used on a project.

For the purposes of future maintenance and development, the As Constructed Drawings must accurately reflect the material or product used.
13.6 HOW TO PROPOSE A SUBSTITUTION  
(in accordance with OPS General Conditions GC5.0)

a) A tenderer may propose a material substitution to the designer. However the tenderer may not assume that the approved lists of materials (10.3.1.) are an approved equal and alternate' materials list, especially, for the purposes of tendering and construction.

b) The designer must evaluate the proposed material substitution, and discuss any changes with the City Engineer or designate. If the designer determines that the proposed substitution is ‘not suitable for use’ for the proposed municipal works, then that substitution can not be used.

c) If the proposed substitution is acceptable to the designer, then the City Engineer must review and accept the proposal. The City Engineer has the final acceptance authority for any proposed material substitution.

d) If the material substitution is approved, then an addendum for the tendering process or a change order for the construction process must be processed. In no cases can a tenderer/constructor independently decide to substitute a material.

e) The ‘As Constructed’ drawings must also accurately reflect the material or product used. The City does routinely consent to viable alternatives provided the appropriate process is followed and the attendant paperwork is in place.
14 CONTACT INFORMATION

14.1 ENVIRONMENTAL AND ENGINEERING SERVICES

Roads and Transportation
- Geomatics ................................................................. 519 661-2500 ext.4908
- Roadway Lighting & Traffic Control ............................... 519 661-2500 ext.4734
- Parks and Recreation Operations .................................... 519 661-2500 ext.6426
- Transportation Planning and Design ............................... 519 661-2500 ext.4580
- Transportation and Roadside Operations ......................... 519 661-2500 ext.8489

Wastewater and Treatment
- Pollution Control Operations ..................................... 519 661-2500 ext.4480
- Sewer Operations ....................................................... 519 661-2500 ext.8489
- Stormwater Management ............................................ 519 661-2500 ext.4574
- Wastewater and Drainage Engineering ......................... 519 661-2500 ext.5489

Water
- Water Engineering .................................................. 519 661-2500 ext.2354
- Water Operations ..................................................... 519 661-2500 ext.2352
- Regional Water Supply ............................................. 519 474-0451

Environmental Programs & Solid Waste
- Environmental Programs ........................................... 519 661-2500 ext.8414
- Forestry ........................................................................... 519 661-2500 ext.5783

14.2 DEVELOPMENT & COMPLIANCE SERVICES

Building Control ............................................................ 519 661-4555
Development Services & Engineering Review ...................... 519 930-3500
Customer Relations ....................................................... 519 661-2500 ext.4570
Parking ............................................................................. 519 661-2500 ext.4537

14.3 PLANNING SERVICES .............................................. 519 661-4980

14.4 WEB SITE www.london.ca (see Consultant Resources in the Business Section)
## 15 INSTALLATION AND INSPECTION OF SEWER AND WATER WORKS

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15 Installation, Inspection of Sewer and Water Works

The following addresses specifications and requirements to be met by the Owner or Contractor for the installation and construction of sewer and water works.

15.1 Approvals of Sewers and Watermains

Prior to installation of sewers and watermains, the Owner must have obtained:

- Final Approval from the Engineer,
- the Certificate of Approvals from the Ontario Ministry of the Environment for all sewer and watermain work, and
- the execution of all required agreements with the City.

Any changes required by the Owner to plans which have received final approval must be resubmitted to the Engineer for approval before the inspector will permit such changes to be made during installation.

Installation shall be in accordance with applicable OPSS and City of London Standard Contract Drawings for Municipal Construction Projects.

15.2 Inspection of Sewers & Watermains

A City Inspector shall, at all times, have access to the work. At least 24 hours before commencing installation, the Owner or Contractor shall apply to the City Technical Services Division for inspection and the Engineer shall determine the extent of inspection required.

15.2.1 Owner's Supervision

The provision of inspection by the City is not to be considered a substitute for supervision by the Owner or Contractor.

A Consultant's Inspector engaged by the Owner to inspect the sewer and watermain installation must have successfully completed the five day OGRA & MEA Inspector's Course called “Sewer and Watermain Construction Inspection (TM43)” or a consultant may obtain approval from the Engineer upon written request for use of Inspectors with a minimum of ten (10) years related construction experience in lieu of MEA/MOE Inspector's Course.

