A1 INTRODUCTION

This section indicates the general requirements of the City of Markham (City) with respect to the design of municipal engineering works in the City. These requirements, however, are general and do not relieve the Consulting Engineer of the responsibility for submitting a finished product of competent engineering design and construction. More detailed requirements, policies, and procedures are found throughout this manual under the respective sections.

All municipal engineering works shall be designed and constructed in accordance with this document, the City's Engineering Standard Drawings, and applicable City policies, specifications, guidelines and by-laws. Where no City Engineering Standard Drawings exist, the Ontario Provincial Standards (OPS) for Roads and Public Works, the Transportation Association of Canada (TAC) - Geometric Design Guide for Canadian Roads, and the Ontario Ministry of Environment, Conservation and Parks (MECP) Guidelines may be used, subject to their acceptance by the Director of Engineering.

The requirements outlined in this document shall be read in conjunction with other current City documents including, but not limited to:

- Engineering Standard Drawings
- Municipal Inspection and Construction Guidelines for Subdivision and Site Plan Development
- Applicable By-Laws
- Trees for Tomorrow - Streetscape Manual
- City of Markham Stormwater Management Guidelines
- City of Markham Accessibility Guidelines
- Cycling, Pathways and Trails Master Plan
- Bicycle Facility Selection Guide
- Bicycle Facility Design: Guideline Toolbox for Intersections

The Consulting Engineer shall incorporate, where applicable, the requirements of other applicable approval authorities (e.g., York Region, Durham Region, Toronto & Region and Conservation Authority (TRCA), Ministry of Environment, Conservation and Parks (MECP), Ministry of Natural Resources and Forestry (MNRF), Department of Fisheries & Oceans (DFO), Ministry of Transportation (MTO), GO Transit, Canadian National Railways (CNR), Canadian Pacific Railways (CPR), Alectra Utilities, Enbridge, Bell, Rogers, etc.) and obtain their respective approvals as part of his or her design.

The Design Criteria has been prepared to provide design consistency and may not be appropriate in all instances. It is the Consulting Engineer's responsibility to determine the appropriateness of applying the Design Criteria when designing the intended municipal engineering works. Where a need to deviate from the Design Criteria or Engineering Standard Drawings is encountered, a proposal with supporting documentation shall be submitted to the Director of Engineering for review and approval, as early as possible, in the design process.

References within this document to the 'Consulting Engineer shall be interpreted as a Professional Engineer licensed by Professional Engineers Ontario (PEO). All drawings, reports, and technical documents submitted to the City must be stamped, signed, and dated by a Professional Engineer licensed by PEO.

A2 ROADWAYS

A2.1 Road Works

All municipal roadways shall be designed and constructed in accordance with the criteria outlined in this document and with the Engineering Standard Drawings, and where applicable, the TAC Geometric Design Guide for Canadian Roads, and the Ontario Provincial Standards and Specifications.

Sidewalks and walkways shall be located and constructed in accordance with the City's Sidewalk Policy and the City Standards.

A2.2 Street Names and Traffic Signs

All regulatory/advisory signs, temporary or permanent, shall be designed and installed in accordance with the Ontario Traffic Manuals (OTM).All regulatory signs required by OTM are required to be shown on accepted Pavement Marking Signage Plans (PMSP) and installed before the road is opened to traffic (temporary or permanent).

A2.3 Pavement Markings

Pavement markings on all roadways greater than two lanes in width are required to be shown on accepted Pavement Marking Signage Plans (PMSP).

The pavement markings shall be installed before the road is opened to the traffic (temporary or permanent).

A2.4 Traffic Signals

Traffic control signals are required to be designed in accordance with the Traffic Signal Drawings (refer to Annex 4).

A2.5 Streetlighting

Streetlights are required to be designed and installed in accordance with the Streetlighting Drawings accepted by the Director of Engineering.

Electrical works shall be designed and constructed in accordance with the City's Streetlighting and Electrical Standards (refer Section N).

A3 WATERMAINS

Watermains and appurtenances shall be designed and constructed in accordance with the Engineering Standard Drawings, City By-laws, and MECP Guidelines. A water distribution analysis report shall also be required to include subject and future lands.

