Centre Wellington

DEVELOPMENT MANUAL

MARCH 2018

About the use of this document.

This document is intended to provide direction for the preparation of detailed designs for development applications within the Township of Centre Wellington. It is the responsibility of the consultant to ensure use of the latest version of this Development Manual. When noted, consultation with Centre Wellington staff is required to confirm applicable design standards.

Our Thanks To:

The Township of Centre Wellington wishes to express its appreciation to the City of Kitchener, the Region of Waterloo and the Town of East Gwillimbury for generously providing their standards and drawings, many of which formed the base of development for information identified within this manual.

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A ENGINEERING SUBMISSIONS

A.1 General

All required information listed below must be submitted with each engineering submission or the submission will be returned to the applicant. The engineering submission shall reflect the entire draft plan and external lands, as applicable.

A.1.1 First Submission

A complete first submission for all development phases is required to be submitted by the Consultant to Planning and Development Services after Draft Plan Approval. Any submissions found to be incomplete will be returned to the Developer. Three (3) complete rolled sets of engineering drawings must be submitted to Planning and Development Services staff for distribution.

Table 1: SUBMISSION DRAWINGS TABLE
Title Sheet
Existing Conditions and Removal plans
Phasing plan
General Plan(s) of the project showing all municipal services
Area grading plan showing all road and lot drainage provisions including adjacent properties
A storm sewer drainage and storm water management plan including the entire area to be drained
A sanitary sewer drainage plan including the entire area to be serviced
Plan and profile of all proposed streets and services
Plans showing miscellaneous notes and details
Landscape and Streetscape Plans
Tree and plant preservation plans
Erosion and Sedimentation Control plans
Composite Utility Plan
Streetlighting Plan
Such other plans as may be required
Signal Wiring Plan and Signalized Intersection Plan
Park and Community Trail Development and Grading Plan (as required)

Three (3) copies of the following:

- Stormwater Management Report;
- Geotechnical Investigation;
- Hydrogeological Report;

- Design sheets for both storm sewer and sanitary sewers, including a digital copy of the Excel spreadsheet.

The first submission drawing sets shall be distributed by Planning and Development Services. The drawings will be reviewed by the various departments and all comments will be sent to the Planning Coordinator who will consolidate all the comments. A marked up copy of the drawings and/ or reports along with a letter consolidating all comments and issues will be sent to the Consultant by the Planning Coordinator. The Consultant shall revise the drawings as per Township comments and resubmit them to Planning and Development Services as a second submission. If the Consultant has any questions or concerns regarding the first submission comments and mark ups from the Township, a meeting request or discussion can be held with the Planning Coordinator. If there are no comments or concerns, a letter approving the drawings will be sent to the Consultant.

A.1.2 Second and Subsequent Submissions

The second and subsequent submissions shall be a revision of the previous submission based on the Township's comments. The Consultant shall submit the second submission to Planning and Development Services as per the Submission Requirements Table once the revisions have been made. After the revisions have been addressed from the first submission, the consultant shall circulate the second submission to all utility companies for comment. As part of the second submission, the consultant shall provide Engineering copies of the letters sent to the utility companies.

A letter from the Consultant addressing the comments and concerns sent by Planning and Development Services staff as part of the first submission drawings and reports review shall also be submitted with the second submission drawings. This letter shall include a description of any additional changes made by the Consultant.

A.1.3 Final Submission

After final approval by the Township of the aforementioned submissions, the following is required:

- Three (3) complete sets of drawings;
- One (1) complete set of drawings in 11 x 17 format;
- Two (2) complete sets of sewer design sheets;
- Two (2) CD's of the digital copy of all drawings and final reports in .PDF format.;
- Two (2) copies of the Draft Contract Documents.

The above are required for approval of the engineering drawings. Approved engineering drawings is a single requirement for construction approval. For construction approval requirements refer to section A.12.

In addition to the above, three (3) complete copy of the following shall be submitted to Planning and Development Services:

- list of all drawings to be included as part of the Service Agreement;
- list of all easements to be granted and all property to be conveyed to the Township;

- all lots unsuitable for building purposes;
- complete detailed cost estimate of all municipal services required;
- listing all lots proposed to have infiltration measures (soak-away pits).

A.1.4 "As-Recorded" Submission

"As-Recorded" drawings are to accurately reflect, both graphically and numerically, the true conditions of the work described. If items described in the drawings were constructed in variance to the designs illustrated in the approved proposed construction drawings, then the "As Recorded" submissions should be revised and / or edited to accurately reflect how the work in question was actually recorded / built. Text and numerical information included on the drawings shall also be edited as required in conjunction with the graphics in their entirety.

These drawings shall show the location both horizontally and vertically of everything which is on, and under the lands to be accepted by the Township. As Recoded information to be provided in GPS coordinates for all water, sanitary and storm system infrastructure (refer to section A.10.4.14). All service connection inverts at the property line must be shown in table form for each lot and block on its respective plan/profile drawing.

Two (2) sets of "As Recorded" drawings shall be submitted to Planning and Development Services for Infrastructure Services review and approval. These drawings will be submitted prior to the first Letter of Credit (LOC) Reduction Request. The LOC reduction will not be processed until the as-recorded information has been received and approved by Infrastructure Services

The "As-Recorded" drawings shall be submitted in white paper full size hardcopy and electronically on a CD as AutoCAD and .PDF files.

The white paper full size hardcopy "As-Recorded" submission will contain the following listed stand-alone drawings:

- General Plan(s) of the project showing all municipal services;
- Phasing Plan;
- Area grading plan showing all road and lot drainage provisions including adjacent properties;
- A storm sewer drainage and storm water management plan including the entire area to be drained;
- A sanitary sewer drainage plan including the entire area to be serviced;
- Plan and profile of all proposed streets and services;
- Plans showing miscellaneous notes and details;
- Landscape Plans;
- Tree and plant preservation plans;
- Sediment and erosion control plans;
- Composite Utility Plans;
- Streetlighting Plan;
- Such other plans as may be required;
- Signal Wiring Plan and Signalized Intersection Plan (as required);
- Park and Community Trail Development/Grading Plan (as required).

Consultants should note the total number of copies to be submitted to Planning and Development Services. The chart below shows each stage of submission, and the submission requirements, which outlines the medium of submission and where Development Engineering Staff distributes to.

Table 2: SUBMISSION REQUIREMENTS				
Submission Requirements	Hard Paper Copy		Digital: AutoCAD	Digital: .PDF
1st Submission	3 sets			2 CD
2nd/Subsequent Submission	3 sets			2 CD
Final Submission	As per A.9.3			
As Recorded Submission	2 sets		2 CD	2 CD

A.1.5 Engineering Submission for Subsequent Phases

Prior to commencing construction with subsequent phases within a subdivision, engineering design shall be updated to reflect updated design standards and as-built condition in earlier phases. Three (3) hard copies to be submitted to Planning and Development Services for review and approval.

A.2 Plans and Drawings

A.2.1 General Drawing Requirements

All drawings shall have the following:

a) Legend;
b) All works shall be performed in reference to an official geodetic control monumentation. All drawings referring such work shall also reference the geodetic control used in the subject work;
c) A local benchmark note shall appear in each drawing;
d) Existing information shall be shown in background or light line weight;
e) Proposed information shall be bolded or foreground line weight;
f) North arrow shall be referenced on all drawings;
g) Chainage on a plan-profile shall increase from left to right;
h) Plan and Profile drawings;
i) All drawings are to be stamped and signed by the appropriate qualified professional, i.e. Professional Engineer or Landscape Architect.

A.2.2 Draft Plans

Draft Plans should be prepared in accordance with the guidelines provided on the Plan of Subdivision Application.

A.2.3 Geodetic Control

Where required, a digital drawing file with the following spatial characteristics shall accompany development applications:

Map Projection: *Universal Transverse Mercator*
Horizontal Datum: *NAD83 Zone 17 North*
Horizontal Units: *Metres*

The graphics in the drawing must be geographically positioned to third order accuracy. The Township's horizontal control network (UTM NAD83) may be used as a control reference and can be acquired from Asset Management staff.

The survey control maps contain the following information for each control point:

a. UTM Northing (e.g. 4759528.620metres);
b. UTM Easting (e.g. 643968.440 metres);
c. Marker Type (e.g. GPM, SCP, BM);
d. Marker ID (e.g. SCP–517);
e. Elevation (e.g. 179.812);
f. Description (e.g. north west corner of lot 32 at property line).

A.2.4 Drawings Package

The drawings package to be submitted to Development and Planning Services for distribution to the other departments shall include:

- Title Sheet;
- Existing Conditions and Removals plan;
- Phasing Plan;
- General Plan(s) of the project showing all municipal services;
- Area grading plan showing all road and lot drainage provisions including adjacent properties;
- A storm sewer drainage and storm water management plan including the entire area to be drained;
- A sanitary sewer drainage plan including the entire area to be serviced;
- Plan and profile of all proposed streets and services;
- Plans showing miscellaneous notes and details;
- Landscape Plans;
- Tree and plant preservation plans;
- Sediment and erosion control plans;
- Composite Utility Plan;
- Street Lighting Plan;
- Such other plans as may be required;
- Signal Wiring Plan and Signalized Intersection Plan;
- Park and Community Trail Development/Grading Plan (as required).

Title Sheet

The Title Sheet will include the following:

a) Name of the Development;
b) Name of the Developer;
c) Township of Centre Wellington logo;
d) Name of the Consulting Engineer;
e) Key Plan at scale of 1:10,000 indicating the location of the proposed development and the proposed new street alignment;
f) Index to each drawing constituting the complete set indicating drawing number and title;
g) Submission and Revision description i.e. 1st Submission, 2nd Submission, etc..

A.2.4.1 *General Plan of Services*

To a scale of 1:1,000, showing the following

a) Roads, blocks, lots and their numbers;
b) Sanitary and storm sewers including pipe diameter and direction of flow and SWM facilities (where applicable);
c) Watermains, hydrants and valves;
d) Maintenance holes and catchbasins;
e) Culverts and easements;
f) Existing street and services surrounding the development and their relation to the proposed work;
g) Location and description of all available benchmarks.

A.2.4.2 *General Notes Sheet*

This Sheet shall list the following notes:

- General Township of Centre Wellington design criteria that apply to all sheets. The pertinent notes for the project can be extracted from the design criteria chapter (i.e. lot service, pipe sizes, curb type, catch basin grate type, etc.);
- Special warnings from utility companies and government agencies (i.e. existing structures and buried services);
- General Township policies and by-laws which apply to the construction activity (i.e. hours of work, mud tracking, fire permits, construction access, etc.).

A.2.4.3 *Traffic Design Plan*

Traffic Design Plan(s) to be drawn to a scale of 1:1,000 or larger and shall show proposed land uses (e.g. Residential, commercial, parks etc.), road layout, sidewalk, bicycle paths, bicycle lanes, multi-use trails, entrances to parks and open space areas, signage for bicycle circulation, pedestrian routing, storage and tapers for turn lanes, traffic control signs including stop bars and other painted lines, on-street parking (0.5 parking spaces per lot) and any traffic calming measures (if proposed/required).

A.2.4.4 *Signal Wiring Plan and Signalized Intersection Plan*

Should traffic signals be required, a separate Signal Wiring Plan; and Signalized Intersection Plan showing location of all poles and mounted hardware, hand wells, ducts/cables, the controller, and full turn lanes (storage and taper). The plans shall be submitted at a scale of 1:500.

A.2.4.5 *Phasing Plan*

If a subdivision plans to be developed in phases, a Phasing Plan showing current and future phases is to be prepared at a scale of 1:1,000 or larger.

If this information can be clearly shown on the General Plan, the two drawings can be combined.

A.2.4.6 *Sanitary Drainage Area Plan*

To a scale of 1:1,000, unless otherwise approved by the Township, showing the following:

a) Proposed sanitary sewers, maintenance holes and appurtenances (including identification numbers), indicating grade, pipe size, length of each section of pipe and direction of flow;
b) Drainage areas within the development and the limits of outside areas within the development and the limits of outside areas draining into the proposed system;
c) Catchment area in hectares, direction of flow and section population or population density shall be indicated on all drainage areas;
d) Street names.

All information to be provided on the sanitary drainage plan is to correspond with the sanitary sewer design sheets.

A.2.4.7 *Storm Drainage Area*

Storm drainage plans are to be drawn to a scale of 1:1,000 or larger. If large external drainage areas affect the development, a separate External Drainage Area Plan is to be produced. The Plan is to be produced to a scale of 1:5,000 and is to indicate the total area to be drained by the proposed storm sewers. The Storm Drainage Plan is to be compatible with the Grading Plan and must indicate the following:

a) Existing contours (0.5 m intervals);
b) Drainage patterns of adjacent lands and a breakdown of contributing external areas;
c) The run-off coefficients and area of tributary areas internal and external to the development for each section of the storm sewers within the development;
d) Direction of run-off (overland flow);
e) Street names;
f) Manhole and Catchbasin numbers;
g) Sewer sizes – Diameter and length;
h) Directions of flow in the sewers;
i) Any infrastructure off of the right of way to be accepted by the Township e.g.: rear lot catchbasins or swales, on lots, parks or blocks, required to accept storm runoff;
j) Complete major and minor storm systems.

A.2.4.8 *Park/Community Trail Development Plans and Grading Plans*

Park/Community Trail Development Plans are to demonstrate that the proposed park facility program, including buffers, can be satisfactorily achieved. Both Park/Community Trail Development Plan and Park/Community Trail Grading Plan are to be a scale of 1:500.

A.2.4.9 *Area Grading Plans*

Grading plans for all lots and blocks are to be drawn to a scale of 1:500 showing existing contours (0.5 m intervals), established from elevations taken in the field.

Grading plans will only be reviewed in conjunction with the submission of servicing and SWM design details. The overall subdivision grading plan is to include enough elevations and grades on the interior of blocks to illustrate how the surface drainage will be managed/ directed until it is later developed through the Site Plan process. This design must consider drainage impacts from these large contributing block areas during this interim condition period, which could have negative affects to existing/future houses and roads. Positive drainage is required on the block itself to ensure water is not ponding. Where required, catchbasins/ ditch inlets/ hickenbottoms are to be installed on the blocks in order to capture this surface flow before it is directed onto the road. These structures are placed on private property, without easements, connected to the storm services which are to be provided to the block through the road servicing. The structures are temporary, and will be removed when the site is developed.

The Township would like to see grading plans without retaining wall construction in new developments. Sometimes it may be necessary to have retaining walls on multiple properties that are reliant on one another. Retaining walls spanning more than one private property are to be avoided if at all possible and shall be considered only if there is a mechanism in place to ensure long-term maintenance and future repairs by the land owners. Planning and Development Services should be contacted where a retaining wall permit is required.

Existing Elevations shall be shown at:

a) The corners of each lot and block;
b) External elevations extending to a minimum 30m perimeter external to the Plan;
c) Overland flow direction for external drainage;
d) The base of all large trees 10cm or more in diameter plus their drip line, and the composite drip line of all contiguous vegetated areas such as woodlands, hedgerows, etc.;
e) Regular intervals within any woodlands or other natural blocks where deemed necessary to determine the effect of grade change on tree preservation.

Proposed Elevations shall be shown at:

a) Intervals along the centreline of all proposed roads (maximum 20.0 m spacing); the slope of each road section is to be noted;
b) All high points (split drainage, rear and side yards, top and bottom of slopes);
c) The corners of each lot and block;
d) The front and rear of each building;
e) 15.0 m intervals along cut-off swales and ditches;
f) The top and bottom elevation of retaining structures;

g) Any other points necessary to properly represent the proposed drainage scheme including tops of catchbasins and bottoms of swales and associated easements;
h) Critical transition points adjacent to walkways or existing lots or (provide section details where useful);
i) Top of grate elevations for rear yard catchbasins.

Other Required Information shall show:

a) Lot fabric and dimensions;
b) Driveway ramp locations;
c) Easements;
d) Blocks and lot numbers;
e) Surface features including road structures (catchbasins and manholes, fire hydrants, hydro transformers and street lights);
f) Direction of gutter flow at intersections;
g) Direction of overland flow routes including points of outlet and ponding limits for the 100 year event;
h) Label all lots with a drainage type and refer to a detail on the detail drawings;
i) Indicate existing trees and proposed tree saving limits; indicate provisions for the preservation of any existing trees where identified for retention;
j) Detail retaining walls and structures were required, including top of wall and bottom of wall elevations;
k) Show all fencing, easements and noise attenuation structures;
l) Indicate the regulatory flood limits of watercourses;
m) Provide percent grade where swales are at a minimum slope or are otherwise critical;
n) Specify run vs. rise ratio where slopes are created with a slope greater than 10% (**Note:** maximum slope = 3:1);
o) Minimum underside of footing elevation for lots close to groundwater;
p) Slopes and slope arrows alongside lot lines;

A.2.4.10 *"Plan and Profile" Drawings*

General Requirements

a) All plan and profile drawings are to be drawn at scales of
    i. 1:500 horizontally
    ii. 1:50 vertically
b) The sewer, storm and watermain profiles shall be drawn so that each street and easement may be filed separately;
c) Refer all datum to a bench mark of geodetic origin;
d) Show all existing and proposed lot numbers and blocks;
e) Show all existing and proposed curbs, road allowances and street names and indicate it as such;
f) Show all existing sidewalks, walkways, and trails;
g) Where two or more sheets are required for one street, match lines must be used and there are to be no overlaps or duplication of information;
h) Where intersecting streets are shown on a plan and profile drawing, only the diameter of the pipe and direction of flow of the intersecting sewers are to be shown. This also applies to easements for which a separate plan and profile drawing has been drawn;

i) Pavement designs for the particular roadway are to be indicated on the plan and profile drawing or on the General Notes Plan;
j) The detail information from all the borehole logs is to be plotted on the profile and located on the plan. Borehole information should contain a borehole plot plus a brief description of soils and the water level;

Plan View

The following information and details are to be included:

a) street names;
b) block/lot number and frontage dimension;
c) block/lot type (single, semi, multiple);
d) servicing locations for storm, sanitary and water;
e) all existing (as needed) and proposed sewers and watermains, manholes, catchbasins;
f) third pipe systems;
g) valve chambers;
h) hydrants;
i) sidewalk;
j) centreline chainage (every 20.0 m);
k) road allowance and pavement dimensions;
l) curb radii;
m) easements;
n) reserves;
o) road sections where clarification is required;
p) detail gutter grades on large radius bends and cul-de-sacs (minimum 0.75%);
q) light standard and transformer locations.

Profile View

a) The type of public service (existing and proposed watermain, sanitary or stormwater), the diameter, length, material grade and class of pipe are to be shown on the profile portion of the drawings only;
b) Where possibility of a conflict with other services exists, connections are to be plotted on the profile (i.e. watermain);
c) Indicate the road profile, existing and proposed. Any structural fill areas are to be hatched in;
d) Provide centreline chainage and elevations. Indicate the elevation at grade changes and provide the slope and length of each section;
e) Provide all vertical curve data on the top of the profile view;
f) Provide existing (as needed) and proposed manhole information, including type which shall be shown in detail on the Detail drawing sheet, pipe inverts at entry and exit, catchbasin lateral inverts, drop structure details. Indicate safety platforms and elevations where required;
g) Provide detailed information for all outfalls external to development, and
h) Borehole data including soils and water table.
i) the type, slope, diameter, grade and inverts of the sewers are to be indicated on the Plan view.

A.2.4.11 *Composite Utility Plan and Street Lighting Plan*

To a scale of 1:1,000 showing the following:

a) Roads, lots and their numbers;
b) The position of all new light standards within the development;
c) The position of existing light standards surrounding the development and their relation to the proposed work;
d) A detail of and tabulated specifications for the type of luminaries proposed;
e) Additional infrastructure to be shown Gas, Bell, Wightman, Cogeco, Hydro, transformers (individual utilities to be colour coded);
f) Photometric design detail.

A.2.4.12 *Miscellaneous Notes and Details Sheet*

These drawing sheets should comprise of detailed drawings of any particular detail referenced on any of the preceding drawings or any additional particular drawing.

Grading details and Engineering details shall be shown on separate drawing sheets. Grading detail drawings shall include details with respect to lot grading type, swales, etc. while Engineering details drawings shall include manhole types, infrastructure details etc.

A.2.4.13 *"As Recorded" Drawings*

As-recorded drawings shall be submitted to Planning and Development Services along with the Maintenance Package and the drawings shall conform to the following criteria:

a) "As Recorded" General Servicing Plans

Prior to the release of LOC, the required location plans for "As Recorded" measurements are to be completed and submitted to Planning and Development Services showing all necessary details for underground service installations.

"As Recorded" General Services Plans are required for the following:

i. Sanitary Sewers

- Location of service tie connections at the main line sewer are to be dimensioned along the mainline sewer from each downstream maintenance hole;
- Pipe manufacturer, type and classification.

ii. Storm Service and Catchbasin

- Location of service and catchbasin lead tie connections at the main line sewer are to be dimensioned along the mainline sewer from each downstream maintenance hole;
- Catchbasin locations are to be dimensioned as a distance along the storm sewer from the downstream maintenance hole and the elevation of the catchbasin rim and lead invert recorded;
- Pipe manufacturer, type and classification.

ii. Watermain Valves, Tees and Appurtenances and Water Services

- Water service main stops are to be drawn along the alignment of the watermain;
- "As Recorded" watermain obvert elevation at 20.0 m intervals,
- . In addition, the manufacturer, make and model of the following must be provided:
    - Pipe (mains, services & fire hydrant leads)
    - Joint Restraints
    - Fire Hydrants
    - Valves
    - Curb Stops
    - Main Stops
    - Saddles

Where watermains are not within road allowances or near sewers, ties to property corner shall be used.

b) "As Recorded" Drawings

"As Recorded" Drawings constitute the original Engineering Drawings which have been plotted again to show "As Recorded" conditions. The "As Recorded" white paper full size hard copy and a copy of the AutoCAD and .PDF drawing files on a CD shall be submitted to the Township for permanent records.

"As Recorded" Field Survey

The "As Recorded" Records revisions shall be based upon an "As Recorded Records" survey of all the development services and shall include a field check of the following items:

- Location of maintenance holes;
- Location of catchbasins;
- Location of hydrants;
- Location of valve chambers and valve boxes;
- Location of streetlights;
- Maintenance hole inverts and lid elevations;
- Sewer pipe inverts;
- Watermain obverts;
- Distance between maintenance holes;
- Special maintenance hole details;
- Catchbasin inverts.
- Road centreline elevations at 20.0 m intervals
- Location, lid and invert elevations for all rear yard and lot catchbasins and inline drains;
- Location of all services connections to all lots and blocks from the nearest downstream maintenance holes/valves;
- Location of all services to all lots and blocks at property line.

"As Recorded" Records Drawings

The "As Recorded Records" drawings for all Municipal Services shall include all infrastructure listed above in the "As Recorded Field Survey" complete with GPS coordinates where applicable, and include a check of the following items and incorporation of the necessary revisions:

- Sewers - Percent grade, pipe size, type, class, bedding and length;
- Invert elevations – sewer at maintenance holes, at plugs for future extensions;
- Top of pipe and/or invert elevations – watermains, at 20m intervals;
- Obvert of watermain and sanitary sewer at centreline of creek crossing;

Note: Original design information (inverts, grades, etc.) are to be removed from the drawing and replaced by the “As Recorded” Records information:

a) Pipe type, class and bedding;
b) Service connections ***at street line*** – sanitary, storm and water;
c) Service connections **at property line** – sanitary, storm and water;
d) Label “As Recorded Records Drawings” (shown in revisions column with date), and on cover sheet;
e) Registered Plan Number is to be shown on plan view of each drawing including general plans;
f) Lot and block numbers shall be in conformity with the registered plan;
g) Street names shall be in conformity with the registered plan or as approved by the Township, and
h) Benchmark.

B ROADS

B.1 General

The geometric design of municipal roads shall conform with standards set out in the latest edition of the “Geometric Design Guide for Canadian Roads” issued by the Transportation Association of Canada (TAC), and the Ontario Provincial Standards (OPS), or as amended herein. Centre Wellington prefers a grid network pattern for the transportation network system.

Generally, roads are classified as minor local, major local, minor collector or major collector as defined in the current Centre Wellington Transportation Master Plan. Minor local roads are neighbourhood streets characterized by light traffic and one narrow parking lane (2.0 m). Major local roads are neighbourhood streets characterized by light traffic, albeit higher AADT than a minor local, and have a wider parking lane (2.5 m).

Purpose and Function of Roads

Collector Roads provide for both traffic service and land access. The primary traffic service function is to carry traffic between Local Streets, other Collector Roads and the Arterial Road system. Local Roads generally serve only the abutting properties and are not intended to carry through traffic.

In addition to vehicular traffic, rights-of-way in Centre Wellington may also be required to be designed to accommodate the following:

- Parking;
- Biking;
- Neighbourhood and community walkability;
- Trees and landscaping;
- Traffic calming; and
- Services and utilities.

Objectives for roadways are further outlined within the Centre Wellington Urban Design Guidelines and the Active Transportation Plan.

B.2 Geometric Standards

Table 4: GEOMETRIC STANDARDS				
	Minor Local Street	**Minor Collector Street A**	**Minor Collector Street B**	**Major Collector Road**
AADT	Up to 500	Up to 1,500	Up to 3,000	Up to 6,000
R.O.W. (minimum)	18.0 m	20.0 m	22.0 m	26.0 m
Pavement Width [1]	8.0 m	8.5 m	9.0 m	10.0 m
Minimum Grade	0.5%	0.5%	0.5%	0.5%
Maximum Grade	8.0%	6.0%	6.0%	5.0%
Maximum Grade for Through Roads at Intersection	3.5%	3.0%	3.0%	3.0%
Vertical alignment/ cross slope at intersection	In accordance with Transportation Association of Canada geometric design criteria			
Maximum Grade for Stop Roads at Intersection	2.0%	2.0%	2.0%	2.0%
Minimum Curb Radius at Intersection with Arterial Road****	9.0m	9.0m	9.0m	15.0m
Minimum Curb Radius at Intersection with Collector Road****	9.0m	9.0m	9.0m	15.0m
Minimum Curb Grade	0.5%	0.5%	0.5%	0.5%
Minimum Curb Grade at Radius of Intersections	0.8%	0.8%	0.8%	0.8%
Cul-de-Sac Minimum Outside Curb Radius	16.8 m (permanent) 12.0 m (temporary)	N/A	N/A	N/A

Table 4: GEOMETRIC STANDARDS				
	Minor Local Street	**Minor Collector Street A**	**Minor Collector Street B**	**Major Collector Road**
(distance from the centre of the cul-de-sac bulb to the e/p)	7.8 m (island)			
Minimum Centreline Radius [3]	60 m	90 m	90-130 m	130-250 m
Design Speed	40-50 km/h	50 km/h	50-60 km/h	60-80 km/h
Vertical Curve Min. sight stopping distance LVC = KA (MUTC) K. for Sag K. for Crest	65 m 12(5)**** 8	65 m 18(8)**** 15	85 m 18(8)**** 15	85-130 m 18(8)*-30(15)**** 15-35
Horizontal Curve Minimum Sight Stopping Distance	65 m	65 m	85m	130-250 m
Maximum Superelevation	N/A	N/A	As Required	As Required
Intersection Angle	70-110^{o} at local, 80-100^{o} at collector and arterial***	80-100^{o}***	80-100^{o}***	90^{o}
Minimum Intersection Spacing Between Adjacent Intersections measured from centreline to centreline of the intersections	60.0m	60.0m	60.0m	200.0m

* Measured e/p to e/p.

** Except at 90^{o} corners for crescents and courts.

*** All streets are to intersect at 90^{o} unless existing road alignments or property restrictions require otherwise.

**** Illuminated condition.

B.3 Road Pavement Design

The pavement design for arterial roads will be considered on an individual basis. The composition and construction thickness of the road pavement shall be designed based upon the following factors as outlined in the geotechnical soils report:

- Mechanical analysis of the subgrade soil;
- Drainage;
- Frost susceptibility, and
- The future volume and class of traffic expected to use the pavement.

Pavements shall be designed for a minimum ADT - 1000 vehicles and an anticipated life of 25 years.

Local	40 mmHL3	Surface Course
	50 mm HL4*	Binder Course*
	150 mm Granular 'A'	Base
	450 mm Granular 'B'	Base
Collector	40 mm HL3	Surface Course
	60 mm HL4*	Binder Course*
	150 mm Granular 'A'	Base
	600 mm Granular 'B'	Base
Local & Collector (Industrial)	40 mm HL3	Surface Course
	100 mm HL4	Binder Course
	150 mm Granular 'A'	Base
	450 mm Granular 'B'	Base

The above are minimum design requirements. The Subdivider is required to engage a Geotechnical Consultant with experience in pavement design to confirm the minimum design based on results of the geotechnical investigation.

* On roads designated as transit routes, the base course asphalt thickness shall be a minimum 100 mm.

Bus bays shall be in accordance with the TAC Geometric Design Guidelines for Canadian Roads.

B.4 Traffic Calming

The primary function of Traffic Calming measures are to reduce speeds, deter non-residential traffic from the area and reduce the incidence of collisions, thereby increasing safety for all users within the right-of-way. In addition, well-designed and landscaped Traffic Calming measures can enhance a neighbourhood's appearance and the quality of life for its residents.

For details on the Centre Wellington Traffic Calming Policy approved by the Township Council please refer to the Centre Wellington Masterplan Transportation Plan

B.5 Roundabouts

At intersections where traffic signals are warranted, the Regional Municipality of Waterloo roundabout policy and related process is applicable and the Centre Wellington will consider the installation of roundabouts at these locations.

All Collector / Arterial Roads intersecting with other Collector/Arterial should be considered for the installation of a roundabout. All roundabouts are to be designed by a qualified roundabout design engineer.

Prior to the undertaking of a detailed Intersection Control Study (ICS) to determine the feasibility of a roundabout, an initial Screening must be completed. The **Initial Screening** shall involve the following:

- Determine the scope of the intersection improvements to implement the traffic signals and other turning lanes and scope of work to implement a roundabout;
- Complete a Traffic Flow worksheet and preliminary lane configuration for the proposed roundabout;
- Develop a preliminary cost estimate to implement each of the traffic control alternatives (roundabouts and signals), and

- Develop a 20-year injury collision costs and implementation costs for each alternative, adjusted to Present Value and compare the results.

The design of roundabout shall include a property line setback from the back of the curb with adequate space to locate utilities in their standard location.

B.6 Road Allowance Cross Section

The typical road allowance cross-section shall be as per standard drawing 101 '20.0 Minor Collector'. Details shall be provided for any approved special provisions required due to unique physical conditions on the site or for existing or future design conditions such as retaining walls, slope protection, culverts, bridges or special crossfall conditions.

B.7 Road Sub-Drains

In general, sub-drains will be required to run continuous along both sides of all roads, as per OPSD 216.021. Perforated HDPE sub-drain shall be 100mm in diameter, geotextile wrapped, and below road base.

B.8 Intersection Visibility

Transportation Engineering staff in consultation with Development Engineering staff will require the dedication of property for intersection daylighting triangles if deemed necessary. Typically 7.5m Daylight Triangles are required for local road intersections, and 9m for collector road intersections. For further information refer to the Centre Wellington Zoning By-law

B.9 Curbs

Barrier curb with standard gutter as shown on Ontario Provincial Standard Drawing OPSD 600.040 shall be used on all streets including cul-de-sacs islands except with reverse slope gutter. Saw cutting of curb or entrance depressions will be allowed. All depressions not used as property entrances shall be replaced with full barrier type curbing. Granular A is to be compacted 300mm past the back of curb. Concrete barrier curb with standard gutter shall have additional width where sidewalk is adjacent to curb or concrete driveway ramps, as per OPSD 600.040.

Mountable curbing may be used in specific situations and/or areas approved by Development Engineering staff in consultation with Transportation Engineering staff.

B.10 Boulevards

All construction debris and surplus granular material will be removed to the required depth and replaced with parent material compacted to 85% proctor. For boulevards, at least 200mm of topsoil will be placed in the boulevard and sodded with No. 1 nursery sod. In cases where the boulevard is less than 1.0m wide between the back of curb and the face of the sidewalk, hard surface is to be used.

B.11 Sidewalks

Concrete sidewalks within the Centre Wellington are to be constructed as per OPSD 310.010 and their locations are to be constructed to the following minimum standards in accordance with OPSS 351:

- 1.5m width, with adjacent boulevard;
- 1.8m curb face;
- Minimum depth of 150mm Granular 'A';
- Concrete sidewalk to be 125mm thick across boulevards and 150mm thick at residential driveways and adjacent to curbs;
- 200mm thick concrete shall be used for sidewalk ramps;
- For sidewalks in business parks/industrial areas, please refer to the Centre Wellington Sidewalk Policy (TBC - is there such a policy?);
- Intersection ramps shall be in accordance with OPSD 310.030, 310.031, and 310.033
- Sidewalks at driveway ramps within Commercial and Industrial areas shall be a minimum of 200 mm thick concrete as per OPSD 310.01;
- Where trees have been identified on the Tree Planting Plan the required root pathways will be placed in the parent material prior to the installation of sidewalks to meet all of the requirements of the Tree Planting section of this manual.

Concrete sidewalks are required:

- As per the Standard Cross Sections;
- Along both sides of all roads within the Downtown Districts, with the exception of public lanes;
- Along both sides of a cul-de-sac and the perimeter of the cul-de-sac bulb;
- For roadways contained within a Heritage Conservation District, sidewalks shall be provided in accordance with the respective District approved policies.
- Designed in accordance with the AODA.

B.12 Walkways

All Walkway Blocks shall be a minimum of 6.0 m in width. Walkways Blocks with services will be a minimum of 9.0 m in width.

The Subdivider will construct a 1.5 m wide by 125 mm thick concrete walkway to Centre Wellington current specifications over a minimum 150 mm compacted Granular "A" base. On both sides of the concrete sidewalk the Subdivider will place a minimum 150 mm of the specified topsoil material and fine grade to achieve positive drainage in accordance with the Approved Grading Plan, and sod using nursery grown sod. At the property lines both sides, the Subdivider will construct on Walkway Block property a 1.5 m black vinyl coated chain link fence consisting of the specified materials including terminal posts and line posts cast into poured in place concrete footings, top and bottom horizontal railing, No. 9 gauge galvanized wire mesh with 38 mm x 38 mm openings. (Refer to Standard Drawings 111 Public Walkway Details and 507 Chainlink Walkway Details.)

For walkways longer than 30 m, with a slope of 1% or less, a 2% crossfall should be considered to help facilitate drainage.

Bollards are to be installed 1.1m either side of centre sidewalk, at both ends of a walkway. Bollard material, type and specific location to be confirmed by the Township.

B.12.1 Walkways – Emergency Access

All Walkway – Emergency Access Blocks shall be a minimum of 6.0 m in width unless otherwise noted. The Subdivider will construct a minimum 4 m wide emergency vehicle carriageway. The carriageway will consist of a 1.8 m wide by 125 mm thick concrete walkway to Centre Wellington current specifications over a minimum 300 mm compacted Granular "A" base, and on both sides, a 1.1 m wide hot laid asphalt paved driving surface consisting of a 50 mm thick HL4 binder course and 40 mm thick HL3 wearing course to achieve a total 90 mm pavement over a minimum 300 mm compacted Granular “A” base. Both sides of the carriageway the Subdivider will place a minimum 150 mm of the specified topsoil material and fine grade to achieve positive drainage in accordance with the Approved Grading Plan, and sod using # 1 Nursery grown sod. At the property lines both sides, the Subdivider will construct on Walkway – Emergency Access Block property a 1.5m black vinyl chainlink consisting of the specified materials including terminal posts and line posts cast into poured in place concrete footings, top and bottom horizontal railing, No. 9 gauge galvanized wire mesh with 38 mm x 38 mm openings. At the property line at both street frontages of the Walkway – Emergency Access Block, the Subdivider will install two of the specified Standard Park Gates cast into poured in place concrete footings, to achieve the locking vehicle barrier with minimum 1.5 m – maximum 1.8 m clear space centered on the concrete sidewalk. (Refer to Standard Drawings 114 Walkway – Emergency Access Details.)

Potential cross reference to the Urban Design Guidelines related section TBD

B.13 Multi-Use Trails

For details regarding the multi-use trails, refer to Section I of this document and the Centre Wellington Active Transportation Plan.

B.14 Bike Lanes (On Road)

Bicycle lanes shall have the same structural standard as the road base. Active Transportation Plan, Trails Masterplan and Ontario Traffic Manual for appropriate signage and design.

B.15 Cul-de-Sacs

All local roads which permanently terminate at one end (dead end streets) shall be provided with a turning circle (cul-de-sac) of sufficient area to enable the turning of garbage trucks, snow removal equipment and emergency vehicles. A road allowance with a 20.0 m radius will be required for a cul-de-sac with a pavement radius of 16.8m if equipped with an island and 13m if

without. Cul-de-sacs shall be in conformance with the Emergency Services Policy. Ensure consistency – Fire Chief to confirm

If an island is provided it shall have a minimum radius of 7.8m to provide a minimum distance of 9m from the outside edge of pavement to the inside edge of pavement.

B.16 Intersections

Refer to the latest edition of the "Geometric Design Guide for Canadian Roads 2017" issued by the Transportation Association of Canada (TAC), section 9.7.4 Vertical Alignment and Cross Slope for requirements regarding intersection drainage and intersection cross falls.

B.17 On-Street Parking

An On-Street Parking Plan will be required as a condition of approval for a Plan of Subdivision

Parking By-Laws are to be updated to reflect approved parking plans.

B.18 Traffic Control – Signs and Pavement Markings

B.18.1 Street Name and Rural Street Signs

The Township is responsible for approving and supplying all street name signs. Prior to the commencement of the maintenance period for the corresponding subdivision, the Subdivider will be responsible for the costs, installation and maintenance of the signs for a period of two years.

Refer to Street Signs standard drawing TBC.

Where streets are named after Veterans they will be white background, green lettering and red poppy (green centre) at the left side of the sign.

B.18.2 Traffic, Pedestrian and Bicycle Control Signs

The Developer is responsible for supplying all traffic, pedestrian and bicycle control signs in accordance with approved drawings. Prior to the commencement of the maintenance period for the corresponding subdivision, the Subdivider will be responsible for the costs, installation and maintenance of the signs for a period of two years.

Refer to the Ontario Traffic Manual for standard traffic, pedestrian and bicycle signage

B.18.3 Open Space Signs

The Township is responsible for approving and supplying all interpretive and regulatory signage related to the public use of woodlands, stormwater facilities, trails and open space. Prior to the commencement of the maintenance period for the corresponding subdivision, the Subdivider will be responsible for the costs, installation and maintenance of the signs for a period of two years.

B.18.4 Pavement Markings

The Township is responsible for supplying and installing all temporary and permanent pavement markings including durable paint required for roads and bicycle lanes while the Subdivider is responsible for the costs. An invoice will be sent to the Subdivider by the Township after the installation of the pavement markings.

B.18.5 Traffic Signals

The Township is responsible for the design and installation of all traffic signals. An invoice may be sent to the Subdivider by the Township after the installation of the traffic signals.

B.19 Driveway Entrances

The Subdivider shall be required to provide for the excavation, paving and maintenance in good condition, until Final Acceptance, of each driveway from the travelled portion of the road to the lot line if there is no sidewalk. If there is sidewalk, the limit shall be from the travelled portion of the road to the sidewalk (ramp). All driveway ramps in new development shall be constructed of asphalt.