The Owner or Contractor shall provide and leave a competent and reliable agent or foreman in charge for him and such person shall be considered as acting in his place and all notices, communications, instructions or orders given, sent or served upon such person shall be taken as served upon the Owner or Contractor.

15.2.2 Revisions to Plans

Any changes required by the Owner to plans which have received final approval must be resubmitted to the Engineer for approval before the inspector will permit such changes to be made during installation.
15.2.3 City Inspector’s Authority

An Inspector may stop the work entirely if there is not a sufficient quantity of suitable and approved material on the site to carry out the work properly, if approved drawings and Specifications are not on the site, or if material or workmanship that is contrary to the plans or Specifications is being used.

If the Owner or Contractor covers or permits to be covered, work that has been designated for tests, inspections or approvals before such tests, inspections or approvals are made, given or completed, he shall, if so directed, uncover such work to have the inspections or tests satisfactorily completed and make good such work at his own expense.

15.2.4 Charges for Inspection

When an Owner or Contractor is required to have a City Inspector on the job, he shall be charged at the prevailing rate plus a trucking charge. In the event the Inspector is required during premium time periods the applicant shall be charged at current overtime rates.

If the work at any site is widespread to a point where an Inspector may not, in the opinion of the Engineer, give proper supervision to a job, then the Engineer shall determine whether extra Inspectors are required.

If required, the Engineer will place these extra Inspectors on the job and charge the Owner or Contractor for the services at the prescribed rate.

15.2.5 Emergency Repairs to Sewer and Water Service by City during Guarantee Period

During the guarantee period, where maintenance of water service to the consumer or consumers is required, or where, in the opinion of the Engineer or his representative, a faulty or damaged installation may cause inconvenience or further damage, the City will act immediately to make safe the condition for consumers after which the owner will be contacted and advised of the problem and given the opportunity to immediately affect repair. If the owner chooses not to respond forthwith or cannot be contacted, immediate repairs will be undertaken by the City. The cost of such repairs will be charged to the Owner. The decision of the Engineer or his representative will be final as to the necessity of repairs done or required and the amount expended for these repairs.
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NOISE ATTENUATION MEASURES

DEFINITIONS

Noise Attenuation Measures are required in site specific situations to mitigate existing or anticipated noise levels which exceed the MOE Criteria for acceptable noise levels for specific land uses. Typical locations where Noise Attenuation Measures may be required occur where residential land uses are adjacent to arterial roads, expressways, freeways, industrial lands, and railway lines. Noise Attenuation Measures can be setbacks, building orientation, earthen berms, noise walls, or any combination necessary to achieve an acceptable noise level, based on MOE Criteria.

NEW DEVELOPMENTS (Draft Plans, Community Plans)

Where new applications for residential development are being proposed along arterial roads, refer to the Official Plan Policy, Section 19.9.6. which can be found in ‘Section 19 – Implementation’ on the City of London web page at: http://www.london.ca/Official_Plan/table-of-contents.htm; for the criteria to be applied.

CAPITAL WORKS

Application & Methodology

For municipal projects, detailed fabrication and layout drawings of the proposed barrier, sealed by a Professional Engineer, shall be submitted to the Transportation Division for approval prior to manufacture or construction.

Dimensions and Location

a) The minimum height of the barrier shall be 2.44m above the finished centreline elevation on the road allowance side of the wall. The minimum height of the barrier on the private property side should be 1.8m. In rolling terrain, the barrier height may reduce to a minimum of 1.1m, in which case the combined height of the noise barrier and retaining wall shall not be less than 2.44 m. A concrete curb and gutter shall be erected along the base of the wall to a height of 0.15m or the bottom panel shall be a material resistant to damage from mowers or trimmers. There shall be no gaps or holes from the finished grade to the top of the barrier, except along the base of the barrier where they can be demonstrated as necessary for drainage.

b) Masonry or concrete noise walls are to be constructed on the road allowance within the 0.3m reserve, and maintained by the City. If no 0.3m reserve exists, the masonry or concrete noise barrier shall be placed adjacent to the property line, located entirely within the right of way.
c) Wooden noise walls are to be located entirely on private property, and maintained by the owner.