A water service connection shall be provided at the property line for each lot or building block, or park block in accordance with the accepted Engineering Drawings.

A4 SANITARY SEWERS

A4.1 Local Sanitary Sewers

Sanitary sewers and appurtenances shall be designed and constructed in accordance with the Engineering Standard Drawings and MECP requirements/guidelines. Sanitary sewers shall be designed to service the adjacent external lands where so required by the Director of Engineering or as indicated in the Master Servicing Plan. A service connection shall be provided at the property line for each lot or building block, or park block in accordance with the accepted Engineering Drawings. Control maintenance holes at the property line shall be provided for Industrial, Commercial, and Institutional sites.

A5 STORM SEWERS

Storm sewers shall be designed and constructed in accordance with the Engineering Standard- Drawings and MECP requirements/guidelines with positive drainage and no adverse effects on the adjacent properties.

Storm sewers shall be designed to provide service for development lands within the upstream watershed and/or for the drainage of any areas identified in the Master Servicing Report or as directed by the Director of Engineering. Stormwater drainage shall be directed to an outlet acceptable to the Director of Engineering and the TRCA. A service connection shall be provided at the property line for each lot or building block, or park block in accordance with the accepted Engineering Drawings. Control maintenance holes at the property line shall be provided for industrial, commercial, and institutional sites.

A6 LOT AND BLOCK GRADING

The grading and drainage of lots and blocks shall be designed and constructed to provide positive drainage with no adverse effects on the adjacent properties.

A7 EROSION AND SEDIMENT CONTROL

Erosion and sediment controls shall be designed, constructed, and maintained for all land development projects in accordance with the City Standards, TRCA guidelines, and accepted Site Alteration Plans. No site alteration shall be permitted until a Site Alteration Plans / Erosion and Sediment Control Plans are accepted by the Director of Engineering and a Site Alteration Permit is issued by the City / a Pre-servicing/Subdivision/Site Plan Agreement is executed by the Owner.

A8 FENCING AND TREE PRESERVATION

Noise Attenuation Fencing shall be designed and constructed in accordance with the recommendations of the Noise Study accepted by the Director of Engineering. For all other types of fencing, reference shall be made to the Fencing By-law or accepted Community Design Plan. All types of fencing must be shown on General Plans, Grading Plans, and Composite Utility Plans.

No site alteration or tree removal shall be permitted on site until a Tree Preservation Plan has been accepted by the City Architect and the appropriate preservation measures are in place and included in the Site Alteration Plan, to the satisfaction of the Director of Engineering and the City Architect.

A9 STANDARD SERVICE EASEMENT OR SERVICING BLOCK REQUIREMENTS

The minimum width of easements or servicing blocks required for various service combinations shall, in general, be in accordance with the following guidelines, unless otherwise accepted by the Director of Engineering:

Size of Pipe	Minimum Width of Easement OR Servicing Block
Single sewer or watermain less than 3.7 m deep, centered on easement or servicing block.	6.0 m
Single sewer or watermain more than 3.7 m deep, centered on easement or servicing block.	9.0 m
A combination of two pipes, either sewer or watermain, less than 3.7 m deep, centered on easement or servicing block, 2.5 m separation (barrel to barrel).	9.0 m
Three or more pipes, less than 3.7 m deep, either sewer or watermain centered on easement or servicing block, 2.5 m separation (barrel to barrel).	Add 3.0 m for each additional pipe to the base width of 9.0 m
A combination of two or more pipes, either sewer or watermain, more than 3.7 m deep, centered on easement or servicing block, 2.5 m separation (barrel to barrel). The Consultant shall submit a detailed cross-section of the easement or servicing block.	To be determined on a case-by-case basis

The above are general requirements and guidelines. Site-specific situations shall be reviewed and considered on an individual basis at the discretion of the Director of Engineering.

In order to protect footings from being undermined or to prevent loading on services from foundations, the Owner may be required to lower the footing of the adjacent houses to accommodate the installation of sewers or watermain within an easement or servicing block between two lots.