Details regarding Commercial, Industrial, Multi-Residential, Residential, and Institutional curb, asphalt, width, sidewalk etc. requirements.

Where paired driveways are constructed between two adjoining properties, the curb cut-out shall be continuous (i.e. where the barrier curb is less than 1 meter between driveways).

Where a driveway ramp is located on a stubbed street, a minimum of 6m between the ramp and dead-end-barricade is to be provided for snow maintenance, and this area must be included within the phase of the project and within the registered Plan of Subdivision. The number of lots allowed to front onto a stub street shall not exceed one per side. Any temporary roads or turning circles must be contained within the subject registered Plan of Subdivision.

B.20 Noise Attenuation

If required, a Noise Study must be prepared by a qualified professional Consultant.

All reports must follow the Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning, Publication NPC-300 put out by the Ministry of the Environment (MOE). In addition the Ministry of the Environment requires the use of the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT) to assess the noise impact from existing roadways on planned residential land uses, to assess the noise impact of roadway projects, to establish the ambient noise sources, and for compliant investigation. Confirm if this last statement is required

B.20.1 Noise Barriers

The maximum barrier wall height shall be 2.4 m; total barrier height may be increased by use of a berm and wall combination; barrier heights greater than 2.4 m require approval by the Township.

The minimum noise barrier wall height shall be 1.8 m.

The minimum density of the noise barrier wall shall be 20 kg/m^2 with no holes or gaps.

Noise barrier walls are to be Durisol Precast Noise Barrier, grey stone face finish, or approved equivalent, complete with anti-graffiti coating. Consultants may contact the Development Project Manager for more detail or a sample design.

Noise barrier walls are to be constructed on private property unless approved otherwise by the Director of Engineering. The Subdivider will be responsible to provide a letter of credit for the noise barrier wall as outlined in the Development Agreement and shall guarantee the noise barrier wall for a period of two years after Township acceptance of the Engineering Consultant certification. The construction of the noise barrier wall shall be inspected and certified by the Engineering Consultant.

Where berms are utilized as a noise barrier, the berm will be located entirely on the Subdividers property; a chain link security fence will be located on the public side of the property line at the base of the berm. Where the noise barrier is a combination of berm and wall, the berm will be located entirely on the Subdivider's side of the property line; the wall will be located at the top of the berm; the wall will have a minimum height of 1.8 m. The maintenance of the noise wall will become the responsibility of the resident once the Subdivider's warranty period has been met. Berms adjacent to Municipal land will have a side slope no steeper than 3:1 (horizontal : vertical) unless otherwise approved by the Township.

Where a noise barrier wall is needed adjacent to a Township roadway, the wall shall be placed 150mm on the private property side of the property line.

Where the wall is on private property adjacent to public property, the Subdivider shall enter into an Agreement with the Centre Wellington which shall be registered on title of Lots immediately upon registration of the subdivision. Said agreement shall implement the following clause with respect to the noise barrier wall located on these lots and must be included in all offers of purchase/sale and tenancy agreements.

"Purchasers/tenants are advised that a noise barrier wall is located at the rear/side of this property. The owner of this property also owns his/her section of the noise barrier wall. The noise barrier wall is not in public ownership. Monitoring, maintenance, inspection, repair and replacement of this noise barrier wall, including any associated costs, are the sole responsibility of the property owner. The Centre Wellington is in no way responsible for this noise barrier wall. Should this noise barrier wall fail, it is the property owner's responsibility to repair or replace his/her section of the wall, at his/her cost. If the property owner fails to maintain the noise barrier wall, the Centre Wellington will notify the requirement to repair in writing. If the property owner does not comply with the Township's request, the Township will correct the deficiency and bill the property owner accordingly". To be copied in the subdivision agreement

B.21 Entrance Features

A Subdivider may submit for approval a design proposal for entrance features which may consist of walls, gates, fences, trees, shrubs, flowers and other related components. The Subdivider will be required to enter into an agreement with the Township for the construction and maintenance of entrance features within the Subdivision Agreement.

The Subdivider shall maintain the entrance feature indemnifying the Township for all claims until the development has been assumed or as otherwise specified in the Agreement.

The Subdivider shall provide a payment for perpetual maintenance fees and securities in accordance with the Subdivision Agreement.

Entrance features may be located within the public road allowance in centre median islands only or on a separate block adjacent to daylighting triangles. The features shall be designed to maintain proper sight distances and turning movements at driveway assesses and intersections. The design of the entrance feature shall be submitted for approval to the Township. Refer to the Centre Wellington, Urban Design Manual for further design details.

All tree planting for entrance features will meet all tree and soil habitat zone requirements identified in Section I of this Manual.

The Township reserves the right to remove all or any element of the entrance feature at its discretion.

B.22 Fencing

Fencing shall conform to the Centre Wellington Fence By-law Zoning By-law and Centre Wellington Urban Design Manual.

B.23 Streetscape and Landscaping

All tree planting will meet all tree and soil habitat zone requirements identified in Section I of this Manual.

A Streetscape Plan will be required in support of an application for a Plan of Subdivision

B.24 Utility Installation

Location and installation details for utilities must be approved by the Township prior to the installation.

All utility trenches within the road allowance are to be backfilled and compacted to 95% Standard Proctor Density.

The Subdivider is responsible to ensure that there is no conflict of plants and appurtenances with other utilities, driveways, tree planting pits, etc. As such, a Composite Utility Plan will will be required in support of an application for a Plan of Subdivision which would identify the location of all street furniture, driveway cut locations, entrance features, street trees, utility locations, traffic calming features and fencing/landscaping details for corner lots.

B.25 Inspections and Testing

NOTE:IN THIS SECTION A NUMBER OF REFERENCES TO KITCHENER CONTRACT SPECIFICATIONS WERE REMOVED. THERE MAY BE SUBSTITUTE CW SPECIFICATIONS THAT SHOULD BE INSERTED

Refer to OPSS Standards in this section

The following are the minimum tests required for roadway construction:

a. Sieve Analysis shall be performed in order to assure that the granular base courses meet the current industry standards. Representative samples are to be obtained by the Consultant prior to and during the road construction operation.

b. "Density Tests" shall be performed in order to assure that the granular base courses have been properly compacted to the current industry standards. Density Tests on the road subgrade shall be performed as directed by the geotechnical engineer.

c. A "Proof Roll" of the road subgrade shall be performed under the supervision of the geotechnical engineer to assure unsuitable road subgrade material is removed,

d. "Asphalt Tests" shall be performed in order to assure that the binder and surface asphalt meets the design mixture tolerances.

e. "Concrete Tests" shall be performed on curbs, sidewalks and driveway ramps

C WATERMAINS

The Safe Drinking Water Act, 2002, section 12 requires that “No person shall operate a municipal drinking-water system or a regulated non-municipal drinking water system unless the person holds a valid operator’s certificate issued in accordance with the regulations”. Only appropriately certified Township operators can operate the drinking water system, once bacteriological testing is complete and the new watermain is connected to the municipal system.

All watermains, appurtenances and service connections shall be guaranteed for a minimum period of two (2) years after initial acceptance by the Township.

C.1 Watermain Design Guidelines

C.1.1 Easements

The minimum easement width shall be 6.0 m. The Engineer shall also consider the soil conditions and constructability and future maintenance when selecting the easement width. In addition, if more than one utility is installed in the easement, the easement width should be increased by the separation distance of the utilities.

C.2 Water Demand

C.2.1 Definitions

C.2.1.1 **Average Day**: The total amount of water demanded within a certain time period, usually one year, divided by the number of days within that time period.

C.1.1.2 **Maximum Day**: The average water demand over the day (midnight to midnight) of highest water demand within any one year.

C.1.1.3 **Minimum Hour**: The smallest short-term (1 hour) demand. Without accurate records, this value can be taken as zero (0) in small systems or as the smallest hourly demand over a typical average day in large systems.

C.1.1.4 **Peak Hour**: The highest short-term (1 hour) demand within a system not including fire flow. The peak hour is normally the highest hourly demand on the maximum day.

C.1.1.5 **Domestic: Any non-fire water use.**

C.2.2 Domestic

Wherever available, the Engineer shall use historical data, as supplied by the Township, to establish the Peaking Factors and Unit Consumption Rates.

C.2.3 Fire Flow

The fire flow requirements shall be determined in accordance with the current issue of “Water Supply for Public Fire Protection”, Fire Underwriters Survey.

At the discretion of the Township, the fire flow requirement for projects that are phased may be reduced to that required under the Ontario Building Code. It must be demonstrated, though, that the ultimate design will satisfy the requirements in the Fire Underwriters Survey. At no time shall the available fire flow be less than that required under the Ontario Building Code.

C.2.3.1 Design Period

The Design Period for watermain sizing purposes shall be 40 years, using the ultimate land use as predicted by the Township.

C.2.3.2 Peaking Factors

The peaking factors used to calculate minimum hour, maximum day and for peak hour must be based on:

- Historical information
- Ministry of the Environment guidelines
- As directed by the Township

C.3 Hydraulic Analysis

C.3.1 Friction Factors

The following “C” friction factors, which include an allowance for age, shall be used for the following materials:

- PVC/PVCO: 150
- DI: 130
- CPP: 130
- HDPE: 140

If the watermain material has not been determined at the time of watermain sizing, a “C” factor of 130 shall be used.

C.3.1.1 Nominal vs. Actual Diameter

The nominal diameter can be used for general water distribution system design. The actual inside diameter shall be used though for the design of critical infrastructure.
The actual inside diameter shall be used for the design of HDPE watermains.

C.3.1.2 Capacity

All watermain distribution systems must be able to transfer the larger of maximum day plus fire or peak hour.

C.3.1.3 Maximum Velocity

The maximum velocity in the watermain under all flow conditions shall not exceed 5.0 m/s.

C.3.1.4 Transient Pressure

All watermains shall be designed to withstand the maximum operating pressure plus the transient pressures to which the watermain will be subjected. As a minimum, the pipe and joint strength shall be such that it can withstand the pressure surge resulting from an instantaneous stoppage of a water column moving at 0.6 m/s.

C.4 Pressure

C.4.1 Pressure Zone Delineation

The Township is responsible for general pressure zone delineation.

C.4.2 Boundary Conditions

The boundary conditions (i.e. available pressure and flow) for new watermains and water distribution systems can be obtained by field testing and/or from the Township. Field testing the water distribution system shall only be conducted with the approval and assistance of the Township.

C.4.3 Preferred Pressure Range

The preferred design pressure ranges are:

Average Day and Maximum Day: 350 kPa (50 psi) to 550 kPa (80 psi)

Minimum Hour and Peak Hour: 275 kPa (40 psi) to 700 kPa (100 psi)

Pressures outside of these ranges are acceptable to the limits described below; but, are not desirable.

C.4.4 Minimum Pressure

Under no circumstances shall the minimal residual pressure during Maximum Day plus Fire scenarios be less than 140 kPa (20 psi) at any location in the water distribution system. Additional analysis may be required for pressures below 275 kPa (40 psi).

C.4.5 Emergency Conditions

The minimum pressure under emergency conditions is 140 kPa (20 psi).

C.4.6 Maximum Pressure

The maximum static pressure in the watermain system should not exceed 700 kPa (100 psi) under any scenario.

C.4.7 In-Line Booster Pumps

In those areas where the pressure at the centreline road elevation will be lower than 275 kPa (40 psi), in-line booster pumping systems may be utilized. This could take the form of a system booster pumping station or individual booster pumps with pressure tanks. The use of booster pumps must be approved by the Township.

If the booster pumping station is designed to supply fire flow, the station shall be equipped with standby power. The booster pumping station shall be designed to the Township's standards as applicable. Contact the Township for specifications required for Booster Pumping Stations.

Individual booster pumps and pressure tanks shall be designed for the application. A backflow preventer in accordance with CAN/CSA-B64-10 shall be installed immediately downstream of the meter.

C.4.8 Design Pressure Location

For design purposes, the pressure is measured at the centreline road elevation. Under fire flow conditions the pressure is considered to be located at the centreline road elevation at the hydrant tee.

C.5 Pipework

C.5.1 Material

As per OPSS 441 “All pipe up to and including 600 mm shall be delivered to the Work Area with end covers.”

Materials shall be as per Part C – Materials. On a project specific basis, the Managing Director of Infrastructure Services may specify or allow alternate materials (e.g. in the case of environmentally impacted soils, or sensitive areas).

The Developer’s Engineer is responsible to ensure that the class or pressure rating of pipe is not exceeded given the expected dead and live loadings and anticipated maximum water pressures.

The transition from one pipe material to another should be made at a tee, cross, or valve, preferably located at a street intersection.

C.5.2 Location

The watermain shall be located as shown on the Township’s typical cross-sectional drawings.

C.5.3 Diameter

C.5.3.1 General

The watermain diameter shall be sized in accordance with a Water Distribution Report prepared for the area under consideration, submitted and approved by the Managing Director of Infrastructure Services.

The diameter of a permanent dead-end watermain shall not exceed the diameter of its feeder watermain.

C.5.3.2 Minimum

The minimum watermain diameter shall be 150 mm.

In Industrial, Commercial and high-density residential areas and in areas specified by the Managing Director of Infrastructure Services, the minimum diameter shall be 300 mm. The Developer’s Engineer shall contact the Managing Director of Infrastructure Services for clarification if necessary.

C.5.3.3 Maximum

The maximum watermain diameter for cul-de-sacs and other permanent dead-end watermains shall be 200 mm, and 300 mm for industrial, commercial and high-density residential areas unless it can be demonstrated and approved by the Managing Director of Infrastructure Services that a unique demand condition exists that necessitates a larger watermain.

C.5.4 Depth of Cover

The depth of cover from finished grade to the top of pipe shall not be less than 2.0 m.

Watermains designed deeper than 2.0 m shall require approval of the Managing Director of Infrastructure Services.

C.5.5 Vertical Connection to Existing System

In the event that the existing watermain has less than 2.0 m of cover, vertical bends shall be utilized as necessary at the construction limits to connect the new watermain (at proper depth) to the existing system. This method of connection facilitates the future lowering of the remainder of the existing watermain.

Sweeping vertical pipe joint deflections shall not be used.

C.5.6 High Points

High points shall be avoided unless an escape route for trapped air is provided.

For local watermains, services will generally provide an escape route for trapped air but it is preferred to locate fire hydrants at high points. Air release valves shall not be installed on local watermains without the approval of the Managing Director of Infrastructure Services.

C.5.7 Minimum Slope

To facilitate the movement of trapped air and to avoid localized high and low points, the preferred minimum slope for watermains is 0.5%. Slopes less than 0.5% will be submitted to the Managing Director of Infrastructure Services for approval.

C.5.8 Dead-end Mains

Dead-end watermains are to be avoided wherever possible. Where dead ends watermains cannot be avoided, the maximum length of a permanent dead-end watermain is 150 m.

A fire hydrant must be located at the end of cul-de-sacs and other permanent dead-ends. A temporary fire hydrant must be installed in-line at temporary dead-ends. An acceptable alternative is to provide a plug on the main line leg of the hydrant tee and install a fire hydrant in its permanent location. A temporary plug or blow off may be acceptable at the approval of the Managing Director of Infrastructure Services.

C.5.9 Minimum Clearance to Sewers

The clear separation between watermains and sewers shall be as per MOE requirements “Watermain Design Criteria for Future Alterations Authorized under a Drinking Water Works Permit.”

C.5.10 Thrust Restraint

Mechanical joint restraints or concrete thrust blocks shall be installed to restrain movement of the watermain.

The limits for which mechanical joints restraints must be installed shall be clearly indicated on the Construction Drawings.

The restraining joint and pipe design shall be based on transferring thrust through the pipe to the surrounding material. A safety factor of 1.5 must be used to calculate restraint length for Ductile Iron and PVC watermain material. A safety factor of 1.5 must be used to calculate restraint length for Concrete Pressure Pipe using methods outlined in AWWA M9.

The Managing Director of Infrastructure Services reserves the right to specify the use of mechanical restraints and/or concrete thrust blocks.

C.5.11 Soil Settlement Areas

On areas subject to possible future soil settlement, the bedding design must minimize pipe movement and mechanical joint restraints must be installed to the limits of the possible settlement area. This requirement may be waived if it can be demonstrated that future settlement will not occur.

C.6 Water Quality

C.6.1 Minimum Chlorine Residual

The minimum chlorine residual as mandated by the Ministry of the Environment is 0.25 mg/L for combined chlorine **or** 0.05 mg/L for free chlorine at any point in the distribution system. The combined chlorine residual is the total chlorine residual minus the free chlorine residual.

C.6.2 Design Considerations

Although the Township has primary responsibility to ensure that the minimum chlorine residuals are maintained in the distribution system, the distribution system must be designed to mitigate the degradation of chlorine residuals. The Managing Director of Infrastructure Services reserves the right to require watermain looping and/or automatic flushing devices to facilitate the maintenance of chlorine residuals.

C.7 Hydrants

C.7.1 Maximum Spacing

The maximum spacing between fire hydrants as measured along the roadway centreline is as follows:

- Residential 150 m
- Industrial, Commercial & High Density Residential 100 m
- Watermains not fronting lots 300 m

The Managing Director of Infrastructure Services:

- Will determine if fire hydrants are required along watermains not fronting lots
- Reserves the right to request additional fire hydrants
- May waive the requirement to provide fire hydrants fronting vacant properties

C.7.2 Lead Size

The minimum hydrants lead size to be 150 mm. On a site specific basis, the Managing Director of Infrastructure Services may request a larger hydrant lead size.

The anchor tee, valve and boot must be the same size as the lead. A reducer shall not be utilized at the hydrant boot.

C.7.3 Location

Fire hydrants shall be installed at the end of cul-de-sacs and other permanent dead end watermains.

The preferred locations for the fire hydrants are:

- At street intersections
- On the same side of the road as the watermain
- Consistently on the same side of the road as existing and future fire hydrants
- At the dividing property line between adjacent properties
- At high points
- At low points

Fire hydrant leads must be installed perpendicular to the road and/or the watermain.

C.7.4 Bends

Bends in fire hydrant leads will not be allowed unless site conditions warrant and with written approval of the Managing Director of Infrastructure Services.

C.7.5 Minimum Clearance

The minimum clearance from above ground obstructions to fire hydrants shall be as follows:

- Behind 0.6 m
- Each Side with a port 2.0 m
- Each Side without a port 1.0 m
- Front no obstructions between the street and the hydrant face

The installation of bollards shall be as directed by the Township.

C.8 Isolation Valving

C.8.1 Size

The valve shall be the same size as the main.

C.8.2 Location

Valving must satisfy the following location criteria:

- 2 valves at tee intersections
- 3 valves at cross intersections
- Separating hydrants such that no two adjacent hydrants will be out of service at one time unless otherwise directed by the Township.
- A valve at either end of a river crossing, bridge, easement or casing is required.

Valving at intersections shall be located in-line with the extension of the property line of the intersecting through street, unless otherwise directed by the Managing Director of Infrastructure Services. Contract Administrator / Contractor to ensure that the valve doesn't conflict with other utilities and /or infrastructure.

C.8.3 Maximum Spacing

In addition to the valving requirements outlined above, the maximum spacing for isolation valves shall be as listed for the following watermain diameters:

- 300 mm diameter and smaller spacing = 300 m
- Larger than 300 mm diameter spacing = as directed by the Managing Director of Infrastructure Services

C.8.4 Valves

All valves shall be direct buried as per Township Standards, unless the Managing Director of Infrastructure Services specifically requires a chamber to be provided.

C.8.5 Minimum Clearance

The minimum clearance from above ground obstructions to valves is 2.0 m.

C.9 Combination Air & Vacuum Release Valves

C.9.1 Utilization

Air and Vacuum Release Valves shall be utilized in watermains in situations where it is possible for air to accumulate or a vacuum to develop and an alternate means for release is not available (i.e. services or fire hydrants) to remove the air. The valves shall be located in accordance with best design practices. This generally includes supply watermains with localized high points, long stretches of flat or gently sloping watermain or at changes in grade.

In general terms, Air and Vacuum Release Valves shall be of the combination configuration. The sole use of either an air release or vacuum release valve must be dictated by the situation and approved by the Managing Director of Infrastructure Services.

Watermains servicing adjacent lots generally do not require air and vacuum release valves because air can escape or enter through the services.

A blowoff or fire hydrant is an acceptable alternate means of air or vacuum release in temporary situations with the approval of the Managing Director of Infrastructure Services.

C.9.2 Watermain Profile

The Developer's Engineer, through a cost-benefit analysis, shall consider reducing the number of air and vacuum release valves by altering the profile of the watermain.

C.9.3 Sizing

Air Release and Vacuum Release valve bodies shall be 25 mm for watermains up to and including 300 mm diameter and 50 mm for watermains larger than 300 mm diameter. If the Developer's Engineer determines that a larger valve body is required, the larger sizing must be approved by the Managing Director of Infrastructure Services.

The orifice sizing shall be determined in conjunction with a transient analysis of the watermain and consultation with the manufacturer.

C.10 Drain Chambers

C.10.1 Utilization

Drain chambers are required where the normal methodology of watermain dewatering is not appropriate due to the watermain size or location. Watermains smaller than 450 mm will generally not require a drain chamber, however, a long downhill gradient without an isolation valve or fire hydrant for bulk draining may necessitate a drain chamber.

With the written approval of the Managing Director of Infrastructure Services, a fire hydrant may be installed with the intention that the watermain will be drained with a hydrant barrel pump.

C.10.2 Location

Drain chambers must be located at the low points of the watermain profile. Consideration should be given to locating low points adjacent to appropriate discharge locations (i.e. near catchbasin)

C.11 Flushing and Swabbing Ports

C.11.1 Utilization

Flushing and swabbing ports shall be considered for watermains over 300 mm. The Developer's Engineer shall contact the Managing Director of Infrastructure Services to determine if a swab launching and/or swab retrieval chamber is required or is available nearby.

C.12 Services

C12.1 Sizing

The minimum nominal service size shall be 25 mm.

The allowable service sizes are 25 mm, 38 mm, 50 mm, 100 mm, 150 mm etc. in 50 mm increments. Multi-block minimum service should be 150 mm (for onsite hydrants). Services larger than the minimum size for the Township shall be sized in accordance with AWWA M22 'Sizing Water Service Lines and Meters'. The Managing Director of Infrastructure Services must approve services sized larger than 300 mm or alternate service sizing.

The service size shall not exceed the diameter of the watermain.

C12.2 Location

The service shall be located as detailed on the Township's typical servicing and/or road cross-section drawings unless otherwise approved.

Water services must be installed perpendicular to the road and/or the watermain wherever practical and within the lot frontage.

C12.3 Number of Services per Property

No more than one individual property shall be serviced by the same service regardless of ownership.

In situations where a fire service is required due to infilling or site development after the water distribution system has been installed, private hydrants can be supplied by a separate service at the discretion of the Township.

In the case of multi-unit blocks, on-site servicing can be arranged to the property owner's convenience, however, there shall only be one service from the municipal system.

In unique circumstances and with the approval by the Managing Director of Infrastructure Services, more than one service may be allowed to one property. However, a testable backflow

preventer in accordance with CAN/CSA-B64-10 shall be installed on each service to eliminate the possibility of system flow through private property.

C12.4 Restraints

Services 100 mm and larger, including valves, joints and bends, regardless of size shall be fully restrained from the watermain to the property line.

C12.5 Bends

Bend fittings shall be avoided wherever possible.

C12.6 Valving

For services 50 mm diameter and smaller, all services shall have two isolation valves. One valve shall be installed immediately adjacent to the watermain (main stop) and buried, and another valve shall be installed at the property line or easement limit (curb stop) and a service box provided to finished grade.

For services 100 mm and larger, the Developer's Engineer shall contact the Township regarding the number, location and need for valves and valve boxes.

The main stop or valve, regardless of size, shall be fully restrained to the watermain through the use of an anchor tee, joint restraint, or bolted connection.

C12.7 Metering

The metering of water use shall be in accordance with the Township's standard. Meters are not permitted in chambers. District Metering may be required.

C12.8 Allowance for Future Servicing

If the location of future servicing is in doubt then the servicing can only be installed with the written approval of the Managing Director of Infrastructure Services.

C12.9 Electrical Grounding

On reconstruction or local improvement projects where existing structures will be serviced by a replacement or new water distribution system, the Developer's Engineer shall determine if the electrical grounding systems are connected to the water service. If so, appropriate measures must be taken to ensure that electrical grounding systems are not compromised. Possible solutions include using copper services or installing new grounding rods or plates (see the Electrical Safety Code).

C.13 Geotechnical Report

C.13.1 Requirements

A geotechnical report must be submitted to the Managing Director of Infrastructure Services as part of the design of the watermain unless otherwise waived by the Managing Director of Infrastructure Services. Recommendations must be made regarding the watermain bedding, thrust restraints, corrosion protection and trench dewatering. The resistivity of the soil must also be provided.

The geotechnical report shall also include test results and recommendations for the use and/or disposal of adversely impacted soils, such as from sodium and petroleum products, in accordance with current regulations.

C14 Corrosion Protection

C14.1 Non-Metallic Watermain

Non-metallic watermain with metallic valves and fittings and non-metallic service laterals, shall have one zinc Z-24-48 (24 lb) anode attached to each metallic fitting. A brass grounding clamp shall be used to connect the anode lead to the fitting.

C.14.2 Tracer Wire Test Stations

Test stations are to be installed at a maximum of 300 m spacing. They are to be located directly behind a fire hydrant and shall be Copperhead model LD14-TP 350mm in length with a cast iron blue locking lid with “water” cast into the cap or approved equivalent. The tracer wire is not to be fastened to the hydrant flange.

C.15 Material Specifications

C.15.1 Watermain Material Specifications

All materials shall be certified to the latest revised applicable specifications of the American Waterworks Association (AWWA), American Society for Testing and Materials (ASTM), National Sanitation Foundation (NSF) 14 & 61, American National Standard Institute (ANSI), Underwriters Laboratory (UL), American Association of State Highway and Transportation Officials (AASHTO) and the Canadian Standards Association (CSA). Certification to be provided to Municipality, as referenced in the following sections.

On a project specific basis, the Contractor may apply to have a product considered approved equivalent for any of the product categories listed in the following sections

Watermain Engineer to Review

Approved Watermain Pipe material

Type of Pipe	Specification	Diameter	Approved Use	Approved Manufacturer
HDPE*	OPS 441 CSA 137.1	Up to 600 mm	Mainline	IPEX or approved equivalent
DR 18 PVC	AWWA C900 CSA B137.3	100mm to 300mm	Mainline, Service Laterals	IPEX or approved equivalent
DR 25 PVC	AWWA C905 CSA B137.3	350mm up to 600mm	Mainline, Service Laterals	IPEX or approved equivalent
PVCO	AWWA 909 CSA B137.3.1 ANSI/NSF 61	100m to 300mm	Mainline	IPEX or approved equivalent

Notes :

1) For any HDPE application the size and manufacturer must be approved by the Managing Director of Infrastructure Services

C15.2 Watermain Pipe

C.15.2 .1 Polyvinyl Chloride Pipe (PVC)

Manufacture

Polyvinyl chloride (PVC) pressure pipe shall be manufactured to cast iron outside diameters. PVC pipe shall be colour coded blue and shall have an integral wall-thickened bell designed for joint assembly using an elastomeric gasket conforming to ASTM D3139.

PVC pipe sizes 100 mm through 300 mm shall be minimum DR18, conform to AWWA C900 and be certified to CSA B137.3. PVC pipe in sizes 350 mm and larger shall be minimum DR25, conform to AWWA C905 and be certified to CSA B137.3.

Fittings

- **Metallic**

  Fittings shall be grey or ductile iron conforming to AWWA C110/A21.10 or compact ductile iron conforming to AWWA C153/A21.53. Fittings shall have mechanical joint ends conforming to AWWA C111/A21.11 unless otherwise specified and shall be cement lined in accordance with AWWA C104/A21.4. Cast iron fittings shall only be used for main sizes where compact ductile iron fittings are not available.

- **Joint Restraints**

  Serrated (machined) ring type joint restraints for PVC pipe shall meet the requirements of Uni-Bell B-13 or ASTM F1674, and AWWA C-111 where appropriate, and be listed by ULc or FM. Accepted products include Clow (Series 300, 350, 360), EBAA (Series 1600, 2500, 2800), Sigma (PV Lok PVP, PVM, PVPF), Star (Stargrip 1000, 1100, 1200), Smith-Blair (Cam-Lock 111,120 pipe ends Bell Lock 115, 135, 153 for pipe bells, hydrants, valves and fittings, Pipe Lock 471,472,473,474 for pvc and ductile iron connection, Flange Lock 911,920,923,973 flanged to plain end pipe), Tufgrip (Series 1000, 2000).

  Wedge action type joint restraints for PVC pipe shall meet the requirements of Uni-Bell B-13 or ASTM F1674, and AWWA C-111 where appropriate, and be listed by ULc or FM. Accepted products include EBAA (Series 2000PV), Sigma (One Lok SLC), Star (Stargrip 4000,4100P) and UniFlange (Series 1500).

C.15.2.2 High Density Polyethylene Pipe (HDPE)

Manufacture

Where high density polyethylene (HDPE) pressure pipe is specified and approved by the Managing Director of Infrastructure for situations of specialized installation, it shall be ductile iron pipe outside diameter, co-extruded blue or blue stripe in colour, and meet the requirements of OPS 441 and CSA 137.1.

- **Fittings**
  HDPE pipe fittings shall meet the requirements of OPS 441.
- **Joint Restraints**
  Joints will be restrained in accordance with OPS 441.

C.15.2.3 Valves

Gate Valves

All Gate valves shall be resilient wedge conforming to AWWA C509.

Resilient wedge valves shall be Mueller, Clow or East Jordan Iron Works Flowmaster.

All gate valves shall be iron body fusion bonded epoxy coated, bronze mounted with inside screw, non-rising spindle and a 50 mm operating nut that opens by turning counter-clockwise.

Gate valves in sizes 100 mm to 350 mm shall have mechanical joint ends.

Combination Air and Vacuum Release Valves

Combination air and vacuum release valves shall consist of an air and vacuum valve and an air release valve in a single body housing. The body and cover shall be cast iron conforming to

ASTM A126 Class B. Combination air and vacuum release valves shall be Golden Anderson Industries (Figure GA945).

Tapping Sleeves

Stainless steel tapping sleeves shall be Ford FAST, Smith-Blair 663, Mueller H304. Stainless steel tapping sleeves including flanges shall be manufactured from Type 304 stainless steel and shall come equipped with Type 304 stainless steel bolts, nuts and washers

C.15.2.4 Valve Chambers

Cast Iron Maintenance Hole Lids

All new maintenance holes shall be fitted with self-adjusting manhole frame and cover from either East Jordan Iron Works (Product No. 00302202) or Bibby-Ste-Croix (Auto Stable C-50M-ONT) or approved equivalent. All covers shall be as per OPSD 401.010 Type A.

Adjustment Units

Concrete adjustment units shall be as per OPSS 407 and OPSD 704.01. Precast adjustment units shall be laid in a full bed of mortar with successive units being joined using sealant as recommended by the manufacturer. The minimum height for adjustment units is 150 mm and the maximum height for adjustment units is 300 mm.

Safety Post

Safety posts shall be galvanized "Ladder Up" as manufactured by "BILCO", MSU Model 3100.

C.15.2.5 Line Closure Couplings

Line closure coupling will not be allowed in the Township, only MJ solid sleeve.

C.15.2.6 Flange Adaptors

Flange adapters shall be Uni-Flange Series 400 or 900, Clow Series 40 and 90, EBAA Iron Megaflange Series 2100, Smith-Blair l Series 913.

C.15.2.7 Valve Boxes

Cast iron valve boxes shall be a screw type box with a No. 6 Base as supplied by Bibby, Mueller or Star. Lid shall read “WATER” or large “W”. The valve box must be raised to final grade.

C.15.2.8 Hydrants

Hydrants shall conform to AWWA C502 for Dry Barrel Hydrants and shall open counter clockwise by a 32 mm square operating nut. Hydrants shall have tapped drain ports, 150 mm mechanical joint inlet with brass to brass fittings on the main valve seat, two 63.5 mm (2.5 in) hose nozzles spread 180 degrees apart and a 114.3 mm (4.5 in) pumper nozzle with a 100 mm ULC approved Storz connection. Hydrants shall be connected to the main using 150 mm lead, 150 gate valve, and anchor tee. Hydrants shall be supplied for a minimum 2.3 m depth of trench. A maximum of one hydrant extension (300 mm or less for new development) shall be

allowed, with authorization of the Managing Director of Infrastructure, between the upper and lower hydrant barrels for deeper installations.

Hydrants barrels shall be painted chrome yellow with a high gloss exterior paint over a quick dry oxide primer. Storz nozzles shall be painted black. The colour(s) of hydrant bonnet and nozzle caps shall be green and painted with a high gloss exterior paint over a quick dry oxide primer.

All private hydrants must be painted red.

All hydrants shall be Canada Valve (Century), Clow Brigadier hydrants or East Jordan WaterMaster 5CD250 (specific heritage locations).

C.15.2.9 50mm and Smaller Service Connections

C.15.2.10 Service Pipe

Copper service pipe for services 50 mm and smaller shall be Type “K” soft copper and shall conform to ASTM B88. All service pipes shall be of new manufacture. Kinked, crushed or distorted tubing will not be accepted.

C.15.2.11 Service Saddles

Saddles shall be 18 gauge Type 304 stainless steel with AWWA tapered thread. Saddles for PVC pipe shall be double bolted. Saddles shall have a minimum of 50 mm bearing width and shall be fully contoured to the outside of the pipe.

Service saddles shall be Cambridge Brass Series 8405, Ford FS303, Romac, Smith-Blair Series 375 and 373 and come equipped with TYPE 304 stainless steel bolts, nuts and washers.

C.15.2.12 Main Stops

Main stops shall be the same size as the service pipe and shall have AWWA tapered thread inlet and compression joint outlet. Main stops shall be equipped with electrical grounding tail nuts when required for connection of tracer wire and anodes for corrosion protection.

Main stops shall be Cambridge Brass Series 302NL, Ford Series F60-4-3 & F60-4-4-, Mueller B-25008.

C.15.2.13 Union Couplings

Union couplings shall have compression joints and shall be Cambridge Brass Series 118, Mueller 15400 Series, Ford Pack Joint C44 or Straub Tabco Inc.

C.15.2.14 Curb Stops

Curb stops shall be the same size as the service pipe and shall be compression joint (CJ) inlet and (CJ) outlet.

Curb stops shall be equipped with electrical grounding tail nuts for connection of tracer wire and anodes for corrosion protection. All rod and pin shall be stainless steel

Curb stops shall be Cambridge Brass 202 Series, Mueller B-25209 Series or Ford B44 Series.

Stop and drain type curb stops are not accepted unless special approval is obtained by the Managing Director of Infrastructure Services.

C.15.2.15 Service Boxes

Service boxes shall be cast iron with a 25 mm upper section and shall have stainless steel rods and cotter pins. Service boxes shall be adjustable to between 1.8 metres and 2.1 metres to suit service depths.

Service boxes shall be Mueller A-314 or A-726

C.15.2.16 Temporary Watermains

All temporary distribution and service piping shall be certified for potable water use as per ANSI/NSF Standard 14 and Standard 61. No galvanized material will be allowed.

The distribution piping shall be a minimum 50 mm diameter, Aqua Mine high impact, ASTM PVC 1120, D2241, SDR17, 1720 kPa. Larger diameter may be required for fire protection.

Service piping shall be minimum 19 mm diameter Kuritec or approved equivalent.

C.15.2.17 Metal Items

C.15.2.18 Bolts, Nuts and Washers

C.15.2.19 Cor-Ten

Cor-Ten T-head bolts, nuts and washers shall conform to the latest issue of ASTM and AWWA.

C.15.2.20 Cadmium Coated

Cadmium coated bolts, nuts and washers shall conform to the latest issue of ASTM. Use Grade 2, Designated A 305 bolts for flanges up to and including 300 mm diameter and Grade 5, Designated A 307 for flanges larger than 300 mm diameter.

C.15.2.21 Stainless Steel

Stainless steel bolts, nuts and washers shall be stainless steel Type 304 conforming to the latest issue of ASTM F593 and F594.

C.15.2.22 Cast Iron

Cast Iron shall conform to ASTM Designation A-48, Class 30B, Standard Specifications for Grey Iron Castings. Cast iron products shall be asphalt coated.

C.15.2.23 Galvanizing

Galvanizing shall conform to the standard specifications for ASTM Designation A.123 - Zinc Coatings on Structural Steel Shapes. Metal products specified as galvanized shall be galvanized after fabrication.

C.15.2.24 Petrolatum Tape Systems

Petrolatum tape systems shall be comprised of three components; paste, mastic, tape and meet the requirements of AWWA C217-09.

Anti-corrosion wrap shall be as supplied by Denso North America Inc. or Petro Coating Systems Ltd. or Rustrol Systems (Interprovincial Corrosion Control Company Ltd). Only material from suppliers listed shall be used on an installation. At no time shall materials from either system be utilized with the other.

Denso coating material shall consist of Denso paste or Denso priming Solution (for cold temperature application), Denso Profiling Mastic or Denso Mastic Blanket, and Denso LT Tape.

PP Series Primer Paste, PM Series Mastic, LT/ST/Ht Petroleum Tape, PVC 250 Overwrap Tape from Petro Coating Systems Ltd.

Rustrol Systems materials shall consist of PetroWrap Primer, PetroWrap Mastic and PetroWrap Tape

C.15.2.25 Anodes

Packaged anodes shall be zinc Z-24-48 (24lb) manufactured using a high purity zinc (99.99% pure zinc) conforming to ASTM B-418 Type II. The anode shall have an average current efficiency of 90% and provide an open circuit potential with a minimum 1.10 Volt D.C. as measured with respect to copper / copper sulphate reference electrode. The zinc casting shall have a minimum 3.2 mm (0.125”) diameter galvanized steel core wire throughout its length and shall be packaged in a cardboard or cloth container approximately 100 mm in diameter. The depolarising material surrounding the zinc casting shall be composed of a gypsum/bentonite base material having an electrical resistivity less than 50 ohm/cm wet. An insulated copper wire (AWG #10/7 strand), 2m minimum in length shall be brazed to the end of the core wire.

C.15.2.26 Tracer Wire

Tracer wire for open trench construction shall be 12 gauge (AWG) Copper Clad Steel (CCS) wire. Wire shall have a minimum break load of 452 lbs, a 30 mil HDPE jacket and rated for direct bury application. Wire shall be blue for water and green for sanitary. Wire shall be Copperhead 1230-BHS, 1230-GHS or approved equivalent.Tracer wire for trenchless construction shall be Extra High Strength (EHS) Copper Clad Steel (CCS) wire. Wire shall have a minimum break load of 1150 lbs, a 45 mil HDPE jacket and rated for directional drill application. Wire shall be blue for water and green for sanitary. Wire shall be Copperhead 1245-BEHS, 1245-GEHS or approved equivalent.

