Municipality of North Grenville

Engineering Standards for Design, Approval, and Construction

August 2022

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Record of Revisions

Version	Date	Description
1	May 6, 2022	Draft - Circulation for Comments
2	June 15,2022	Draft – Circulation to Council
3	July 22, 2022	Draft – Revisions based on Comments
4	August 3, 2022	Final Draft

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Appendices

SECTION A - GENERAL INFORMATION

Municipality of North Grenville
Engineering Standards for Design, Approval, and Construction

August 2022

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SECTION A – GENERAL INFORMATION

A1.00 Definitions

In this specification, the following definitions shall apply:

"**AODA**" means Accessibility for Ontarians with Disabilities Act.

"As Constructed" Drawings shall mean the Design/Contract and Shop Drawings incorporating all revisions, field changes and as-built surveys that occur during the construction phase of the work. Refer to PEO Guideline 'Preparing As-Built and Record Documents.'

"AWWA" shall mean the American Water Works Association.

"**BMP'S**" means best management practices.

"CA" shall mean the Rideau Valley and/or South Nation Conservation Authorities.

"Consultant" shall mean professional engineers licensed to practice in Ontario and shall be responsible for the preparation of drawings and specifications to the satisfaction of the Municipality. The Consultant shall act on behalf of the Developer/Owner.

"Contractor" shall mean the firm of Contractors, the company, or individual acting as the Contractor and having entered into a contract with the Developer/Owner to install the services.

"CSA" shall mean the Canadian Standards Association.

"County" shall mean United Counties of Leeds and Grenville

"Developer(s)/Owner(s)" shall mean the person(s) appearing on the subdivision agreement/site plan with the Corporation of the Municipality of North Grenville.

"Developer's Representative" shall mean the person(s) identified by the Developer to act on their behalf.

"DFO" shall mean the Department of Fisheries & Oceans, Canada.

"Director" shall mean the Municipality of North Grenville Director of Public Works, their representative, or designate.

"LID" shall mean Low Impact Development.

"MECP" shall mean the Ontario Ministry of Environment, Conservation and Parks.

"MNRF" shall mean the Ontario Ministry of Natural Resources and Forestry.

"**MOE/MOECC**" shall mean Ontario Ministry of the Environment and Climate Change

"MTO" shall mean the Ontario Ministry of Transportation.

"Municipal Representative" shall mean any person assigned to a project by the Municipality to carry out work on their behalf. The name of the Representative shall be specified prior to the start of construction on any project.

"Municipality" shall mean the Municipality of North Grenville.

"OBC" shall mean the Ontario Building Code.

"OHBDC" shall mean the Ontario Highway Bridge Design Code.

"OPSD" shall mean the - Ontario Provincial Standards Drawings.

"OPSS" shall mean the Ontario Provincial Standard Specification.

"OTM" shall mean Ontario Traffic Manuals.

"PEO" shall mean Professional Engineers Ontario

"**SHG**" shall mean specific house grade / ground elevation at house location

"SWM" shall mean Stormwater Management.

"TAC" shall mean Transportation Association of Canada

"TCP" shall mean Traffic Control Plan.

A2.00 Introduction

The material presented herein is to be used as a guideline for the design of roads and services for land development and construction projects within the Municipality of North Grenville (Municipality). These guidelines are to be used in conjunction with industry standard practices and appropriate provincial and federal guidelines and standards for design and construction (e.g. OPSS, OPSD, MTO, TAC, MECP, OBC).

The design of all municipal services in the Municipality is to be based upon the specifications and standards in effect at the time of submission. It is incumbent upon the Developer's Representative to ensure the latest specifications are being utilized. All plans are to be accepted by the Municipality before they are used for construction, however, such acceptance in no way relieves the Developer and the Developer's Representative(s) from providing a design and constructed works that comply with current municipal requirements and applicable codes and standards.

The Municipality reserves the right to apply discretion in the interpretation of these guidelines and to require the use of other applicable guidelines and good engineering judgment when reviewing each project.

These guidelines will be subject to revision as local and provincial requirements continue to evolve particularly in areas of low impact development and sustainability.

It is understood that while there is flexibility, if a standard is not being met by a developer and they wish to proceed with a design and construction (if approved) the following may apply: increased municipal costs, third party costs, increased approval timeline, increased inspection costs, and extension of warranty.