16.3.3. **Materials**

a) Panel materials shall be durable and impervious to ultraviolet light, with a predicted maintenance-free lifespan of 20 years. The barrier system and its components shall be designed in accordance with the requirements of the Ontario *Highway Bridge Design Code*. The barrier shall be constructed to meet a reference wind pressure of 0.36kPa for a 10-year return period, and the wall surfaces are to be “sound absorptive.” For a barrier, the material shall have a surface density not less than 20kg/m², and a demonstrated Effective Sound Transmission Class (E.S.T.C.) of 32 or greater.

b) Concrete for the post footings shall be 20MPa, in conformance with OPSS 1350

c) Wooden Noise Walls shall have steel posts.

### 16.4 NOISE ATTENUATION MEASURES WHERE RESIDENTIAL LANDS ABUT PROVINCIAL HIGHWAYS OR RAILWAY LINES

16.4.1 **Noise Assessment Study**

A Noise study or report is required when a proposed development is situated within certain design setbacks from a provincial highways or a railway line. The noise study is to comply with Ministry of the Environment “Noise Assessment Criteria in Land Use Planning”. All recommendations and details from the Noise Assessment Study are to be met or exceeded and reflected on the servicing drawings.

16.4.2 **Dimensions & Location**

Are to comply with the Noise Assessment Study, the Railway Line Setbacks, and the Draft Plan Conditions.

16.4.3 **Materials**

Are to comply with the Noise Assessment Study, Railway Line Requirements, Draft Plan Conditions, and Section 16.3.3 (above).
17 Trenchless Technologies (for new construction)

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17 Trenchless Technologies (for new construction)

17.1 APPLICATION

Trenchless installation of gravity sewers, watermains and forcemains is becoming more prevalent as a design alternative as the capabilities of the trenchless technologies advance. Trenchless Technologies can be a requirement of the City or proposed by a Consulting Engineer, as a viable alternative, given the particular design challenges for the specific site. Trenchless applications allow for the installation of the infrastructure with minimal disturbance of the surface area. Typical examples of where Trenchless Technologies may be viable alternatives to conventional methods include the installation of servicing through Environmentally Significant Areas (ESA’s), under major roadways or railway lines, in built up areas where space is limited and the social costs would be excessive or even residential streets with mature trees.

In the past, when a Trenchless Technology was proposed, the Design Engineer relied heavily on the expertise of the contractor for any given scenario. As new methods come on stream, and the technologies are advancing, the onus will be shifting from the Contractor to the Design Engineer to design specific elements of the trenchless installations. It is important that the Design Engineer be qualified to design and oversee (certify) the specific types of technology being proposed.

17.2 GEOTECHNICAL BASELINE REPORT (GBR)

A Geotechnical Baseline Report (GBR) is required when a Trenchless installation is being considered. The GBR will provide detail information related to the anticipated groundwater and soils conditions, including defining and assigning the various risks and liabilities to the Owner and/or the Contractor associated with the possible changes in ground conditions that may be encountered on the proposed alignment. This information will help the designer and contractor determine the appropriate trenchless method(s) for the proposed design application. The Design Engineer should provide necessary design parameters for the trenchless installation.

17.3 TRENCHLESS DESIGN REQUIREMENTS

17.3.1 Items to be Considered by the Design Engineer as Part of the Design Process

As a minimum, the Design Engineer is to give due regard for designing the following elements of an appropriate Trenchless Installation:

i) Pipe design (casing and/or carrier pipe as applicable)
   a) Material, along with specific characteristics of this material
   b) Dimensional Ratio (pulling forces, live loads, dead loads – as applicable)
   c) Diameter
   d) Alignment
   e) Radius of Curvature (if applicable)
   f) Grade

ii) Adequate room for staging areas, pipe assembly, entry and exit portals (as appropriate)
iii) Blocking and grouting requirements (of carrier pipe within a casing pipe)
iv) Slurry/spoil disposal
v) Erosion/Sediment Control Measures
vi) Bore Geometry
vii) Annular Space Plug
viii) GBR Recommendations
ix) Define the need for Dewatering and/or Permit to Take Water (if applicable)
x) Timing as it relates to other activities, i.e. order of operations
xi) Prequalification of the contractor

17.3.2 Information to be Included on the Construction Servicing Drawings/Tender Documents

This information should be shown on the engineering drawings and/or form part of the Tender Documents:
i) Pipe design (casing and/or carrier pipe)
   a) Diameter
   b) Alignment
   c) Grade (plus or minus if applicable and acceptable)
ii) Adequate room for staging areas, pipe assembly, design of entry and exit portals (as appropriate)
iii) Erosion/Sediment Control Measures
iv) GBR Recommendations
v) Define the need for Dewatering and/or Permit to Take Water (if applicable)