All connectors shall be filled with waterproof dielectric silicone and rated for direct bury application. New connections (12 gauge wire) shall use Copperhead snakebite connectors (Model LSC-123-0B) or approved equivalent. Existing connections of 14 to 10 gauge wire shall use a Copperhead lug style connection (Model 3WB-01) or approved equivalent. Connections for 1245-EHS wire shall be a Copperhead tin plated, copper alloy split bolt connector (Model SC-3WPB-01) or approved equivalent. Existing connections for 4 to 8 gauge wire shall use a twist style connector (Copperhead Model SCB-01-LG) or approved equivalent.

C16 Construction Specifications

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C16.1 Watermain Construction Specifications

This section provides direction on project coordination and notification requirements and also describes how watermains, service connections and associated appurtenances are to be installed, commissioned and tested to meet the technical requirements of the Contract Documents

C16.2 Ontario Provincial Standard Specifications

The watermain works shall be installed in accordance with OPSS 441 and 442 except as amended or extended herein.

C16.3 Project Coordination

This sub-section defines responsibility with respect to project coordination objectives required prior to, during and following the water system construction.

C.16.3.1 Notification of Operating Authority

The Contractor shall notify the local operating authority of the water distribution system at least 48 hours prior to the commencement of any work that may affect the existing water distribution system.

C.16.3.2 Notification of Local Water Users

The Contractor shall notify all local water users who will be affected by the shutting down of any section of a permanent or temporary watermain system.

The Contractor shall provide written hand delivered notification of the water service interruption at least two (2) full working days prior to the interruption to all affected water users. The notification letter / door hanger shall be to the Township's standards and approved by the Township prior to distribution.

The notification shall include:

- 24 hr. Contractor contact name(s) and phone number(s)
- Start date and time
- Duration of service interruption

C.16.3.3 Shutting Down or Charging Mains

Only Township licensed operators shall operate valves on existing watermains for the purpose of controlling water. No person other than Township licensed operators shall shut down or charge any section of existing watermain or operate any valve for the purpose of controlling water from existing watermains.

The Contractor shall provide the Township with at least two (2) full working days advance notice when a change in control of the water is required. All necessary water supply interruptions shall be scheduled in cooperation with the Township during normal working hours. If the Contractor elects to have the Township make system changes after normal working hours, the Contractor may be responsible for additional costs.

The Contractor shall operate only those valves, hydrants and curb stops installed in their Contract during the construction period prior to final connection to the existing distribution system. After final connection, only Township personnel may operate the system.

C.16.3.4 Water Interruption

The Contractor shall take all measures reasonable to ensure that water service is not interrupted before 9:00 a.m. and after 4:00 p.m. The Managing Director of Infrastructure Services reserves the right to require that specified water users not be interrupted at all or that the interruption is limited to a certain time span. The Managing Director of Infrastructure Services also reserves the right to require that any water interruptions be conducted outside of normal working hours.

C.16.3.5 Requirements Outside of Contract Limits

The Contractor shall ensure that construction activities will not unduly affect, in the opinion of the Township, the water distribution system outside of the contract limit.

C.16.3.6 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment shall be considered to be included in the watermain installation.

C16.4 Temporary Water Distribution System

C.16.4.1 General

In the event that existing water users must be taken out of service for a period exceeding eight (8) hours, or at the discretion of the Contract Administrator or the Managing Director of Infrastructure Services, a temporary water distribution system shall be provided to all interrupted users.

This sub-section provides direction on the installation of Temporary Water Distribution System that the Contractor is required to perform to meet the technical requirements of the Contract Documents.

The temporary water system shall remain in service and not be removed until the Managing Director of Infrastructure Services has approved the final connection of the new watermain to the existing system and authorized removal of the temporary water system.

The temporary watermain must run with a low flow once commissioned to maintain the quality of the water. The water is to be dechlorinated and discharged to a storm inlet.

Existing fire hydrants removed from service shall be bagged as out of service in accordance with the direction of the Township.

The ends of the temporary watermain should be capped when arriving on site and kept capped until placed in use.

The inspector shall update the contract administrator and the Township whenever the following occurs:

- Buildings are placed on temporary water
- Buildings are taken off of temporary water
- Any changes in the sampling plan/ locations for approval prior to the change
- Any changes in the source for approval prior to the change
- Any breaches of the temporary water supply as soon as possible

C.16.4.2 Layout Plan

Prior to installing the temporary water distribution system, a detailed plan of the system shall be provided by the Contractor and approved by the Managing Director of Infrastructure Services. Allow two weeks for review and approval. The plan shall detail:

- Connection points to municipal system
- Backflow preventor size (Backflow to be reduced pressure zone RPZ)
- Materials for mainline and services
- Mainline and service sizes
- Sampling points
- List of addresses of affected properties including unit, apartment and suite numbers
- Emergency procedures and After Hours contact information
- Fire lines and any dead ends shall be identified and be blown out
- Other related information about the temporary water system

The Contractor shall demonstrate that the level of service to the water users will not be impacted and that the temporary system will supply water demands at pressures normal to the existing system. The Contractor shall identify large or exceptional water users and/or fire protection requirements and incorporate their needs into the temporary water distribution system. The installation of temporary fire hydrants (where required) shall be as outlined in the Contract Documents.

The Township requires metering of temporary watermains and as such, the layout plan must include the size and location of the water meter. A water meter can be obtained by the Township and meter readings must be taken by the Township.

C.16.4.3 Minimum Diameter

The minimum pipe size shall be 50 mm for mainlines and 19 mm for individual service connections.

The temporary water system shall be adequately sized to provide water at pressures normal to the existing water distribution system including the supply to fire suppression systems in serviced buildings. If temporary fire hydrants are required, the required fire flows shall be specified by the Managing Director of Infrastructure Services. The Contractor may be requested to provide confirmation of the supply adequacy of the temporary watermain system by flow and pressure tests or by calculations.

C.16.4.4 Location

The temporary distribution piping shall be installed behind the sidewalk and service piping shall be installed along the edge of existing driveways to avoid grass-cutting conflicts.

All above ground piping shall be installed with appropriate ramping or burial such that the piping will:

- Not to be endangered by equipment or vehicular traffic
- Not pose a hazard for pedestrians (tripping, etc)
- Provide a barrier-free access
- Be constructed to safeguard against vandalism and tampering

C.16.4.5 Isolation Valves

Isolation valves are required at the source water connection, branches (2 on 3 way, 3 on 4 way) and at every service.

C.16.4.6 Source Water Connection

The connection of the temporary water system to the existing distribution system shall be done in a secure location and be vandal and tamper resistant. A backflow preventer is required to separate the two systems as long as the temporary system is in service. The backflow preventer shall be a reduced pressure type assembly and shall be installed, maintained, and field-tested in accordance with the latest edition of CAN/CSA-B64.10.

At the beginning of the project on the first installation and all subsequent relocations, the backflow preventer must be certified by an appropriately licensed technician and submitted to the Managing Director of Infrastructure prior to the backflow preventer being put into service. Source water connections to fire hydrants are discouraged unless it is demonstrated that the hydrant is the only feasible option. The hydrant shall be pressurized at all times that it serves as a source of potable water.

C.16.4.7 Pressure Testing and Leakage

All above ground piping shall be regularly inspected to ensure leak tight connections at the beginning and during the period that the temporary water distribution is in use.

At the discretion of the Contract Administrator or the Managing Director of Infrastructure Services, buried temporary water distribution piping shall satisfy hydrostatic pressure testing.

C.16.4.8 Chlorine Residual and Bacteriological Testing

After the temporary water system is installed (both mainlines and services) in its final location, but before service piping is connected to the water users, the temporary water distribution system shall satisfy the chlorine residual and bacteriological testing standards and protocols for the commissioning of new watermains. Samples must be collected at the end of each branch (individual services under 50 mm exempt unless designated by Contract Administrator) and at maximum 350 m intervals.

All procedural standards, bacteriological and chlorine residual requirements detailed for commissioning new watermain distribution systems apply to testing the temporary water distribution system, including swabbing.

One week after the temporary water system is placed into operation and weekly thereafter, chlorine residual and bacteriological samples shall be taken until the temporary system is decommissioned. The chlorine residual and bacteriological requirements after the temporary system is installed shall be that associated with the existing distribution system.

The Contract Administrator is to be contacted immediately if there is damage or loss of pressure to the temporary distribution system. This will require the Township to perform another round of bacteriological testing.

If a water sample is shown adverse in accordance with O.Reg. 170/03 after the temporary water distribution system is in service, the Contract Administrator will notify the Contractor as soon as possible. The severity of the problem will be addressed and corrective action determined by the Township. If a Boil Water or Drinking Water Advisory must be issued, or if the temporary water system must be disconnected, the Contractor shall supply bottled water or an alternate acceptable water supply to the interrupted water users. Before the temporary water system can be placed back into operation, it must satisfy the chlorine residual and bacteriological testing standards and protocols used to initially commission the temporary system and/or the requirements of the Medical Officer of Health, Public Health Department, or the Township of Centre Wellington. The Contactor shall have forces available at all times during the corrective action and testing periods to conduct necessary work or assist with sampling as necessary and will be responsible for any costs incurred by the Township for corrective action and/or testing.

C.16.4.9 Temporary Sampling Ports and Flushing

Sampling ports are to be copper from the temporary main connection to the end (no plastic pipe) with a removable handle for the valve. A gooseneck configuration or a tee configuration (both fully copper) are acceptable. A description of the sampling port or reference this section is required for the temporary watermain commissioning plan. Sample locations shall be kept clean and shall be located high enough to minimize any ground splashing back onto the sample port.

Once commissioned, the temporary watermain shall continuously flush at all dead ends to ensure water movement (dechlorinated and directed to the storm sewer, whenever possible).

C.16.4.10 Service Connections

The service connection piping shall be installed and disinfected at the same time as the main line in order that disinfection is accomplished on the service piping. The final connection to the water user shall not be made until the chlorine residual and bacteriological testing requirements have been satisfied. During service connections, the Contractor shall minimize the portion of the system depressurized.

A check valve shall be installed on the service connection between the mainline and the connection to the water user.

Prior to connection to water users, individual service lines shall be thoroughly flushed. The final connectors shall be spray-disinfected and swabbed with a minimum 1% and maximum 5% solution to disinfect the fittings. The Contractor shall arrange for the plumbing system to be flushed to remove any elevated chlorine residuals.

A typical service connection to a private building shall be at an outside hose bib. An individual WYE type connector shall be installed. A vacuum breaker shall be installed on the side opposite the service connection. In the event that this scenario is not possible, it is the responsibility of the Contractor to determine how to provide temporary water service to the satisfaction of the property owner. Any excavation on private property or internal plumbing modifications shall only be done after written approval is obtained from the property owner and applicable plumbing permits obtained. A copy of any written approvals shall be provided to the Contract Administrator.

The Contractor is responsible to provide an appropriate connection to the water user. The property owner is under no obligation to allow the temporary water system to be connected to their internal system at any location other than on the public side of the curb stop. In the event that a property owner will not permit an above ground connection as typical, it shall be the Contractor's responsibility to make alternate arrangements to service the property. In lieu of making above-ground temporary servicing, the Contractor has the option to connect the temporary distribution system to the public side of the existing curb stop.

C.16.4.11 Operation

The temporary water distribution system shall be continually pressurized after the bacteriological testing is completed and be capable of supply normal water demands throughout its installation.

In the event of a main or service break, the Contractor shall advise the Managing Director of Infrastructure Services and take immediate steps to minimize water loss and to avoid system contamination. Each end of the broken pipe shall be elevated in a manner to avoid backflow into the pipe. All fittings used in the repair and the pipe ends shall be spray-disinfected and swabbed with a minimum 1% and maximum 5% solution to disinfect the connection. At the discretion of the Township, a round of chlorine and bacteriological samples may be taken to ensure the integrity of the system.

C.16.4.12 Off-hours Corrective Action

In the event that corrective action is needed to the temporary water distribution system outside of normal working hours, the Contract Administrator and/or the Township will attempt to contact the Contractor to take corrective actions. If, in the sole opinion of the Township, the Contractor is unable to make the corrections in a timely manner, the Township may direct their own forces to take corrective steps. The Contractor will be responsible for any costs incurred by the Township.

C.16.4.13 Relocation of the Temporary Distribution System

The relocation of the temporary water system either in whole or parts by any means without conducting and passing the chlorine residual and bacteriological requirements shall not be permitted. Relocation here is defined as depressurising and moving the pipework in order to service other water users.

C.16.4.14 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment of any temporary water systems required to be installed, commissioned and tested shall be considered to be included in the watermain installation.

C16.5 Source Water Connection for New Water System

This sub-section provides information on submission requirement and procedures to be followed by the contractor in order to acquire approval to complete the Source Water Connection for the temporary water system and/or the testing and/or commissioning of the watermain system.

C.16.5.1 Physical Separation

All connection points between the existing water distribution system and new watermains, including temporary water distribution systems, shall be kept physically separated until the watermain has successfully passed commissioning and testing requirements.

C.16.5.2 Use of Fire Hydrants

Source water connections to fire hydrants are discouraged unless it is demonstrated that the fire hydrant is the only feasible option. The fire hydrant shall be pressurized at all times that it serves as a source of potable water.

C.16.5.3 Temporary Connection and Backflow Preventer

To facilitate watermain commissioning, a temporary connection to the existing water distribution can be made through the use of a temporary or “jumper” connection equipped with a backflow preventer as the Township’s Standards. The connection to the existing distribution system shall be done in a secure location and be vandal and tamper resistant and shall be no larger than 50 mm diameter. Multiple jumpers or larger connections are acceptable with the approval of the Township.

The backflow preventer shall be a reduced pressure type assembly and shall be installed, maintained, and field-tested in accordance with the latest edition of CAN/CSA-B64.10.

At the beginning of the project on the first installation and all subsequent relocations, the backflow preventer must be certified by an appropriately licensed technician and submitted to the Managing Director of Infrastructure prior to the backflow preventer being put into service. The backflow preventer must be re-certified when the unit is relocated. The existing distribution systems and the backflow preventer shall be physically disconnected from the test section during hydrostatic testing.

C.16.5.4 Connection Point Relocation

In the event that the connection point of the new watermain to the existing watermain distribution system is in a location that is impractical to install a temporary jumper connection or carry out testing requirements, the Contractor may elect, or be directed by the Township, to re-locate the connection point to a more suitable location. This situation may occur if the connection point to the existing water distribution system is within the travelled portion of a roadway, would raise safety concerns or may cause environmental or property damage if an excavation were left open or pipe work exposed aboveground.

The Contractor shall carry out the disinfection of the watermain installed to relocate the connection point in accordance with AWWA 651 and the procedures outlined under “Final Connection” for new watermains.

After the watermain connection has been installed, the Township or the Contract Administrator may elect to conduct additional chlorine residual and bacteriological testing in accordance with the requirements outlined for new watermains to verify the disinfection of the watermain. If the watermain connection fails either the chlorine residual or bacteriological requirements, the Township will direct corrective action and the Contractor shall cooperate fully.

C.16.5.5 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment of any source water connections required to be installed, commissioned and tested shall be considered to be included in the watermain installation.

C16.6 Watermain Installation

This sub-section provides direction on the watermain installation operations that the Contractor is required to perform to meet the technical requirements of the Contract Documents. As per OPSS 441 “All pipes up to and including 600 mm shall be delivered to the Work Area with end covers.

C.16.6.1 Watermain Layout Tolerance

The allowable laying tolerance from that shown on the Construction Drawings for all sizes and along the entire length of watermains is as follows:

Horizontal:	50 mm
Vertical:	25 mm

C.16.6.2 Joint and Pipe Deflection

The deflection of joints shall not exceed that recommended by the pipe manufacturer. Pipe barrels shall not be deflected to any degree or placed under lateral or vertical stress.

C.16.6.3 Joint and Thrust Restraint

Joint and thrust restraint, poured-in-place concrete, shall be installed on mains up to and including 300 mm dia.:

- As per Township Standards
- As shown on the Construction Drawings
- As shown on the pipeline Shop Drawings
- At all horizontal and vertical bends (one pipe length on each side of the bend)
- As shown on approved shop drawings
- As directed by the Contract Administrator and/or the Managing Director of Infrastructure Services

Mechanical joint restraints shall be installed on mains of all sizes:

- On all main valves, hydrant leads, tees, crosses, flushing and swab ports, and all service laterals 100 mm or greater in size

- In areas where concrete thrust blocking to undisturbed soil is impractical
- In areas subject to settlement
- As directed by the Contract Administrator and/or Managing Director of Infrastructure Services

All joints to be restrained a minimum 10 m from either side of any appurtenance or as per approved shop drawings, or as per manufacturer's specificatioThreaded rod shall not be installed unless written permission is obtained from the Contract Administrator with the approval of the Managing Director of Infrastructure Services.

C.16.6.4 Tracer Wire

The tracer wire shall be installed as per the Township's Standards and taped to the top centre of all non-metallic watermain and service piping at 5m intervals.

The tracer wire on non-metallic systems shall **not** be connected to new or existing metallic watermain piping and/or associated fittings connected to the metallic watermain in order not to interconnect corrosion protection systems.

A grounding anode shall be installed at the terminus of the tracer wire which is not otherwise connected to an existing tracer wire. The anode shall be Copperhead model ANO-12 or approved equivalent.

C.16.6.5 Corrosion Protection

- **Non-Metallic Mains**

  The anode shall not be connected to the tracing wire and shall be connected to each metallic fitting. A brass grounding clamp shall be used to connect the anode lead to the fitting.

- **Anode Offset**

  The packaged anode is to be placed parallel to the watermain, 0.3 metres from the pipe.

C.16.6.6 Bolts, Nuts and Washers

Bolts, nuts and washers used on buried fittings shall be Cor-Ten or stainless steel. Cor-Ten T-head bolts, nuts and washers shall conform to the latest issue of ASTM and AWWA. Stainless steel bolts, nuts and washers shall be stainless steel Type 304 conforming to the latest issue of ASTM F593 and F594.

All bolts, nuts and washers shall be covered with a petrolatum tape system (regardless of whether it is coated or not), which shall be installed in accordance with the manufacturer's instructions.

C.16.6.7 Wrapping

All metallic fittings (excluding curb/main stop and brass fittings) and appurtenances including saddles, valves, tees, bends etc are to be wrapped with an approved petrolatum system consisting of paste, mastic and tape.

C.16.6.8 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of watermain will be in accordance with the Ontario Provincial Standards. If not otherwise specified, the supply and installation of joint and thrust restraint, tracer wire, warning tape and corrosion protection shall be considered to be included within the watermain installation.

C.16.6.9 Method of Construction

Pipe shall be laid with the bell or pre-coupled ends facing in the direction of laying, unless directed otherwise by the Township. Where pipe is laid on a grade greater than 10%, the laying shall proceed up-grade with the bell end at the higher end of each length of pipe.

C.16.6.10 Joining Pipe and Fittings

Pipe shall, in general, be joined in strict conformance with the recommendations of the manufacturer of the pipe in use, and as herein specified. The Contractor shall provide and maintain bracing or chain blocks to prevent "creep" until the pipe is anchored and fixed.

a) Push-on Joints

For PVC pipe, the ball area and gasket must be clean and factory installed gaskets must not be tampered with or altered. Apply lubricant to bevelled spigot end only. Push lubricated end past gasket until reference line is even with bell.

b) Mechanical Joints

Place the gland and rubber gasket over the plain end of the pipe and then insert the plain end into the bell until the spigot is firmly seated in the bell. The gasket is then pushed into position so that it is evenly seated in the socket. The gland is moved into position against the face of the gasket. Bolts are inserted and tightened. All nuts shall be tightened with a suitable (preferably "torque limiting") wrench. Nuts spaced 180 degrees apart, shall be tightened alternatively, in order to produce equal pressure on all parts of the gland.

The torque for various size of bolts shall be as follows:

Table 3: BOLT TORQUE Size in Millimetres	Range of Torque in Newtons/Metre			
16	61	-	81	Nn/m
19	102	-	122	Nn/m
25	136	-	163	Nn/m
31	163	-	203	Nn/m

For PVC pipe, use plain rubber tip gaskets (not lead tip). Do not use bevelled pipe ends.

C16.7 Hydrant, Valve and Chamber Installation

This sub-section provides direction on the installation of hydrants, valves and chambers that the Contractor is required to perform to meet the technical requirements of the Contract Documents.

Backfill for hydrant is 19 mm clear stone surrounded with filter cloth and Granular A or approved native backfill. Backfill for valve is 19 mm clear stone surrounded with filter cloth from the top of bedding to the upper gland (just below the operating nut) and Granular A from the upper gland to the subgrade. Backfill for chambers is select subgrade material in accordance with OPSS 1010 or as dictated by the Managing Director of Infrastructure Services.

C.16.7.1 Setting of Hydrants

Unless otherwise specified, hydrants shall be installed in accordance with the Township's Standards.

Hydrants set in areas with a high ground water table shall have the hydrant drain hole plugged as directed by the Contract Administrator.

Horizontal and vertical bends shall not be installed in the hydrant lead unless written approval is obtained from the Managing Director of Infrastructure Services.

For non-metallic watermains and/or hydrant leads, the tracer wire shall be connected to the hydrant boot attached to the barrel up to the test station.

Fire hydrants not in service shall be bagged as out of service as directed by the municipality.

C.16.7.2 Valves

Unless otherwise specified, valves shall be installed in accordance with the Township's Standards. Hydrant valves shall be restrained directly to the main using anchor tees.

Road levellers of any style shall not be installed, the valve box must be raised to final grade.

C.16.7.3 Minimum Clearance

- **Fire Hydrants**

  The minimum clearance from above ground obstructions to fire hydrants shall be as follows:
  Behind 0.6 m
  Each Side 2.0 m
  Front clear to the curb line
  The installation of bollards shall be as directed by the Municipality.

- **Valves**

  The minimum clearance from above ground obstructions to valves shall be 2.0m.

C.16.7.4 Chambers

Unless otherwise specified, chambers shall be installed in accordance with the Township's Standards.

C.16.7.5 Valve Box and Chamber Lid Adjustment

Maintenance hole frames and lids shall be adjusted so that when tested with a 3 m straight edge in any direction of the surface, shall meet the following grade variance requirements between the bottom of the straight edge and the surface of the asphalt or frame and appurtenance.

+Gap, mm	Action
Up to 7	Acceptable
Greater than 7	Unacceptable

C.16.7.6 Bolts, Nuts and Washers

- **Buried Installations**

  Bolts, nuts and washers used on buried fittings shall be Cor-Ten or stainless steel.

  Bolts, nuts and washers used on fittings in chambers shall be stainless steel.

  If the Contractor elects to use Cor-Ten or stainless steel bolts, nuts and washers on buried valves or fittings, the entire connection shall be covered with a petrolatum tape system (paste, mastic and tape) which shall be installed in accordance with the manufacturer's instructions.

- **Chambers**

  Bolts, nuts and washers within chambers shall be stainless steel plus a petrolatum tape system. The use of zinc or cadmium coated bolts, nuts and washers are not permitted within chambers.

C.16.7.7 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of hydrants, valves and chambers will be in accordance with the Ontario Provincial Standards.

C16.8 Service Connections

This sub-section provides direction on the installation of service connections that the Contractor is required to perform to meet the technical requirements of the contract specification.

C.16.8.1 Installation

Unless otherwise specified, service connections shall be in accordance with the Township's Standards.

Procedure for New Water Service Connection to Existing at Property Line

The below procedure should prevent blockages occurring in the existing water service piping.

After exposing the existing water service at the property line, the house water meter valve should be opened and the line back flushed from the temporary supply until the water runs clear and then close the meter valve again.

After the new water service is connected to the existing water service, the new service should be charged, curb stop opened, meter valve opened and outside hose bib opened to flush this line until it runs clear.

If access to the meter valve is not possible at the time of connection for back flushing, then the contractor should proceed with the connection at the property line, but keep the curb stop closed until access is available. Then the curb stop can be opened, water meter valve opened and outside hose bid opened to flush this line until runs clear.

C.16.8.2 Live Tapping

Service connections shall be completed under pressure (live tapping) for the following:

- All service connections 50 mm and under on metallic watermains
- All service connections 50 mm and under on non-metallic watermains utilising a service saddle
- All connections utilising a tapping sleeve and valve
- Inspect connections to ensure drip tight prior to backfilling
- Certified Township staff must be present during all watermain tapping on a commissioned watermain.

In the event that water service boxes must be raised beyond the extension height, only screwed couplers will be accepted to install extensions. Extensions utilising set screws or other means will not be accepted.

Services shall be installed perpendicular to the watermain. Bends shall not be installed without the written approval of the Township. Gooseneck bends shall not be considered bends and therefore are exempt, no approval shall be necessary.

C.16.8.3 Tapping for Connections 100mm and Larger

All tapping of watermains for connections 100 mm and larger shall be approved by the Township and performed by a designated watermain tapping contractor. Tapping shall be done only when the watermain is under pressure (live tapping) and shall be inspected to ensure a drip tight connection prior to backfilling.

C.16.8.4 Pressure Testing

All new services shall be pressure tested to the valve or curb stop at the property line as per OPSS 441, including reconstruction projects.

C.16.8.5 Disinfection

All new service material shall be super-chlorinated and thoroughly flushed afterwards.

All services 100 mm and larger shall be sampled to ensure these services pass the chlorine residual and bacteriological requirements for new watermains.

Where existing services are connected to a new watermain within the watermain trench, the Contractor shall ensure that the new service material is free of dirt and debris and the connection is made under as clean conditions as possible. The Contractor shall make arrangements to thoroughly flush the service through an inside or outside hose bib for a minimum of 3 to 5 minutes or until the water runs clear and chlorine residuals have reduced to levels normal to the existing distribution system. If there is any question as to the water quality, the Contract Administrator may request a water sample for bacteriological analysis to the standards outlined for new watermains. In the event that the water sample is adverse, the Contractor shall take whatever corrective action is deemed necessary by the Contract Administrator and the Township.

C.16.8.6 Union Couplings

Only one (1) union per service will be allowed on copper services over 20m and no unions are allowed for non-metallic services.

Service pipe union couplings shall not be installed under gravel or asphalt road surfaces.When there is damage to a service, the service from the main to the curb/edge of pavement shall be replaced. The same material shall be used, unless the material is in conflict with the approved material list.

C.16.8.7 Marker

For new construction where the new service is not connected to an existing private system, the ends of service connections shall be marked at the curb box by extending a 38 mm x 89 mm timber marker vertically from the curb stop to a height of 1.0m above finished ground level. The exposed end of these marker stakes shall be painted blue.

C.16.8.8 Thrust Restraint

Thrust restraint shall be accomplished by approved mechanical joint restraints or concrete thrust blocks.

C.16.8.9 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of services and associated appurtenances will be in accordance with the Ontario Provincial Standards.

C16.9 Commissioning

This sub-section provides information on the submission and testing requirements and procedures to be followed by the Contractor to complete the commissioning of the watermain.

C.16.9.1 General

In order for a watermain to be considered for acceptance by the Managing Director of Infrastructure Services, the following procedures and tests shall be successfully completed by the Contractor in the presence of the Township and the Contract Administrator:

- swabbing
- hydrostatic pressure test
- disinfection
- de-chlorination
- chlorine residual and bacteriological sampling tests
- final connection
- tracer wire conductivity test
- valve positioning

All field tests conducted in this subsection shall be performed in the presence of the Township and Contract Administrator. The contractor/ developer may be responsible for the cost of water to undertake the field tests.

Prior to the initiation of the watermain commissioning procedures, the Contractor shall submit a Watermain Commissioning Plan for review by the Township. The Watermain Commissioning Plan shall contain a complete description of all the steps the Contractor will undertake to ensure the watermain satisfies all the testing and sampling requirements. In addition to the Watermain Commissioning Plan for development that is approved under a Subdivision Agreement, the developer must also provide a Chlorine Residual Maintenance Plan.

The Watermain Commissioning Plan, and Chlorine Residual Maintenance Plan, if required, shall be submitted a minimum of two (2) weeks in advance of the initiation of the watermain commissioning. This Watermain Commissioning Plan shall also include the specific reporting protocols as described under the particular commissioning procedures in the following sections.

A Watermain Commissioning Plan, and Chlorine Residual Maintenance Plan requirements is provided in **Part E.** The Watermain Commission Plan is also to be followed for temporary watermain plans (drawing to be included).

C.16.9.2 Swabbing

Prior to disinfection and in the presence of the Township and the Contact Administrator, all sections of watermain shall be swabbed using a minimum of four new foam swabs. Swabs shall be polyurethane with a density of 24.7 kg/m3 and shall have a minimum diameter 50 mm larger than the diameter of the watermain and have a minimum length of one and one half times its diameter.

The Contractor shall charge the watermain fully with water prior to the commencement of swabbing. The water used to conduct the chlorine residual and bacteriological testing shall be **normal** to the existing water distribution system. In most cases, test water can be supplied by the adjacent existing distribution system; however if this source is not available, or the Contractor elects not to use, then potable water from a prior Municipally approved location within the existing water distribution system may be brought to the watermain under consideration at the Contractor’s expense.

For mains 300 mm diameter or smaller, swabs shall be propelled through the watermain at a speed of 0.5 to 1.0 metre/second using potable water. For mains greater than 300 mm diameter and for mains where the Managing Director of Infrastructure Services requires a velocity lower than 0.5 m/s, the velocity calculations provided in the Watermain Commissioning Plan will be reviewed by the Managing Director of Infrastructure Services.

The Contractor shall discharge water to an approved outlet ensuring all required erosion and sediment control and dechlorination measures are followed. The Contractor shall demonstrate how the appropriate swabbing velocity will be achieved.

Stubs for future watermains longer than one (1) pipe length shall be swabbed. Servicing stubs 100mm diameter and larger and longer than one (1) pipe length shall also be swabbed.

The swabbing shall continue until the discharge water runs clear within ten seconds of the last swab exiting the discharge point.

After swabbing has been completed, the Contractor shall flush every fire hydrant lead, stub and service.

The Contractor shall mark, number, and demonstrate to the Contract Administrator that all swabs, or parts thereof, have been retrieved. The Contractor shall be liable for costs associated with damage caused by and retrieving swabs that, for whatever reason, escape into the existing water distribution system. The Contractor shall provide a letter co-signed by the Contract Administrator that all swabs were retrieved.

C.16.9.3 Hydrostatic Pressure Test

Hydrostatic pressuring testing shall be carried in accordance with OPSS 441. A minimum of the specified test pressure shall be applied to all points (including high points) in the watermain section being tested. The Township and the Contract Administrator shall witness the pressure test and provide written confirmation with the attached form provided in Part E.

C.16.9.4 Disinfection

Disinfection shall be carried out in accordance with MOECC Watermain Disinfection Procedure (as related to new watermain) 1 and AWWA C651 (last version). As per AWWA C6510, acceptable types of chlorine include sodium hypochlorite, calcium hypochlorite (conforming to ANSI/AWWA B300), and liquid chlorine (conforming to ANSI/AWWA B301). Type of chlorine must be stated in the commissioning plan. The chlorine injection concentration and the chlorine concentration at any point in the piping shall not exceed 100 mg/l.

C.16.9.5 De-chlorination

All water wasted shall be discharged into the stormwater system and shall be neutralized to provide a total chlorine residual of less than 0.2 mg/l. Acceptable dechlorination/ neutralizing agents are sodium thiosulphate and hydrogen peroxide. Neutralizing agent shall be noted in the commissioning plan. The Contract Administrator will monitor the discharge of waste water. Should tests show a residual greater than 0.2 mg/l, the discharge shall be ceased immediately and the procedure modified to meet less than the 0.2 mg/l objective.

Where detrimental effects may be suffered by plants and/or animals in the natural environment, the wasted water shall be neutralized to provide a total chlorine residual of less than 0.002 mg/l (2 ppb) (Provincial Water Quality Objective) at the outfall. The Contract Administrator will monitor the discharge of waste water. Should tests show a residual greater than 0.002 mg/l, the discharge shall be ceased immediately, the Managing Director of Infrastructure Services shall be notified, and the procedure modified to meet the less than 0.002 mg/l objective. Sites within 100m of natural drainage, or with direct discharge to a water body, should be considered high risk. In such instances, the Managing Director of Infrastructure may request a dechlorination

plan along with contingency and mitigation plans in the event that the chlorine residuals exceed those specified.

The Contractor may be permitted to discharge waste water into the sanitary collection system only upon approval of the Managing Director of Infrastructure Services. The Contractor will need to demonstrate that there are no other available options. The Managing Director of Infrastructure Services may direct the Contractor to de-chlorinate to a specified chlorine residual prior to discharge or limit the discharge rate to the sanitary collection system. The Contract Administrator will monitor the discharge of wastewater to ensure the chlorine residual and discharge limits are not exceeded.

The Managing Director of Infrastructure Services reserves the right to direct the Contractor to dispose of wasted water to a sanitary sewer with chlorine residual not to exceed a specified limit or discharge rate.

The Contractor shall flush every part of the water system including fire hydrant leads, stubs for future watermains and services to remove all super chlorinated water

C.16.9.6 .Chlorine Residual & Bacteriological Testing

C16.10 Procedure

Prior to the commencement of chlorination residual and bacteriological testing, the Contractor shall submit a sampling plan detailing the source water location, final connection locations and the sampling locations via the Contract Administrator to the Managing Director of Infrastructure Services for approval. The Contractor shall allow two (2) weeks for review and approval. Appropriate coding or labelling shall be provided on the plan to clearly correlate the sample results to the sampling locations.

Before the watermain can be approved for connection to the existing water distribution system, two (2) consecutive rounds of water samples, taken at least 24 hours apart, shall pass both the chlorine residual and bacteriological standards outlined below for consecutive samples. Prior to chlorine residual and bacteriological testing, all other testing (i.e. hydrostatic, disinfection) shall be completed and any super-chlorinated water removed from all portions of the watermain system under consideration including fire hydrant leads, stubs, branches, services, etc.

The watermain test section shall **not** be disturbed or flushed during the period between the 1st and 2nd sampling rounds, except to obtain a water sample.

The watermain shall be continually pressurized from the start of bacteriological testing until the final connection to the existing system is undertaken.

Only after the tested watermain has passed all chlorine residual and bacteriological requirements and has been approved to be put into service by the Managing Director of Infrastructure Services, shall the watermain be connected to the existing water distribution system.

After the completion of the final connection, the watermain shall be re-pressurized by the existing system as soon as possible.

The Managing Director of Infrastructure Services or the Contract Administrator may request additional bacteriological sampling after the final connection has been made as a precaution against or in response to possible contamination during the final connection.

C.16.10.1 Source Water

The water used to conduct the chlorine residual and bacteriological testing shall be normal to the existing water distribution system. In most cases, test water can be supplied by the adjacent existing distribution system; however if this source is not available, or the Contractor elects not to use, then potable water from an approved location within the existing water distribution system may be brought to the watermain under consideration at the Contractor's expense.

Should the Contractor elect to undertake a bacteriological sample of source water from the Township system, the sample must be taken from the new watermain side of the backflow preventer. In the event that this sample is adverse, the Township may undertake a sample to verify the results.

C.16.10.2 Sample Locations

Unless otherwise directed, chlorine residual and bacteriological testing samples shall be taken:

- At the end of each branch or stub (excluding fire hydrants)
- At the end of services 100 mm or larger
- A maximum of every 350 metres along the watermain test section
- A maximum of 150m from the source water connection
- Any additional locations as required to ensure that adequate chlorination is achieved (e.g. to ensure that both sides of a crescent are chlorinated)
- As identified in the Special Provisions
- As directed by the Contract Administrator
- As directed by the Managing Director of Infrastructure Services

Sampling of fire hydrant leads is not required unless the Contractor has elected or is requested to utilize a fire hydrant location to satisfy any of the above sampling location criteria. Regardless of whether fire hydrants are used for a sampling location, all fire hydrant leads shall be thoroughly flushed to remove debris and any super-chlorinated water.

In the event that the maximum distance criteria cannot be satisfied or if additional sampling points are required by the Township, the Contractor may be directed by the Township to install sampling taps on the watermain for the sole purpose of obtaining a water sample. During the completion of the or after the watermain has been commissioned the Contractor shall remove the sampling line and replace the main stop with a plug. Stainless steel plugs must be installed on saddles and brass plugs for ductile iron.

All sampling ports shall be copper or approved polyethylene lines 25 mm or smaller and brought a minimum of 1.0m above the surface. The Contractor shall be available to operate underground valves as necessary during sampling.

C.16.10.3 Chlorine Residual Requirements

At each sampling location, the water shall satisfy the chlorine residual requirements as follows:

Sampling Round 1:

The total chlorine residual in the sample shall be equal to the source water total chlorine residual plus or minus 0.2 mg/L; and,

The free chlorine residual shall be equal to or greater than 0.05 mg/L.

Sampling Round 2:

The total chlorine residual in the sample shall be no more than 0.2 mg/L above the source water total chlorine residual;

The total chlorine residual in the sample shall be no less than 50% of the source water total chlorine residual from day one; and;

The free chlorine residual shall be equal to or greater than 0.05 mg/L. .

A single failed chlorine residual parameter will constitute a failure of that entire sampling round, both chlorine residual and bacteriological and will necessitate the Contractor re-initiating Sampling Round 1 testing. The Contractor may elect to re-sample (chlorine and bacteriological) or take other corrective action to achieve two (2) consecutive rounds of acceptable chlorine residual and bacteriological results.

The chlorine readings shall be taken at the same time as the water sample for bacteriological testing is collected.

The source water chlorine residual readings, against which all sampled chlorine residual results are measured, are those chlorine residuals representative of the source water charged into the watermain for the intention of bacteriological testing. If the watermain is flushed to re-initiate another bacteriological testing protocol, new source water total and free chlorine residuals readings shall be taken. The source water chlorine residual readings (total and free) shall be taken within four (4) hours of charging the watermain for bacteriological testing.

In the event that the source water has a free chlorine residual less than 0.05 mg/L, the Managing Director of Infrastructure Services shall be notified immediately to take appropriate action.

Only Township licensed operators shall measure and report on chlorine residuals.

C.16.10.4 Bacteriological Requirements

At each sampling location, the water shall satisfy the bacteriological requirements as follows both Sampling Round 1 and 2:

E. Coli	A (Presence / Absence Test)
Total Coliform	A (Presence / Absence Test)
Background	<25 (Membrane Filtration)

Bacteriological samples shall be taken as outlined on the sampling plan. A single failed bacteriological parameter will constitute a failure of that entire sampling round and will necessitate the Contractor re-initiating Sampling Round 1 testing. The Contractor may elect to re-sample (chlorine and bacteriological) or take other corrective action to achieve two (2) consecutive rounds of acceptable bacteriological results. Corrective action for a failed water sample during the 3rd round (after the final connection has been made) will be addressed by the Contract Administrator in the consultation with the Managing Director of Infrastructure Services.

C.16.10.5 Laboratory Submissions

Costs associated with providing operations and or water may apply. The Developer/ Contractor is responsible for all analytical fees including the fees related to additional samples submitted due to failed results. .

Water samples for analysis will only be collected Monday to Thursday 7:00am to 200pm. Special arrangements may be made for submissions outside of the designated hours with prior approval of the Township.

The laboratory can only release results to the Township and will not discuss the results with the Contract Administrator or Contractor.

C.16.10.6 Custody Control

The Contract Administrator or their representative and contractor must witness all chlorine residual and bacteriological sampling. All water samples shall stay under the control of the Township's licensed operator until the samples are delivered to the laboratory.