A2.01 Familiarization

Design work is to adhere to the Municipality's Master Plans and the requirements set out in the **"**North Grenville Developer's Guide**"**. Technical servicing issues must be designed and detailed within the engineering submissions, regardless of the source of the information (geotechnical, acoustic, landscaping, etc.).

All engineering design and submission procedures and requirements are outlined herein, or in the "North Grenville Developer's Guide". It is incumbent upon the Developer's Representative to familiarize themselves with these documents prior to proceeding to engineering servicing design.

The "North Grenville Developer's Guide" can be obtained from the Municipality's Planning Department.

A3.00 General Submission Requirements

A3.01 Study and Plan Requirements

Refer to North Grenville's Developer's Guide for general submission requirements and confirm specific requirements with the Director as part of a consultation meeting.

A3.02 Ministry of the Environment, Conservation, and Parks (MECP) Applications

The Developer will be responsible for obtaining all necessary approvals from the Ministry of the Environment, Conservation, and Parks (MECP). After the engineering design and drawings are prepared to the satisfaction of the Director, completed Environmental Compliance Approval (ECA) Forms are to be submitted to the Municipality for signature of the Director. The Developer's Representative will then make application to the MECP for approval under the Ontario Water Resources Act.

Approval from the MECP will not be required for water distribution systems as the Municipality is a holder of a Municipal Drinking Water Licence under Part V of the Safe Water Drinking Act. Any addition, modification, replacement or extension of a water distribution system is to be designed by a Professional Engineer. The Engineer shall submit three duplicate-completed "Form 1 – Record of Watermain" forms together with three copies of the General Services Plans showing the watermains to the Municipality for review and signature of the Director. One copy of the form signed on behalf of the Municipality will be returned to the Developer's Representative for record purposes. The Municipality's Licence Number will be provided by the Director and is to be inserted into Part 1 of the Form.

A3.03 Miscellaneous Approvals

The Developer's Representative is required to determine all approval requirements and make all submissions and representations necessary to obtain approvals from all other affected authorities. This includes but is not limited to:

i. United Counties of Leeds and Grenville
ii. Ministry of Transportation
iii. Ministry of Natural Resources
iv. Department of Fisheries and Ocean's Canada
v. Conservation Authority
vi. Railways
vii. Canada Post Corporation
viii. Utility Companies

The Developer's Representative shall copy the Director on pertinent correspondence relating to the progress of these submissions.

A3.04 Original Drawings

After acceptances have been received from all applicable agencies, the original (sealed) drawings shall be submitted to the Director for review and/or acceptance.

A3.05 Requirements Prior to Commencement of Construction

Prior to the commencement of construction, the Developer's Representative shall submit the following information to the Municipality:

i. Three sets of full-size issued for construction drawings and specifications along with two sets of reduced size drawings (16" x 24"), PDF versions, and CADD drawings.

ii. The names of the proposed Contractor and any Sub-contractors.

iii. The Contractor's list of suppliers. If not available prior to commencement, provide planned supplier and if the supplier changes, provide an update prior to beginning the work.

iv. Securities as outlined in the Subdivision Agreement in a form acceptable to the Municipality's Director of Finance.

v. Proof of public liability insurance naming the Corporation of the Municipality of North Grenville and the Municipality's Consultant(s) of Record as additional insured in amounts and form satisfactory to the Municipality's Director of Finance.

vi. Emergency contact information for the Developer's Representative and Contractor.

vii. Any other information as required by the Municipality or as specified in the Subdivision Agreement.

Once the above has been provided and deemed to be acceptable the Director will provide a letter authorizing the Developer to proceed with construction. The Developer's Representative will arrange for a kickoff/ startup meeting required prior to construction with the Public Works Department Representative in attendance.

A3.06 Requirements During Construction

For subdivisions and other works to be assumed by the municipality, full time on-site supervision is to be provided by the Developer's Representative/Consulting Engineer for all underground, concrete, and asphalt works. Part-time inspection may be considered for road building, landscaping, and utilities; written approval from the Director is required.

For private services and site plan, comply with the site plan agreement and the owner's commitment to have general review undertaken by architects and/or professional engineers per Ontario Building Code requirements.