17.3.3 Items to be Considered in the Contract Tender Documents

Consideration should be given to addressing and/or including the following items as part of the contract tender:
i) a tender item for a 911 emergency shaft
ii) a tender item for “Frac Out” mitigation measures
iii) cutter head requirements
iv) over cut dimensions
v) Swab run (depending on diameter and site specifics)
vii) Bentonite lubrication
vii) Machine launch & retrieval (groundwater impacts)
vi) Annular space grouting
ix) Settlement/heave
x) Mitigation/contingency plans
xi) Damaged Pipe
xii) Tracking requirements
xiii) Spoil/slurry disposal
xiv) Methods of restraint against pull-back (as applicable)
xxv) Complete GBR
xvi) Quality control (i.e. – videos, joint testing, etc. as appropriate for the technology being installed)
17.3.4 Record Drawing

As part of the Record Drawing submission, at the conclusion of the project, the drawings are to be updated to show what was installed including:

i) Identify method of installation

ii) Pipe design (casing and/or carrier pipe as applicable)
   a) Material
   b) Dimensional Ratio
   c) Diameter
   d) Alignment
   e) Grade

iii) Blocking and grouting measures (as applicable)

iv) Location of staging areas, entry/exit portals – in case of settlement issues later
# 18 DRAFTING AND DESIGN REQUIREMENTS FOR NEW SUBDIVISIONS

## 18.1 DRAWING REQUIREMENTS FOR NEW SUBDIVISIONS

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18.1 DRAWING REQUIREMENTS FOR NEW SUBDIVISIONS

18.1.1 Basic Drawing Requirements

Drawings are to contain the following details:

a) A list of “Construction Notes for Engineering Drawings”. Note, all required reports associated with the design and as per Council Conditions, Approval Authority Conditions and Ontario Municipal Boards Conditions are to be listed onto the details drawings;

b) A general list of most common standards used [Ontario Provincial Standard Drawings (OPSD) & City of London]; and

c) A typical road and sewer trench cross-section detail identifying road, boulevard, sidewalk, curb & gutter, subdrains, watermain, forcemain sanitary & storm sewers, trench zones/slopes, bedding, together with all applicable dimensions and construction notes for the above.

18.1.2 Transportation Drawing Requirements

a) Road Profiles
   Road profile are required for all roads constructed within or in conjunction with a plan of subdivision. As well, additional road profiles are required as follows:

   **60m Road Profile of Adjoining Existing Street:**
   To ensure proper drainage is maintained and/or evaluated a profile extending into the existing subdivision is required.

   **120m Road Profile of Adjoining Future Street:**
   To review future alignment extensions of existing ground and proposed finished ground.

b) Typical Road Cross-section Detail
   A typical road cross-section detail, identifying recommended pavement structure and subgrade information (minimum to City of London standards, and as recommended by a Geotechnical Engineer) is required in conjunction with the typical sewer trench cross-section detail. Curb & gutter cross-sections to be incorporated into the typical combined road and sewer trench cross-section detail.

c) Driveway Locations.
   Driveway locations are to be identified where non-standard cul-de-sacs and curves in the roads are designed, adjacent to walkways, CICBs and the last lot on dead end streets.

d) Cul-de-sac Roads:
   i. **General**
      Minimum curb & gutter road grade around a cul-de-sac is 0.5%, and maximum road grade within the cul-de-sac is 3%.
ii. **Residential:**
   As per City of London Drawing Standard SR-5.0.

iii. **Industrial:**
    As per City of London Drawing Standard SR-5.1

e) **Ultimate Road Profile:**
   To achieve proper road design parameters on future/proposed arterial and collector road networks. Limitations and designs are to be reviewed and accepted by Transportation Division.

   **Note:** Existing abutting road plan & profiles are required for the full frontage of subdivision.

### 18.1.3 Sewer Design

a) **Connections To Future Subdivisions**

Sanitary and Storm sewers are to be extended to the edge of the subdivision limit for future servicing connections.

**Note:** All active sewers/stubs require a maintenance hole. If sewer/stub not active maintenance hole is not required.

b) **Plan & Profile Details**

A plan & profile drawing is required for all sewer designs. A typical sewer trench cross-section and details are also required. This may be done in conjunction with the road cross section, if applicable and required when.