The laboratory results will be provided to the Township. All sampling results shall be reviewed and approved by the Township before the new watermain can be approved for connection to the existing water distribution system. The Township will contact the Contract Administrator who in turn will relay the information to the Contractor.

C.16.10.7 Post Final Connection Bacteriological Testing

Contractors are advised that the Contract Administrator and/or the Managing Director of Infrastructure Services has the authority to request a third round of water samples for bacteriological analysis after the final connection has been made to the existing water distribution system to confirm the continued quality of the water within a period of two (2) working days. In the event that adverse water samples occur, the Managing Director of Infrastructure Services will direct the corrective actions to be taken. The Contractor shall cooperate and participate fully in the corrective actions at the Contractors expense.

In the event, the Contractor does not take appropriate measures to correct adverse water samples and/or at the discretion of the Managing Director of Infrastructure Services, the new system may be isolated from the municipal water system and the Contractor will be required to provide two (2) consecutive rounds of chlorine and bacteriological to the standards set out to commission the new water system.

The inspector must inform the Township if additional testing/flushing is required upon final connection (e.g. due to possible suspected contamination or unsanitary site).

C16.11 Final Connection to Existing Water System

C.16.11.1 Procedure

After the pressure, leakage, chlorine residual and bacteriological tests have passed; the Contractor shall obtain written approval from the Managing Director of Infrastructure Services to make the final watermain connection to the existing watermain distribution system.

If a temporary water system has been installed, it shall not be removed until after the Managing Director of Infrastructure Services has accepted the final connection of the new watermain to the existing municipal system and has authorized the removal of the temporary water system.

The Township shall be contacted two (2) full working days prior to the final connection.. The Contractor will be responsible for all costs for call outs of Township staff if the Contractor fails to notify the Township that the connection will not take place.

A Township licensed operator and the Contract Administrator shall be present to witness the entire final connection process of the new watermain to the existing water distribution systems.

Watermains shall be cut back to remove all temporary taps. The Contractor shall disinfect the connection watermain as outlined below and shall, using all means possible, dewater the watermains and trench in a controlled manner to not allow backflow into the watermains.

If trench water, dirt or debris has entered the watermain during the final connection the watermain shall be aggressively flushed and additional bacteriological samples shall be taken as directed by the Contract Administrator and/or the Managing Director of Infrastructure Services. Managing Director of Infrastructure Services reserves the right to request the above steps be taken regardless. Final connections must be made within 10 days of acceptable sample results.

All procedures must comply MOECC Watermain Disinfection Procedure and AWWA C651-05.

C.16.11.2 Connections Equal To or Less Than One Pipe Length

For a final connection length equal to or less than one pipe length, the new piping, fittings and valves required for the connection shall be spray-disinfected and swabbed with a minimum 1% and maximum 5% solution of chlorine just prior to being installed. The Contractor shall ensure that the workers undertaking the disinfection process thoroughly wash their hands with soap and use hygienic practices.

C.16.11.3 Connections Greater Than One Pipe Length

In the event that the final connection point of the new watermain to the existing watermain distribution system is in a location that requires a connection length greater than one pipe length, the new piping, fittings and valves required for the connection shall be assembled aboveground, disinfected and tested in accordance with MOECC Watermain Disinfection Procedure and AWWA 651. The connection piping shall satisfy the chlorine residual and bacteriological requirements outlined for new watermains.

The pre-assembled watermain connection shall be drip tight. Only after satisfactory chlorine residual and bacteriological results have been achieved, shall the pre-assembled connection be

installed. The pre-assembled watermain shall be maintained under pressure from the start of chlorine residual and bacteriological testing protocol until just prior to the installation. All caps shall be kept in place during the installation procedure until immediately prior to making the connection.

The Contractor shall not hand disinfect one pipe length at a time to circumvent the requirements to preassemble connection piping over one pipe length aboveground.

Should the Contractor find it necessary to deviate from the protocol as outlined above, the Contractor shall submit a Connection Plan to the Managing Director of Infrastructure Services for review and approval. The Contractor shall allow two weeks for review.

C.16.11.4 Tracer Wire

During the final connection of the new watermain to the existing distribution system, the Contractor shall insure that the new tracer wire is connected to the existing tracer wire.

C.16.11.5 Tracer Wire Conductivity Test

Prior to base asphalt or final grading, the Contractor shall demonstrate the integrity of the underground tracer wire by applying a conductivity signal and confirming the signal on all watermains and services. The Contract Administrator shall witness the conductivity test(s) and provide written confirmation to the Township. Upon completion of base asphalt, the Township will also conduct a conductivity test as confirmation.

The intent of this test is to confirm that the tracer wire has been installed on all non-metallic watermains and services as specified. Specifically, the test shall demonstrate the integrity and continuity of the tracer on all watermains and services.

A continuity signal shall be applied to the tracer wire and the signal confirmed over the entire length of all tracer wire installed. The signal shall be detectable for a distance of at least 300m from either side of the signal connection point. At no time shall there be a break in the continuity of the tracer wire.

It shall be demonstrated that the tracer wire on the services is connected to the watermain tracer wire and that the service tracer wire is intact for the length of the service (where applicable).Acceptable means of undertaking the conductivity test include using traditional locating techniques and/or determining if a low voltage electrical current travels from the connection point to test points.

C.16.11.6 Valve Positioning

The Contractor shall demonstrate that all valves, main line and service, are in the final positioning as outlined in the Contract Documents or as directed by the Contract Administrator.

C.16.11.7 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for commissioning of the water system shall be considered to be included within watermain installation.

C16.12 Material Handling

This shall include all loading, hauling, stringing, storing and handling of pipe, valves, fittings, or other material required for the construction of watermains.

C.16.12.1 Loading and Unloading

As per manufacturer's instructions.

C.16.12.2 Storing

As per manufacturer's instructions.

C.16.12.3 Measurement of Payment

The Contractor shall supply all materials, furnish all facilities for handling, and shall provide a suitable place for storage of all construction materials at no expense to the Township. All work prescribed in this article shall not be paid for directly, but shall be included as part of the unit prices for watermain construction unless otherwise provided for in the Contract Documents.

C.17 Standard Drawings

The following drawings are to be referred to in conjunction with this section.

C.17.1 Ontario Provincial Standard Drawings (OPSD)

The following OPSD's are to be referred to in conjunction with this section.

Title	**OPSD**
Pipe Bedding – Granular "A" Cover Material – Granular "A" or sand	802.010, 802.013 802.030, 802.033
Valve Chamber Frame and Grate • Standard • Watertight	 401.010 (Type "A") 401.030
Valve Chambers – Precast	Section 1100
Valve Chamber Steps	405.010 – Hollow Aluminum
Water Service	1104.010, 1104.020
Valve Box	1101.020
Hydrant Setting	1105.010
Trust Blocks	1103.010, 1103.020

D SANITARY SEWERS

All sanitary sewers shall be designed in such a manner and be of adequate size and depth to provide for the service of adjacent lands where so required by the Managing Director of Infrastructure Services. A lateral sewer connection from the sewer main to the edge of the road allowance shall be constructed for each property in the plan of subdivision.

All sanitary sewers, appurtenances and connections shall be guaranteed for a minimum period of two (2) years after initial inspection and acceptance of all underground services by the Township, but shall not be released from the maintenance period until the sewers have been inspected by video inspection and finally accepted by the Township.

Prior to commencement of the maintenance period for sanitary connections, invert elevations at the property line in table form shall be provided to Township.

D.1 Sanitary Design Guidelines to be reviewed by the Engineer

D.1.1 Pipework

D.1.1.1 Design Flow

The quantity of sewage flow for residential area shall be calculated on the following basis:

The design flow of sewage including infiltration

Allowance shall be made in the designed capacity of the sewer to provide for future sewage requirements

Flow data sheets and plans showing drainage area must accompany plan and profile submission

In accordance with MOE approval requirements

D.1.1.2 Flow Calculations

Sanitary sewer flows are to be determined using the following design criteria.

- **Residential**

  Average flow - 0.35 m3/c/d or 0.004 l/s/c

  Use actual or projected populations based on information (zoning or otherwise) to be provided by the Municipality

  Peak the average flow using the Harmon Formula

$$F = \frac{1 + 14}{4 + \sqrt{P}} \qquad (P = \text{Population}/1{,}000)$$

Daily domestic flows to be provided from municipal sanitary sewer master plans

- **Industrial**

  Average flow: 0.50 l/s/ha

  Use higher design flows for point sources known to have significantly greater flows than the average design allowance

  Use actual flows for large known discharges

  Use peaking factor as per MOE guidelines “Typical Industry Sewage Flow Peaking Factors”

- **Commercial**

  Average flow – Core =1.16 l/s/ha; Shopping Mall = 0.3 l/s/ha; General = 0.6 l/s/ha

  Use higher design flows for point sources known to have significantly greater flows than the average design allowance

  Use actual flows for large known discharges

  Peak using a factor of 2.5

- **Schools**

  In accordance with MOE Design Guidelines.

- **Other Miscellaneous Average Flow Rates**

In accordance with MOE Design Guidelines.

- **Infiltration**

  Add an infiltration allowance of 0.15 l/s/ha, or as directed by the Municipality.

Note: person Per Unit (ppu) densities are not to be used for sanitary flow calculations.

D.1.1.3 Design Flow Calculations

Design flow calculations for sanitary sewer systems shall be completed on Sanitary Sewer Design Sheets in accordance with MOE Design Guidelines and the MOE Pipe Data Form.

Note: trunk sewers to be designed to maximum 80% of full pipe capacity. Local sewers are not to be designed over 85% of full pipe capacity.

D.1.1.4 Minimum Pipe Size

In accordance with MOE Design Guidelines.

D.1.1.5 Manning’s “n”

The value of "n" using the Manning formula shall be 0.013 for all pipe materials.

D.1.1.6 Pipe Slope

The minimum gradient for the first reach of permanent dead end sewers shall be 1%.

For sewers other than the first reach of permanent dead end the minimum slope shall be 0.5%, unless otherwise approved by the Managing Director of Infrastructure Services.

D.1.1.7 Flow Velocities

In accordance with MOE Design Guidelines.

All sanitary sewers shall be designed to have a minimum flow velocity, when flowing full, of at least 0.8 m/s.

Velocities in sanitary sewers shall not be greater than 3 m/s.

D.1.1.8 Selection of Bedding and Class of Pipe – Rigid Pipe

Rigid sanitary sewer pipe is to be designed to withstand all earth loads, superimposed loads and hydraulic loads placed on it in accordance with methods provided by manufactures and suppliers such as the “Concrete Pipe Design Manual” produced by the Ontario Concrete Pipe Association (OPCA).

The 0.3 mm crack, three edge bearing strength shall be used as the design criteria as specified in the CSA standards on concrete pipe. For non-reinforced pipe, a factor of safety of 1.5 must be used.

Pipe strength design calculations are to be completed. The class of bedding type and pipe shall be noted on the plans. If transition width is not used for design, the design width of all trenches shall be specified on the construction drawings. In case the actual trench width exceeds the design width, it must be noted that the Contractor shall be responsible for the supply of additional bedding and/or stronger pipe.

D.1.1.9 Selection of Bedding and Class of Pipe – Flexible Pipe

Flexible sanitary sewer pipe shall be designed so as to accommodate external dead and live loading (i.e. Traffic, soil, ground water changes, frost actions, soil settlement, etc.) imposed on it in accordance with the criteria and methodology as outlined in the current version of the MOE Design Guidelines.

Pipe strength design calculations shall be completed and provided to the Managing Director of Infrastructure Services for review. Pipe and bedding type class shall be noted on the construction drawings.

D.1.1.10 Pipe Depth

The obvert shall be a minimum of 2.8 metres below the final road grade.

For depths over 5.0 m, a secondary collection system may be required and shall be approved by the Managing Director of Infrastructure Services.

D.1.1.11 Industrial Area Requirements

Vitrified clay pipe (VC) is not allowed in Industrial areas. The preferred pipe is Polyvinyl Chloride (PVC) however Polyethylene pipe (PE) can be used upon approval by the Director of Engineering Services.

D.1.2 Maintenance Holes

D.1.2.1 Structure

Maintenance holes 3000 mm and smaller shall be precast concrete.

D.1.2.2 Spacing

The maximum spacing for maintenance holes shall be as follows for the sewer diameters indicated:

- 200 mm to 450 mm — 90 m
- Larger than 450 mm to 900 mm — 120 m
- Larger than 900 mm — at approval of the Managing Director of Infrastructure Services

D.1.2.3 Size

The maintenance hole shall be sized to receive pipes as per Townships Standards. The minimum maintenance hole size is 1200 mm diameter.

D.1.2.4 Drop Inlet Structures

A drop inlet structure shall be provided in accordance with MOE Design Guidelines and OPSD 1003.01 (external); 1003.031 (internal). The use of external drop structures requires Township approval.

Note: MOE guideline applies for a difference of 0.6 m.

D.1.2.5 Safety Grates

For maintenance hole depths between 5.0 and 10.0 m, a safety grate must be installed at the mid-point. For maintenance hole depths between 10.0 and 15.0 m, a safety grate must be installed at the third points. Refer to OPSD 404.02.

D.1.2.6 Minimum Invert Drop

Where pipes enter and leave inline or at angles between 0° to 45°, the minimum drop from invert to invert across the maintenance hole shall be 0.030 m.

Where pipes enter and leave at angles of 45° to 90°, the minimum drop from invert to invert across the maintenance hole shall be 0.060 m.

D.1.2.7 Location

In accordance with MOE Design Guidelines.

D.1.2.8 Watertight Lids

Where there is a possibility for flooding, watertight lids shall be installed.

D.1.2.9 Flow Direction Changes

Changes in direction of flow through a maintenance hole greater than 90° will not be permitted.

In pipe sizes 675 mm or greater, a change in direction of flow through a maintenance hole greater than 45° shall not be permitted.

D.1.3 Services

All sanitary sewer connections shall be inspected and tested at the same time as the sanitary sewer mains. All abandoned services are to be capped at the main with a pre-manufactured end cap.

All sanitary sewer connections shall be guaranteed for a period of two (2) years. This guarantee period shall commence at the same time that the sanitary sewer mains are placed on Maintenance Guarantee.

D.1.3.1 Minimum Diameter

The minimum service size is 100 mm for residential and 150 mm for multi-residential, commercial, institutional and industrial.

D.1.3.2 Location

Services shall be installed perpendicular to the main wherever practical.

D.1.3.3 Slope

The minimum service slope is 2%.

The maximum service slope is 8%.

D.1.3.4 Depth

The sanitary service invert at property line shall be 2.5 m below the finished grade.

D.1.3.5 Connections to Maintenance Holes

Sanitary service connections to maintenance holes are permitted. If the invert of the service entering the maintenance hole is 0.60 m or more above the lowest invert, a drop pipe must be installed to direct flow to the main channel.

D.1.4 Curvilinear Sewers

Curvilinear sewers may be considered for sanitary sewers 600 mm diameter and larger.

D.1.4.1 Forcemains

Forcemains shall be designed by a Professional Engineer licensed in Ontario. Pipe strength, pressure rating and dimension ratio shall be determined through the completion of a transient analysis. The design of the forcemain shall also include the installation of pressure and vacuum

relief valves and forcemain flushing connections as recommended by the transient analysis completed by Professional Engineer. Isolation valves shall be as specified above. The forcemain shall be buried at a minimum depth of 2.0 m and shall be installed with tracer wire.

D.2 Geotechnical Report

A geotechnical report must be submitted to the Managing Director of Infrastructure Services as part of the design of the sanitary sewer system unless otherwise waived by the Managing Director of Infrastructure Services. Recommendations must be made regarding the sanitary sewer bedding, trench dewatering, and pipe selection.

The geotechnical report shall also include test results and recommendations for the use and/or disposal of adversely impacted soils, such as from sodium and petroleum products, in accordance with current regulations.

D.2.1 Soil Tests

Soil test borings shall be placed at intervals not exceeding seventy five (75.0 m) metres or as required by the Managing Director of Infrastructure Services and to a depth of not less than one and one half (1.5 m) metres below the deepest proposed structure, where applicable. If the depth of the proposed structure is unknown, then the soil test borings shall be completed to a depth no less than four and one half (4.5 m) metres below the proposed pavement grade. Soil classifications, moisture content, etc., shall be recorded and noted on the plans and profiles submitted for acceptance. Where poor or unstable soil conditions have been noted, additional borings shall be taken to establish the boundaries of this soil (on the street allowance).

In addition to samples taken for mechanical analysis, representative samples shall be obtained for California Bearing Ratio (CBR) tests.

On smaller projects a minimum of two mechanical analysis and two CBR tests will be required.

All tests shall be conducted by a recognized soils laboratory certified by the Canadian Council of Independent Labs (CCIL) and copies of such tests shall be submitted to the Township.

D.3 Easements

The Township requires 6.0 m or 2 times the depth (where depth is from the proposed final grade to the invert rounded up to the nearest half meter), whichever is the greater.

D.4 Material Specifications

The following outlines the supplementary specifications to be applied to the design and construction of Sanitary Sewer works for development in the Township.

D4.1 Sanitary Sewer Material Specification

D.4.1.1 Pipe Materials

Pipe materials for sanitary sewer mainline, fittings and service laterals shall be certified by CSA international or accredited by the Standard Council of Canada (SCC).

D.4.1.2 Concrete Sewer Pipe and Fittings

Circular concrete pipe and fittings shall conform to OPSS 1820 and shall be manufactured at a plant certified under the Ontario Concrete Plant Prequalification Program. Non reinforced concrete pipe shall be according to CSA A257.1. Reinforced concrete pipe shall be according to CSA A257.2. Precast reinforced concrete manhole shall be according the CSA A257.4.Joints and gaskets shall be according to CSA A257.3.

D.4.1.3 PVC Sewer Pipe and Fittings

Circular PVC pipe and fittings complete with bell and spigot joints, rubber gasket, lubricant and all other necessary appurtenances shall be manufactured in conformance with OPSS 1841 and shall be certified to CSA B182.2 for PVC Sewer Pipe and Fittings or CSA B182.4 for Profile PVC Sewer Pipe and Fittings. PVC pipe shall have a minimum pipe stiffness of 320 kPa.

D.4.1.4 HDPE Sewer Pipe and Fittings

Circular PE pipe and fittings complete with bell and spigot joints, rubber gasket, lubricant and all other necessary appurtenances shall be manufactured in accordance with OPSS 1840 using virgin resin and shall be certified to CSA B182.6 for Profile Polyethylene Sewer Pipe and Fittings. Circular PE pipe and fittings shall have a minimum pipe stiffness of 320 kPa and 100 kPa gasket joints.

D.4.1.5 Approved Sewer Pipe Materials to be reviewed by the Engineer

Type of Pipe	Specification	Diameter	Approved Use	Approved Manufacturer
Non-Reinforced Concrete	CSA A257.1 Extra Strength	200 mm to 250 mm	mainline	Hanson
Reinforced Concrete	CSA A257.2	300 mm and larger	mainline	Hanson, Concast, Coldstream, Munro, Hyprescon, M-Con, Rainbow
SDR 35 PVC	CSA B182.2, 320 kPa Stiffness	200 mm and larger	mainline	IPEX, Rehau, Royal
SDR 35 PVC	CSA B182.2, 320 kPa Stiffness	200 mm and larger	mainline	IPEX (Enviro-Tite)
SDR 28 PVC	CSA B182.2, 625 kPa Stiffness	100 mm and 150 mm	service laterals	IPEX, Rehau, Royal

Type of Pipe	Specification	Diameter	Approved Use	Approved Manufacturer
Profile Polyethylene	CSA B182.6 320 kPa Stiffness	100 mm and 150 mm	service laterals (requires approval from Township)	Armtec (Polytite)

The Township will not accept flexible pipe over 450 mm diameter.

D.4.1.6 Forcemain Material

Sanitary forcemain material shall be selected to suit the installation and system requirements and be pre-approved by the Township. Forcemain shall be white or purple in colour and under no circumstances shall the forcemain be blue in colour.

D.4.1.7 Cast Iron Maintenance Hole Lids

All new maintenance holes shall be fitted with self-adjusting manhole frame and cover from either East Jordan Iron Works (Product No. 00302202) or Bibby-Ste-Croix (Auto Stable C-50M-ONT) or approved equivalent. All covers shall be as per OPSD 401.010 Type A.

D.4.1.8 Maintenance Hole Adjustment Units

Concrete adjustment units shall be as per OPSS 407 and OPSD 704.01. Precast adjustment units shall be laid in a full bed of mortar with successive units being joined using sealant as recommended by the manufacturer. The minimum height for adjustment units is 150 mm and the maximum height for adjustment units is 300 mm.

Concrete brick and mortar shall not be used.

The Township will only accept concrete adjustment units conforming to OPSS 407.

D.4.1.9 Flexible Couplings

Flexible couplings shall be as supplied by Fernco or Mission.

D.4.1.10 Watertight Connectors to be reviewed by the Engineer

Watertight connectors shall be resilient connectors and applied to flexible pipe for sanitary sewers. Concrete sanitary sewers shall have resilient connectors.

All pipe to maintenance hole shall meet and or exceed ASTM C 923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manholes, Structures, Pipes and Laterals. All mechanical devices if employed, including castings, bolt assemblies shall use non-magnetic 300 series stainless steel with no welds or rivets in the sleeve or bolt assembly. Take up clamps shall use non-magnetic 304 series stainless steel. Plastic parts or components aren't allowed. Connector sizes 700 mm (28") and above shall employ multiple adjusters to better equalize the rubber and provide a uniform seal. The installation of the connector shall be accomplished at initial install and shall require no additional adjustments or installation at a later time to provide a watertight seal.

D.5 construction Specifications

This section provides direction on how sanitary sewers and their associated service connections and appurtenances are to be installed, commissioned and tested to meet the technical requirements of the Contract Documents and all applicable regulations and acts.

D5.1 Sanitary Sewer Construction Specifications

D.5.1.1 Ontario Provincial Standard Specifications

The sewer works shall be installed in accordance with Ontario Provincial Standard Specification 410 & 401 except as amended or extended herein.

D.5.1.2 Sewer Installation

This sub-section provides direction on the sewer installation operations that the Contractor is required to perform to meet the technical requirements of the Contract Documents.

D.5.1.3 Laying Tolerance

The allowable laying tolerance for inverts from that shown on the Construction Drawings for all sizes and at any point along the entire length of a sewer is as follows:

Horizontal:	25 mm
Vertical for slope less than or equal to 1%:	5 mm
Vertical for slope greater than 1%:	10 mm

Additionally, pipes shall be installed with no visible ponding.

D.5.1.4 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of sewers will be in accordance with the Ontario Provincial Standards.

D.5.1.5 Maintenance Hole Installation

This sub-section provides direction on the installation operations of maintenance holes that the Contractor is required to perform to meet the technical requirements of the Contract Documents

D.5.1.6 Maintenance Hole Lid Adjustment Tolerance

Maintenance hole frames and lids shall be adjusted so that when tested with a 3 m straight edge in any direction of the surface, the gap shall not exceed 7 mm between the bottom of the straight edge and the surface of the asphalt or frame and appurtenance.

The Township does not accept ring maintenance hole risers.

D.5.1.7 Adjustment Unit Parging

The inside to be parged only between the pre-cast and first moduloc as well as the last moduloc and the frame.

D.5.1.8 Maintenance Holes Connections

At new concrete maintenance holes, resilient connector shall be used to connect flexible pipe on sanitary sewers and services, and concrete brick and mortar used for connecting a concrete pipe to the concrete maintenance hole. Pipe shall be installed flush with the inside wall of the maintenance hole.

At existing maintenance holes, the opening shall be cored and the connection made as per a new maintenance hole or a sand collar connection.

Only concrete brick and appropriate mortar shall be used to fill void around concrete pipes. Clay bricks, stones and rubble shall not be used. The inside wall of the opening shall have a smooth mortar finish. Parging of brick and mortar connections shall be completed on the exterior of connections.

The Township requires parging on the inside of the watertight adaptors. The Managing Director of Infrastructure Services must approve any non Kor-N-Seal adapter.

Resilient connectors must be used for concrete trunk sanitary sewer connections.

D.5.1.9 Maintenance Hole Benching

All maintenance holes shall be benched up to springline in sanitary sewers. All benching shall slope up and away from the pipe at 8% slope.

D.5.1.10 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of maintenance holes and catchbasins will be in accordance with the Ontario Provincial Standards.

D.5.2 Service Connections

This sub-section provides direction on the installation of service connections that the Contractor is required to perform to meet the technical requirements of the contract specification.

D.5.2.1 Installation

Lateral service connections for sewers shall be installed in the locations specified on the drawings, in accordance with the Municipality's standard location, or as directed the Contract Administrator.

D.5.2.2 Minimum Pipe Length

Pipe for lateral service connections shall be installed in 4 metre minimum lengths with one cut off to terminate at the property line. The second last pipe shall be shortened to ensure that the last service pipe is not less than 1.2m in length.

D.5.2.3 Line and Grade

The line and grade of all lateral service connections shall be as specified on the drawings as provided by the Contract Administrator. In general all sewer lateral service connections to serve

private land shall be constructed at a 2% minimum and 8% maximum grade and 2.5m below finished grade at the property line unless otherwise specified

D.5.2.4 Mainline Connection

Service connections to the main pipe sewer shall be made using factory made tees or wyes. Wye connections to be installed with the direction of flow. For infill developments PVC strap-on-saddles complete with stainless gear clamps are required or approved equivalent.

D.5.2.5 Maintenance Hole Connections

Sanitary service connections to maintenance holes are permitted. All services connected to maintenance holes shall be resilient connectors. If the invert of the service entering the maintenance hole is 0.60m or more above the lowest invert, a drop pipe must be installed to direct flow to the main channel.

D.5.2.6 Caps

Watertight rubber gasket caps shall be installed in the ends of all lateral service connections. All caps shall be as specified by the pipe manufacturer to insure a watertight seal.

Plugs are not to be installed unless written approval is provided by the Managing Director of Infrastructure Services.

D.5.2.7 Markers

The ends of lateral service connections (and the location of caps) shall be marked by extending a 38 mm x 89 mm timber marker vertically from the cap to a height of 1 metre above finished ground level. The exposed end of these marker stakes shall be painted green for sanitary.

D.5.2.8 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of services and associated appurtenances will be in accordance with the Ontario Provincial Standards.

D.5.3 Commissioning

This sub-section provides information on the testing requirements and procedures to be followed by the Contractor to complete the commissioning of the sewer system.

D.5.3.1 General

In order for a sewer to be considered for acceptance by the Managing Director of Infrastructure Services, the following procedures and tests shall be successfully completed in the presence of the Contract Administrator:

- leakage
- visual inspection
- cleaning and flushing
- deflection
- CCTV Inspections

All field tests conducted in this subsection shall be performed in the presence of the Contract Administrator. Under no circumstance swabbing shall be completed on new sewer mains prior to CCTV. This is to ensure ponding is visible during CCTV inspection.

D.5.3.2 Leakage

All sewer shall be tested for "Exfiltration or Infiltration" to assure that all joints and manholes are properly installed in accordance to the latest OPSS 410 standard.

D.5.3.3 Visual Inspection

The sewers, maintenance holes and all related appurtenances shall be cleaned of all foreign material either by flushing, the use of cleaning buckets, by hand or by a combination of all three.

The sewers shall be inspected by the Contract Administrator for alignment and obstructions. Ponding in gravity sewers will not be accepted.

Regardless of the results of tests as hereinafter provided, all visible or detectable leaks in sanitary sewers shall be repaired by the Contractor as a prerequisite to acceptance of the sewers.

D.5.4 Cleaning and Flushing

D.5.4.1 Flushing

All sewer and maintenance holes must be flushed and cleaned prior to testing. Sewer sections shall be cleaned using a combination unit with a high velocity jet, approved by the Managing Director of Infrastructure Services. Contractors may obtain water from approved Municipal filling station.

The cleaning equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action in all sizes of pipe. The combination unit shall include a water tank, debris tank, suction mechanism and hydraulically driven hose reel.

Cleaning equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes by use of a vacuum system. The Contractor shall be required to make as many passes as necessary.

If cleaning of an entire section cannot be successfully performed from one manhole, it can be assumed an obstruction is present and cleaning efforts will cease and further investigations done.

D.5.4.2 Cleaning Precautions

During cleaning operations, satisfactory precautions shall be taken so that the water pressure created does not damage or cause flooding of public or private property. When possible, the flow of sewage in the sewer shall be utilized to aid in the cleaning process. In older sections of the Township, it may be necessary to reduce pressures to less than 7,000 kPa to prevent water damage to homes. A maximum pressure of 11,000 kPa will be used to prevent damage to the sewer lines. The Contractor is responsible for any flooding caused by his flushing operation and must respond immediately to any complaints received.

D.5.4.3 Material Removal

Debris such as dirt, sand, rocks, grease and other solid or semi-solid material, which is a result of cleaning, shall be removed at the downstream manhole of the section being cleaned. The Contractor shall plug, bag and/or screen the sewer at the outlet to prevent materials from being flushed into downstream reaches. Passing material from manhole to manhole shall not be permitted due to the risk of a line plugging. This material shall be removed. At the end of each day back flush the last section of sewer cleaned to ensure no build-up of debris has occurred.

D.5.4.4 Disposal of Material

The Contractor shall make provision to properly dispose of all debris in accordance with all provincial legislation and MOE guidelines.

D.5.4.5 Re-Inspection

If in the opinion of the Contract Administrator, it is determined that re-inspection is required as a result of inadequate cleaning, the Contractor shall re-clean and re-inspect the sewer at no additional cost to the Municipality.

D.5.5 Deflection

A mandrel test shall be performed on all flexible pipe sewer mains, forcemains and catchbasin leads in accordance to the latest OPSS 410 standard.

D.5.6 CCTV Inspections

D.5.6.1 General

Inspections shall be carried out by the Contractor using television cameras and video recording equipment as specified in OPSS 409. A continuous record of the internal condition of the piping system shall be provided in digital format as specified by the Municipality. Video recording of all sewers will be required at the follow three intervals:

1. Prior to Preliminary Acceptance (after base asphalt and curb is placed)
2. Prior to surface asphalt
3. Prior to Final Acceptance of development

D.5.6.2 Acceptance

Acceptance of sewer line cleaning shall be made upon the successful completion of the **television inspection and shall be to the satisfaction of the Contract Administrator. If CCTV** inspections show the cleaning to be unacceptable, the Contractor is required to re-clean and re-inspect the sewer until accepted by the Contract Administrator.

D.5.6.3 Flow Control and By-Pass Pumping

When interruptions of sewer section flows are necessary to effectively conduct inspections, the Contractor shall, subject to the approval of the Managing Director of Infrastructure Services, control flows using plugging and blocking methods.

The Managing Director of Infrastructure Services reserves the right, when necessary, to request bypassing and dewatering of a sewer to be inspected to ensure that the full diameter of pipe is visible.

The contractor will be responsible for any damage to public or private property resulting from the bypass operation or lack thereof. This operation may be requested when the flow depth covers the entire lens for approximately 35% of the line.

A sewer line plug shall be inserted into the line at a manhole upstream from the section to be inspected. The plug shall be designed so that all or any portion of the sewage flows can be released during the inspection. Flows shall be reduced in order to inspect the pipe invert. Sewage levels upstream of the plugged section **shall be monitored at all times**. After the work is completed, flows shall be restored to normal.

If a By-Pass is required the contractor will submit a plan for review and approval by the Township.

D.5.6.4 Measurement and Payment

Unless otherwise provided for in the Contract Documents or the Ontario Provincial Standards, measurement and payment for the commissioning of the sewer system shall be considered to be included within sewer installation

D.5.6.5 Inspection and Testing

"The following inspection and testing work shall be carried out during and after construction of services.

i) "Sieve Analysis" of the pipe bedding material to assure that the material meets the latest OPSS 802.010 & 802.013 standard. Representative samples are to be obtained by the Consultant prior to and during construction operations.

ii) "Density Tests" shall be performed to assure that the pipe bedding material has been compacted properly.

iii) "Density Tests" shall be performed on the backfill material to ensure proper compaction.

vi) Full time inspection of all work during construction.

vi). Physical/Visual inspection of all work after construction to ensure all defects are rectified prior to the Township’s inspections. The consultant's inspector is responsible for the following: To bring the general site servicing drawing and/or the as recorded drawings to the inspection; to provide all labour and equipment to assist Township staff during the inspection and to ensure all structures have been pre-inspected and all imperfect work has been rectified by the contractor. Failure to comply with any of the above will result in cancellation of the inspection and a charge to the Developer.

D.6 Low Pressure Sewer (LPS)

Contact the Township for specifications required for the LPS.

D.7 Sewage Pumping Stations (SPS)

Contact the Township for specifications required for SPS.

D.8 Standard Drawings

The following drawings are to be referred to in conjunction with this section.

D.8.1 Ontario Provincial Standard Drawings (OPSD)

The following OPSD's are to be referred to in conjunction with this section.

Title	**OPSD**
Pipe Bedding – Granular "A" Cover Material – Granular "A" or sand	802.010, 802.013 802.030, 802.033
Manhole Frame and Grate • Standard • Watertight	 401.010 (Type "A") 401.030
Manholes – Precast	Section 700
Manhole Benching	701.0210
Manhole Steps	405.010 – Hollow Aluminum
Safety Platform – Aluminum	404.02
Internal Drop Structure for Existing Manhole	1003.030
Internal Drop Structure for New Manholes	1003.031
Sewer Service Connections	1006.010

E STORM SEWERS

Storm sewers designed and constructed in accordance with the most recently revised specifications of the Township shall be required on every street within all plans of residential subdivision. All storm sewers shall be designed in such a manner and be of adequate size and depth to provide for the development of lands lying upstream within the watershed and/or to provide for the drainage of such areas as may be designated by the Managing Director of Infrastructure Services. All storm drainage shall be conducted to an outlet considered adequate in the opinion of the Managing Director of Infrastructure Services.

Any channel improvements, bridges, culverts and all other drainage structures or improvements shall be designed and constructed in accordance with the specifications and to the approval of the Managing Director of Infrastructure Services.

All storm sewers, appurtenances and connections shall be guaranteed for a minimum period of two (2) years after initial inspection and acceptance of all underground services by the Township, but shall not be released from the maintenance period until the sewers have been inspected and finally accepted by the Township.

Prior to commencement of the maintenance period for storm connections, invert elevations at the property line in table form must be provided to Township.

E.1 Design Guidelines To be reviewed by the Engineer

E.1.1 Storm Design Guidelines

E.1.1.1 General – Sarah to Refer to DGSSMS

E.1.1.2 Pipework

E.1.1.3 Design Flow Calculations

Trunk sewers to be designed to maximum 80% of full pipe capacity. Local sewers are not to be designed over 85% of full pipe capacity.

E.1.1.4 Rainfall Intensity

Refer to Table X of Section X for rainfall intensity data.

E.1.1.5 Minimum Pipe Size

E.1.1.6 Manning's "n"

Refer to Table X, Section X for Manning's n values.

E.1.1.7 Pipe Slope

The minimum slope for the first reach of permanent dead end sewer shall be 1%, where connecting into existing infrastructure. For sewers other than the first permanent dead end reach, use Ministry of the Environment and Climate Control Design Guidelines.

E.1.1.8 Flow Velocities

All storm sewers shall be designed to have a minimum flow velocity, when flowing full, of at least 0.8 m/s.

Velocities in storm sewers shall not be greater than 6 m/s.

E.1.1.9 Selection of Bedding and Class of Pipe – Rigid Pipe

Rigid storm sewer pipe is to be designed to withstand all earth loads, superimposed loads and hydraulic loads placed on it in accordance with methods provided by manufactures and suppliers such as the “Concrete Pipe Design Manual” produced by the Ontario Concrete Pipe Association (OPCA).

The 0.3 mm crack, three edge bearing strength should be used as the design criteria as specified in the CSA standards on concrete pipe. For non-reinforced pipe, a factor of safety of 1.5 must be used.

Pipe strength design calculations are to be completed. The class of bedding type and pipe shall be noted on the plans. If transition width is not used for design, the design width of all trenches shall be specified on the construction drawings. In case the actual trench width exceeds the design width, it must be noted that the Contractor shall be responsible for the supply of additional bedding and/or stronger pipe.

E.1.1.10 Selection of Bedding and Class of Pipe – Flexible Pipe

Flexible storm sewer pipe shall be designed so as to accommodate external dead and live loading (i.e. Traffic, soil, ground water changes, frost actions, soil settlement, etc.) imposed on it in accordance with the criteria and methodology as outlined in the current version of the MOE. Design Guidelines.

Pipe strength design calculations shall be completed and provided to the Managing Director of Infrastructure Services for review. Pipe and bedding type class shall be noted on the construction drawings.

E.1.1.11 Pipe Depth

The obvert shall be a minimum of 1.5 m below the final road grade for new sewers and a desirable depth of 1.5 m for reconstruction projects.

E.1.1.12 Curvilinear Sewers

Curvilinear sewers may be considered for storm sewers 600 mm diameter and larger only upon the written approval of the Managing Director of Infrastructure Services

E.1.1.13 Elliptical Sewers

Elliptical Pipe may be utilized for clearance and/or cover purposes.

E.1.1.14 Blind Connections

Blind connections using factory made tees are permitted for:

- Storm Sewers greater then 900mm

These requirements do not apply to rear yard catchbasins. A catchbasin maintenance hole shall be installed for rear yard catchbasins.

E.1.1.15 Safety/Rodent Grates

Manufactured safety / rodent grates are required on open inlets and outlets 200 mm and larger, except in driveway culverts.

E.1.1.16 Head Walls To be reviewed by the Engineer

Head walls shall be used for 525 mm diameter and larger sewers, permanent pool or submerged conditions.

For outlets 450 mm diameter and smaller or driveway culverts, use OPSD 801.020

For outlets 525 mm diameter to 900 mm diameter, use OPSD 804.03 or OPSD 804.04.

For outlets greater than 900 mm in diameter, use OPSD 804.04.

A handrail as per OPSD 980.101 shall be installed around headwalls 0.6 m or larger in height.

E1.2 Maintenance Holes

E.1.2.1 Structure

Maintenance holes 3000 mm and smaller shall be precast concrete.

E.1.2.2 Spacing

Where required, the maximum spacing for maintenance holes shall be as follows for the sewer diameters indicated:

300 mm to 900 mm	90 m
Larger than 900 mm and smaller than 1350 mm	120 m
1350 mm and larger	at approval of the Managing Director of Infrastructure Services.

E.1.2.3 Size

The maintenance hole shall be sized adequately to receive pipes as per Townships Standards. The minimum maintenance hole size is 1200 mm diameter.

E.1.2.4 Drop Inlet Structures

A drop inlet structure shall be provided in accordance with MOE Design Guidelines and OPSD 1003.01 (external); 1003.031 (internal). The use of external drop structures requires Township approval.

Note: MOE guideline applies for a difference of 0.6 m.

E.1.2.5 Location

In accordance with MOE Design Guidelines.

E.1.2.6 Safety Grates

For maintenance hole depths between 5.0 and 10.0 m, a safety grate must be installed at the mid-point. For maintenance hole depths between 10.0 and 15.0 m, a safety grate must be installed at the third points. Refer to OPSD 404.02.

E.1.2.7 Minimum Invert Drop

Where pipes enter and leave in line, the drop from invert to invert across the maintenance hole shall be a minimum of the slope of the upstream pipe.