Construction meetings are to be held with the Municipality at; start up, temporary water plan review, and watermain commissioning plan review. The Municipality will be provided with a construction schedule noting sanitary, storm watermain, services, concrete, asphalt, and utility work.

See Appendix 1 for certification requirements.

Failure to provide the required certifications outlined in the appropriate OPS standard and these design guidelines may result in the municipality requiring any or all of the following at the Developer's cost:

- Destructive testing
- Removal and replacement
- Monetary penalties.

A3.07 Subdivision Notice Signage

Once the roads have been constructed to base course asphalt, the Developer is to provide and erect, in a prominent location at the "entrance" to the subdivision, a Subdivision Notice Sign as per Municipality of North Grenville Standard Drawing A-01

A4.00 Engineering Drawing Requirements

A4.01 Title/Cover Sheet

A title/cover sheet is required for the drawings.

A4.02 Latest Version of AutoCAD

All drawings shall be prepared using AutoCAD 2022 (or latest version). All drawings are to be prepared in a neat and legible fashion. All plans shall be prepared on standard 600 mm x 900 mm sheets.

A4.03 Title / Revision Blocks and Version Control

Standard title blocks shall be used indicating the name of the development and having provision for a table for revision notes within the block. The revision number, description, and date for each deliverable is to be include on each submission to the municipality.

A4.04 Elevations

All elevations shown on the drawings are to be of geodetic origin and reference to the geodetic benchmark is required.

A4.05 Lot and Block Numbers

All existing and proposed lot and block numbers, and intended purpose for blocks (i.e., school, park, etc.) are to be included on the drawings. All easements are also to be shown on the drawings.

A4.06 Natural Hazards

Natural hazards are to be indicated on all plans affected including but not limited to:

- Floodlines
- Unstable bedrock
- Unstable slopes
- Retrogressive landslide areas.

Additional review and discussion with the municipality and conservation authority may be required depending on the hazard.

A4.07 North Arrow

A North arrow shall be referenced on all drawings. North shall generally point to the top or right on the drawings.

A4.08 Key Plan

A key plan shall be shown on all Plan and Profile Drawings as well as the General Services Plan. The area covered by the drawing shall be clearly identified.

A4.09 Engineer's Stamp / Seal

All engineering submissions shall be stamped/sealed by a Professional Engineer in accordance with PEO guidelines.

A5.00 General Services Plan

A5.01 Scale

A drawing showing General Services shall be prepared for all developments at a maximum scale of 1:1000.

A5.02 Division of Drawings

When more than one General Services Plan drawing is required for any development then the division of drawings shall reflect the limits of the Registered Plans as closely as possible. An overall drawing layout plan with sheet numbers is acceptable.

A5.03 Benchmarks

The reference geodetic benchmark and the site benchmarks to be used for construction shall be identified on the General Services Plan.

A5.04 Drawing Index

A drawing index shall be shown on all General Services Plans to identify the Plan and Profile Drawing Number for each street or easement shown. An overall drawing layout plan with sheet numbers is acceptable.

A5.05 Street Names

All streets shall have the approved street names indicated.

A5.06 Line Types

It should be clear on the plans what is existing and what is proposed. All existing services, utilities and abutting properties are to be shown in shaded lines. All proposed services to be constructed are to be shown on the General Services Plan in bold lines.

A5.07 Maintenance Holes, Catchbasins and Additional Structures

All structures will be shown and are to be numbered in accordance with the design drawings. Storm and Sanitary Maintenance Hole Numbering will be approved by the Municipality.

A5.08 Sewers

All existing and proposed storm and sanitary sewers are to be shown including size, length, grade, direction of flow and type of the sewer. Services must be shown for all lands to be registered. Services are to be terminated at the limits of the developed lands where future extension is expected, of if required by the Director.

A5.09 Watermains

All watermains, valves and hydrants are to be shown. Watermains are to be identified by size and material.

A5.10 Curbs and Sidewalks

All curbs and sidewalks are to be shown, including details of connections to existing sidewalk networks.

A5.11 Fencing

All fencing is to be indicated by height and type. Consult with the Director to confirm type and

height required. Refer to details A-02 – A-07.

A5.12 Exterior Electrical

All street lighting poles, disconnects and hydro transformers are to be shown.