- For poured maintenance holes
  - Unusual benching configurations within the maintenance holes

**Note:** Trench construction to be in accordance with the latest specifications regarding trench widths (Occupational Health and Safety Act – Regulation 213/91).

c) **Steep Grades of Sewers**

**Note:** Anchoring or concrete encased sewers are required for steep grades and/or velocities.
18.1.4 General

a) Drafting Standards

All drawings and calculations are to be completed, in metric units and to the City of London’s Engineering Record Drawings - Drafting Standards (Revised March 3, 2012).

b) Layout Information

For all fire hydrants, maintenance holes, catch basins, etc., layout information is required or alternatively a note indicating the use of UTM Coordinates

c) Temporary Measures

Temporary measures (i.e. DICB, ditches, maintenance holes, turning circles, grading, barricades, easements, etc...) may apply to some designs depending on the planning and future connections of the subdivision, and where applicable, these guidelines are to be adhered to, unless otherwise approved by the City Engineer.

Note: Details for the above should be provided on all pertinent drawings.

18.1.5 Urban Forestry

The following are to be shown on plan and profile drawings on existing streets and on the Tree Planting plan for new streets, as required by Urban Forestry:

a) Tree planting;
b) Tree preservation; and
c) Tree removal.

18.1.6 Parks Planning & Design Division

The following are to be shown on lot grading plans, tree preservation plans and/or detail drawings within lots/blocks and open space areas, as required by Parks Planning & Design Division:

a) Tree planting;
b) Tree preservation;
c) Tree removal;
d) Park grading;
e) Pedestrian system;
f) Park design; and
g) Landscaping plan.
### 18.1.7 Other Nonstandard Drawing Requirements

For more complex requirements, details drawings are required for the following:

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|                                                     | - Water level gauge cross-section and details;  
|                                                     | - Outlet swale/ditch plan & profile and cross-section details;  
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| Retaining Wall Details and Notes                      | - Typical profile view of retaining wall and footings;  
|                                                     | - Profile required for relatively high (1.0m or greater) and long retaining walls; and  
|                                                     | - Cross-sections views of retaining wall.                                             |
| Headwall Details                                      | - A plan & profile detail is required for all headwall designs together with all pertinent details. |
| Traffic Calming Measures Details and Notes            | - Plan & cross-section views of type of traffic calming measures and details; and  
|                                                     | - Curb cross-section details.                                                         |
| Access Roads Details and Notes                        | - Plan & profile of access road; and  
|                                                     | - Cross-section view of access road and details.                                      |
| Abutting an existing or proposed arterial road        | - Required where the common property line of the proposed subdivision plan abuts an existing or proposed arterial road, as per City of London Standard "Subdivisions Grading Along Arterial Roads" (See Chapter 9 Figure 9.1.). |
| Construction Roads                                   | - Plan & profile of construction road; and  
|                                                     | - Cross-section view of construction road.                                            |
| Pedestrian Pathway Systems Details and Notes          | - Plan & profile drawing and details; and  
|                                                     | - Cross-section view of pedestrian pathway systems.                                 |
| Sediment & Erosion Control Measures                   | - Plan & profile of checkdams; and  
|                                                     | - Cross-section of all pertinent measures                                              |
| Other Non-standard Works or Services                  | - Plan & profile; and  
|                                                     | - Cross-section details; as required by the City Engineer.                           |
18.2 OTHER AGENCY APPROVALS

18.2.1 Utilities Coordinating Committee (U.C.C.)

Works on Existing Assumed Streets:

U.C.C. is to be advised about all works on existing assumed streets other than lateral connections.

Non-Standard Service Locations:

U.C.C. approval is to be obtained for all proposed services which are to be constructed in non-standard locations on new or existing streets.

Sub-Standard Boulevard Widths and/or Non-Standard Road Widths:

Consultant is to notify all utilities regarding sub-standard boulevard widths, non-standard R.O.W. widths and utility easements required adjacent to sub-standard boulevards through U.C.C..

18.2.2 Board of Education

Board of Education approval is required for all services which are constructed on their lands. As well their approval is required for proposed services to a proposed/existing school block.

18.2.3 Upper Thames River Conservation Authority (UTRCA)

Review and approval from UTRCA is required, prior to the construction, of works, services and sediment & erosion control measures within flood plain areas and in or adjacent to open watercourses, ravines and natural areas under the jurisdiction of UTRCA.