Where pipes enter and leave at angles deflected 0° to 45°, the minimum drop from invert to invert across the maintenance hole shall be 0.030 m.

Where pipes enter and leave at angles deflected 45° to 90°, the minimum drop from invert to invert across the maintenance hole shall be 0.060 m.

E.1.2.8 Flow Direction Changes

Changes in direction of flow through a maintenance hole greater than 90° will not be permitted.

In pipe sizes of 675 mm or greater, a change in direction of flow through a maintenance hole shall not be greater than 45°.

E.1.3 Catchbasins

E.1.3.1 Minimum Lead Size

The minimum lead size diameter shall be:

- Double Catchbasin Lead: 300 mm
- Single Catchbasin Lead: 250 mm

E.1.3.2 Spacing

The maximum spacing between catchbasins or highpoint to first catchbasin shall be:

Road Type	**Road Grade**		
	< 3%	3% to 5%	>5%
For two (2) lane roads	90m	75m	60m
For four (4) lane roads	75m	60m	60m

The Engineer shall ensure that the catchbasin spacing and casting cover is adequate to collect the storm water.

E.1.3.3 Intersection Location

Catchbasins shall be located on the upstream side of all intersections where the road grade falls towards the intersection

E.1.3.4 Flow Direction Changes

Horizontal bends are to be avoided.

E.1.3.5 Double Catchbasin

Double catchbasins are required at all low points, when water is collected from two directions. A single catchbasin may be considered if the total aggregate spacing to the adjacent catchbasins is less than the maximum spacing allowable, as noted above.

E.1.3.6 Side Inlet Catchbasin

The Township requires side inlet catchbasins unless otherwise approved.

E.1.3.7 Sub-drains

Township requires continuous sub drain along curb on all projects. The minimum size is 150mm dia. unless specified otherwise by geotechnical engineer.

E.1.3.8 Slotted Drain Pipe

Use of slotted drain pipe must be approved by the Managing Director of Infrastructure Services.

E.1.3.9 Rear Yard Drainage

A maintenance hole is required on the main line for the connection of a rear yard catchbasin lead, regardless of the lead size.

Surface inlets (catchbasin or inlet basin) are required every 2 units (townhouse or singles) along rear lot line swales. Singles will require full catchbasins for all structures. Townhouses require a catchbasin at the lead from the road but inlet basins can be used thereafter.

Sewer from the road to the rear yard (i.e. on sideyard) is to be 300 mm concrete o/s 0.5 m from lot line situated on a 3 m easement divided equally on side lot line.

Sewers across the rear lot line to be 1 m off the lot line on a 3 m easement entirely on one lot.

Sewers along the rear lot lines of townhouses are to be minimum 200 mm. Where the number of upstream inlets basins exceeds 2, the pipe size is to be increased to 250 mm. These sewers along the rear can be plastic if desired.

Sewers along the rear lot lines of singles are to be minimum 250 mm. Where the number of upstream catchbasins exceeds 1, the pipe size is to be increased to 300 mm. These sewers along the rear can be plastic if desired.

E.1.3.10 Frames and Grates

Catchbasin frames and grates shall conform to the Townships Standards.

E.2 Services

E.2.1 Minimum Diameter

Single storm sewer services, a minimum of 100 mm in diameter, shall be provided for each dwelling unit in a residential subdivision.

E.2.2 Location

Services shall be installed perpendicular to the main wherever practical.

E.2.3 Slope

The minimum service slope is 2%
The maximum service slope is 8%

E.2.4 Flow Direction Changes

Horizontal bends are to be avoided.

E.2.5 Depth

The storm service invert at property line shall be 1.2 m below the finished grade

E.3 Geotechnical Report

A geotechnical report must be submitted to the Managing Director of Infrastructure Services as part of the design of the storm sewer system unless otherwise waived by the Managing Director of Infrastructure Services. Recommendations must be made regarding the storm sewer bedding, trench dewatering, and pipe selection.

The geotechnical report shall also include test results and recommendations for the use and/or disposal of adversely impacted soils, such as from sodium and petroleum products, in accordance with current regulations.

E.3.1 Soil Tests

Soil test borings shall be placed at intervals not exceeding seventy five (75.0 m) metres or as required by the Managing Director of Infrastructure Services and to a depth of not less than one and one half (1.5 m) metres below the deepest proposed structure, where applicable. If the depth of the proposed structure is unknown, then the soil test borings shall be completed to a depth no less than four and one half (4.5 m) metres below the proposed pavement grade. Soil classifications, moisture content, etc., shall be recorded and noted on the plans and profiles submitted. Where poor or unstable soil conditions have been noted, additional borings shall be taken to establish the boundaries of this soil (on the street allowance).

In addition to samples taken for mechanical analysis, representative samples shall be obtained for California Bearing Ratio (CBR) tests.

On smaller projects a minimum of two mechanical analysis and two CBR tests will be required.

All tests shall be conducted by a recognized soils laboratory certified by the Canadian Council of Independent Labs (CCIL) and copies of such tests shall be submitted to the Township.

E.4 Open Ditch and Culvert Design

The minimum allowable culvert size shall be 450 mm in diameter.

E.5 Easements

The Township requires 6.0m or 2 times the depth (where depth is from the proposed final grade to the invert rounded up to the nearest half meter), whichever is the greater.

E.6 Material Specifications

The following outlines the supplementary specifications to be applied to the design and construction of Storm Sewer works for development in the Township.

E.7 Storm Sewer Material Specifications

E.7.1 Pipe Materials

Pipe materials for storm sewer mainline, fittings and service laterals shall be certified by CSA international or accredited by the Standard Council of Canada (SCC).

E.7.2 Concrete Sewer Pipe and Fittings

Circular concrete pipe and fittings shall conform to OPSS 1820 and shall be manufactured at a plant certified under the Ontario Concrete Plant Prequalification Program. Non reinforced concrete pipe shall be according to CSA A257.1. Reinforced concrete pipe shall be according to CSA A257.2. Precast reinforced concrete manhole shall be according the CSA A257.4.Joints and gaskets shall be according to CSA A257.3.

E.7.3 PVC Sewer Pipe and Fittings

Circular PVC pipe and fittings complete with bell and spigot joints, rubber gasket, lubricant and all other necessary appurtenances shall be manufactured in conformance with OPSS 1841 and shall be certified to CSA B182.2 for PVC Sewer Pipe and Fittings or CSA B182.4 for Profile PVC Sewer Pipe and Fittings. PVC pipe shall have a minimum pipe stiffness of 320 kPa.

E.7.4 HDPE Sewer Pipe and Fittings

Circular profile PE pipe shall be complete with bell and spigot joints, rubber gasket, lubricant and all other necessary appurtenances and shall meet the requirements of OPSS 1840 (latest revision) and be manufactured in accordance with CSA B182.8 Profile Polyethylene Storm Sewer and Drainage Pipe and Fittings (latest revision) using virgin resin and shall be certified to this standard by a product certification body accredited by the Standards Council of Canada (SCC). Circular profile PE pipe shall have a minimum pipe stiffness of 320 kPa and 74 kPa water tight gasket joints (Type 1). All fittings used for PE installation shall be PVC quality and certified to either CSA B182.2 for PVC Sewer Pipe and Fittings or CSA B182.4 for Profile PVC Sewer Pipe and Fittings. PVC pipe shall have a minimum pipe stiffness of 320 kPa.

E.7.5 Approved Sewer Pipe Materials To be reviewed by the Engineer

Type of Pipe	Specification	Diameter	Approved Use	Approved Manufacturer
Concrete	CSA A257.1 Extra Strength	250 mm to 300 mm	catchbasin lead and service connections	Hanson
		200 mm to 300 mm	service connections	Hanson
Concrete	CSA A257.2 Reinforced	300 mm and larger	mainline and service connections	Hanson, Concast, Coldstream, Munro, Hyprescon, M-Con, Rainbow
SDR 35 PVC	CSA B182.2 – 320 kPa Stiffness	200 mm and larger	Mainline, catchbasin lead and service connections	IPEX, Rehau, Royal
SDR 28 PVC	CSA B182.2 - 625 kPa Stiffness	100 mm	service connections	IPEX, Rehau, Royal
SDR 28 PVC	CSA B182.2 - 625 kPa Stiffness	100 mm	service connections	IPEX (Enviro-Tite)
Profile HDPE	CSA 182.8 – 320 kPa stiffness watertight gasket min 75 kPa, PVC fittings to be used	300 mm min. (See Note below)	Mainline	ADS Hancor
Profile PVC 1	CSA B182.4 – 320 kPa Stiffness	200 mm and larger	service connections main line only?	IPEX, Rehau, Royal
		250 mm and larger	mainline and catchbasin lead main line only	IPEX, Rehau, Royal
Profile HDPE	CSA B182.6 320 kPa Stiffness	200 mm and larger	service connections	Armtec (Polytite) Ideal Challenger 3000

Type of Pipe	Specification	Diameter	Approved Use	Approved Manufacturer
		250 mm and larger	mainline and catchbasin lead	Armtec (Polytite) Ideal Challenger 3000

The Township will not accept flexible pipe over 375 mm diameter.

The **City of Kitchener, City of Waterloo** and the **Township of Wilmot**, and **Township of Woolwich** does **not** accept Profile PVC pipe (CSA 182.4). **To be reviewed by the Engineer**

E.7.6 Cast Iron Maintenance Hole Lids

All new maintenance holes shall be fitted with self-adjusting manhole frame and cover from either East Jordan Iron Works (Product No. 00302202) or Bibby-Ste-Croix (Auto Stable C-50M-ONT) or approved equivalent. All covers shall be as per OPSD 401.010 Type B.

E.7.7 Cast Iron Catchbasin Frames and Grates

Cast iron catchbasin frames and grates shall conform to OPSS 1850 and shall be manufactured by Bibby, East Jordan or Star. Catchbasin frames and grates shall be as per:

- OPSD 400.082 when installed in side inlet
- OPSD 400.110 when installed as a standard catchbasin
- OPSD 400.10 when installed in parking lots
- OPSD 400.120 when installed in rear yards

E.7.8 Maintenance Hole and Catchbasin Adjustment Units

Concrete adjustment units shall be as per OPSS 407 and OPSD 704.01. Precast adjustment units shall be laid in a full bed of mortar with successive units being joined using sealant as recommended by the manufacturer. The minimum height for adjustment units is 150 mm and the maximum height for adjustment units is 300 mm.

E.7.9 Slotted Pipe Drain

Use of slotted drain pipe must be approved by the Managing Director of Infrastructure Services.

E.7.10 Flexible Couplings

Flexible couplings shall be as supplied by Fernco or Mission.

E.7.11 Watertight Connectors To be reviewed by the Engineer

Watertight connectors shall be resilient connectors and applied to flexible pipe for sanitary and storm sewers. Concrete sanitary sewers shall have resilient connectors.

All pipe to maintenance hole shall meet and or exceed ASTM C 923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manholes, Structures, Pipes and Laterals. All mechanical devices if employed, including castings, bolt assemblies shall use non-magnetic

300 series stainless steel with no welds or rivets in the sleeve or bolt assembly. Take up clamps shall use non-magnetic 304 series stainless steel. Plastic parts or components aren't allowed. Connector sizes 700 mm (28") and above shall employ multiple adjusters to better equalize the rubber and provide a uniform seal. The installation of the connector shall be accomplished at initial install and shall require no additional adjustments or installation at a later time to provide a watertight seal.

E.8 Construction Specifications

This section provides direction on how storm sewers and their associated service connections and appurtenances are to be installed, commissioned and tested to meet the technical requirements of the Contract Documents and all applicable regulations and acts.

E.9 Storm Sewer Construction Specifications

E.9.1 Ontario Provincial Standard Specifications

The sewer works shall be installed in accordance with Ontario Provincial Standard Specification 410 & 401 except as amended or extended herein.

E.19.2 Sewer Installation

This sub-section provides direction on the sewer installation operations that the Contractor is required to perform to meet the technical requirements of the Contract Documents.

E.9.3 Laying Tolerance

The allowable laying tolerance for inverts from that shown on the Construction Drawings for all sizes and at any point along the entire length of a sewer is as follows:

Horizontal:	25 mm
Vertical for slope less than or equal to 1%:	5 mm
Vertical for slope greater than 1%:	10 mm

Additionally, pipes shall be installed with no visible ponding.

E.9.4 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of sewers will be in accordance with the Ontario Provincial Standards.

E.10 Maintenance Hole and Catchbasin Installation

This sub-section provides direction on the installation operations of maintenance holes that the Contractor is required to perform to meet the technical requirements of the Contract Documents

E.10.1 Maintenance Hole Lid Adjustment Tolerance

Maintenance hole frames and lids shall be adjusted so that when tested with a 3 m straight edge in any direction of the surface, the gap shall not exceed 7 mm between the bottom of the straight edge and the surface of the asphalt or frame and appurtenance.

The Township does not accept ring maintenance hole risers.

E.10.2 Adjustment Unit Parging

The inside to be parged only between the pre-cast and first moduloc as well as the last moduloc and the frame.

E.10.3 Maintenance Holes Connections

At new concrete maintenance holes, resilient connector shall be used to connect flexible pipe on storm sewers and services, and concrete brick and mortar used for connecting a concrete pipe to the concrete maintenance hole. Pipe shall be installed flush with the inside wall of the maintenance hole.

At existing maintenance holes, the opening shall be cored and the connection made as per a new maintenance hole or a sand collar connection.

Only concrete brick and appropriate mortar shall be used to fill void around concrete pipes. Clay bricks, stones and rubble shall not be used. The inside wall of the opening shall have a smooth mortar finish. Parging of brick and mortar connections shall be completed on the exterior of connections.

The Township requires parging on the inside of the watertight adaptors. The Managing Director of Infrastructure Services must approve any non Kor-N-Seal adapter.

Resilient connectors must be used for concrete trunk sanitary sewer connections.

E.10.4

All maintenance holes shall be benched up to springline in storm sewers and ¾ of the pipe height in storm sewers regardless of the pipe size. All benching shall slope up and away from the pipe at 8% slope. Storm sewer maintenance holes shall not be pre-benched by the manufacturer. Benching maintenance holes must be completed during construction on site.

All catchbasin maintenance holes regardless of outlet pipe size shall be installed with a 600 mm sump.

E.10.5 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of maintenance holes and catchbasins will be in accordance with the Ontario Provincial Standards.

E.11 Service Connections

This sub-section provides direction on the installation of service connections that the Contractor is required to perform to meet the technical requirements of the contract specification.

E11.1 Minimum Pipe Length

Pipe for lateral service connections shall be installed in 4 metre minimum lengths with one cut off to terminate at the property line. The second last pipe shall be shortened to ensure that the last service pipe is not less than 1.2m in length.

E11.2 Line and Grade

The line and grade of all lateral service connections shall be as specified on the drawings as provided by the Contract Administrator. In general all storm lateral service connections to serve

private land shall be constructed at a 2% minimum and 8% maximum grade and 1.2m below finished grade at the property line unless otherwise specified

E11.3 Mainline Connection

Service connections to the main pipe sewer shall be made using factory made tees or wyes. Wye connections to be installed with the direction of flow For infill developments PVC strap-on-saddles complete with stainless gear clamps are required or approved equivalent.

E11.4 Maintenance Hole Connections

Storm service connections to maintenance holes are permitted. All services connected to maintenance holes shall be resilient connectors. If the invert of the service entering the maintenance hole is 0.60m or more above the lowest invert, a drop pipe must be installed to direct flow to the main channel.

E11.5 Caps

Watertight rubber gasket caps shall be installed in the ends of all lateral service connections. All caps shall be as specified by the pipe manufacturer to insure a watertight seal.

Plugs are not to be installed unless written approval is provided by the Managing Director of Infrastructure Services.

E11.6 Markers

The ends of lateral service connections (and the location of caps) shall be marked by extending a 38 mm x 89 mm timber marker vertically from the cap to a height of 1 metre above finished ground level. The exposed end of these marker stakes shall be painted white for storm.

E11.7 Measurement and Payment

Unless otherwise provided for in the Contract Documents, measurement and payment for the installation of services and associated appurtenances will be in accordance with the Ontario Provincial Standards.

E12 Commissioning

This sub-section provides information on the testing requirements and procedures to be followed by the Contractor to complete the commissioning of the sewer system.

E.12.1 General

In order for a sewer to be considered for acceptance by the Managing Director of Infrastructure Services, the following procedures and tests shall be successfully completed in the presence of the Contract Administrator:

- leakage
- visual inspection
- cleaning and flushing
- deflection
- CCTV Inspections

All field tests conducted in this subsection shall be performed in the presence of the Contract Administrator. Under no circumstance swabbing shall be completed on new sewer mains prior to CCTV. This is to ensure ponding is visible during CCTV inspection.

E.12.2 Leakage

All sewer shall be tested for "Exfiltration or Infiltration" to assure that all joints and manholes are properly installed in accordance to the latest OPSS 410 standard.

E.12.3 Visual Inspection

The sewers, maintenance holes and all related appurtenances shall be cleaned of all foreign material either by flushing, the use of cleaning buckets, by hand or by a combination of all three.

The sewers shall be inspected by the Contract Administrator for alignment and obstructions. Ponding in gravity sewers will not be accepted.

Regardless of the results of tests as hereinafter provided, all visible or detectable leaks in storm sewers shall be repaired by the Contractor as a prerequisite to acceptance of the sewers.

E.13 Cleaning and Flushing

E.13.1 Flushing

All sewer and maintenance holes must be flushed and cleaned prior to testing. Sewer sections shall be cleaned using a combination unit with a high velocity jet, approved by the Managing Director of Infrastructure Services. Contractors may obtain water from approved Municipal filling station.

The cleaning equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action in all sizes of pipe. The combination unit shall include a water tank, debris tank, suction mechanism and hydraulically driven hose reel.

Cleaning equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes by use of a vacuum system. The Contractor shall be required to make as many passes as necessary.

If cleaning of an entire section cannot be successfully performed from one manhole, it can be assumed an obstruction is present and cleaning efforts will cease and further investigations done.

E13.2 Cleaning Precautions

During cleaning operations, satisfactory precautions shall be taken so that the water pressure created does not damage or cause flooding of public or private property. In older sections of the Township, it may be necessary to reduce pressures to less than 7,000 kPa to prevent water damage to homes. A maximum pressure of 11,000 kPa will be used to prevent damage to the sewer lines. The Contractor is responsible for any flooding caused by his flushing operation and must respond immediately to any complaints received.

E.13.3 Material Removal

Debris such as dirt, sand, rocks, grease and other solid or semi-solid material, which is a result of cleaning, shall be removed at the downstream manhole of the section being cleaned. The Contractor shall plug, bag and/or screen the sewer at the outlet to prevent materials from being flushed into downstream reaches. Passing material from manhole to manhole shall not be permitted due to the risk of a line plugging. This material shall be removed. At the end of each day back flush the last section of sewer cleaned to ensure no build-up of debris has occurred.

E.13.4 Disposal of Material

The Contractor shall make provision to properly dispose of all debris in accordance with all provincial legislation and MOE guidelines.

E.13.5 Re-Inspection

If in the opinion of the Contract Administrator, it is determined that re-inspection is required as a result of inadequate cleaning, the Contractor shall re-clean and re-inspect the sewer at no additional cost to the Municipality.

E.13.6 Deflection

A mandrel test shall be performed on all flexible pipe sewer mains, forcemains and catchbasin leads in accordance to the latest OPSS 410 standard.

E.14 CCTV Inspections

E.14.1 General

Inspections shall be carried out by the Contractor using television cameras and video recording equipment as specified in OPSS 409. A continuous record of the internal condition of the piping system shall be provided in digital format as specified by the Municipality. Video recording of all sewers will be required at the follow three intervals:

- Prior to Preliminary Acceptance (after base asphalt and curb is placed)
- Prior to surface asphalt
- Prior to Final Acceptance of development

E.14.2 Acceptance

Acceptance of sewer line cleaning shall be made upon the successful completion of the **television inspection and shall be to the satisfaction of the Contract Administrator. If CCTV** inspections show the cleaning to be unacceptable, the Contractor is required to re-clean and re-inspect the sewer until accepted by the Contract Administrator.

E.14.3 Flow Control and By-Pass Pumping

When interruptions of sewer section flows are necessary to effectively conduct inspections, the Contractor shall, subject to the approval of the Managing Director of Infrastructure Services, control flows using plugging and blocking methods.

The Managing Director of Infrastructure Services reserves the right, when necessary, to request bypassing and dewatering of a sewer to be inspected to ensure that the full diameter of pipe is visible.

The contractor will be responsible for any damage to public or private property resulting from the bypass operation or lack thereof. This operation may be requested when the flow depth covers the entire lens for approximately 35% of the line.

A sewer line plug shall be inserted into the line at a manhole upstream from the section to be inspected. The plug shall be designed so that all or any portion of the sewage flows can be released during the inspection. Flows shall be reduced in order to inspect the pipe invert.

Sewage levels upstream of the plugged section **shall be monitored at all times**. After the work is completed, flows shall be restored to normal.

E.14.4 Measurement and Payment

Unless otherwise provided for in the Contract Documents or the Ontario Provincial Standards, measurement and payment for the commissioning of the sewer system shall be considered to be included within sewer installation

E.15 Inspection and Testing

"The following inspection and testing work shall be carried out during and after construction of services.

i) "Sieve Analysis" of the pipe bedding material to assure that the material meets the latest OPSS 802.010 & 802.013 standard. Representative samples are to be obtained by the Consultant prior to and during construction operations.

ii) "Density Tests" shall be performed to assure that the pipe bedding material has been compacted properly.

iii) "Density Tests" shall be performed on the backfill material to ensure proper compaction.

vi) Full time inspection of all work during construction.

vi). Physical/Visual inspection of all work after construction to ensure all defects are rectified prior to the Township's inspections. The consultant's inspector is responsible for the following: To bring the general site servicing drawing and/or the as recorded drawings to the inspection; to provide all labour and equipment to assist Township staff during the inspection and to ensure all structures have been pre-inspected and all imperfect work has been rectified by the contractor. Failure to comply with any of the above will result in cancellation of the inspection and a charge to the Developer.

E.16 Standard Drawings

The following drawings are to be referred to in conjunction with this section.

E.17 Ontario Provincial Standard Drawings (OPSD)

The following OPSD's are to be referred to in conjunction with this section.

Title	**OPSD**
Pipe Bedding – Granular "A" Cover Material – Granular "A" or sand	802.010, 802.013 802.030, 802.033
Manhole Frame and Grate • Standard	 401.010 (Type "B")
Catchbasin Frame and Grate • Standard • Side Inlet • Rear Yard • Ditch Inlet	 400.110 400.082 400.120 403.010
Manholes – Precast	Section 700
Catchbasin – Precast	Section 700
Catchbasin Manhole – Precast	Section 700

Manhole Benching	701.0210
Manhole Steps	405.010 – Hollow Aluminum
Safety Platform – Aluminum	404.02
Internal Drop Structure for Existing Manhole	1003.030
Internal Drop Structure for New Manholes	1003.031
Sewer Service Connections	1006.010

F STORMWATER MANAGEMENT

F.1 Introduction

The Township of Centre Wellington has adopted a watershed planning approach to development. An important part of this process is stormwater management (SWM), which refers to the use of planning techniques and/or engineering controls to minimize the effect of urbanization on the hydrological cycle.

The purpose of this section is to outline the criteria that is to be used to design stormwater infrastructure within Centre Wellington, including municipal projects and new land development, as well as for the redevelopment of existing lands.

There are several companion documents which support this document, including the Township of Centre Wellington's Official Plan and Urban Design Manual, as well as numerous Federal and Provincial publications including, but not limited to:

- Stormwater Management Planning and Design Manual, MOECC, 2003
- Natural Hazards Technical Guides, MNR, 2006
- Erosion and Sediment Control Guideline for Urban Construction, GHHA CA, 2006
- Low Impact Development Stormwater Management Planning and Design Guide, CVC & TRCA, 2010
- Runoff Volume Control Targets for Ontario, Prepared by Aquafor Beech Ltd. and Earthfx Inc. for the MOECC, 2016

The consultant is responsible for ensuring that they are referencing the most recent versions of these documents, as well as for obtaining all necessary permits and approvals from other governing agencies.

F.2 Stormwater Management Criteria

In areas where a watershed/subwatershed/master drainage plan has been prepared and approved, the requirements and criteria cited within the plan shall be adopted in all instances. Where a larger plan does not exist, the following general requirements should be used as the minimum design criteria.

F.2.1 Quantity Control

There are two types of water quantity controls that must be considered when developing a stormwater management plan – peak flow control and volume control.

Peak flow control may also be referred to as flood control, as it aims to protect both urban and natural areas from flooding by controlling the rate at which stormwater runoff is allowed to discharge into a receiving system. In general, flows to receiving systems shall not be increased from pre-development flows. Certain areas, as specified by a watershed plan, may be required to restrict flow rates further below pre-development conditions in order to address downstream flooding issues. Upstream and surrounding area drainage circumstances should also be taken into consideration for flood management purposes. Peak flow control performance should be evaluated for the 2 year through 100 year storms.

Volume control seeks to protect the environment by maintaining the natural hydrological cycle. This is done by matching infiltration and runoff volumes between pre- and post-development conditions. Efforts to maximize infiltration shall be used wherever soil conditions allow. Volume control performance should be evaluated for the 25 mm storm event (which represents approximately 90% of the average annual rainfall in Ontario) or through continuous modelling.

F.2.2 Quality Control

Where a watershed plan does not specify otherwise, water quality control shall be provided in accordance with provincial regulations. MOECC (2003) standards specify three levels of water quality protection, based on a general relationship between total suspended solids (TSS) removal and the lethal and chronic effects of suspended solids on aquatic life. The three levels of protection correspond to the following long term suspended solids removal:

- Enhanced protection: 80% TSS removal
- Normal protection: 70% TSS removal
- Basic protection: 60% TSS removal (there are no water systems in the Township of Centre Wellington where a basic water quality level of protection would be deemed appropriate)

Table 3.2 of the MOECC Stormwater Management Planning and Design Manual (2003) specifies the required storage volumes to meet these levels of water quality protection. If an alternative method is used for the design of water quality systems, performance should be evaluated for the 25 mm storm event, or through continuous modelling.

F.2.3 Erosion Control

In areas where no watershed plan exists, receiving water systems shall be protected from erosion in accordance with MOECC guidelines and to the satisfaction of the Township and

GRCA, unless it can be demonstrated through appropriate modelling and/or analysis that stream stability will not be adversely affected by the proposed development. While the needs of a receiving system should be assessed on an individual basis, erosion control criteria may be able to be met by providing extended detention storage for the 25 mm storm event. Additional modelling or calculations may be required to support this minimum requirement at the Township's, GRCA's, or MOECC's discretion.

In areas where the downstream receiving watercourse is determined to be unstable, or where control/over control of flow rates is ineffective or not feasible, design of channel alterations might be considered, subject to design in accordance with natural channel design principles as per MNR requirements (2006).

Storm sewer outfalls in watercourses should be provided with proper protection against erosion which includes appropriate bank scouring protection on either side of the outfall and watercourse. When storm sewer outfalls outlet to steep and/or deep valleys, drop structures should be designed in such a manner as to provide integral bank stability. Such local erosion protection measures should be designed so as not to interfere with the watercourse forming processes of the receiving watercourse system or the system's ecological features or functions.

F.3 Analytical Methods

There are numerous hydrologic and hydraulic analytical methods available that may be used in the development of a stormwater management plan. The analytical methods presented herein represent established techniques that are generally considered acceptable by the Township of Centre Wellington. Alternative methods may be submitted for consideration to the Township. Pre-consultation with the Township is strongly recommended for all methods, including those identified in the following sections, in order to ensure suitability based on site specific conditions. Consultation with the GRCA and/or other agencies (MOECC, MNR, MTO, etc.) may also be required prior to selecting a specific analytical method.

F.3.1 Hand Calculations

F.3.1.1 The Rational Method

The Rational Method is a simplified calculation method that is to estimate peak flow. It may only be used in the Township of Centre Wellington for sites with a total area of less than 5.0 ha that are further subdivided into smaller drainage areas (2.0 ha or less).

$$Q = 2.78 \times c \times i \times A$$

Where:

Q = Peak flow (L/s)

c = Runoff Coefficient

i = Peak rainfall intensity (mm/hr)

A = Area (ha)

Peak rainfall intensity can be estimated using Intensity – Duration – Frequency (IDF) curves.

$$i = \frac{A}{(T_c + B)^C}$$

Where:

i = Peak rainfall intensity (mm/hr)

A, B, and C = IDF curve parameters

T_c = Time of concentration (min)

Table X: IDF Curve Data

Parameter	2 year	5 year	10 year	25 year	50 year	100 year
A						
B						
C						

Table X: Recommended Stormwater Runoff Coefficients

Land Use		Runoff Coefficient (C)
Asphalt / Concrete / Rooftops		0.9
Sports Field / Parks / Urban Open Space		0.35
Grass	Short / Mowed	0.35
	Long / Natural	0.25
Bush / Forest		0.2

F.3.1.2 The Manning's Equation

The Manning's equation may be used to determine the hydraulic capacity of simple channels (storm sewers, swales, etc.).

$$v = \frac{1}{n} \times R_h^{\frac{2}{3}} \times S^{\frac{1}{2}} \qquad R_h = \frac{A}{P_w}$$

Where:

v = Velocity (m/s)

n = Manning's roughness coefficient

R_h = Hydraulic radius (m)

A = Cross sectional area of flow (m^2)

P_w = Wetted perimeter (m)

S = Slope (m/m)

Table X: Recommended Manning's Roughness Coefficients

Surface Type		Manning's n
Concrete / PVC / HDPE		0.013
CSP		0.024
Grass	Short / Mowed	
	Long / Natural	
Natural / Vegetated Channel		
Gravel / Rock Channel		0.015

F.4 Computer Simulations

F.4.1 Event Based Models

Event based hydrologic models use synthetic design storms based on IDF rainfall data to simulate how a catchment will behave during typical storm events. Efforts should be made to use the same synthetic design storm when developing site or subdivision level SWM plans that was used in the watershed level plan for the area. In areas where no watershed plan exists, synthetic design storms should be selected based on which would result in the most conservative design. Examples of synthetic design storms and their applications is contained in Table X below.

Table X: Evaluation of Synthetic Design Storms

Synthetic Design Storm	Typical Applications
24 hour SCS Type II	
4 hour Chicago	

Table X below contains a list of event based models that are considered industry standards and are generally acceptable for use within the Township of Centre Wellington, although consultation with Township staff is recommended to confirm the preferred software prior to use.

Table X: Acceptable Event Based Models

Hydrology Only	Hydrology and Hydraulics	Hydraulics Only
SWMHYMO	SWMM	HECRAS

OTTHYMO	MIDUSS	

F.4.2 Continuous Models

Continuous models differ from event based hydrologic models in that rather than using a synthetic design storm based on IDF data, a long term time series of historical meteorological data is used for the input driving function. In addition to historical rainfall data, continuous models typically require seasonal state variables. Continuous models are usually more complex than event based hydrologic models, as typically the models consider more processes including temperature, evapotranspiration, snow conditions, and groundwater. Continuous models are typically used in the development of watershed level plans, but may be used for site scale purposes as well. Consultation with the Township, GRCA, and/or other agencies (MOECC, MNR, MTO, etc.) is required to determine specific continuous modelling requirements in all instances. Meteorological data should be obtained from the nearest rainfall gauge. This may result in a trade-off between duration of record and proximity; however, the minimum duration for meaningful continuous simulation is 20 to 25 years. Historical rainfall data may be obtained available from the GRCA and/or Environment Canada.

F.5 Modelling Standards of Practice

All modelling must be completed by a qualified practitioner and overseen by a licensed Professional Engineer. It is the responsibility of the Engineer to ensure that sound modelling practices are followed at all times, and that all decisions and/or assumptions are based on sound engineering principles.

The following standards of practice are intended to guide general model preparation:

1. Define the study objectives/purpose and model requirements.
2. Outline how the selected approach will meet the study objectives and identify how the selected model meets the requirements.
3. Define any assumptions and provide all relevant background information for the selection of input parameters.
4. Calibrate the model using available data where possible, or validate the model using other methods or tests.
5. A sensitivity analysis should be conducted on a limited number of parameters depending on the model type and complexity.
6. Provide an explanation for any errors.
7. Provide results in summary form for the relevant storm events.

F.6 Conveyance Systems

F.6.1 Minor System

All minor flow routes shall be designed to convey the 5 year event.

F.6.1.1 Storm Sewers

Refer to Section X for storm sewer requirements.

F.6.1.2 Swales

Swales shall have a minimum depth of 0.15 m, with a preferred depth of 0.3 m. The maximum length of a swale shall not exceed 50.0 m. They shall have a minimum longitudinal slope of 2% wherever feasible, although minimum slopes of 0.5% may be considered on a case-by-case basis. Swale slopes shall not exceed 8%. Swales shall have a maximum side slope of 3:1. The optimum side slope is 6:1. A typical cross-section of a swale is provided on Standard Drawing 404.

Any swale deemed "significant" by Township staff, which may require future maintenance, will be acquired as a permanent easement by the Township and designated as an overland flow route. In general, swales conveying 0.7 m^3/s or more for the 100-year storm shall be considered significant by the Township. This flow rate is based on a 1.0 m wide grassed swale with 3:1 side slopes flowing at a depth of 0.3 m at a slope of 2%. The Township also reserves the right to deem a swale as significant on a case-by-case basis, even if they do not meet these characteristics. Swale easements should be a minimum width of 5.0 m.

F.6.1.3 Roof Leaders

Rooftop runoff is considered clean stormwater and, therefore, should be infiltrated wherever possible. As such, roof drain connections to storm laterals are expressly prohibited. Roof drains should discharge to surface (with flows directed away from the building foundations and without erosion or inconvenience to others) or directly to infiltration facilities (see Section X below). Unless otherwise approved by the Township, runoff from roof drains that discharge to grade shall flow across pervious ground surfaces prior to entering the storm systems. Roof leaders may not discharge to ponding areas due to lot grading standards and West Nile Virus concerns. Additionally, where pedestrian traffic is anticipated over a roof leader discharge, efforts must be taken to address winter icing concerns.

F.6.1.4 Foundation Drains

All foundation drainage must be directed to sump pumps and discharged to grade or a storm lateral.

F.6.2 Major System

All major flow routes shall be designed to convey the 100 year event.

F.6.2.1 Overland Flow Routes

Major overland flow routes (i.e. roadside ditches or other large channels) shall be designed to safely convey the 100 year peak flow into the downstream receiver or SWM facility. Overland flow routes shall be flat bottomed channels, with maximum 3:1 side slopes and a maximum flow depth of 0.5 m plus 0.3 m of freeboard. All major overland flow routes shall be vegetated, and additional erosion protection (i.e. soil reinforcement systems, rip rap, etc.) is required at all inlets and outlets or where high velocities are anticipated.

F.6.2.2 Roadway Conveyance

Major roadways and local streets often convey runoff during severe storm events. For new development, road grades shall be constructed to provide positive conveyance to major

watercourses or storm sewer inlets. The depth and extent of street flooding in new developments shall be limited to 0.15 m above the centerline elevation in order to protect property and public safety, and allow emergency vehicle access. The roadway major system interface between existing and proposed development shall, whenever possible, be positively graded to convey roadway overland drainage to the flow capacity of the existing roadway system while maintaining roadway flooding depths to the foregoing standards. Should overland flows from the proposed development be above the existing receiving overland flow system, storage of overland flow or other methods of reducing flows to the receiver flow capacity will be required. Road reconstruction projects within the Township of Centre Wellington shall not negatively impact the existing overland flow system. Where an increase in impervious area is proposed the grading design must attempt to control the overland flow depths to the maximum 0.15 m depth. If this cannot be achieved, storage of overland flow or other methods of reducing flows to the receiver flow capacity will be required.

F.6.2.3 Roadway Crossings

Waterway openings for culverts and bridge crossings shall be designed in accordance with the MTO policies and guidelines.

F.6.2.4 Outfalls

Where an outfall discharges directly into a natural watercourse it should blend into the natural surroundings, in an environmentally acceptable and aesthetically pleasing manner, given the size and location. Access shall be provided to all outfalls for maintenance purposes.

F.7 Natural Channels and Watercourses

Natural channels and watercourses shall be designed as per the most recent MNR requirements and subject to MNR, Township, GRCA, and DFO approval. The design shall be based on natural channel forming processes to achieve a dynamically stable system, and must incorporate hydrology, stream hydraulics, fluvial morphology, and biology. Special consideration must be given to the vegetation and a landscape plan must be designed by a member of OALA in good standing. Alteration to a regulated watercourse will require a permit and/or approval from the GRCA, MNR, and DFO.

The Township requires that natural channel and watercourse design consider channel maintenance requirements by incorporating access routes. Access routes (minimum 4.0 m wide, maximum 4% slope) shall be located within the appropriate top of bank setback limit or adjacent to the low flow area in appropriately designated areas, to the satisfaction of the Township. Fencing may be required to prevent public access and encroachment. Should fencing be required, it shall be on public property, 150 mm from the property line. No access gates will be permitted directly from private properties.

Finally, the area must be posted as naturalized area and wording within the purchase and sales agreement should reflect this requirement.

F.8 Hierarchy of Stormwater Management Practices

The Township of Centre Wellington advocates for the application of SWM practices on a hierarchical basis, whereby more proactive techniques are considered first. The philosophy behind this hierarchy is that SWM practices are more effective at achieving the required criteria (particularly water balance and water quality criteria) when applied at the source. The hierarchy is based on the recommendations made in the Runoff Volume Control Targets for Ontario report (Aquafor Beech & Earthfx, 2016) and may be updated as further recommendations from the MOECC become available. The hierarchy adopted by the Township of Centre Wellington is as follows, listed in order of preferred application:

- Onsite retention controls: Low impact development (LID) controls that use infiltration, evapotranspiration, or water reuse techniques to reduce stormwater runoff volumes and pollutant loads.
- Lot level water quality and onsite detention controls: LID controls or other traditional practices that filter stormwater runoff and/or temporarily detain it onsite before releasing it into the receiving system at a controlled rate.
- End-of-pipe controls: End-of-pipe controls receive and manage stormwater runoff from a larger area, such as a subdivision or industrial park. End-of-pipe facilities shall be centralized wherever possible in order to reduce capital and long-term maintenance costs. New end-of-pipe facilities are to take into consideration existing upstream flows and future development in surrounding and upstream areas.

Tables X through X below contain a summary of the SWM practices under each of these categories that are acceptable for use within the Township of Centre Wellington. The Township is also open to alternative approaches on a case-by-case basis, given an appropriate amount of time for consideration. Furthermore, sites must be assessed on an individual basis, and the Township may have additional criteria and/or restrictions within a specific area (e.g. due to it being a wellhead protection area) that could affect the applicability of the SWM techniques being proposed.