A5.13 Floodplains

If a subdivision encroaches on an existing floodplain, the extent of the natural hazard and the associated lands regulated by the Conservation Authority.

A5.14 Existing Buildings and Structures

All existing buildings and structures on the lands are to be shown, including ones to be removed.

A5.15 Coordination Plan

As part of final approval to proceed to construction, a detailed plan view shall be provided that overlays utilities including:

i. Poles
ii. Signs
iii. Mailboxes
iv. Landscaping elements
v. Underground services
vi. Curbs
vii. Sidewalks
viii. Pathways
ix. Trees
x. Any other structures

This detailed plan view is required to confirm potential conflicts have been reviewed and impacts have been mitigated.

A6.00 Plan and Profile Drawings

A6.01 Scale

All Plan and Profile Drawings shall be prepared at a maximum scale of 1:500 horizontally and 1:50 vertically for rural projects and 1:250 horizontally and 1:50 vertically for urban projects. A complete legend shall be provided on each drawing.

A6.02 Plan and Profile Drawings

Plan and Profile Drawings are required for all roads, blocks, and easements (rear yard and side yard storm sewers excluded) where services are proposed, as well as for all outfalls and all boundary roadways abutting the development.

A6.03 Line Types – Shaded

All existing or future services, utilities and abutting properties shall be shown in shaded lines.

A6.04 Line Types - Bold

All services to be constructed are to be shown in bold lines.

A6.05 Road Allowances, Lots, Etc.

All road allowances, lots, blocks, easements, and reserves are to be identified.

A6.06 Curbs, Gutters, and Sidewalks

All curb, gutter and sidewalks are to be shown and dimensioned on the plan portion of the drawings.

A6.07 Sewers and Culverts

All sewers and culverts shall be shown and dimensioned on the plan and shall be plotted on the profile of the drawings to true scale size. All sewers and culverts shall show the type, size, slope, length, material, and direction of flow on both the plan and profile portion of all drawings.

A6.08 900 mm+ Diameter Sewers

All sewers 900 mm in diameter or larger shall be shown with two lines on the plan view of drawings.

A6.09 Maintenance Holes

All maintenance holes shall be shown on the plan and profile portion of the drawings. The maintenance holes shall be identified by number on the plan portion and by number, size, invert elevations and applicable Ontario Provincial Standard Drawing on the profile portion of the drawing. Sanitary maintenance holes shall include the letter “SA” after the number designation. Numbering is to be approved by the Municipality. Maintenance holes that have safety platforms or drop connections shall be noted. Maintenance holes are to be drawn to scale showing the outside of the structure and the location of the lid.

A6.10 Catchbasins

All catchbasins and catchbasin connections shall be shown. All grate and invert elevations for rear lot catchbasins are to be shown.

When streets are of a length that requires more than one drawing, match lines are to be used.

A6.11 Reference Drawings Numbers

The reference drawing numbers for all intersecting streets and match lines shall be shown on all Plan and Profile Drawings.

A6.12 Watermain, Hydrants, etc.

All watermains, hydrants, valves, etc., shall be described and dimensioned on the plan portion of the drawings. The watermain is to be plotted to true scale size on the profile portion of the drawing and shall be described.

A6.13 Service Connection Locations

The location of all storm, water and sanitary service connections shall be shown and dimensioned on the plan portion of the drawings or on a typical detail.

A6.14 Centreline of Construction

The centreline of construction with 20.0 m stations shall be noted with a small cross on the plan portion of the drawings. Chainage shall generally start on the left side of the sheet and increase from left to right on all drawings. Existing and proposed centreline elevations shall be shown at 20.0 m intervals along the bottom of the profile.

A6.15 Original Ground at Centreline

The original ground at centreline and the proposed centreline road grade shall be plotted on the profile. The proposed profile shall be fully described (length, grade, vertical point of intersection [V.P.I]. elevations, vertical curve data, etc.) with all elevations shown to three decimal places. Chainage for the centreline of construction as well as the chainages for V.P.I., beginning of vertical curve (B.V.C.), end of vertical curve (E.V.C.) shall be noted on the profile portion of the drawings.