18.3 TEMPORARY MEASURE DESIGN REQUIREMENTS

18.3.1 Temporary Turning Circles

Temporary turning circles are required if no intersecting street is within 45.0m of a dead end street as per City of London Drawing Standard SR-5.2.

18.3.2 Dead End Street

If a temporary turning circle is not warranted, then a dead end barricade is required, as per OPSD-906.01.

Note: A driveway for maintenance vehicles must be provided on last lot of the dead end street, but not adjacent to the subdivision limit. Sufficient snow storage area must be provided at the end of a dead end street without a temporary turning circle.
18.3.3 Work on Existing City Streets

When proposed works from a subdivision are to extend and/or be constructed on existing City Streets, the following is required:

a) limits of construction;
b) sawcut/milling/steep milled joint;
c) backfill & compaction specifications; and
d) restoration details.

**Note:** Steeped milled joint is required for all proposed road widenings, and where proposed asphalt designs meet existing asphalt designs, as per City of London Drawing Standard SR-13.1.

18.4 SEDIMENT & EROSION CONTROL MEASURES

18.4.1 Rip Rap

Constructed in conjunction with an approved geotextile within inlet/outlet structures, over flow protection, channel banks, gabions and rockfill structures.

Graded in sizes ranging from 100mm to 200mm, as per Ontario Provincial Standard Specification (OPSS)-1004.05.06.01.

18.4.2 Rock Protection

Graded in sizes ranging from 100mm to 500mm, as per Ontario Provincial Standard Specification (OPSS)-1004.05.06.02

18.4.3 Turfstone.

Constructed in conjunction with an approved geotextile, for use as over flow protection, channel lining, and/or surface access roads using City approved products.

**Note:** Turfstone voids are to be filled with topsoil and seeded.

18.4.4 Geotextile

Constructed within inlet/outlet structures, sub-drains, blanket drains, gabion lining, retaining walls, ditch lining, channel linings, access roads, rockfill structures, dykes and energy dissipaters. Type and sizing of geotextile is to be approved by the City.
18.5  PLANNING RELATED DESIGN REQUIREMENTS

18.5.1  Road Geometrics / Design

a) Road Widening

Where a subdivision abuts an existing City street, road widening may be required for future or present improvements to these streets. The City’s Official Plan Transportation Map and the City of London’s Zoning By-law Z-1 classifies roads throughout the City as secondary collectors, primary collectors or arterials. All other roads are considered to be local streets.

b) 0.3 metre Reserves (Blocks)

0.3 meter reserves along block frontages and at the rear and/or flankage of lots which are adjacent to arterial and collector road networks, where applicable (outside of right-of-way) and are also required at the dead end of proposed road networks which abut future proposed road networks and where roads in a subdivision abut lands outside the subdivision.

18.5.2  Minimum Lot Frontages

In most cases the zoning by-law adequately satisfies requirements for minimum frontages for single-family and semi-detached lots. However, where bends in streets occur or on cul-de-sacs, lots must be designed such that when side lot lines are projected to the fronting curb, an adequate frontage is provided at the curb line to avoid conflicting driveway locations. These minimum frontages at the curb line are as follows:

- Single-family: 5.5m
- Semi-detached: 9.0m

18.5.3  Noise Barrier Walls General

Noise barrier walls are required for residential developments which back onto or flank arterial road networks, or as otherwise required in accordance with the draft plan of subdivision conditions and City practices.

All noise barrier wall designs are to comply with the accepted Noise report and meet the minimum requirements and specifications of the Ministry of Transportation Noise Barrier Wall guidelines.

**Note:** Noise barrier walls for uses other than along arterial roads are to comply with Ministry of the Environment “Noise Assessment Criteria in Land Use Planning” requirements and approved by the Planning Division.

18.5.4  Noise Study/Report

Required when the proposed subdivision or development is situated within certain design setbacks from a Provincial Highway or Railway, as per the Ministry of the
Environment “Noise Assessment Criteria in Land Use Planning” and/or as indicated in the draft plan conditions and/or subdivision agreement, all approved by Planning Division.

All recommendations and details from noise barrier wall studies/reports are to be reflected on the servicing drawings.

18.5.5 **Noise Wall Location**

**Arterial Roads:**

a) **Masonry/Concrete:**

Wall, posts and brick pillars are to be located on City property within the proposed 0.3m reserve and maintained by the City.

b) **Wooden:**

Wall, posts and brick pillars are to be located entirely on private property and maintained by the owner.