Table X: Onsite Retention Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Infiltration galleries	Peak flow Volume Quality Erosion	Small drainage areas (< 2 ha) Residential Commercial Industrial Institutional	Native soil infiltration rate must be 15 mm/hr or higher Must be protected during construction Only rooftop runoff maybe be sent directly to infiltration galleries, surface runoff requires pre-treatment before In residential areas, infiltration facilities are to be located in rear yards, and must be maintained by the property owner Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Preferred method
Bioretention	Peak flow Volume Quality Erosion	Small drainage areas (< 2 ha) Residential Commercial Light industrial Institutional	Native soil infiltration rate must be 15 mm/hr or higher, otherwise an underdrain is required Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Preferred method
Permeable pavers	Peak flow Volume Quality Erosion	Small drainage areas (< 2 ha) Residential Light commercial Institutional	Native soil infiltration rate must be 15 mm/hr or higher, otherwise an underdrain is required Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Case-by-case

Table X: Onsite Retention Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Enhanced swales	Peak flow Volume Quality Erosion			Preferred method where appropriate
Green roofs	Peak flow Erosion Other	Large, flat roofs Commercial Industrial	Building structural design must account for additional load from water and green roof materials Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Case-by-case

Table X: Lot Level Water Quality Controls

Filter strips	Quality	Small drainage areas (< 2 ha) Low density development	Most effective when located adjacent to watercourses or other systems that receive sheet flow	Part of treatment train only
Buffer strips	Quality	Located between developed areas and the receiving water system or natural area	Usually established at the watershed planning level with input from the GRCA and provincial agencies	Part of treatment train only
Oil and grit separators	Quality	Small drainage areas (< 2 ha) Industrial Commercial	Can be used to provide water quality control for redevelopment or infill areas where space is limited Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Required for industrial and commercial properties
Spill prevention and control	Quality	Industrial Commercial		Required for industrial and commercial properties

Table X: Onsite Detention Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Rooftop storage	Peak flow	Large, flat roofs Commercial Industrial	Building structural design must account for additional load from water Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Acceptable for commercial or industrial properties
Parking lot storage	Peak flow	Commercial Industrial	A maximum ponding depth of 0.3 m is acceptable for parking areas and loading bays	Acceptable for commercial or industrial properties
Oversized (super) pipes	Peak flow		Appropriate in redevelopment of existing areas, infill areas, and some smaller developments, where no other practical alternative exists	Must demonstrate there is no other suitable alternative

Table X: End-of-Pipe Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Dry ponds	Peak flow Erosion	Large drainage areas (> 5 ha)	Separate water quality control practices may be required	Acceptable where other methods are not feasible
Wet ponds	Peak flow Erosion Quality	Large drainage areas (> 5 ha)	Pre-treatment required	Preferred method
Constructed wetlands	Peak flow Erosion Quality	Large drainage areas (> 5 ha)	Pre-treatment required	Preferred method
Community infiltration facilities	Peak flow Erosion Volume Quality	Suitability must be determined through a hydrogeological study	Native soil infiltration rate must be 15 mm/hr or higher Must be protected during construction Rooftop runoff is ideal for infiltration	Case-by-case

F.9 Cash-in-Lieu

Cash-in-lieu may be considered for infill and redevelopment projects, if it can be shown that there would be no negative environmental impacts to the downstream receivers. Additionally, the receiver must be considered a low sensitivity receiver.

Cash-in-lieu would involve a financial contribution towards offsite SWM infrastructure, elsewhere in the Township, in lieu of providing onsite SWM. Cash-in-lieu may only be applied for water quality control requirements. Onsite water quantity control would still be required.

How much?

F.10 Stormwater Management Facilities Design Specifications

SWM ponds (dry ponds, wet ponds, and constructed wetlands) shall be designed and constructed as per the MOECC Stormwater Management Planning & Design Manual (2003). The design standards contained in Table X below shall be used to complement the MOECC manual. The Township of Centre Wellington may allow for exceptions and consider alternative approaches on a case-by-case basis, if requested, and provided adequate time to review.

Table X: Stormwater Management Ponds Design Specifications

Storage volumes	Storage volumes to be as required to meet the criteria specified in Sections 2.1 – 2.3 of this document Length-to-width ratio: Minimum 3:1
Water depths	Dry ponds: Total storage depth: 1.8 m Wet ponds: Permanent pool: Minimum 1.0 m / Maximum 1.5 m Extended detention depth: Maximum 1.0 m above permanent pool Peak flow attenuation: Maximum 1.8 m above permanent pool Total storage depth: Maximum 3.3 m Constructed wetlands: Permanent pool: Minimum 0.15 m / Maximum 0.3 m Extended detention depth: Maximum 1.0 m above permanent pool Peak flow attenuation: Maximum 1.8 m above permanent pool Total storage depth: Maximum 2.1 m Forebays: Minimum 1.0 m / Maximum 1.5 m Micropools: Maximum 0.3 m below the permanent pool level
Side slopes	Permanent pool: Maximum 5:1 Above permanent pool: Maximum 3:1
Berms	Freeboard: Minimum 0.3 m above 100 year water level

Table X: Stormwater Management Ponds Design Specifications

	Top width: Minimum 1.5 m
Pre-treatment	Pre-treatment is required for all pond types Preferred methods of pre-treatment include oil and grit separators, enhanced grassed/vegetated swales, and/or filter strips Areas subject to the collection of contaminants or spills shall be fitted with oil and grit separators Forebays should be used only where preferred methods are not feasible, and shall not exceed 20% of the total pond or wetland surface A treatment train approach is encouraged, particularly for dry ponds
Inlet structures	One inlet shall be provided to all SWM ponds where possible' Pond inlet inverts shall not be lower than the maximum extended detention level Headwalls and grating shall conform to OPSD Rip rap underlain with geotextile to be provided at pond inlet, crossing the width of the headwall and extending 1.5 m out in both directions
Outlet structures	Minimum allowable outlet diameter: 75 mm Reverse slope pipe or perforated riser pipe outlet structures encouraged for wet facilities Erosion protection at outlets shall consist of a combination of rip rap and vegetation, with the size and depth of stone based on consultant and / or Township recommendations and subject to approval
Emergency overflow spillway	All SWM ponds shall include an emergency overflow spillway to allow drainage to safely exit the facility should the outfall structure fail or in the event of an extreme storm event (i.e. larger than the 100 year storm) The overflow spillway shall be designed to convey the Regional Event or the 100 year allowable release rate, whichever is the greater Erosion protection shall be provided along the entirety of the spillway

Table X: Stormwater Management Ponds Design Specifications

	If the emergency overflow spillway is also to be used for maintenance access, materials such as the Unilock Duramat system may be used for erosion protection Side slopes at the top of the spillway shall be 3:1 maximum, and shall have a maximum slope of 10%, if used as an access roadway
Maintenance access roadways	A 4.0 m wide, minimum 300 mm compacted Granular "A" maintenance roadway shall be provided to all pond inlets, outlets, and forebays A minimum 4.0 m wide maintenance access area shall be provided around the entire pond The maximum slope of all maintenance access areas shall be 10% The Unilock Duramat system is the preferred product for access areas where heavy vehicular loading is anticipated
Plantings	All slopes 5:1 and steeper shall be planted Native and non-invasive trees, shrubs, ground covers and aquatic plants are required in a low maintenance landscape design (See Appendix X for acceptable plant lists) For constructed wetlands, it is encouraged to incorporate a wide range of slopes and ponding depths to facilities a wide range of flora and fauna habitat conditions Shrub plantings shall discourage public access on all 3:1 slopes Shrub plantings shall discourage public access to forebay areas slopes (excluding maintenance access areas)
Groundwater	The permanent pool is to be located above the natural groundwater elevation, which is to be confirmed by a geotechnical investigation Lining of the pond bottom (or permanent pool area) with an impermeable material will be required where soil conditions are very permeable, the permanent pool level is close to the groundwater elevation, or where groundwater interference and/or contamination is a concern The type and thickness of lining material shall be based on geotechnical recommendations; however, a clay liner is preferred over synthetic materials for stormwater management facilities

Table X: Stormwater Management Ponds Design Specifications

	If a plastic or man-made liner is proposed, a 400 mm thick, 200 mm diameter rock layer is required over the liner as a warning to avoid damage to the liner during cleanout, and a concrete sump shall be provided in the forebay to facilitate forebay dewatering
Fencing	Fencing of stormwater management facilities shall, in general, be discouraged; however it may be required as determined by the Township Where residential lots back onto a SWM facility a 1.2 m chainlink fence shall be provided between the lots and the SWM block
Miscellaneous	Children's play equipment shall not be permitted within stormwater management facilities In the event that a community trail has been identified and/or required by the Township in the vicinity or adjacent to a stormwater management pond, they shall be implemented above the maximum extended detention level or 5 year storm level, whichever is greater Designated pedestrian areas shall not exceed a maximum slope of 6:1

F.11 Temporary Stormwater Management Facilities

In development situations where the ultimate downstream receiver(s) have not been completed, temporary onsite facilities may be required. Temporary facilities shall provide an equivalent level of quality and quantity control as per the ultimate facility. The design requirements for temporary facilities may be modified from those for permanent facilities, as follows:

- Side slopes: Maximum 3:1, all areas
- Fencing: Facility perimeter to be fenced with 1.8 m chain link on all sides with lockable access gate in accordance with OPSDs

Temporary facilities shall remain in place until the ultimate receiver has been constructed and approved by the Township.

Where a temporary SWM facility is required, the site plan or subdivision agreements will be written to require the Developer to be solely responsible for the maintenance and operation of the temporary facilities, as well as any works associated with decommissioning of the temporary facility, including the removal and disposal of sedimentation. The cost for a temporary stormwater facility, including its removal, shall be borne solely by the Developer. Securities will be required to cover the cost of any required interim maintenance and/or future removal.

F.12 Reporting Requirements

F.12.1 Stormwater Management Report

The Stormwater Management Report shall include the following minimum requirements, viewed as a generic list applicable to both preliminary and final stormwater management reports:

Descriptions of:

- The existing and proposed/future land use conditions of the study area;
- The receiving system and outlet locations, including confirmation of legal status;
- SWM criteria for volume, flooding, quality, flooding, and erosion control, and the source of each criteria;
- The hydrologic and hydraulic analysis, including, but not limited to, the justification for the model selection, input parameters, assumptions, and methods/calculations; and,
- Design details of the SWM practices to be implemented in order to meet applicable criteria, policies, and guidelines.

Tables containing:

- Hydrologic parameters for existing and proposed/future land use;
- Pre- and post-development peak flows and runoff volumes at all outlets;
- Pre- and post-development runoff and infiltration volumes for all catchments;
- Stage-storage-discharge relationships for all SWM facilities; and,
- Overland flow depths and velocities at key points on roads and at outfalls.

Figures/drawings indicating:

- General location plan;
- Drainage catchment areas for existing and proposed/future land use including all external areas;
- Details of overland flow routes;
- Schematic of computer models;
- Details of all SWM facilities including cross sections and appurtenances (inlets and outlets); and,
- Details of erosion and sediment controls.

All reports and plans are to be stamped and signed by a Professional Engineer licensed in Ontario.

F.12.2 Stormwater Management Drawings

The following information must be included on the engineering drawings:

- Lot and road layout with land use;
- Elevations at key points (in a contour map);
- Any surveyed constraint lines (e.g. top of bank, floodlines, wetlands);
- Minor drainage system, with storm sewers, manholes, catchbasins;
- Major drainage system with overland flow routes at key points;
- Overland flow routes;
- Details of stormwater management practices, e.g. storage facilities, and,
- Erosion and sediment controls.

All plans must clearly indicate the project name, municipal address, and legal description of the study area, and all plans must be stamped and signed by a Professional Engineer licensed in Ontario.

F.12.3 As-Constructed Requirements

The Developer or their agent(s) shall certify that all SWM facilities have been constructed and are operating in general conformance with the approved plans and design report. An as-constructed topographic survey incorporated into the SWM facility engineering plans, along with any supporting calculations, shall be provided to the Township prior to assumption. The as-constructed drawings and calculations must confirm the water levels (elevations) and volumes, construction materials, and inlet and outfall structure details.

Should the Township determine that a facility is not performing according to the approved design, the Developer will be required to perform any retrofits or other changes as required to bring it into compliance prior to assumption by the Township.

F.12.4 Operations, Maintenance, and Monitoring Manual

The submission of the final Stormwater Management Report must be accompanied by a separate Operations and Maintenance Manual, which is to outline the operational and maintenance procedures required to ensure the proper functioning of the facility as defined within the report. All operations, maintenance, and monitoring recommendations or requirements shall be as per the MOECC Planning and Design Manual or the TRCA & CVC LID Planning and Design Guide (2010).

The following information must be included in the Operations and Maintenance Manual, as a minimum requirement:

- The method and frequency of sediment removal.
- A list and frequency of all other regular maintenance activities that are to be performed.
- Potential safety hazards (i.e. drowning, trapping, contamination, noxious weed growth, West Nile Virus, odours, etc.) and the appropriate mitigation measures.
- Potential scenarios in which the facility may fail, and the procedures to be followed in each event, including unexpected maintenance.
- The expected quantity and quality performance of the facility under varying conditions, such as dry weather conditions, winter conditions, frequent rainstorms, and rainfall events exceeding the design capacity.
- A list of the parameters to be monitored in order to evaluate performance, including the monitoring procedures and equipment, the acceptable range of values for each parameter, trigger limit(s) which when exceeded require immediate attention because of regulatory or safety considerations, the format for logging the measured values, and recommended methods for analysis of the recorded data (monitoring plan may be subject to approval by the Township, MOECC, and GRCA).
- A breakdown of the estimated annual maintenance and operating costs.
- Winter operations for the proposed stormwater quality control facility.

F.12.5 Ministry of the Environment and Climate Change Environmental Compliance Approval

Prior to final acceptance, the Developer must ensure compliance with the MOECC ECA requirements.

F.13 Watershed Planning Approach

The Township of Centre Wellington has adopted a watershed planning approach to development. An important part of this process is stormwater management (SWM), which refers to the use of planning techniques and/or engineering controls to minimize the effect of urbanization on the hydrological cycle.

The purpose of this section is to outline the criteria that is to be used to design stormwater infrastructure within Centre Wellington, including municipal projects and new land development, as well as for the redevelopment of existing lands.

There are several companion documents which support this document, including the Township of Centre Wellington's Official Plan and Urban Design Manual, as well as numerous Federal and Provincial publications including, but not limited to:

- Stormwater Management Planning and Design Manual, MOECC, 2003
- Natural Hazards Technical Guides, MNR, 2006
- Erosion and Sediment Control Guideline for Urban Construction, GHHA CA, 2006
- Low Impact Development Stormwater Management Planning and Design Guide, CVC & TRCA, 2010
- Runoff Volume Control Targets for Ontario, Prepared by Aquafor Beech Ltd. and Earthfx Inc. for the MOECC, 2016

The consultant is responsible for ensuring that they are referencing the most recent versions of these documents, as well as for obtaining all necessary permits and approvals from other governing agencies.

F.14 Stormwater Management Criteria

In areas where a watershed/subwatershed/master drainage plan has been prepared and approved, the requirements and criteria cited within the plan shall be adopted in all instances. Where a larger plan does not exist, the following general requirements should be used as the minimum design criteria.

F.14.1 Quantity Control

There are two types of water quantity controls that must be considered when developing a stormwater management plan – peak flow control and volume control.

Peak flow control may also be referred to as flood control, as it aims to protect both urban and natural areas from flooding by controlling the rate at which stormwater runoff is allowed to discharge into a receiving system. In general, flows to receiving systems shall not be increased from pre-development flows. Certain areas, as specified by a watershed plan, may be required to restrict flow rates further below pre-development conditions in order to address downstream flooding issues. Upstream and surrounding area drainage circumstances should also be taken into consideration for flood management purposes. Peak flow control performance should be evaluated for the 2 year through 100 year storms.

Volume control seeks to protect the environment by maintaining the natural hydrological cycle. This is done by matching infiltration and runoff volumes between pre- and post-development conditions. Efforts to maximize infiltration shall be used wherever soil conditions allow. Volume

control performance should be evaluated for the 25 mm storm event (which represents approximately 90% of the average annual rainfall in Ontario) or through continuous modelling.

F.14.2 Quality Control

Where a watershed plan does not specify otherwise, water quality control shall be provided in accordance with provincial regulations. MOECC (2003) standards specify three levels of water quality protection, based on a general relationship between total suspended solids (TSS) removal and the lethal and chronic effects of suspended solids on aquatic life. The three levels of protection correspond to the following long term suspended solids removal:

- Enhanced protection: 80% TSS removal
- Normal protection: 70% TSS removal
- Basic protection: 60% TSS removal (there are no water systems in the Township of Centre Wellington where a basic water quality level of protection would be deemed appropriate)

Table 3.2 of the MOECC Stormwater Management Planning and Design Manual (2003) specifies the required storage volumes to meet these levels of water quality protection. If an alternative method is used for the design of water quality systems, performance should be evaluated for the 25 mm storm event, or through continuous modelling.

F.14.3 Erosion Control

In areas where no watershed plan exists, receiving water systems shall be protected from erosion in accordance with MOECC guidelines and to the satisfaction of the Township and GRCA, unless it can be demonstrated through appropriate modelling and/or analysis that stream stability will not be adversely affected by the proposed development. While the needs of a receiving system should be assessed on an individual basis, erosion control criteria may be able to be met by providing extended detention storage for the 25 mm storm event. Additional modelling or calculations may be required to support this minimum requirement at the Township's, GRCA's, or MOECC's discretion.

In areas where the downstream receiving watercourse is determined to be unstable, or where control/over control of flow rates is ineffective or not feasible, design of channel alterations might be considered, subject to design in accordance with natural channel design principles as per MNR requirements (2006).

Storm sewer outfalls in watercourses should be provided with proper protection against erosion which includes appropriate bank scouring protection on either side of the outfall and watercourse. When storm sewer outfalls outlet to steep and/or deep valleys, drop structures should be designed in such a manner as to provide integral bank stability. Such local erosion protection measures should be designed so as not to interfere with the watercourse forming processes of the receiving watercourse system or the system's ecological features or functions.

F.15 Analytical Methods

There are numerous hydrologic and hydraulic analytical methods available that may be used in the development of a stormwater management plan. The analytical methods presented herein represent established techniques that are generally considered acceptable by the Township of Centre Wellington. Alternative methods may be submitted for consideration to the Township. Pre-consultation with the Township is strongly recommended for all methods, including those

identified in the following sections, in order to ensure suitability based on site specific conditions. Consultation with the GRCA and/or other agencies (MOECC, MNR, MTO, etc.) may also be required prior to selecting a specific analytical method.

F.15.1 Hand Calculations

F15.1.1 The Rational Method

The Rational Method is a simplified calculation method that is to estimate peak flow. It may only be used in the Township of Centre Wellington for sites with a total area of less than 5.0 ha that are further subdivided into smaller drainage areas (2.0 ha or less).

$$Q = 2.78 \times c \times i \times A$$

Where:

Q = Peak flow (L/s)

c = Runoff Coefficient

i = Peak rainfall intensity (mm/hr)

A = Area (ha)

Peak rainfall intensity can be estimated using Intensity – Duration – Frequency (IDF) curves.

$$i = \frac{A}{(T_c + B)^C}$$

Where:

i = Peak rainfall intensity (mm/hr)

A, B, and C = IDF curve parameters

T_c = Time of concentration (min)

Table X: IDF Curve Data

Parameter	2 year	5 year	10 year	25 year	50 year	100 year
A						
B						
C						

Table X: Recommended Stormwater Runoff Coefficients

Land Use		Runoff Coefficient (C)
Asphalt / Concrete / Rooftops		0.9
Sports Field / Parks / Urban Open Space		0.35
Grass	Short / Mowed	0.35
	Long / Natural	0.25
Bush / Forest		0.2

F15.1.2 The Manning's Equation

The Manning's equation may be used to determine the hydraulic capacity of simple channels (storm sewers, swales, etc.).

$$v = \frac{1}{n} \times R_h^{\frac{2}{3}} \times S^{\frac{1}{2}} \qquad R_h = \frac{A}{P_w}$$

Where:

v = Velocity (m/s)

n = Manning's roughness coefficient

R_h = Hydraulic radius (m)

A = Cross sectional area of flow (m^2)

P_w = Wetted perimeter (m)

S = Slope (m/m)

Table X: Recommended Manning's Roughness Coefficients

Surface Type		Manning's n
Concrete / PVC / HDPE		0.013
CSP		0.024
Grass	Short / Mowed	
	Long / Natural	
Natural / Vegetated Channel		
Gravel / Rock Channel		0.015

F15.2 Computer Simulations

Events Based Models

Event based hydrologic models use synthetic design storms based on IDF rainfall data to simulate how a catchment will behave during typical storm events. Efforts should be made to use the same synthetic design storm when developing site or subdivision level SWM plans that was used in the watershed level plan for the area. In areas where no watershed plan exists, synthetic design storms should be selected based on which would result in the most conservative design. Examples of synthetic design storms and their applications is contained in Table X below.

Table X: Evaluation of Synthetic Design Storms

Synthetic Design Storm	Typical Applications
24 hour SCS Type II	
4 hour Chicago	

Table X below contains a list of event based models that are considered industry standards and are generally acceptable for use within the Township of Centre Wellington, although consultation with Township staff is recommended to confirm the preferred software prior to use.

Table X: Acceptable Event Based Models

Hydrology Only	Hydrology and Hydraulics	Hydraulics Only
SWMHYMO OTTHYMO	SWMM MIDUSS	HECRAS

F.15.2.1 Continuous Models

Continuous models differ from event based hydrologic models in that rather than using a synthetic design storm based on IDF data, a long term time series of historical meteorological data is used for the input driving function. In addition to historical rainfall data, continuous models typically require seasonal state variables. Continuous models are usually more complex than event based hydrologic models, as typically the models consider more processes including temperature, evapotranspiration, snow conditions, and groundwater. Continuous models are typically used in the development of watershed level plans, but may be used for site scale purposes as well. Consultation with the Township, GRCA, and/or other agencies (MOECC, MNR, MTO, etc.) is required to determine specific continuous modelling requirements in all instances. Meteorological data should be obtained from the nearest rainfall gauge. This may result in a trade-off between duration of record and proximity; however, the minimum duration for meaningful continuous simulation is 20 to 25 years. Historical rainfall data may be obtained available from the GRCA and/or Environment Canada.

F.15.3 Modelling Standards of Practice

All modelling must be completed by a qualified practitioner and overseen by a licensed Professional Engineer. It is the responsibility of the Engineer to ensure that sound modelling practices are followed at all times, and that all decisions and/or assumptions are based on sound engineering principles.

The following standards of practice are intended to guide general model preparation:

8. Define the study objectives/purpose and model requirements.
9. Outline how the selected approach will meet the study objectives and identify how the selected model meets the requirements.
10. Define any assumptions and provide all relevant background information for the selection of input parameters.
11. Calibrate the model using available data where possible, or validate the model using other methods or tests.
12. A sensitivity analysis should be conducted on a limited number of parameters depending on the model type and complexity.
13. Provide an explanation for any errors.
14. Provide results in summary form for the relevant storm events.

F.16 Conveyance Systems

F16.1 Minor System

All minor flow routes shall be designed to convey the 5 year event.

F16.1.1 Storm Sewers

Refer to Section X for storm sewer requirements.

F16.1.2 Swales

Swales shall have a minimum depth of 0.15 m, with a preferred depth of 0.3 m. The maximum length of a swale shall not exceed 50.0 m. They shall have a minimum longitudinal slope of 2% wherever feasible, although minimum slopes of 0.5% may be considered on a case-by-case basis. Swale slopes shall not exceed 8%. Swales shall have a maximum side slope of 3:1. The optimum side slope is 6:1. A typical cross-section of a swale is provided on Standard Drawing 404.

Any swale deemed “significant” by Township staff, which may require future maintenance, will be acquired as a permanent easement by the Township and designated as an overland flow route. In general, swales conveying 0.7 m^3/s or more for the 100-year storm shall be considered significant by the Township. This flow rate is based on a 1.0 m wide grassed swale with 3:1 side slopes flowing at a depth of 0.3 m at a slope of 2%. The Township also reserves the right to deem a swale as significant on a case-by-case basis, even if they do not meet these characteristics. Swale easements should be a minimum width of 5.0 m.

F16.1.3 Roof Leaders

Rooftop runoff is considered clean stormwater and, therefore, should be infiltrated wherever possible. As such, roof drain connections to storm laterals are expressly prohibited. Roof drains should discharge to surface (with flows directed away from the building foundations and without erosion or inconvenience to others) or directly to infiltration facilities (see Section X below). Unless otherwise approved by the Township, runoff from roof drains that discharge to grade shall flow across pervious ground surfaces prior to entering the storm systems. Roof leaders may not discharge to ponding areas due to lot grading standards and West Nile Virus concerns. Additionally, where pedestrian traffic is anticipated over a roof leader discharge, efforts must be taken to address winter icing concerns.

F16.1.4 Foundation Drains

All foundation drainage must be directed to sump pumps and discharged to grade or a storm lateral.

F16.2 Major System

All major flow routes shall be designed to convey the 100 year event.

F16.2.1 Overland Flow Routes

Major overland flow routes (i.e. roadside ditches or other large channels) shall be designed to safely convey the 100 year peak flow into the downstream receiver or SWM facility. Overland flow routes shall be flat bottomed channels, with maximum 3:1 side slopes and a maximum flow depth of 0.5 m plus 0.3 m of freeboard. All major overland flow routes shall be vegetated, and additional erosion protection (i.e. soil reinforcement systems, rip rap, etc.) is required at all inlets and outlets or where high velocities are anticipated.

F16.2.2 Roadway Conveyance

Major roadways and local streets often convey runoff during severe storm events. For new development, road grades shall be constructed to provide positive conveyance to major watercourses or storm sewer inlets. The depth and extent of street flooding in new developments shall be limited to 0.15 m above the centerline elevation in order to protect property and public safety, and allow emergency vehicle access. The roadway major system interface between existing and proposed development shall, whenever possible, be positively graded to convey roadway overland drainage to the flow capacity of the existing roadway system while maintaining roadway flooding depths to the foregoing standards. Should overland flows from the proposed development be above the existing receiving overland flow system, storage of overland flow or other methods of reducing flows to the receiver flow capacity will be required. Road reconstruction projects within the Township of Centre Wellington shall not negatively impact the existing overland flow system. Where an increase in impervious area is proposed the grading design must attempt to control the overland flow depths to the maximum 0.15 m depth. If this cannot be achieved, storage of overland flow or other methods of reducing flows to the receiver flow capacity will be required.

F16.2.3 Roadway Crossings

Waterway openings for culverts and bridge crossings shall be designed in accordance with the MTO policies and guidelines.

F16.2.4 Outfalls

Where an outfall discharges directly into a natural watercourse it should blend into the natural surroundings, in an environmentally acceptable and aesthetically pleasing manner, given the size and location. Access shall be provided to all outfalls for maintenance purposes.

F.17 Natural Channels and Watercourses

Natural channels and watercourses shall be designed as per the most recent MNR requirements and subject to MNR, Township, GRCA, and DFO approval. The design shall be based on natural channel forming processes to achieve a dynamically stable system, and must incorporate hydrology, stream hydraulics, fluvial morphology, and biology. Special consideration must be given to the vegetation and a landscape plan must be designed by a member of OALA in good standing. Alteration to a regulated watercourse will require a permit and/or approval from the GRCA, MNR, and DFO.

The Township requires that natural channel and watercourse design consider channel maintenance requirements by incorporating access routes. Access routes (minimum 4.0 m wide, maximum 4% slope) shall be located within the appropriate top of bank setback limit or adjacent to the low flow area in appropriately designated areas, to the satisfaction of the Township. Fencing may be required to prevent public access and encroachment. Should fencing be required, it shall be on public property, 150 mm from the property line. No access gates will be permitted directly from private properties.

Finally, the area must be posted as naturalized area and wording within the purchase and sales agreement should reflect this requirement.

F.18 Hierarchy of Stormwater Management Practices

The Township of Centre Wellington advocates for the application of SWM practices on a hierarchical basis, whereby more proactive techniques are considered first. The philosophy behind this hierarchy is that SWM practices are more effective at achieving the required criteria (particularly water balance and water quality criteria) when applied at the source. The hierarchy is based on the recommendations made in the Runoff Volume Control Targets for Ontario report (Aquafor Beech & Earthfx, 2016) and may be updated as further recommendations from the MOECC become available. The hierarchy adopted by the Township of Centre Wellington is as follows, listed in order of preferred application:

- Onsite retention controls: Low impact development (LID) controls that use infiltration, evapotranspiration, or water reuse techniques to reduce stormwater runoff volumes and pollutant loads.
- Lot level water quality and onsite detention controls: LID controls or other traditional practices that filter stormwater runoff and/or temporarily detain it onsite before releasing it into the receiving system at a controlled rate.
- End-of-pipe controls: End-of-pipe controls receive and manage stormwater runoff from a larger area, such as a subdivision or industrial park. End-of-pipe facilities shall be centralized wherever possible in order to reduce capital and long-term maintenance costs. New end-of-pipe facilities are to take into consideration existing upstream flows and future development in surrounding and upstream areas.

Tables X through X below contain a summary of the SWM practices under each of these categories that are acceptable for use within the Township of Centre Wellington. The Township is also open to alternative approaches on a case-by-case basis, given an appropriate amount of time for consideration. Furthermore, sites must be assessed on an individual basis, and the Township may have additional criteria and/or restrictions within a specific area (e.g. due to it being a wellhead protection area) that could affect the applicability of the SWM techniques being proposed.

Table X: Onsite Retention Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Infiltration galleries	Peak flow Volume Quality Erosion	Small drainage areas (< 2 ha) Residential Commercial Industrial Institutional	Native soil infiltration rate must be 15 mm/hr or higher Must be protected during construction Only rooftop runoff maybe be sent directly to infiltration galleries, surface runoff requires pre-treatment before In residential areas, infiltration facilities are to be located in rear yards, and must be maintained by the property owner Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Preferred method
Bioretention	Peak flow Volume Quality Erosion	Small drainage areas (< 2 ha) Residential Commercial Light industrial Institutional	Native soil infiltration rate must be 15 mm/hr or higher, otherwise an underdrain is required Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Preferred method
Permeable pavers	Peak flow Volume Quality Erosion	Small drainage areas (< 2 ha) Residential Light commercial Institutional	Native soil infiltration rate must be 15 mm/hr or higher, otherwise an underdrain is required Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Case-by-case

Table X: Onsite Retention Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Enhanced swales	Peak flow Volume Quality Erosion			Preferred method where appropriate
Green roofs	Peak flow Erosion Other	Large, flat roofs Commercial Industrial	Building structural design must account for additional load from water and green roof materials Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Case-by-case

Table X: Lot Level Water Quality Controls

Filter strips	Quality	Small drainage areas (< 2 ha) Low density development	Most effective when located adjacent to watercourses or other systems that receive sheet flow	Part of treatment train only
Buffer strips	Quality	Located between developed areas and the receiving water system or natural area	Usually established at the watershed planning level with input from the GRCA and provincial agencies	Part of treatment train only
Oil and grit separators	Quality	Small drainage areas (< 2 ha) Industrial Commercial	Can be used to provide water quality control for redevelopment or infill areas where space is limited Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Required for industrial and commercial properties
Spill prevention and control	Quality	Industrial Commercial		Required for industrial and commercial properties

Table X: Onsite Detention Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Rooftop storage	Peak flow	Large, flat roofs Commercial Industrial	Building structural design must account for additional load from water Property owner would be required to enter into a maintenance agreement in order to maintain long-term performance	Acceptable for commercial or industrial properties
Parking lot storage	Peak flow	Commercial Industrial	A maximum ponding depth of 0.3 m is acceptable for parking areas and loading bays	Acceptable for commercial or industrial properties
Oversized (super) pipes	Peak flow		Appropriate in redevelopment of existing areas, infill areas, and some smaller developments, where no other practical alternative exists	Must demonstrate there is no other suitable alternative

Table X: End-of-Pipe Controls

Method	Objectives	Siting	Special Considerations	Township of Centre Wellington Perspective
Dry ponds	Peak flow Erosion	Large drainage areas (> 5 ha)	Separate water quality control practices may be required	Acceptable where other methods are not feasible
Wet ponds	Peak flow Erosion Quality	Large drainage areas (> 5 ha)	Pre-treatment required	Preferred method
Constructed wetlands	Peak flow Erosion Quality	Large drainage areas (> 5 ha)	Pre-treatment required	Preferred method
Community infiltration facilities	Peak flow Erosion Volume Quality	Suitability must be determined through a hydrogeological study	Native soil infiltration rate must be 15 mm/hr or higher Must be protected during construction Rooftop runoff is ideal for infiltration	Case-by-case

F.18.1 Cash-in-Lieu

Cash-in-lieu may be considered for infill and redevelopment projects, if it can be shown that there would be no negative environmental impacts to the downstream receivers. Additionally, the receiver must be considered a low sensitivity receiver.

Cash-in-lieu would involve a financial contribution towards offsite SWM infrastructure, elsewhere in the Township, in lieu of providing onsite SWM. Cash-in-lieu may only be applied for water quality control requirements. Onsite water quantity control would still be required.

How much?

F.19 Stormwater Management Facilities Design Specifications

SWM ponds (dry ponds, wet ponds, and constructed wetlands) shall be designed and constructed as per the MOECC Stormwater Management Planning & Design Manual (2003). The design standards contained in Table X below shall be used to complement the MOECC manual. The Township of Centre Wellington may allow for exceptions and consider alternative approaches on a case-by-case basis, if requested, and provided adequate time to review.

Table X: Stormwater Management Ponds Design Specifications

Storage volumes	Storage volumes to be as required to meet the criteria specified in Sections 2.1 – 2.3 of this document Length-to-width ratio: Minimum 3:1
Water depths	Dry ponds: Total storage depth: 1.8 m Wet ponds: Permanent pool: Minimum 1.0 m / Maximum 1.5 m Extended detention depth: Maximum 1.0 m above permanent pool Peak flow attenuation: Maximum 1.8 m above permanent pool Total storage depth: Maximum 3.3 m Constructed wetlands: Permanent pool: Minimum 0.15 m / Maximum 0.3 m Extended detention depth: Maximum 1.0 m above permanent pool Peak flow attenuation: Maximum 1.8 m above permanent pool Total storage depth: Maximum 2.1 m Forebays: Minimum 1.0 m / Maximum 1.5 m Micropools: Maximum 0.3 m below the permanent pool level
Side slopes	Permanent pool: Maximum 5:1 Above permanent pool: Maximum 3:1
Berms	Freeboard: Minimum 0.3 m above 100 year water level

Table X: Stormwater Management Ponds Design Specifications

	Top width: Minimum 1.5 m
Pre-treatment	Pre-treatment is required for all pond types Preferred methods of pre-treatment include oil and grit separators, enhanced grassed/vegetated swales, and/or filter strips Areas subject to the collection of contaminants or spills shall be fitted with oil and grit separators Forebays should be used only where preferred methods are not feasible, and shall not exceed 20% of the total pond or wetland surface A treatment train approach is encouraged, particularly for dry ponds
Inlet structures	One inlet shall be provided to all SWM ponds where possible' Pond inlet inverts shall not be lower than the maximum extended detention level Headwalls and grating shall conform to OPSD Rip rap underlain with geotextile to be provided at pond inlet, crossing the width of the headwall and extending 1.5 m out in both directions
Outlet structures	Minimum allowable outlet diameter: 75 mm Reverse slope pipe or perforated riser pipe outlet structures encouraged for wet facilities Erosion protection at outlets shall consist of a combination of rip rap and vegetation, with the size and depth of stone based on consultant and / or Township recommendations and subject to approval
Emergency overflow spillway	All SWM ponds shall include an emergency overflow spillway to allow drainage to safely exit the facility should the outfall structure fail or in the event of an extreme storm event (i.e. larger than the 100 year storm) The overflow spillway shall be designed to convey the Regional Event or the 100 year allowable release rate, whichever is the greater Erosion protection shall be provided along the entirety of the spillway

Table X: Stormwater Management Ponds Design Specifications

	If the emergency overflow spillway is also to be used for maintenance access, materials such as the Unilock Duramat system may be used for erosion protection Side slopes at the top of the spillway shall be 3:1 maximum, and shall have a maximum slope of 10%, if used as an access roadway
Maintenance access roadways	A 4.0 m wide, minimum 300 mm compacted Granular "A" maintenance roadway shall be provided to all pond inlets, outlets, and forebays A minimum 4.0 m wide maintenance access area shall be provided around the entire pond The maximum slope of all maintenance access areas shall be 10% The Unilock Duramat system is the preferred product for access areas where heavy vehicular loading is anticipated
Plantings	All slopes 5:1 and steeper shall be planted Native and non-invasive trees, shrubs, ground covers and aquatic plants are required in a low maintenance landscape design (See Appendix X for acceptable plant lists) For constructed wetlands, it is encouraged to incorporate a wide range of slopes and ponding depths to facilities a wide range of flora and fauna habitat conditions Shrub plantings shall discourage public access on all 3:1 slopes Shrub plantings shall discourage public access to forebay areas slopes (excluding maintenance access areas)
Groundwater	The permanent pool is to be located above the natural groundwater elevation, which is to be confirmed by a geotechnical investigation Lining of the pond bottom (or permanent pool area) with an impermeable material will be required where soil conditions are very permeable, the permanent pool level is close to the groundwater elevation, or where groundwater interference and/or contamination is a concern The type and thickness of lining material shall be based on geotechnical recommendations; however, a clay liner is preferred over synthetic materials for stormwater management facilities

Table X: Stormwater Management Ponds Design Specifications

	If a plastic or man-made liner is proposed, a 400 mm thick, 200 mm diameter rock layer is required over the liner as a warning to avoid damage to the liner during cleanout, and a concrete sump shall be provided in the forebay to facilitate forebay dewatering
Fencing	Fencing of stormwater management facilities shall, in general, be discouraged; however it may be required as determined by the Township Where residential lots back onto a SWM facility a 1.2 m chainlink fence shall be provided between the lots and the SWM block
Miscellaneous	Children's play equipment shall not be permitted within stormwater management facilities In the event that a community trail has been identified and/or required by the Township in the vicinity or adjacent to a stormwater management pond, they shall be implemented above the maximum extended detention level or 5 year storm level, whichever is greater Designated pedestrian areas shall not exceed a maximum slope of 6:1

F.19.1 Temporary Stormwater Management Facilities

In development situations where the ultimate downstream receiver(s) have not been completed, temporary onsite facilities may be required. Temporary facilities shall provide an equivalent level of quality and quantity control as per the ultimate facility. The design requirements for temporary facilities may be modified from those for permanent facilities, as follows:

- Side slopes: Maximum 3:1, all areas
- Fencing: Facility perimeter to be fenced with 1.8 m chain link on all sides with lockable access gate in accordance with OPSDs

Temporary facilities shall remain in place until the ultimate receiver has been constructed and approved by the Township.

Where a temporary SWM facility is required, the site plan or subdivision agreements will be written to require the Developer to be solely responsible for the maintenance and operation of the temporary facilities, as well as any works associated with decommissioning of the temporary facility, including the removal and disposal of sedimentation. The cost for a temporary stormwater facility, including its removal, shall be borne solely by the Developer. Securities will be required to cover the cost of any required interim maintenance and/or future removal.

F.20 Reporting Requirements

F20.1 Stormwater Management Report

The Stormwater Management Report shall include the following minimum requirements, viewed as a generic list applicable to both preliminary and final stormwater management reports:

Descriptions of:

- The existing and proposed/future land use conditions of the study area;
- The receiving system and outlet locations, including confirmation of legal status;
- SWM criteria for volume, flooding, quality, flooding, and erosion control, and the source of each criteria;
- The hydrologic and hydraulic analysis, including, but not limited to, the justification for the model selection, input parameters, assumptions, and methods/calculations; and,
- Design details of the SWM practices to be implemented in order to meet applicable criteria, policies, and guidelines.