The Owner shall not be allowed to erect any building or structure nor place or remove any fill on or from any part of the easement, or servicing block, or plant any trees/shrubs over the easement or servicing block. Grass is permitted over the easement or servicing block.

A10 BENCHMARKS

Vertical Control

All design and construction shall be referenced to a minimum of two City benckmarks. The Consulting Engineer shall contact the City's Asset Management Department to obtain a description of current benchmarks adjacent to the proposed work. Benchmarks used during construction shall be clearly identified on the design drawings with the City's Benchmark number and the Benchmark Elevation, based on the City's Geodetic Benchmark System.

Horizontal Control

All new design and construction shall be referenced to the Markham Integrated Horizontal Control Network. This system is based on the North American Datum 1983 6^{o} UTM Coordinate System.

Horizontal control data is available from the City's Asset Management Department.

A11 "AS-CONSTRUCTED" DRAWINGS

The Consulting Engineer shall be responsible for obtaining "As-Constructed" inverts and ties for all underground services, Tee's, and lateral connections. The "As-Constructed" information shall be checked against the design as the construction proceeds in order to discover at an early date any discrepancies so that corrective action can be taken, if required. Sufficient "As-Constructed" information shall be obtained to allow record drawings to be prepared as described in Section J.

The on-site Consulting Engineer or Resident Inspector shall keep one set of all contract drawings on site for the sole purpose of "As-Constructed" information. "As-Constructed" information shall be recorded throughout the project and shall be available for review at all times by the City's Inspection Staff.

A12 VIDEO CAMERA SEWER INSPECTION REQUIREMENTS

All storm and sanitary sewers, including sewer laterals, shall be inspected by video camera in accordance with the Subdivision/Construction Agreement and the sewer camera inspection requirements. Inspection shall be carried out by the Consulting Engineer and the Contractor. The Owner and/or the Contractor shall be financially responsible for the inspection.

All USBs and reports shall be submitted to the Director of Engineering together with the 'As Consructed' sketches submitted for "Acceptance for Maintenance". City maintenance hole inventory numbers shall be used for video inspection reports.

A13 MANDREL DEFLECTION TESTING OF SEWERS

Post Installation Inspection of sewers shall be carried out as per OPSS 410.07.16.05 for Quality Assurance.

The Mendrel (Ring) deflection testing shall be performed on all PVC sewers. For pipes 100 mm to 750 mm, the maximum allowable deflected pipe diameter is 7.5% of the base inside diameter of the pipe. For pipes greater than 750 mm in diameter, the maximum allowable deflected pipe diameter is 5.0% of the base inside diameter of the pipe. Base inside diameter is defined in CSA B182.11, Tables 6, 7, and 8.

A Mandrel shall be pulled through the sewers to demonstrate that the pipe deflection does not exceed the allowable deflected pipe diameter. The Mandrel test shall be performed no sooner than 30 days after the completion of backfilling and installation of service connections.

All sections of pipes that fail the deflection test shall be replaced/repaired and retested.

A14 LEAKAGE TESTS

Leakage Tests (Infiltration/Exfiltration) for pipes shall be performed as per OPSS 410.

A15 POST-CONSTRUCTION ACCEPTANCE TESTS

In addition to the above tests, the Director of Engineering may require additional tests to ensure quality assurance for any construction/materials.

A16 CITY'S FACILITY ID NUMBERS

Prior to the 1st Engineering Drawings submission, the Consulting Engineer shall request the City for City's Facility ID numbers and include the same in all Engineering Drawings and Design Sheets, for the following:

- Sanitary Maintenance holes (including Control MHs at the property line)
- Storm Maintenance holes (including Control MHs at the property line)
- Hydrants (except within a site plan)
- Valves (including valves in chambers but excluding V&B at the property line)
- Chambers
- Streetlight Poles

City's Facility ID numbers are not required for any temporary flushing hydrants, flushing stations, and valve boxes.

A17 GENERAL NOTES:

- For Subdivision Engineering Drawings, refer to Standard Drawing (MR35)
- For Site Alteration Plans, refer to Standard Drawing (MP14)
- For Lot Grading, refer to Standard Drawing Plan (ML1)
- For Composite Utility Plans, refer to Design Criteria (Section G)