**Other Situations:**

Locations as per the approved Noise Study (i.e. berms/walls adjacent to railways, etc.).

18.5.6 **Minimum Height**

2.4 above ultimate centerline road profile design or as required by an accepted Noise Study.

18.5.7 **Material Density**

Ministry of Environment Criteria - Minimum surface density of 20 kg/sq.m. (4lbs/sq.ft.).

18.5.8 **Materials**

**Masonry/Concrete:**

Constructed of a concrete material with a surface density of 20kg/sq.m. (4lbs/sq.ft.). Previously accepted masonry/concrete walls: Durisol and bricked.

**Wooden:**

Constructed of a wood material with a surface density of 20kg/sq.m. (4lbs/sq.ft.). Previously accepted wooden walls: Western Red Cedar, Red Wood and Yellow Cyprus.
18.5.9 **Noise Wall/Retaining Wall Combined**

Where the property line along the road undulates requiring the use of retaining walls, the standard 2.4m wall can be reduced to a minimum of 1.1m wall in hill sections.

**Note:** the overall combined noise wall and retaining wall height, must be 2.4m above the ultimate centerline road profile design or as required in the accepted Noise Study.

18.5.10 **Site Lines**

Site lines to be maintained in accordance with Section 4.24 of Zoning By-Law Z-1.

18.5.11 **Return End Walls**

Required at the end of all proposed noise barrier walls which terminate at an abutting property which does not have an existing noise barrier wall present or where an opening is required (e.g. at a walkway).

18.5.12 **Gaps/Holes**

To be free of any holes or gaps within and at the bottom of all proposed noise barrier walls.

18.5.13 **Drainage**

Proper surface drainage to and away from the noise barrier wall is required for all proposed designs.

18.5.14 **Overland Flow Routes Through Noise Barrier Walls**

In exceptional situations, an adequately designed opening in the wall is required to allow overland flow route to pass through the wall, in conjunction with a toe wall or berm behind the opening in the wall to provide a supplemental noise attenuation measures at the opening.

18.5.15 **Details**

A typical profile view of the noise wall/footings is required together with cross-sections and details for any pertinent brick pillars/footings and wooden posts/footings, which are to comply with the Ontario Building Code.
18.6 STORM CHANNELS

18.6.1 General

Specifications and design information to be in accordance with the Ontario Provincial Standard Drawings the Municipal Works Design Manual (MEA) and as approved by SWM Unit.

18.6.2 Channel and Hydraulic Report

To be reviewed and accepted by SWM Unit. All recommendations and details from the report are to be shown on the servicing drawings.

18.6.3 Width/Depth/Freeboard/ Type

Dependent on accepted report by SWM Unit.

18.6.4 Side Slopes

3:1 side slopes maximum.

18.6.5 Linings/Material

Grass-lined slopes, and where velocities are high, gabion-lined, approved erosion protection mat, or rip/rock protection side slopes, and/or as per the accepted Channel/Hydraulics Report and Geotechnical Report.

18.6.6 Inlet/Outlet Structures

As per Headwall and Culvert Sections, 5.18.

**Note:** All inlet/outlet structures which are different from those identified in the Ontario Provincial Standard Drawings and Municipal Works Design Manual (MEA) are to have Structural Engineer’s certification.

18.6.7 Pedestrian System

Location, width and materials to be reviewed and approved by Parks Planning & Design Division, in conjunction with Development Services.

**Note:** Grades and drainage to be reviewed by Development Services.

18.6.8 Landscaping Plan

Reviewed and approved by Parks Planning & Design Division, in conjunction with Development Services.
18.6.9 **Maintenance Access**

A 3.0m to 4.6m wide topsoil and sodded access without any trees, plantings or other obstructions is required for maintenance vehicles and equipment used to service all inlets/outlets within the channel. Adequate curves and turn-around facilities are required for maintenance vehicles to maneuver. Slopes (10% maximum), cross-falls (2% minimum) and drainage of access roads are also to be addressed in the design.

Note: A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s); and sufficient room is to be provided on the top of each side of the channel, generally 6.0m.

18.6.10 **Details**

A plan & profile is required for all storm channel designs together with frequent cross-sections and details. Plan view, cross-sections and details of the inlet/outlet structures or other pertinent design features within the channel are also required.