Tables containing:

- Hydrologic parameters for existing and proposed/future land use;
- Pre- and post-development peak flows and runoff volumes at all outlets;
- Pre- and post-development runoff and infiltration volumes for all catchments;
- Stage-storage-discharge relationships for all SWM facilities; and,
- Overland flow depths and velocities at key points on roads and at outfalls.

Figures/drawings indicating:

- General location plan;
- Drainage catchment areas for existing and proposed/future land use including all external areas;

- Details of overland flow routes;
- Schematic of computer models;
- Details of all SWM facilities including cross sections and appurtenances (inlets and outlets); and,
- Details of erosion and sediment controls.

All reports and plans are to be stamped and signed by a Professional Engineer licensed in Ontario.

F20.2 Stormwater Management Drawings

The following information must be included on the engineering drawings:

- Lot and road layout with land use;
- Elevations at key points (in a contour map);
- Any surveyed constraint lines (e.g. top of bank, floodlines, wetlands);
- Minor drainage system, with storm sewers, manholes, catchbasins;
- Major drainage system with overland flow routes at key points;
- Overland flow routes;
- Details of stormwater management practices, e.g. storage facilities, and,
- Erosion and sediment controls.

All plans must clearly indicate the project name, municipal address, and legal description of the study area, and all plans must be stamped and signed by a Professional Engineer licensed in Ontario.

F20.3 As-Constructed Requirements

The Developer or their agent(s) shall certify that all SWM facilities have been constructed and are operating in general conformance with the approved plans and design report. An as-constructed topographic survey incorporated into the SWM facility engineering plans, along with any supporting calculations, shall be provided to the Township prior to assumption. The as-constructed drawings and calculations must confirm the water levels (elevations) and volumes, construction materials, and inlet and outfall structure details.

Should the Township determine that a facility is not performing according to the approved design, the Developer will be required to perform any retrofits or other changes as required to bring it into compliance prior to assumption by the Township.

F20.4 Operations, Maintenance, and Monitoring Manual

The submission of the final Stormwater Management Report must be accompanied by a separate Operations and Maintenance Manual, which is to outline the operational and maintenance procedures required to ensure the proper functioning of the facility as defined within the report. All operations, maintenance, and monitoring recommendations or requirements shall be as per the MOECC Planning and Design Manual or the TRCA & CVC LID Planning and Design Guide (2010).

The following information must be included in the Operations and Maintenance Manual, as a minimum requirement:

- The method and frequency of sediment removal.
- A list and frequency of all other regular maintenance activities that are to be performed.
- Potential safety hazards (i.e. drowning, trapping, contamination, noxious weed growth, West Nile Virus, odours, etc.) and the appropriate mitigation measures.
- Potential scenarios in which the facility may fail, and the procedures to be followed in each event, including unexpected maintenance.
- The expected quantity and quality performance of the facility under varying conditions, such as dry weather conditions, winter conditions, frequent rainstorms, and rainfall events exceeding the design capacity.
- A list of the parameters to be monitored in order to evaluate performance, including the monitoring procedures and equipment, the acceptable range of values for each parameter, trigger limit(s) which when exceeded require immediate attention because of regulatory or safety considerations, the format for logging the measured values, and recommended methods for analysis of the recorded data (monitoring plan may be subject to approval by the Township, MOECC, and GRCA).
- A breakdown of the estimated annual maintenance and operating costs.
- Winter operations for the proposed stormwater quality control facility.

F20.5 Ministry of the Environment and Climate Change Environmental Compliance Approval

Prior to final acceptance, the Developer must ensure compliance with the MOECC ECA requirements.

G STREETLIGHTING

~~Streetlighting is to be designed to meet the requirements outlined within the "Streetlighting Design PF-8 Standard"~~

Design Drawings are to be prepared indicating how the required photometric standards have been met.

G.1 Ornamental Streetlighting

Within residential subdivision, Subdividers have the opportunity to install ornamental streetlighting as an alternative to the standard municipality approved streetlighting equipment. The Subdivider shall confirm whether ornamental lighting will be used for the subdivision prior to servicing. The Township has established a standard for ornamental roadway streetlighting in new plans of subdivision regarding illumination levels and equipment.

The following conditions and responsibilities shall apply.

G.1.1 Approval

Consent

- The Subdivider will obtain consent from the Township for installation of the approved ornamental streetlighting equipment.
- The Subdivider will proceed based on use of Township approved ornamental streetlighting.
- One factor that will determine if ornamental lighting would be permitted will be the type of lighting that has been installed in adjacent plans of subdivision (if present). The intent being that on connecting streets, between plans of subdivision, the lighting style will be consistent. The use of standard or ornamental roadway lighting throughout the development will be as directed by the Township having jurisdiction. Where possible, Subdividers are encouraged to work together on proposals for lighting for adjacent plans

G.1.2 Financial

Initial Capital Cost

The Subdivider will be responsible for 100% of the capital cost for ornamental street lighting equipment as well as any additional engineering design costs, including extra poles for closer spacing.

Maintenance

- In view of the substantially higher capital cost of the upgraded ornamental street lighting equipment and increased maintenance costs over the normal Township approved standard, Subdividers are required to contribute a one-time cash contribution towards future maintenance and replacement costs. The contribution will be equal to 10% of the capital equipment cost plus applicable taxes for such equipment or minimum of $2,000.00, whichever is the greater, prior to Initial Acceptance of the subdivision stage underground services. The contribution will be paid directly to the Township. The Subdivider will include, along with payment, copies of all invoicing from the streetlighting supplier.
- The Township will fund 100% of all maintenance costs for streetlighting within its jurisdiction after each subdivision development's streetlighting electrical system is energized.
- The Subdivider will fund 100% of all maintenance costs prior to electrical energization of the subdivision streetlight system. This includes costs due to theft, vandalism, and damage caused by construction.
- Costs relating to maintenance required prior to energization will be charged on a time and material basis to the Subdivider. Replacement equipment for emergency maintenance purposes shall be billed to the Subdivider.

G.1.3 Design

Equipment Selection

Selection of ornamental streetlighting equipment will be limited to the Township's approved equipment. Substitutions of equipment will not be accepted unless approved in writing by the Township.

Subdivider Responsibilities

The Subdivider shall provide the streetlighting photometric design layout of the development and supply drawingswhich detail:

a. Luminaire mechanical and electrical details.
b. Pole construction and installation details.
c. Overall layout and dimensional locations of all poles and luminaries along roadway allowance. Locations are to be reviewed and approved by the Subdivider in regard to location conflicts with driveways, services and other street furniture.
d. Light level calculations to confirm that the roadway and intersection lighting levels will meet the Township's standard. ~~See attached Tables 1 & 2 for recommended values from ANSI/IESNA RP-8-00.~~ The streetlighting design including that for intersections, pedestrian areas and bikeways shall comply with ANSI/IES RP-8-14 or latest version thereof. Light trespass at property lines shall follow recommended values outlined under IES RP-33-14 or latest version thereof. It is the Township's intent to illuminate the areas using the minimum lamp wattage that will achieve the desired level at a reasonable luminaire spacing of approximately 35.0 – 45.0 metres. Over-illumination of areas, in view of luminaire wattage standardization by the Subdivider, will not be permitted.
e. The preferred layout of poles and luminaries is on both sides of the roadway in a staggered pattern. ~~Exceptions shall be on divided median roadways and at intersections.~~

G.1.4 Construction

Purchase, Shipping and Storage of Streetlighting Equipment

a. Subdividers will be responsible for purchase and storage of ornamental streetlighting equipment associated with each stage of subdivision development.

b. The Subdivider will confirm with the equipment supplier the information needed to purchase the required ornamental streetlighting equipment for each development. Information will include manufacturer, model number, style and quantities.

c. The equipment referred to above shall include (but not necessarily be limited to) poles, luminaries and support brackets.

d. The Subdivider will store and make accessible, all equipment in a secure location on the subdivision development site. Disposal of equipment packaging material shall be the responsibility of the Subdivider.

e.

Installation

An approved contractor will make all necessary installations of equipment associated with streetlighting on the public right-of-way within the development.

The Subdivider shall make all necessary installations of lighting as required in the following areas:

i) Public walkways;

ii) Parks, and
iii) Privately owned lands or developments.

The Subdivider shall co-ordinate other construction activities of the development with installation of the streetlighting system.

G.1.5 Material Selection

The specifications below are the approved ornamental streetlighting equipment for the Centre Wellington. The Subdivider is to confirm all ordering information with the manufacturer before purchase.

Luminaire Option 1

Manufacturer:	King Luminaire Inc.
Style:	Washington – K118R
Optical System:	External Optics Rippled Polycarbonate globe
~~IES Lighting Classification:~~	~~Type II~~
Wattage:	~~HPS-70W or HPS-100W (to suit road classification)~~
	LED Light source at 3000K
Lamp Socket Type:	Mogul
Input Voltage:	120 Volts AC
Ballast Type:	CWI constant wattage isolated secondary
Wiring Accessories:	Quick disconnect wiring harness
Globe Ring Assembly:	“Rotolock” tool free globe removal c/w globe hanger and globe hanger hook
Pole Adapters:	K5 / K9 Capital (for use on single pole top locations to accept a 7 inch OD tenon)
	K16 Capital (for use with poles having KA65 Lansing twin arms and single locations on Hydro poles (using K69S brackets with 3.5 inch OD tenons)
Ornamental Accessories:	GR General Electric Ring (gold), and #1 Top Finial (gold)
Paint Colour:	Black

Bug Rating

Pole

Manufacturer:	King Luminaire
Type:	KT14 Talisman, KT13 Talisman (for twin arm)
Finish:	E10 Eclipse Etched Finish
Colour:	Midnight Lace E-10

Bracket

Manufacturer:	King Luminaire
Twin Arms:	KA65-Lansing Arm
Single Arm:	K69-S (for mounting on KW Hydro poles)

Luminaire Option 2

Recommended Values from ANSI/IESNA RP-8-00

Table 13: Recommended Values from ANSI/IESNA RP-8-00						
Road and Pedestrian Conflict Area		**Pavement Classification (Minimum Maintained Average Values)**			**Uniformity Ratio E_{avg}/E_{min}**	**Veiling Luminance Ratio L_{vmax}/L_{avg}**
Road	**Pedestrian Conflict Area**	**R1** lux/fc	**R2 & R3** lux/fc	**R4** lux/fc		
Freeway Class A		6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Freeway Class B		4.0/0.4	6.0/0.6	5.0/0.5	3.0	0.3
Expressway	High	10.0/1.0	14.0/1.4	13.0/1.3	3.0	0.3
	Medium	8.0/0.8	12.0/1.2	10.0/1.0	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Major	High	12.0/1.2	17.0/1.7	15.0.1.5	3.0	0.3
	Medium	9.0/0.9	13.0/1.3	11.0/1.1	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Collector	High	8.0/0.8	12.0/1.2	10.0/1.0	4.0	0.4
	Medium	6.0/0.6	9.0/0.9	8.0/0.8	4.0	0.4
	Low	4.0/0.4	6.0/0.6	5.0/0.5	4.0	0.4
Local	High	6.0/0.6	9.0/0.9	8.0/0.8	6.0	0.4
	Medium	5.0/0.5	7.0/0.7	6.0/0.6	6.0	0.4
	Low	3.0/0.3	4.0/0.4	4.0/0.4	6.0	0.4

Table 14: Recommended Illuminance for the Intersection of Continuously Lighted Urban Streets from ANSI/IESNA RP-8-00 (Based on the values In Table 1 for R2 and R3 pavement classifications)

Functional Classification	Average Maintained Illumination at Pavement by Pedestrian Area Classification lux/fc			E_{avg}/E_{min}
	High	Medium	Low	
Major/Major	34.0/3.4	26.0/2.6	18.0/1.8	3.0
Major/Collector	29.0/2.9	22.0/2.2	15.0/1.5	3.0
Major/Local	26.0/2.6	20.0/2.0	13.0/1.3	3.0
Collector/Collector	24.0/2.4	18.0/1.8	12.0/1.2	4.0
Collector/Local	21.0/2.1	16.0/1.6	10.0/1.0	4.0
Local/Local	18.0/1.8	14.0/1.4	8.0/0.8	6.0

H LOT GRADING

H.1 Purpose

The purpose of Lot Grading is to ensure individual parcels or properties are designed to minimize the impact precipitation events have on that parcel or property and the surrounding area. The design is based on an overall stormwater management and grading plan and interpolated by the designer at an individual lot level.

The design shall:

- Follow the Drainage Act;
- Ensure surface drainage from or on adjacent lands is accommodated or not adversely affected;
- Grading, drainage and building construction should be such that unanticipated stormwater does not enter the sanitary sewer system;
- Grading and drainage on lands developed should be congenial with nature and thus preserve the natural terrain as much as possible, and
- Grading and drainage schemes shall include erosion and sediment control measures. Refer to Section H of the Development Manual.

H.2 General

Lots, including drainage ditches and swales, are to be completely top soiled and sodded with a minimum 150mm of topsoil. The soil depth for all tree planting areas will meet the requirements of the Tree Planting Plan and the requirements of Section J of the manual.

All surface drainage, including downspout discharge, shall be diverted away from the building(s), including adjacent existing or future buildings.

Grade areas to:

- Provide proper surface drainage and maximum usable land area;
- Preserve existing trees where possible; and
- Direct flows away from buildings.

Front yard grades shall be:

- Minimum yard slope of 2.0%;
- Optimum yard slope of 4.0%, and
- Maximum yard slope of 6.0%;

Rear yard grades shall be:

- A minimum of 6m of the rear lot area from the back of the house shall be graded between 2% to maximum 6%.

From House to Side Lot Lines grades shall be:

- Minimum slope of 2.0% (always away from the house), and
- Optimum slope of 4.0%.

Driveway grades shall be:

- Minimum driveway slope of 2.0%;
- Optimum driveway slope of 4.0%, and
- Maximum driveway slope of 8.0%.

Walkway grades shall be:

- Minimum cross slope of 2.0% (where gradient is less than 2.0%), and
- Maximum walkway gradient and cross slope of 5.0% (combined).

Paved Utility Areas are required for the placement of Hydro boxes, cable/telephone boxes and are located in the Township Right of Way and shall be installed by the Utility. The Paved Utility Area grades shall be:

- Minimum paved utility area slope of 0.5%;
- Optimum paved utility area slope of 1.0%, and
- Maximum paved utility area slope of 6.0%.

Lot grading shall be designed in accordance with the following Centre Wellington Standard Drawings:

- Lot Drainage Type ‘A’ (Standard Drawing 400)
- Lot Drainage Type ‘B’ (Standard Drawing 401)
- Lot Drainage Type ‘C’ (Standard Drawing 402)
- Lot Drainage Type ‘D’ (Standard Drawing 403)

H.3 Rear Yard Catchbasins

- The maximum distance from the swale high point to the rear yard catchbasin shall be the lesser of 50.0m or three (3) single family lots, unless otherwise approved by the Director of Engineering Services;
- Rear yard catchbasins shall not have sumps;
- Rear yard catchbasins and outlet pipes shall be located entirely on one (1) lot, and
- Easement requirements for rear yard catchbasins and leads shall be as per the table below.

Table 15: EASEMENT REQUIREMENTS	
Size of Pipe	**Minimum Width of Easement**
250mm to 375mm	5.0m
450mm to 1500mm	6.0m
1650mm and up	6.0m plus 3 times O.D. of Pipe

H.4 Swales

Swale grades shall be:

- Minimum longitudinal swale slope of 2.0%;
- Maximum longitudinal swale slope of 8.0%;
- Optimum side slope of 6:1; and
- Maximum side slope of 3:1.

Swale Length:

- The maximum length of a swale shall not exceed 50.0m.

Swale Depth:

- Minimum swale depth is 150mm.

A cross-section of a swale is provided on Standard Drawing 404.

H.5 Roof Leaders and Sump Pumps

Roof drain connections to storm laterals are expressly prohibited. Roof drains should discharge to the front of the building to grade, with flows directed away from the building foundations and without erosion or inconvenience to others, except where infiltration facilities are connected. Unless otherwise approved by the Township Engineer, run-off from roof drains shall flow across pervious ground surfaces prior to entering the storm systems.

Note: All foundation drainage must be directed to sump pumps and discharged to grade or a storm lateral if so installed.

H.6 Groundwater

Minimum 0.6m separation is required between the underside of the footing to seasonally high groundwater elevation. In conjunction a third pipe ground water collection systems may be permitted to create the required separation at the discretion of Centre Wellington - to be installed to lower existing groundwater elevations to achieve the required groundwater separation.

Subdivision applications are to demonstrate difference of elevation between seasonally high groundwater elevations to the underside of footing elevations. This is to be submitted at time of Draft Plan and updated during detailed design (minimum two year groundwater elevation monitoring at time of detailed design submission, however some sites may require additional monitoring requirements).

Where lots are proposed within an area of concern, the geotechnical consultant shall provide the minimum underside of footing elevation for those lots, and is to be shown on the lot grading plan. A letter is required from the geotechnical consultant certifying the minimum elevations as correct.

Infiltration systems that will be assumed by the Township are to be accepted as a whole for the subdivision after 95% build out, or as outlined in the Subdivision Agreement.

I EROSION & SEDIMENT CONTROL

I.1 Erosion and Sediment Control

Erosion control is a preventative measure and is defined by keeping soil on the project site through reduced grading of areas, timely re-vegetation, cover and erosion protection. Sediment control is a mitigation measure which stops silt migration once it has commenced. A multi-barrier approach is preferred.

To this end, soil erosion and sediment movement must be minimized and controlled in accordance with the latest requirements of the Grand River Conservation Authority..

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

All erosion and sediment controls are temporary applications constructed prior to any land grading or disruption activities on the site. They shall be inspected and maintained by the Subdivider's Consultant for the duration of the construction period, including building construction or until the site is stabilized.

Based on the above, no silt can leave the site or impact any waterways, wetlands or environmentally significant lands that cross or are adjacent to the site. At a minimum, silt fence shall be erected along the property limits. Mud mats will be required at construction access points to limit the amount of silt and dirt entering the roadway. The silt fence shall be maintained throughout the year and replaced on a need to basis.

All disturbed ground left inactive shall be stabilized by seeding, sodding, mulching or covering, or other equivalent control measure. The period of time of inactivity shall not exceed 30 days, unless otherwise authorized by the Director of Development Engineering.

Winter grading may be permitted at the sole discretion of the Director of Development Engineering; however, a sediment and erosion control plan shall be submitted to the Director of Engineering Services.

All Erosion and Sediment Control Facilities are to be inspected by the Consultant once a week, after each rainfall in excess of 25 mm and after a significant snowmelt. Daily inspections are required during extended rainfall or snow melt periods. These inspections are to ensure that the facilities are in proper working condition and all damaged Erosion and Sediment Control facilities are to be repaired and/or replaced within 48 hours of the inspection. A permanent record of these inspections must be forwarded to the Development Engineering staff within five (5) days of the inspection. Please see Centre Wellington website for a sample Inspection and Monitoring Sheet

Sediment basins are a permitted sediment control measure within the Grand River Conservation Authority watershed. All sediment basins are subject to review and approval by the Grand River Conservation Authority. Should the sediment barrier be breached, the Consultant shall contact the Township and Grand River Conservation Authority immediately and a restoration plan shall be proposed within 24 hours.

I.2 Topsoil Stockpile Protection

Topsoil stockpiles containing more than 100 m^3 of material shall be located a minimum of 10.0 m away from the roadway, drainage channel or an occupied residential lot, and a minimum of 2.5 m from the property lines. The maximum side-slopes for topsoil stockpiles shall be 1.5 horizontal to 1.0 vertical. The stockpiles shall be protected by heavy duty silt fence (OPSD 219.130) for stockpiles as per the Grand River Conservation Authority ESC Guidelines.

Topsoil Stockpiles can be located on blocks owned by the Developer. The topsoil has to be removed and block graded to approved grades prior to conveyance to the Township. Topsoil Stockpiles can also be located on private lands between houses and on rear yards.

Runoff from all topsoil stockpiles shall be controlled by a sediment control fence or other approved devices.

J PARKS & MULTI-USE PATHWAYS DESIGN STANDARDS

J.1 Community Planning Context and General Guidelines

Parks and Open Space policies are described in the Official Plan and Centre Wellington Parks Masterplan.

J.1.1 Parks Classification

Parks have been described with the following hierarchy of use and land requirements. Planning and Development services will verify provisional verifications.

J.1.2 Townshipwide Parkland

- To be provided as may be required to meet special community-wide needs and serving Township-wide functions such as a fairgrounds or major indoor and outdoor recreation complexes.
- Intended to serve as unique destination points drawing residents from the Township-wide urban and rural populations as well as visitors from beyond the boundaries of the Township.
- No defined size but likely to be large blocks of land. Park size will vary depending upon intended program and function of facilities to be included. Size of Township-wide Parks to be determined through future studies undertaken by the Township in partnership with community stakeholders.
- May feature civic, historic, cultural, recreational and heritage significance

J.1.3 Community Parks

- To be provided at a rate of 1.2 hectares per 1000 population.
- May be between 2 to 8 hectares in size but not normally be less than 4 hectares in size to facilitate efficient complexes of at least 2 athletic facilities.
- Community Parks are intended to serve a greater community or series of neighbourhoods.
- To be situated with appropriate separation to other Community Parks.
- May contain illuminated major sports fields, field houses, indoor recreation facilities and parking.
- To have frontage on an arterial road with minimum 100 metres of continuous frontage.
- Shall generally be integrated with one secondary school or up to 2 elementary schools where possible.
- Where possible to be integrated with Stormwater Management ponds

- Where possible will be integrated with natural features and will assist in the conservation and protection of those features through the design of park program and landscape.
- Where possible include clearly defined entrances to the local trail system integrating trail head locations into the designs of the park.

J.1.4 Neighbourhood Parks

- To be provided at the rate of 1.0 hectares per 1000 population.
- Shall not normally be less than 1.6 hectares in size except where smaller parks and local greens are Township-approved within a development.
- Optimum size 2.0 hectares for provision of 1 unlighted athletic facility will be encouraged.
- Neighbourhood Parks are intended to serve the local neighbourhood with walk-to playground facilities.
- To be located centrally within the neighbourhood they are intended to serve.
- To be located within an 800 metre walking distance for the majority of residents within the local neighbourhood, without crossing any arterial roads or natural barriers.
- To have frontage on a local or collector road, minimum 60 metres continuous frontage.
- Will generally be integrated, where deemed appropriate, with one elementary school, except local greens or smaller parks as may be approved in the community design of a plan area, and where possible with natural features to assist in the conservation and protection of those features through the design of park program and landscape.
- Where possible, include clearly defined entrances to the local trail system integrating trail-head locations into the designs of the park.

J.1.5 Open Space Linkages

Parkland, as described above in all three categories is primarily intended to ensure sufficient tableland park for active recreational pursuits. Hand in hand with this dedication of parkland, are the goals of environmental stewardship and conservation. Dedicated parkland is to provide valuable physical and visual linkages to the open spaces of the Township-wide natural heritage systems. Parkland shall be linked directly with open space (including storm water management facilities) and preserved environmental areas wherever appropriate, and the design of such parkland is to be environmentally responsible and is to reflect the context of the surrounding natural landscape.

Although natural landscapes occur throughout the valley lands, wetlands and non-urban areas of the municipality; passive natural areas, woodlands, environmentally sensitive areas and other natural heritage features may also occur on tableland property. Such tableland natural landscapes may be protected through mechanisms of Official Plan policy and through policies of the Regional Municipality and Conservation Authority thereby not requiring dedication as parkland under the provisions of the Planning Act. Parkland conveyance is encouraged to further protect such valuable natural assets through the sensitive and thoughtful dedication of parkland in community planning and land use design.

A clear distinction is to be made between what is preserved natural tableland by policy; and the legislated and regulated areas of lowland open space and other hazard lands intended for conservation and protection purposes. In addition to connectivity of parkland, it is the objective of the Township to provide walkway linkages and trail systems for pedestrian and bicycle use connecting parkland with valley-lands and other open space greenways wherever practicable and compatible with environmental conditions. Trail linkages may also extend to the street system for access and continuity of the trail system as an active transportation system where deemed appropriate by the Township.

J.2 Assembly of Community Parkland

J.2.1 Dedication Through Development

Parkland, as described above in all three categories is primarily intended to ensure sufficient tableland park for active recreational pursuits. Hand in hand with this dedication of parkland, are the goals of environmental stewardship and conservation. Dedicated parkland is to provide valuable physical and visual linkages to the open spaces of the Township-wide natural heritage systems. Parkland shall be linked directly with open space (including storm water management facilities) and preserved environmental areas wherever appropriate, and the design of such parkland is to be environmentally responsible and is to reflect the context of the surrounding natural landscape.

Although natural landscapes occur throughout the valley lands, wetlands and non-urban areas of the municipality; passive natural areas, woodlands, environmentally sensitive areas and other natural heritage features may also occur on tableland property. Such tableland natural landscapes may be protected through mechanisms of Official Plan policy and through policies of the County and Conservation Authority thereby not requiring dedication as parkland under the provisions of the Planning Act. Parkland conveyance is encouraged to further protect such valuable natural assets through the sensitive and thoughtful dedication of parkland in community planning and land use design.

A clear distinction is to be made between what is preserved natural tableland by policy; and the legislated and regulated areas of lowland open space and other hazard lands intended for conservation and protection purposes. In addition to connectivity of parkland, it is the objective of the Township to provide walkway linkages and trail systems for pedestrian and bicycle use connecting parkland with valley-lands and other open space greenways wherever practicable and compatible with environmental conditions. Trail linkages may also extend to the street system for access and continuity of the trail system as an active transportation system where deemed appropriate by the Township.

J.2.2 Location of Parkland Within Planning Areas

Parkland will be consolidated in a location deemed most appropriate by the municipality for the population it is intended to serve, in the interest of good community planning and the preservation and integration of the natural environment regardless of the disposition of land ownership. Parkland as a result may become a joint conveyance from two or more ownerships. In such instances where multiple landowners are involved in the conveyance of a park, the owners are to attempt to reach agreement as to their cost-sharing and performance obligations

under the subdivision agreements or other planning requirements of the Township with regard to the conveyance; thereby avoiding the need for mediation from the Township in this regard.

J.2.3 Parkland Acquisition

If land required for a park and its anticipated program exceeds the available parkland dedication from development under policy, the Township may choose to acquire the balance needed, ensuring that the park location and configuration satisfies the Township's standards for facility layout, setbacks, and orientation. Such land will be subject to the same performance standards as the surrounding conveyance and developers shall be responsible to ensure the lands are free of encumbrances, fully prepared as described herein and in a condition acceptable to the Township.

The Township will acquire such lands in fair and reasonable manner in consideration of policy, market value for un-serviced developable land and open negotiations with ownerships.

J.2.4 Parkland Conveyance and Registration

The timing of conveyance of parkland in accordance with the Planning Act will be stipulated in the
Subdivision Agreement. The Township will require conveyance be made to the municipality during registration of the first phase of a subdivision. Condition of the land to be conveyed shall be
as described herein or as stipulated in the Subdivision Agreement. If as a matter of necessity, and
with the agreement of the Township, conveyance is to occur later in the development process, the Township will secure a letter-of-credit for the value of lands to be conveyed. The Subdivision Agreement where possible is to identify development sequencing and the developer shall to the best of his ability supply the Township with an approximate schedule of timing for the development to allow the
Township to forecast capital investments and manage expenditures and updating of financial planning
under the Development Charges By-law.

J.3 Park/School Campus Development

J.3.1 Campus Layout

Where deemed advantageous and appropriate in community planning, the Township will endeavour to site parks and schools together in a campus layout for the benefit of continuity of public land uses, efficiency in layout of structured recreational facilities, and for the purposes of integrating or sharing facilities wherever practicable. The Township will consider the size of applicable parkland in the potential relationship with adjoining school facilities. In accordance with policy of the Official Plan and Master Plan, Neighbourhood Parks larger than 2 hectares may generally be located adjacent to one elementary school, and Community Parks greater than 5 hectares may be located adjacent to one secondary school or a maximum of two elementary schools. Smaller Neighbourhood Parks will not be considered for a campus with

adjacent schools as they are intended for local, low intensity use and will be of insufficient size and function to withstand the impacts of over-use typically generated by school populations.

The Township of Centre Wellington promotes the efficient utilization of publicly controlled parks and open spaces. In recognition of the efficiencies of joint use and campus design, the municipality encourages avoiding the installation of boundary fencing or other physical barriers at park/school boundaries; except trees and/or other naturally occurring features. Design of such campuses through site plan control and park design shall be developed to avoid unnecessary duplication of drainage and grading features between adjoining sites; creating an integration of design for structured recreational facilities and site features and amenities. In such planned campuses, consideration shall be given to allow the park to be developed

independently should the applicable school board decide not to develop a school at its option. Such parks may be reconsidered by the municipality as to their role and function within the community area upon clear notice that a school shall not be developed. Planning for parks is to anticipate this eventuality and the disposition of school sites within a plan of subdivision may include options for full or partial acquisition by the Township contingent upon conditions and terms of the subdivision agreement.

J.3.2 Shared Facilities

To further the objectives for efficient utilization of publicly controlled land and open spaces, the Township of Centre Wellington encourages its agency partners to consider joint-use of public lands and assets. Where deemed to be in the best interest of the parties, the Township and School Boards may choose to share facilities across a common boundary within a park/school campus to provide operational and program advantages to each agency. In such instances, the Township and applicable Board may establish a mutual agreement for the purposes of negotiating the costs of capital development and future maintenance of such shared facilities. Such agreements shall ensure clarity for the parties with regard to land dedication and capital investments as they may pertain to Development Charge funding and park development (as attributable to service level calculations of future Development Charge By-laws). The Township will encourage joint-use of park/school facilities where there is no obvious interference with normal site function for either party.

Joint use is considered as an advantage to the community as a whole; increasing useable green space for residents while limiting the need for repetitive facilities, particularly in paved areas for parking and recreational play-court facilities. In principle, no permit cost will be charged between the parties for shared facility usage except if the costs of grounds maintenance and repair are unduly affected for one of the agencies. Such mutual agreements shall consider insurances and liabilities and the maintenance implications of the campus. It is suggested that such agreements be reviewed and modified from time to time as may be required to ensure fairness for the parties and the reasonable management of operating costs.

J.4 Tree Preservation

NOTE: This section to be cross referenced with the Centre Wellington Urban Forest Strategy

J.4.1 Tree Preservation Plans

Owners of lands subject to development shall be required to submit a Tree Preservation Plan and Arborist's Report for tableland forest units or individual trees within or adjoining the lands, to the approval of the Township. Tree Preservation Plans and Arborist's reports shall clearly indicate the specific measures and practices required from the owner and its agents for the effective preservation of trees and forest units identified for practical preservation in the post development scenario.

Tree Preservation Plans are to be produced in a timely way in step with engineering design for the lands in order that engineering for the lands not unduly prejudice the ability to effectively preserve trees and woodland units of significant value to the community. Tree Preservation Plans shall be produced in accordance with applicable Township policy documents and the requirements and conditions of the Draft Plan of Subdivision or Site Plan Approval processes and any applicable policies of the County and Conservation Authority. Pre-servicing or construction activity within a development plan may proceed only with approved Tree Preservation Plans in place and shall be conducted with regard to and in conformity with the approved Tree Preservation Plans.

Draft Approved Plans of Subdivision may contain tree preservation in conjunction with a Park Block or Open Space. Prior to the start of any type of construction activity for the development of the lands, tree preservation measures as described by the approved Tree Preservation Plan shall be installed and inspected and approved by the municipality. Preservation measures and fencing are to be routinely inspected and repaired/replaced as required for the duration of the construction process.

J.4.2 Compensation for Tree Removal and Loss

NOTE: This section to be cross referenced with the Centre Wellington Policy

The Township will require financial compensation for the removal or damage to trees identified for preservation or in compensation for development where clear cutting of tableland forest units is required. In cases of unauthorized tree removal, the amount of financial penalty will be based on the valuation methodology outlined in the Township Policy or By-law

Compensation for tree removal enabling development of a property will be valuated on a case by case basis, acting reasonably consi d9er ing variables of density, species, area in question and quality of trees affected. The Township will request or require that trees removed or damaged be compensated within public initiatives for re-forestation and rehabilitation of natural landscape.

J.4.3 Conveyance of Woodlots, Maintenance and Acceptance

Prior to acceptance of a tree preservation area by the Township, the developer will convene site inspections with Township forestry staff to ascertain the extent of required arboriculture work, hazard tree removals and what general maintenance work is required for acceptance. This may include hiring the professional services of a Certified Arborist for pruning of dead branches, removal of hazard trees identified as risks to people or property, site clean-up of all debris and garbage, and removal of any other hazards identified. Completion of such works shall be considered in the release of letters-of-credit for the subdivision. The tree preservation area will be conveyed and assumed by the Township only after inspections and acceptance for compliance with Township standards. These arboriculture standards are to also be applied to preserved vegetation that will be retained in private ownership through site plan or subdivision plan development. The continued maintenance and monitoring of such private preservation areas shall not be the responsibility of the Township at any time before, during or after the development process.

J.5 Stormwater Management Facilities

NOTE: This section to be cross referenced with the Stormwater Management Section

J.5.1 Storm Water Management Ponds

Storm water management facilities required for new developments shall not be acceptable as parkland dedication under the Planning Act and Official Plan. As such, storm water ponds or extended detention facilities shall be located within the boundaries of lands conveyed as tableland parks. Storm water facilities are considered as hazard lands and shall occur on lands intended specifically for such purposes. Engineering requirements of the Township and Conservation Authority shall define the land requirements and location for such facilities. Ponds are commonly located in close proximity to other hazard lands and as such may form part of a continuous open space system adjoining park facilities. In such instances, care shall be taken in the design and sizing of pond blocks to assure that any required grade transition areas do not offer undue risk to park users.

J.5.2 Storm Water and Overland Flow Facilities

If no other storm water management alternatives are available, and at the developer's expense, storm water controls such as overland flow routes may be accommodated within parks with the approval of the Township. Such requirements will be accommodated where they will not compromise the full use of the park program as planned by the Township and offer no risks to park users in the routine use of the park and its facilities. All recreational facilities must be uninterrupted and above top-of-bank

and/or the 100-year storm event. If overland flow routes cannot be accommodated without compromising the use of the park, the developer will be required to red- line the plan of subdivision to consolidate additional lands with the park to satisfy both requirements. Should there be no other engineering design solutions; and underground sewer systems or other utilities be required to pass through the vicinity of the parkland, alignments will be reviewed and approved by the Township for conformity with the park design program. Where red-line adjustment to the plan of subdivision proves unworkable, such lands encumbered by the presence of the utility or easement shall be deducted from the calculation of dedicated parkland and compensation provided to the municipality based upon the market value of serviced land.

J.5.3 Ponds and Recreation

The Township encourages the use of storm water ponds for additional purposes of continuity of green space and to potentially provide pedestrian linkages to adjoining open space systems, provided such use can be accommodated with appropriate public safety. Storm water management facilities are viewed as open space assets to the community and are to be part of the public land system of open spaces. Their design will consider opportunity for recreational uses such as pedestrian trails or linkages to larger trail networks within the open space system and shall also provide opportunities for interpretation and public education regarding the purposes and roles of storm water facilities.

J.5.4 Ponds as Natural Systems

Ponds are to be designed as naturalistic landscapes utilizing native plant materials and planting designs that emulate the natural environment of local plant communities. Where ponds are a continuation of adjacent natural landscapes they shall be designed to extend any readily apparent natural system of forest or meadow community. Where the edges of an existing habitat are dominated with invasive or exotic species of plant the development of the pond shall ensure the removal of such species and the replacement of foreign vegetation communities with native planting design for the purpose of rehabilitation of the land.

J.5.5 Urban Area Pond Aesthetics

When storm water ponds are situated within an urban area of high visibility within the streetscape, their design will provide a complementary design with high quality of aesthetics and present a visual benefit to the community. The shared boundary of the pond and street shall feature a continuous maintenance strip of sod at least 3.0 metres in width and safe and manageable grading with slopes with a steepness of 5:1 or less. Designs of this type of pond shall still be dominated by native selections of plants and will provide the opportunity for the integration of streetscape features, community theme elements and trail connections where appropriate.

J.5.6 Landscape Maintenance

All pond designs are to be developed with an emphasis on sustainable design utilizing locally available and recycled materials wherever possible. In general terms ponds are intended to appear to be natural landscapes and are to be designed to minimize maintenance requirements for the municipality. The hierarchy of maintenance is to be clearly understood by the public and designs are to provide a clear maintainable interface (mowing strip) with any adjoining fence-lines of residential properties. Township standard restrictive warning signage will be supplied by the developer and posted for warning purposes upon the initial excavation of the pond and prior to occupancies for the subdivision or site plan development.

J.6 PARK DESIGN AND DEVELOPMENT

J.6.1 General Requirements

The following section describes the general requirements of development interests in the condition, pre-servicing and physical development of lands to be conveyed for public use as parkland. These requirements are further to any conditions and requirements outlined in the subdivision agreement and its schedules, site plan agreements, Zoning By-laws, along with those required as a component part of the Development Charges By-law and its related supporting documentation. In the case were requirements overlap or vary, the Township shall be the sole arbiter of what requirements will be required for development on a case by case basis.

J.6.2 Pre-development Condition of Parkland

Municipal property preserved as open space or intended for parkland development will not be used for the purposes of temporary stockpiling or storage of earth, construction supplies, debris or any other materials without express permission of the Township. Upon the initiation of development activity, designated parks and open spaces will be routinely monitored by Township inspectors for activities of dumping or burying of any sort of garbage or waste and should such materials be discovered in the construction of the future park, the developer will be required to remove such materials at no cost to the Township.

Designated parkland and open space will not be used for the erection of advertising signage or for the storage construction trailers or construction equipment. The developer will maintain pre- serviced parkland in a clean condition at all times until the park is accepted by the municipality for the purposes of park construction. Once designated lands have been pre- graded and pre-serviced they shall be defined and protected at their boundary with fencing to the satisfaction of the Township.

The lands shall not be utilized for the stockpiling of topsoil stripped from the subdivision except in such quantities as may be required for the finishing of the park. Upon completion of pre-grading, the developer is to provide a survey plan, prepared by a registered Ontario Land Surveyor, describing the as-built topographic condition of the park. The survey is intended to demonstrate that the park pre-grades reflect as closely as possible the intent and designed geodetic elevations of the subdivision engineer's grading and drainage plans.

It is the intent of the Township, with the cooperation of the developer to reduce disturbances to the park and those who reside in the vicinity and to take advantage of available economies of scale and cost efficiency by limiting the need for temporary restoration by the developer. In this way it is hoped that the park development process can be sequential and streamlined to allow construction by the Township or the developer immediately upon completion of pre-grading. If the park construction cannot be feasibly started within one year of completion of pre-grading, the developer will be required to provide temporary restoration of the park in the form of seeding with a seed mix suitable for the soil conditions and approved by the Township in accordance with the subdivision agreement.

J.6.3 Topsoil Stripping and Grading

Prior to grading of the park by the developer, the full depth of existing topsoil will be stripped. Topsoil stripping is to occur in logical sequence with the balance of the subdivision or phase. Topsoil, in quantities necessary for the park development shall be conserved and made available for the final grading of the park block with depths of not less than 150 mm and up to 300mm. Topsoil conserved for the park is to be tested by the developer to ensure the fertility and composition is suitable for use in park construction. Such test results are to be submitted to the Township for approval prior to the development of the park block. The developer will be responsible to ensure that sufficient quantities of approved topsoil are available for the construction of the park.

J.6.4 Soil and Topsoil Depth (This section moved from the Urban Forest section)

The Township's minimum standard for topsoil in the soil habitat zones is 150 mm. Topsoil is permitted to a maximum depth of 300 mm within these zones. The soil habitat zones (public/private front lawn, cul-de-sac, active parkland) is required to have the subsoil to be mechanically scarified to a depth of 450 mm below rough grade and amended with 100 mm of high quality compost prior to the placement of topsoil. –Prior to topsoil placement the subsoil must be free of construction material larger than 50mm diameter, debris, garbage, rocks and wood

Utilizing the approved Park Concept Plan or subsequent Grading Plan, the developer is to provide suitable structural fill below all hard-surface areas including pathways, paved recreation facilities and parking areas within the park.

Areas of structural fill are to be tested by a Geotechnical Consultant and the results of such testing submitted to the Township for information. The Developer will be required

to establish sub-grade elevations as described by the Grading Plans for the park. Where park blocks are stripped and pre- graded in accordance with subdivision engineering plans at the early stages of the subdivision development, the developer shall be responsible to execute additional grading to the park to bring the lands into conformance with the specific plans developed for the park by his landscape architectural consultant.

J.6.5 Co-ordination of Services

The developer shall at a minimum provide inlet drop structures at each frontage of the park block. These structures shall be in conformance to Provincial standards (O.P.S.D.) for the construction of manholes or manhole/catchbasins. Connections from these structures to the surrounding storm sewer system shall be of an invert elevation set low enough to efficiently drain the entire block of land below frost penetration levels. The park block shall be effectively drained in its interim pre- grade condition with inlet structures as needed for each sub-drainage/catchment area within the park block. Should the structures provided be shown to be insufficient to outlet the future internal drainage system of the park as designed, additional drop structures and road crossing connections shall be the responsibility and cost of the developer.

In addition to storm sewer servicing and as a part of the servicing requirements for sanitary, electrical and water supply throughout the subdivision, the developer will be responsible to construct services
1.5 metres into the park property as follows:

- Community Park: a sanitary sewer manhole chamber and stub; a 150mm diameter water supply line with curb-stop and 3-phase electrical power. Where the Community Park has two or more street frontages, all or some of these services are to be provided at each frontage to the park as confirmed with the Township.

- Neighbourhood Park: At the discretion of Centre Wellington staff, a sanitary sewer manhole chamber and stub; a 50mm diameter water supply line with curb-stop and 3-phase electrical power. Where the Community Park has two or more street frontages, all or some of these services are to be provided at each frontage to the park as confirmed with the Township

The above requirements for drainage and servicing are considered as a component part of the general development of the subdivision but in detail are to be separate from the developer's responsibility for any storm water management mechanisms that may be permitted within or be associated with the park. Costs for such subdivision storm water engineering works are to be entirely attributable to the developer in the development of the lands. Drainage requirements for the ultimate development of the park block will be determined in the detail design processes described herein.

J.6.6 Park Fencing

Notwithstanding the installation of temporary protective fencing of park and open space blocks, the developer is to provide a 1.5 metre (6 ft) high black vinyl coated chain-link fence, to the Townships standard detail, around the perimeter of the park along shared property lines with adjoining residential or commercial developments. The mesh fabric of the fence shall have 38mm diamond-shaped openings made from 9 gauge wire before vinyl coating. Terminal posts shall be a minimum of 88.9 mm (3 ½") OD pipe, line posts of 60 mm (2 3/8") OD pipe and rails of 43mm (1 7/8") OD pipe. All piping shall be schedule 40, galvanized steel, treated with etching primer and factory painted black. Concrete footings are to create a minimum of 150mm of cover to the edges of posts and shall be generally poured against smooth native ground and formed at the top of foundation. Where ground conditions prevent the creation of smooth sided augured post holes, footings shall poured into sono-tube for the full depth of footing to 1.2 metres below grade with voids around the outside of the form filled with compacted limestone screening. Alternatives may be considered at the discretion of Centre Wellington, at detailed design stage.

J.6.7 Securities and Acceptance

Performance of the above-referenced requirements shall be guaranteed through the provisions of the subdivision agreement and the value of the works described for the preparation of the applicable schedule/section of that agreement. The Township shall secure from the developer a letter-of-credit for the value of all work described above in this section and for any additional requirements as may be stipulated in the subdivision agreement at the discretion of the Township. The letter-of-credit will be based on a cost estimate prepared by the developer's consultants and reviewed and approved by the Township. The Township will assume responsibility for the park only at such time as the property is substantially completed under the Development

Charges Policy.

J.6.8 Park Construction by Developer

Development and/or Subdivision Agreements will require the developer to construct parks in response to timing or permissions with regard to construction of phases within a development.

Performance of park construction will be treated as any other municipally approved subdivision construction. The developer is expected to develop a park to the approval of the Township, completing the construction to a set of Township-approved technical drawings, specifications and standards. The construction tender and contract process

shall be open and the Township reserves the right to review and approve the award of the park construction tender. An agreement will be executed and a letter-of-credit will be secured from the developer to ensure timely completion to a level of quality and workmanship acceptable to the Township. Joint Township/Developer tenders may also be approved to take advantage of cost and time efficiency. The Township will reimburse to the developer the portion of costs the Township is responsible for under the Development Charges By-law within a time frame and re-payment structure agreeable to both parties in the construction agreement.

J.6.9 Park Construction Timing

Parks will generally be constructed within one year following commencement of a residential subdivision. Where the developer's phasing of a subdivision, as a result of servicing availability or other factor may delay the park construction timing within the entire subdivision. The Township will maintain capital construction forecasts for parks to the best of its ability based upon growth forecast information provided by developers and the five year trend evidenced by building permit issuance activity.

J.7 Requirements for Park Design Plans

Park Design and Facility Development

Park facilties and amenities constructed by or on behalf of the Township may include, but not be necessarily be limited to include all of the following features;

J.7.1 Township-Wide Parks

Any facilities described under the following sub-sections for Local and Community Parks may also apply to a Township park depending upon the nature of the park and its purpose in the overall parks and open space system. Township wide parks can be a variety of sizes and have a variety of purpose depending upon context and municipal setting. Regardless of this the intent is that such facilities are to be memorable places within the community whether it be for outstanding sporting and recreation facilities or for architecture, art, historical reference or cultural significance. Facility requirements and design standards will be determined on a site specific basis at the time of Park Concept Plan preparation.

J.7.2 Community Parks

Community Parks may also contain some, or all of the following park features:

- Designs shall include sustainable features including recycled products, water and

energy conservation features and locally manufactured products wherever possible
- Sports fields for Senior and Junior Play - including soccer pitches, softball or slow-pitch diamonds complete with park features and furnishings such as backstops and boundary fences, goal posts, players benches and spectator bleachers.
- Any combination of 2 or more major athletic facilities including: baseball, softball/slow pitch, soccer pitches, rugby grounds, field or box lacrosse, tennis courts, bowling greens or other structured sport facility
- Public art or historical display features
- Park identification signs and signs for information and regulations
- Shaped landforms, berms and drainage swales
- Areas of tree preservation or rehabilitation planting
- Planting designs of trees and shrubs to provide shade, interest and emphasis within the park
- Playground apparatus including junior and senior play elements with a clear emphasis on barrier-free design
- Water splash pad or other water play feature to serve a broader community area
- Basketball and hard surface multi-purpose courts
- Gazebos, picnic shelters or other seasonal structures
- Field houses/washroom buildings
- Indoor Recreation Facilities and supporting parking facilities.
- Parking on site and/or in combination with an adjoining school site
- Three-Phase Electrical Supply and walkway lighting systems with isolation circuit
- Walkway lighting and lighting for security at park structures
- Floodlighting of major athletic facilities
- 150mm water supply line, utility building for irrigation and water play infrastructure
- Sanitary sewer service to park buildings
- Landmark features of park architecture or public art
- Large areas of unstructured parkland or naturalistic landscapes linked to the surrounding community and open space system
- Trail heads and trail connections to the interconnected trail network

J.7.3 Neighbourhood Parks

- Designs shall include sustainable features including recycled products, water and energy conservation features and locally manufactured products wherever possible
- Sports fields for Senior and Junior Play - including soccer pitches, softball or slow-pitch diamonds complete with park features and furnishings such as backstops and boundary fences, goal posts, players benches and spectator bleachers.
- Play Courts for junior play, full or half courts for basketball or other sports
- Playground apparatus including junior and senior play elements
- Pathways, sitting areas and park furnishings
- Passive open grassed areas for unstructured activities
- Shade structures and park architecture
- Public art or historical display features
- Park identification signs and signs for information and regulations
- Shaped landforms, berms and drainage swales
- Areas of tree preservation or rehabilitation planting
- Planting designs of trees and shrubs to provide shade, interest and emphasis within the park
- Sub-surface storm and sanitary sewer systems

- 50 mm diameter water service and utility building for irrigation and water play infrastructure
- Single-Phase Electrical Supply and walkway lighting systems with isolation circuit

J.7.4 Park Concept Plan and Facility Fit

Working with the recommendations of the Master Plan, staff consultation and the relevant planning documents, the developer shall engage the professional services of a qualified, O.A.L.A. registered Landscape Architect to prepare a Park Concept/ Facility Fit Plan during the preliminary stages of engineering design and master servicing for the subdivision and the preparation of the Draft Plan of Subdivision.

The Concept Plan shall demonstrate, at a minimum, that:

- Park configuration and size is suitable to accommodate the park design program identified by the Master Plan as modified by the Township from time to time,
- Sufficient setbacks as depicted and described in the Township's Standard Details (Section 3.0 of this manual) are possible to buffer residents from active recreational uses.
- Setbacks for active facilities shall generally be a minimum of 20 metres from residential property to the edge of the recreational use and 15 metres from the street line of neighbouring roads. Setbacks for specific facilities are described in section 2.4.4 herein and may be listed on standard drawings.
- General setbacks shall not limit the flexibility of Township in determining larger or smaller setbacks as may be deemed reasonable for the design of individual park programs and circumstances.
- Orientation of facilities and layout meets with Township standards
- Tree preservation requirements will be addressed in accordance with the approved Tree Preservation Plans and related documents as submitted for the subdivision
- The general relationship of park grading and drainage to the surrounding subdivision conforms to Township requirements and general approval.
- Display any encumbrance made necessary by the development engineering of the subdivision

- Required services for the future construction of the park are verified and generally located on the Concept Plan
- Surface and sub-surface storm-water and sanitary drainage systems are available and can accommodate the predicted needs of the park development.
- The Developer is responsible to secure any relevant approvals from all agencies (Hydro, Pipelines etc.) that may be affected by the plan.

The developer/builder shall be required to display the approved Park Concept Plan in project sales offices. Any misrepresentation of the park design, or misleading portrayal of park amenities displayed in sales pavilions or advertising media shall be the sole responsibility of the developer/builder.

Prospective purchasers are to be encouraged to approach the Township directly for information on the timing and program of the park development.

J.7.5 Construction Drawings

At the municipality's option, the developer shall engage the professional services of an O.A.L.A. registered Landscape Architect to prepare Detail Design/ Technical Drawings to fully describe the construction of all park features. The costs of such professional services when requested are attributable to the legitimate park development costs assigned to the park project through Development Charges. The developer shall file a copy of a proposal for professional services with the Township for reference in the accounting of the project. These fees shall be distinct from those fees which may have been incurred as a developer cost in the processing of the subdivision and the production of the Park Concept/ Facility Fit Plan and subdivision engineering and servicing designs for park blocks. Proposals for professional park design fees shall anticipate up to three detail reviews by municipal staff of complete drawing packages submitted for a park development. Proposals are to receive Township agreement prior to detail design works being submitted for review.

The following drawings shall be included at a minimum for all parks to be constructed, whether by the municipality or by the developer on behalf of the municipality:

a. Existing Conditions Plan: Plans and construction drawings are to be prepared utilizing current engineering base information completed for the subdivision design along with current OLS survey information for existing legal boundaries and survey monuments and topographic features, spot elevations and contours. Such information shall include all features unique to the block of land including existing vegetation and geodetic elevations at the base of individual specimen trees.

b. Layout Plan: the plan shall present an accurate representation of all works to be constructed for the park complete with dimensions and offsets tied to known legal lines for the block. Park facilities are to be shown in conformance with the minimum standards developed by the Township for facility layout. All materials and finishes for the park development are to be labelled and construction details cross referenced to Township of Centre Wellington standards or other technical details as may be suitable and required.

c. Grading Plan: the plan shall show current geodetic information of the existing grades and conditions at 0.5 metre interval contour lines. Grading plans shall show the ultimate finished grades for all facilities and components of the proposed park. Grades shall be shown for all sports-fields and shall illustrate current standards for field grading and drainage in accordance with Township Standards. Grading design shall be done in recognition of the pre-grade conditions and structural fill preparation established for the park. The grading plan shall show all areas requiring additional engineered fill for construction of the park facilities. Spot elevations shall be shown to adequately describe all pathway construction, curbs, walls and edges and drainage swales through soft landscape areas. The grades to be achieved at drainage inlets are to be clearly shown on the plans.

d. Servicing Plan: the plan shall show all necessary underground servicing to allow for the function of park facilities in accordance with current codes and best industry practices. The Servicing plan shall show all services, connections and crossings within the park block in context to each other and the development of the park and its features. Sewer systems shall be illustrated complete with descriptions of pipe materials and dimensions as well as all pipe crossing and inlet invert elevations. Local sub-drains required for park facilities are to be illustrated as to their location and connection to the main system of drainage. Water supply systems shall be illustrated with all necessary pipe dimensions, backflow prevention devices, chambers, meters, pipe reducers and appurtenances. All cross references for details and OPSD are to be clearly understood from the plans.

e. Planting Plan: Plans will be prepared illustrating all tree, shrub and groundcover plantings proposed for the park. Plantings shall be accurately represented as to the extent of planting beds and the location of specimen trees relative to park features, servicing and paving. The planting plan shall include the contour grades of the proposed park development to ensure accuracy of context for planting.

Particular care is to be taken in the selection of plant species to conform to the details and standards of the Township Public Forest Policy and the intent for landscape development in context to the surrounding environment as expressed in Section 1 herein. Emphasis is to be placed upon the inclusion of native and indigenous species in park designs and to limit the extent of maintenance required to manage the park effectively. All areas of seeding and sodding shall be illustrated clearly by the plan.

f. Irrigation Plans and Details: Irrigation Plans are to be produced by a Certified Irrigation Designer in general conformance to the standards of the Township. The irrigation plan is to be specifically reviewed with Township operations staff to ensure the proposed equipment and controllers are complementary to existing systems currently maintained by the Township and that systems represent current technology for water conservation. The Township encourages the design of irrigation systems supported or entirely operated through the conservation of rainwater or water generated by other park facilities.

g. Electrical Plan: Plans are to be prepared by an independent electrical consultant with established municipal experience in the design of lighting systems for parks. The plan shall be prepared detailing the location and type of all walkway, parking area and sport lighting poles and fixtures. Plans and details shall be in conformance with the standards of the Township and shall reflect current rules and regulations with respect to electrical design. Electrical designs are to promote energy efficient and increased sustainability systems such as solar powered systems or LED lighting systems.

h. Construction Details: Detail drawings are to be provided to fully explain the methods of construction for all elements of the park. The details shall, at a minimum, comply with the performance standards established in the Township's construction detail standards as shown in Section 3. Other details as may be necessary to explain the full extent and implications of the park construction shall be included for the review of the municipality and its departments. Any overhead structures and load-bearing foundations are to be reviewed and certified by a Structural Engineer.

Drawings shall be prepared in a format compatible to the Township's GIS mapping systems wherever possible. Such drawings are to be submitted at the time of issuance for tender and at the completion of construction as "As-Built" records, to be retained as a permanent record for the project.

The developer will retain the services of a professional engineer to perform storm sewer design for the park including sizing of pipe, catch basin elevations and inverts, to be co-ordinated with the grading plans of the subdivision.

7.8 Design and Construction Standards

The Township of Centre Wellington has established minimum standards for park design and construction. Applicants and consultants are to assure themselves that they are working from the most current versions of these documents in the preparation of park plans and construction documents for submission to the municipality.

These details are not intended to be prescriptive in all cases but rather are intended to assure a baseline of quality which may be improved upon at the suggestion of the applicant and with the agreement of the Township on a case by case basis. The general intent of the standards is to assure the appropriate configuration and construction of recreational facilities, the design of attractive and environmentally responsible parks and open spaces and to promote cost effectiveness and the reduction of long-term maintenance and life cycle costs. The following is a discussion of park development guidelines for which these standards can apply.

7.8.1 Sustainable Design

The Township of Centre Wellington encourages the inclusion of sustainable and "green" design strategies wherever possible. Park designs are to have regard for contemporary approaches to sustainable design wherever possible. Designs shall promote the use of native plant materials; the reduction of maintenance loads and machine use; the conservation of storm water and its quality treatment in on site devices such as bio-swales and infiltration galleries; the re-use of potable water through grey- water and other water re-use systems; the use of durable recycled products for site furniture and park features.

7.8.2 Public Safety by Design

Design of park features and recreational facilities shall conform to local, provincial and national regulations and recommendations for the health and safety of park users and those who maintain park systems. The most recent C.S.A Z614 standards for playground safety as well as Township standards for setbacks and run-out areas for active sports facilities are to be applied to the design of parks. Park design shall have regard for the inclusion of the recognized approaches and principles of Crime Prevention Through Environmental Design (CPTED).

7.8.3 Design for Accessibility

It is the policy of the Township to provide barrier free access to all municipal facilities wherever it is practicable and wherever possible to design parks for the universal use and appreciation of all constituents. Park design will address barrier free access by eliminating or providing alternatives to stairs, curbs and other obstructions. Such alternatives shall be in conjunction with the primary circulation route wherever possible rather than separated by significant distances. The experience of the park is to be similar for all users. Park design will also consider the inclusion of features, activities and facilities to engage the full range of users. Integrated design elements are encouraged to provide a complete and inclusive park experience for all potential visitors.

- All park design should take into consideration appropriate Accessibility Design Guidelines
- All park facilities including athletic fields will be accessible wherever possible.
- Playground structures for Neighbourhood Parks should present opportunities for universal play
- Inclusive play areas are intended for Community and Township Wide Parks. These parks may offer associations with a Community Centre or other public building offering support for special needs requirements and may be sites for organized, inclusive, programming.
- Pavements within parks are to be barrier free. Trails are to utilize barrier free pavement surfaces to the extent possible for the type/class of trail being constructed.

- Maximum slope for ramps and walkways will conform to the Ontario Building Code and the Township Standards.

7.8.4 Site Grading and Drainage

Responsibility for site grading and subsurface drainage design is shared between the developer and Township. Grading and drainage is to be undertaken in accordance with construction drawings and specifications as prepared by a qualified Landscape Architect. Standards to which earthworks are undertaken shall respond to the structural integrity requirements of facilities and the future maintenance requirements of the Township.

- Subsurface drainage and sewer works will be installed complete with the required catch basins, manholes and connection to subdivision storm sewer system.
- Grading design is to be developed to afford sheet drainage of water wherever feasible in order to facilitate infiltration for surrounding soils. Sheet drainage shall be designed in a reasonable and sensible fashion within sub-drainage areas of the park block. It is not the intent to avoid a sewer system but to achieve balance between the use of overland flow and piped systems. Grading shall ensure that drainage is contained within the park block and is not shed onto neighbouring private properties.
- Drainage requirements of the park will be determined early in the engineering design process of the subdivision to eliminate the use of culverts. Catch-basins/ inlet structures are to be placed at sufficient intervals and in sufficient quantity to ensure that there are no areas of trapped drainage within the site and to avoid deep swales with steep side slopes.
- Engineered fill, free of Topsoil organics is required underneath all paved surfaces, playgrounds and ball diamond infields. Fill is to be placed and compacted to 95% S.P.M.D.D. in 200mm lifts. Completed filling works are to be tested and the results submitted to the Township.
- Turf-grass swales will be graded to a 2% slope along their length whenever possible. 1.5% slopes may be accepted over short distances to avoid overly steep side slopes for swales.
- Slopes and berms will be graded to a maximum 4:1 slope for ease of maintenance. Level turf-grass areas (except purpose-designed athletic fields) will have a minimum slope of 2% for drainage purposes.
- Natural turf sport fields will be graded to 1.5% slopes and crowns as described by technical drawings.
- A Minimum 150mm/Maximum 300mm topsoil layer is required under all grassed areas. Topsoil may be thicker in uniform compacted layers. A balanced grading program of topsoil stripping and sub-grade cutting and filling is to be undertaken for a park development. Trapped pockets of organic material are not to be created..
- All park areas are to be finished with fine grade and sod with the exception of preserved natural areas and areas of environmental rehabilitation.

7.8.5 Setbacks to Facilities

All recreation sport field facilities including run-out areas, playgrounds and play courts will be sited so as to ensure a minimum setback from the facility perimeter to adjacent residential property lines of 30 metres for ball diamonds and 20 metres for other

facilities. This space may contain grading, drainage and buffer planting as required to ensure the performance of the facility and the protection of adjoining facilities or properties. Athletic facilities shall be designed in consideration of the impacts of the activity of the game-play and will generally not be sited directly adjacent to roads where this setback must be increased to 40 metres or 2.4 metre high fencing provided to prevent conflict with traffic.

7.8.6 Athletic Field Facilities

Sports fields will be sited in their most favourable orientation and with symmetrical grading design. Design is to consider configurations that will minimize noise disturbance to adjacent residents. Field dimensions may vary with classification and use, but must always include the required clearance from neighbouring properties and adjacent park uses.

The relationship and foul ball risks associated with the placement of backstops will be carefully considered to avoid risk impacts on other park facilities. Lighted sports fields may be provided only in Community or Township-Wide parks and shielded, dark sky compliant lighting will be provided to prevent spillage onto adjacent residential properties. Lights will be controlled by activation circuits and timers for automatic shut-off at park closing hours.

7.8.7 Ball Diamonds

- Field measurements are to be in accordance with the appropriate Township standard detail for the level of play provided.
- Run-out area shall be 6 metres around perimeter containing no grade changes or obstacles. The perimeter of the outfield is to be assumed as extending from the line of the backstop and line fence.
- Home run fence in outfield allows run-off distance to be reduced to perimeter line.
- Home run fence to be 1.5m minimum in height.
- Optimum orientation should place home plate facing to the north-east.
- Grading to be crowned at centre-line or sheet draining from infield to outfield.
- Infield should be centre crowned from the pitching location at 2%.
- Outfield is to be centre crowned at minimum1.5% consistently from infield to outfield fence to avoid grade separation of outfield positions.
- Engineered fill is required under entire infield to sub-grade level to accept infield mixture depths, and for backstop and bleacher sitting areas.
- Topsoil depth in outfield may exceed 200mm in uniform consistent depth with no isolated topsoil pockets.
- Backstop and line fence footings are to be founded in suitable soils. Size and dimension of footings for structure bearing posts and supports are to be reviewed by a Structural Engineer based upon soils testing for the site.

7.8.8 Soccer Fields

- Field measurements are to be in accordance with the appropriate Township standard detail for the level of play provided with 5 metre run-out areas for field perimeters.
- Orientation of north-south direction between goals is considered optimal for sun orientation.
- Grading – centre-crowned and sloping to sides at maximum and minimum 1.5 % slope for natural turf fields.
- Non-crowned fields are not acceptable for senior play.
- Senior competitive fields are to be irrigated and sub-drained. Fields may be constructed of specialty sand/soil mixes where recommended and directed by the Township.
- Perimeter line markings are to be provided using powdered chalk or other environmentally safe compound.

7.8.9 Playgrounds

Playgrounds are to be set back 20 metres at their perimeter from any residential property lines. Junior play-spaces may be set back at 10 metres were approved by the Township. Play areas are to be set back from street lines of local roads by a minimum of 15 metres and 20 metres from the street line of a collector road where the boulevard will also act as a buffer. Grading around playground areas is to be designed to allow visual surveillance into the play area from the road and surroundings. No dense evergreens will be planted near playground areas where views may be obstructed and safety of users be affected.

- Playground equipment design will suit the age group intended to be served.
- Playgrounds shall include safety signage indicating the appropriate age range for the use of the equipment and contact information for the Township with regard to maintenance and security.
- Equipment to be manufactured from steel treated with a durable powder paint finish.
- Equipment design and clearances are to conform to CSA standards, latest edition.
- Play equipment and resilient surfacing is to be enclosed within a curbed/edged area, set to level to prevent the drifting of materials.
- Resilient surfacing is to conform to C.S.A. Standards for the drop-heights included in the equipment provided.
- Sub-surface drainage of flexible perforated PVC pipe in clear 10mm diameter stone drainage bed near perimeter of curb/edged so as not to conflict with play structure posts. From perimeter of enclosure the drainage pipe is to be solid PVC connected to a nearby catch basin or storm sewer at minimum 1% slope.
- Sitting areas are to be provided within hard surface area to allow for ease of supervision for the entire play area.
- Shade is to be provided through a structure or shade-trees

7.8.10 Hard Surface Play Courts

Tennis courts, basketball courts and other multi-purpose hard surface play areas will be provided in Community Parks where sufficient space separation is available to minimize noise impacts from bouncing balls on adjacent residential neighbourhoods and where a reasonable space separation is possible from children's playground equipment. Lighted play courts may be provided in Community Parks only with a timer for light control

7.8.11 Water Spray Features

Spray pads or similar water play features may be provided in Community Parks or Neighbourhood Parks. Water supply, plumbing and drainage will conform to requirements of the Township of Centre Wellington's Plumbing Permit requirements and will be housed in an above-grade utility building.

- Water supply to be potable water only.
- Water Meter, backflow prevention device and all appropriate valves as required are to be housed in an above grade utility building whenever feasible.
- Drainage to be connected to sewer system. Standing water is not to be a feature of the water play facility. The facility shall drain freely to an inlet structure(s).
- Activated by timer with manual activation and shut-off capabilities.
- Non slip pavement or non slip rubberized surface.

7.8.12 Seating Areas

Benches, waste receptacles, bicycle racks and picnic tables will be provided in park shelters, along pathways and at activity locations in support of uses within the park. Park furniture will be selected and approved on a site by site basis and in response to specific urban design and community design for the area. Furnishings for general use are to be cost-effective, durable and vandal resistant using recycled materials wherever possible. Site furniture for high profile sites and historical areas shall be selected in response to the specific design theme and historical reference of the area they are installed.

- Seating areas will be provided in association with active and intensive park uses and be barrier free.
- Trees will be planted near seating areas to provide shade for comfort of users.
- Benches selected will be comfortable, durable, low maintenance and vandal resistant.
- Waste receptacles and recycling stations will be sufficiently large to minimize the need for excessive pickup requirements.
- Site furniture will be permanently mounted
- Site furniture will provide for barrier free access.

7.8.13 Parking Areas

Typically parking lots will be paved in asphalt with a cast-in-place concrete barrier curb or defined by precast concrete/recycled rubberbumper curbs. The use of permeable pavings and designs promoting storm water infiltration for parking area construction is encouraged by the Township. Granular parking lots may be provided in less formal parklands and open spaces and where it is deemed that the characteristic of free-draining granular is more desirable. Parking stalls shall be a minimum of 3 metre x 6 metre with a 6.5 metre wide circulation lane.

- Parking lots within parks are not maintained in winter except if associated with a specific trail head area or for year round use.
- Subsurface drainage and connection to storm sewer is typically required for all parking lots enclosed by a poured concrete curb, with surface draining toward the inlet structures at 2% minimum slope.
- Poured barrier curbs shall be a minimum of 150mm above finished surface of asphalt parking lot.
- Dropped/depressed curbs are to be a minimum of 2.5 metres width and will be provided in direct association with handicapped parking stalls, with appropriate connection to walkways.
- The number of and design thereof for Handicapped parking spaces will conform to the County of Wellington Accessibility Design Guidelines
- Line painting (100mm wide) will be provided on asphalt surfaces to identify each parking stall using yellow O.P.S. standard traffic paint.
- Granular Parking Lots shall have pre-cast concrete or recycled plastic bumper curbs, each to identify one parking space.
- Curb units are to be pinned in place 300mm inside of perimeter of the parking area to afford ease of edge maintenance and grass cutting.
- Granular parking lots will be at a minimum 2% slope
- Granular base shall be a minimum compacted depth of 250mm depth of approved coarse aggregate compacted to 98% Standard Proctor Density.
- Paving surface will be two courses of asphalt (30mm HL3A and 50mm HL8).
- Compaction and materials testing is to be carried out and all base material and paving certified by an accredited testing agency.
- Gravel parking lots will have a minimum 250mm depth of approved coarse aggregate finished with a 50mm layer of 19mm crushed stone compacted to 98% Standard Proctor Density.
- Use of solar technology, where applicable, is encouraged

7.8.14 Pedestrian Walkways

NOTE: The location and design of walkways is to conform with the Centre Wellington Trails Masterplan. Consultants must reference to that document in addition to the following:

Walkways will be provided within parks to connect recreation facilities or to provide amenity and accessibility to passive areas in a convenient, safe and barrier-free manner. Parks should have a defined entrance visible within the streetscape. The park entrance should be visible and convenient with regard to access to the site and the likely desire lines expected from park users.

Park users should have a clear view of approaching pedestrian and vehicular traffic on adjacent roadways. Proper connections will be made to municipal sidewalks, roadways, and open space linkages where appropriate. Seating areas and other pedestrian pavement surfaces may be of asphalt, concrete, unit paving or combination thereof, as dictated by site conditions and design intent.

7.8.15 Tree Planting

In addition to protecting the existing vegetation that is designated for preservation within parkland, new tree planting will be provided to support existing natural landscapes, remediate and recover existing landscapes, enhance community aesthetics and design objectives for the park, provide shade and shelter for park users, define space and to generally support environmental quality. A mixture of deciduous and coniferous trees will be provided, in consideration of the facilities being accommodated and the intent of the park design.

- Emphasis is to be given to the planting of native trees and those indigenous to the area.
- Tree planting will be designed to allow visibility and surveillance into the park from the street and surrounding neighbourhood. Public safety will be considered through the principles of Crime Prevention Through Environmental Design (CPTED).
- Shade trees will be provided adjacent to sitting areas, parking lots and in other locations where comfort zones are desirable.
- Parkland will focus on accommodating a diversity of native trees, flowering species and specialty specimens which may not be typically used for street tree planting.
- Trees shall generally be a minimum 50-70mm caliper for deciduous shade trees, 2.5 metres height for coniferous trees.
- Extensive shrub planting and floral displays requiring high levels of maintenance are to generally be avoided: except where approved as appropriate as features in Community or Township-wide Parks; or as gateway features approved in accordance with the municipality's ability to maintain them.

The Developer will provide at least 1 tree and the required soil habitat zone for each residential unit built

C.2 PARKS FACILITIES AND CONSTRUCTION – STANDARD DETAILS

Township of Centre Wellington - Standard Details

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K URBAN FOREST – TREE PLANTING & ESTABLISHMENT

Note: The Centre Wellington Public Forest Policy is the overall guiding document related to development and the Urban Forest. No tree shall be removed without prior written approval from the Township of Centre Wellington. Where tree preservation has been determined to be impractical based upon consultation with the Township, the replacement of trees will be determined through review and approval by the Township of Centre Wellington of an accepted Tree Planting Plan.

K.1 Urban Forest Requirements

K.1.1 New Residential - Street Tree Planting Minimum Requirements

The Developer will provide at least 1 tree and the required soil habitat zone for each residential unit built

All tree planting on private lands must include a restrictive covenant or equivalent to protect the tree and soil habitat zone.

K.1.2 Cash-in-Lieu Payments

Where the Developer cannot meet the minimum targets for tree planting on residential streets and active parkland, the Township will accept a cash-in-lieu payment for the value of the tree/s, required soil volume/s, installation and maintenance costs established through the Letter of Credit process for large, medium and small stature trees.

Where the cash-in-lieu payment is greater than 20% of the minimum target, the Developer will demonstrate to the Township that all planting options have been considered before the Township will accept the cash-in-lieu payment. Cash-in-lieu payments to the Township will be made at the time of Initial Acceptance of the street trees.

K.1.3 Species Diversity & Selection

Species diversity and selection are key elements in the creation of a sustainable urban forest. Recognizing that cities are cultural creations, a sustainable urban forest that maximizes community benefits for the lowest cost, supports the planting of native and non-native species in the appropriate location. No one species can exceed 10% of the total planted trees. No more than 6 trees of any one species shall be planted in a row. The Township may request changes and substitutions through the design of the tree plans.

K.2 Pre Construction Process

K.2.1 Submissions & Approvals

Note: For additional information refer to the following details in Appendix C and the Centre Wellington's Operations Tree Planting & Establishment Best Management Practices Manual.

K.2.2 Draft Plan Review

At the time of Draft Plan Review, the Developer's Consultants will provide a Preliminary Tree Planting Plan showing how the minimum tree planting requirements, of 1 tree per residential unit (or other stated requirement), will be prepared for review and comment by Township Staff.

K.2.3 Street Tree Planting Plan

Street Tree Planting Plan

At the time of submission of the detailed engineering drawings, the consultant will provide the Township with a Tree Planting Plan (TPP) for review. The drawing will show the proposed: road, lot, driveway, boulevard, proposed utility locations (sanitary, water, storm, hydro, front yard infiltration facilities, telecommunications, and gas layout information) along with the all known proposed aboveground infrastructure (all street furniture including sidewalks, driveways, community mailbox locations, telecommunication pedestals, utility structure/buildings, streetlight poles, conduits, ductwork, hydro vaults, gas valves and all utility crossings).

K.2.4 Approved Street Tree Planting Plan

The landscape architectural consultant will continue to submit Street Tree Planting Plans to coincide with engineering submissions where these are revised and may affect the Street Tree Planting Plan, until the Township's Development Engineering advises that the Plan has been accepted. At this point the approved plan will become the Approved Street Tree Planting Plan.

K.2.5 As-Recorded Street Tree Planting Plan

Street trees are considered one of the assets that the Centre Wellington is required to include in their reporting of municipal assets to the federal government. In addition, street trees are part of the urban infrastructure fabric compiled from Subdivider submission requirements. .

As-Recorded Street Tree Planting Plans will be a requirement for achieving Final Acceptance on a street-by-street basis. The Subdivider's consultant team are required to submit these because a number of actions during the build-out of a stage of subdivision may cause acceptable deviations from the Approved Street Tree Planting Plan, including:

- Driveways not constructed according to plan at the decision of individual builders, necessitate street tree relocations;
- Changes to the location of other municipal infrastructure and utilities approved after the Approved Street Tree Planting Plan is achieved;
- Subdivider's contractor responds to homeowner requests for new tree plantings that were not approved;
- During the time between the Subdivider achieving the Approved Street Tree Planting Plan and the street tree planting within a given stage of subdivision, street trees may be planted in locations not previously approved, and existing boulevard trees forming a part of the Approved Street Tree Planting Plan may have previously been removed, and;
- Other changes which may occur during the planning and construction of stages of subdivision, following approval of the street tree planting plan e.g. Modifications to the Approved Draft Plan of Subdivision, etc.
- Trees are to be identified in an AutoCAD DWG format drawing file. This drawing must be georeferenced to the UTM Zone 17, NAD 83 projection and datum with an accuracy in accordance with Ontario Regulation 216/10 Section 14(2). The drawing must indicate removed trees and new trees to be planted. A schedule indicating the species of tree to be planted and its caliper/diameter at breast height shall be provided in an excel spreadsheet format

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K.3 Post Construction Process

K.3.1 Maintenance & Warranty

The Developer will provide all required maintenance to ensure that after the two year establishment period, all trees are healthy, growing vigorously and have a fully established root system that no longer requires regular, supplementary watering. The Developer will be responsible for the maintenance and related costs until Final Acceptance of the trees. The Township will be responsible for maintenance after Final Acceptance of the trees.

Through the development of a community stewardship watering program or scheduled maintenance the Developer will ensure all trees are watered on a weekly basis, and provided with 10 gallons (40 litres) of water per week. All planted trees will receive supplementary watering from the first day of May to the last day of September. Additional weekly watering and/or an increased watering may be required if drought conditions exist.

The Developer's Maintenance Contractor will also inspect and maintain all of the planted trees after the first growing season. This will include the inspection of the tree stakes, any corrective maintenance, removal of broken or dead branches, the maintenance of the mulched area including the correction of mulch deficiencies (removal of volcano mulching, topping up low mulch, etc.), and the approved educational material will be left with each resident. All maintenance work will be done to the Centre Wellington Standards.

Prior to Final Acceptance, the Developer's Maintenance Contractor will carry out all of the required work for the first growing season, and all tree stakes will be removed. After the completion of the first year of maintenance, and during the active growing season June 1st to September 30th, the Developers Landscape Architect will complete an inspection of all trees using the Site Inspection Report and provide a written report to the Township of Centre Wellington concerning the maintenance, health and vigour of the trees.

The maintenance period will cover two full growing seasons,

K.3.2 Final Acceptance

After two full growing seasons from the Initial Acceptance the Developer's Landscape Architect will request an inspection for Finial Acceptance during the active growing season (June 1st to September 30th).

Prior to the site meeting, the Developer's Landscape Architect will provide the Final Acceptance Certificate signed and dated stating that all of the trees as per the plan are established, healthy and growing vigorously, no longer require supplementary watering, and all other requirements during the warranty period have been carried out. Assessment of plant vigour will be based, in part, on evidence of regular watering throughout the warranty period and the extent of new growth which is consistent with this regular watering.

At Final Acceptance, all street trees must meet the following acceptance criteria:

- All staking materials to be removed.
- Organic mulch placed a minimum of 50 mm deep over the tree pit. No mulch is to be in contact with the trunk of the tree as per the Township Standard Planting Details.
- Planting depth to be completed in accordance with the Township Standard Planting Details and relative to finished grade and elevation of topmost structural root, in accordance with Canadian Nursery Trades Association standards.
- Trees to have proper form and branching for the species.
- All dead wood shall be pruned and removed prior to inspection.
- All suckering and adventitious growth to be removed prior to inspection.
- Trees must show evidence of continuous growth and establishment since the Initial Acceptance.
- Trees shall be in good general health, free of mechanical bark damage, no evidence of disease and overall structurally sound.

The Developer's Landscape Architect will set up a site inspection, which will include the Developer's Landscape Architect and Operations Representative and Engineering Representative.

When all issues have been addressed, the Township will approve the Final Acceptance Certificate and the Township will assume full responsibility for the trees on Township lands and their maintenance. With the approval of Final Acceptance, the Developer may request to have the remaining amount (value of the supply and install of the trees and two years maintenance) of the Letter of Credit reduced). Where trees have been planted on other public or private lands, the Developer's Consultant will inform the owners that the trees are now their responsibility.