18.7 **STORM CULVERT**

18.7.1 **General**

Precast Box:
Constructed for access (i.e. road and pedestrian) crossings within a ditch, creek and/or river.

All major crossings, where applicable, are to be reviewed and approved by SWM Unit.

Corrugated Steel:
Same as precast box, where applicable.

18.7.2 **Culvert Calculations and Report**

Precast Box:
To be reviewed and accepted by SWM Unit.

All recommendations and details from the accepted report are to be reflected on the servicing drawings.

Corrugated Steel:
Same as box, where applicable.

18.7.3 **Minimum Diameter/Size**

Precast Box:
1800mm (span) x 900mm (rise).

Corrugated Steel:
450mm diameter

18.7.4 Maximum Depth of Cover

Precast Box:
As per OPSD-803.010.

**Note:** if depth of cover is less than the above, certification from a Structural Engineer is required.

Corrugated Steel:
300mm OR diameter divided by 6, whichever is greater. As per OPSD-805.01.

**Note:** If depth of cover is less than the above, certification from a Structural Engineer is required.

18.7.5 Culvert Crossings Over Services

Precast Box:
In addition to the City’s review and approval, where a culvert crosses an existing/proposed sewer and/or watermain, frost protection over the above existing/proposed services is warranted, and insulation is required, as per City of London Drawing Standard W-CS-68.

Corrugated Steel:
Same as box culverts.

18.7.6 Railings

Precast Box:
Required for concrete culverts where the drop is greater than 1.0m, as per the Ontario Building Code. As per OPSD-980.101.

Corrugated Steel:
Same as box culverts, where applicable.

18.7.7 Flood Plain Areas

Precast Box:
Upper Thames River Conservation Authority’s review and approval is required where storm culverts are constructed within flood plain areas.

Corrugated Steel:
Same as box culverts.

18.7.8 Rip Rap/Rock Protection

Precast Box:
Required at the inlet/outlet with high velocities. As per the Sediment & Erosion Control Section 10.

Corrugated Steel:
Same as box culverts, where applicable.

18.7.9 Sediment & Erosion Control Measures

Precast Box:
As per the Sediment & Erosion Control Section 10 and as per the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.

Corrugated Steel:
Same as box culverts.

18.7.10 Bedding

Precast Box:
As per OPSD-803.010.

Corrugated Steel:
As per OPSD-802.010.

18.7.11 Materials

Precast Box:
Concrete.

Corrugated Steel:
Corrugated Steel Pipe.

Note: For 300mm to 600mm diameters, specified minimum wall thickness to be 1.6mm. All other diameters, minimum wall thicknesses as per OPSD-805.01.

18.7.12 Maintenance Access

A 3.0m to 4.6m wide topsoil and sodded access without trees, plantings or other obstructions is required for maintenance access and equipment used to service all culverts. Adequate curves and turn-around facilities are required for maintenance vehicles to manoeuvre.

Slopes (10% maximum), cross-falls (2% minimum) and drainage of access roads are also to be addressed in the design.

Note, a 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s).

18.7.13 Details

Precast Box:
Plan & Profiles are required for all culverts together with frequent cross-sections and details (e.g. inlets/outlets).

Corrugated Steel:
Same as box culverts.

18.8 STORM DITCHES

18.8.1 General
Required for existing road network surface drainage in rural road situations without existing or proposed storm drainage systems have not been warranted.

18.8.2 Grade
Minimum 0.3%. Maximum dependent on erosion velocity of soil and erosion protection provided.

18.8.3 Depths
Dependent on right-of-way widths, safety features and other design constraints.

18.8.4 Slopes
3:1 side slope maximum.

18.8.5 Lining/Materials
Grass-lined, and where velocities are high, approved erosion protection mat, if warranted.

18.8.6 Inlets/Outlet Structures
As per Types of Headwalls Section 5.18.1, Storm Culverts Section and Types of Catchbasins Section 5.16.4.

18.8.7 Subdrains
May be required to be constructed adjacent to and/or drain to ditches, as required by the Geotechnical Engineer and Transportation Division, as per City of London Standard Contract Documents, Section 405.07.01.

18.8.8 Rip Rap/Rock Protection
As per the Sediment & Erosion Control Section 10 and as per the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.

18.8.9 Sediment & Erosion Control Measures
As per the Sediment & Erosion Control Section 10 and as per the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.

18.8.10 Details
Plan & Profile required together with frequent cross-sections and details.