A6.16 Gutter Grades

Details of the gutter grades for cul-de-sacs and crescents shall be provided on the grading plan as a separate detail at a scale of 1:200.

A6.17 Chainage for Centreline of Construction

Chainage for the centreline of construction, including chainages for point of intersection (P.I.), beginning of curve (B.C.), and end of curve (E.C.) and horizontal curve data shall be shown on the profile portion of the drawings.

A6.18 Proposed Pavement Structure

The proposed pavement structure design and dimensions shall be noted on the profile portion of the drawings using a note and leader to signify the area between the top of asphalt and subgrade.

A6.19 Existing Utilities and Services

All existing utilities and services shall be shown on the plan view of the drawings. Utility locates may be required to determine the extent and location of existing utilities. It may be necessary to dig test holes/hydrovac to determine the actual elevations of these services to avoid conflicts with new construction. These elevations shall be shown on the profile portion of the drawings. The Director may request utility elevations to be confirmed by test holes/hydrovac prior to approving design drawings. This does not relieve the Developer from their responsibility for the planning, design, and construction of the works.

A6.20 Roadway Profiles

Profiles of roadways shall be produced sufficiently beyond the limits of the proposed roads to confirm the feasibility of future extensions.

A6.21 Details for Plan Portion of Drawings

In addition to the above, the following details shall be shown on the plan portion of the drawings:

i. the curb radii at all intersections

ii. any special notes

A7.00 Lot Grading Plans

A7.01 Criteria

All Lot Grading Plans shall be prepared in accordance with the criteria outlined in Section F of this document.

A7.02 Scale

The plans shall be prepared at a minimum scale of 1:500 or as required to clearly show the works.

A7.03 Plan Content

The plans must show overall lot fabric with lot and block numbers, street names, right-of-way limits, road curb and gutters, catchbasins, sidewalks, all aboveground street furniture, driveway locations, culverts, wells, septic systems, pools, and any other proposed structures.

A7.04 Road Grades

Road grades shall be shown at 20 m intervals and at all changes in grade. Directional arrows shall be provided indicating the overland flow route.

A7.05 Existing Grades

Existing grades along with proposed elevations at the lot corners shall be indicated along with elevations at any break points and swales.

A7.06 Lots Requiring Engineered Fill or Specialized Structural Design

The grading plan shall identify development areas noted in the site geotechnical report as requiring specialized construction requirements.

A7.07 Maximum Building Envelope

The maximum building envelope shall be shown on all lots inclusive of private services.

A7.08 Flow

Directional arrows shall be provided on all lots indicating the direction of flow and grade of flow in percent (%) along side lot lines and rear lot lines.

A7.09 Existing Trees

All existing trees are to be shown. All trees are to be clearly identified with appropriate shading as “to be preserved” or “to be removed.”

A7.10 Existing Structures

Any existing structures shall be shown with notes clearly identifying whether they are to be retained or demolished/decommissioned.

A7.11 Other Constraints

Development constraints including but not limited to; easements, buffer zones, no touch zones, tree buffers, Ontario Building Code setbacks for private services, and agency setbacks are to be noted.

A8.00 Composite Utility Plans

A8.01 Criteria

A Composite Utility Plan (or Plans) is to be prepared in accordance with the criteria outlined in Section G of this document.

A8.02 Scale

The plans shall be prepared at a minimum scale of 1:500.

A8.03 Plan Content

The plans must show overall lot fabric with lot and block numbers, municipal addresses provided by the municipality, street names, right-of-way limits, road curb and gutters, catchbasins, sidewalks, street trees, all aboveground street furniture and driveway locations.

A8.04 Road Cross-sections

Typical road cross-sections must be included on the plans.

A8.05 Public Utility Clearance Requirements

Public Utility Clearance Requirements must be included on all plans to clearly indicate minimum separation distances and clearances from hydro, communications, gas and municipal infrastructure, signs, driveways, etc. This could be in the form of a table or typical detail.

A8.06 Location of Utilities

The location of all utilities must be clearly shown (hydro, telecommunications, gas, cable, street lighting) along with Canada Post mailbox locations.

A8.07 Location of Utility Services Locations to Lots

The location of all utility service locations to lots must be clearly identified along with storm, sanitary and water connections.

A8.08 Details

Details shall be included indicating location and spacing requirements of services for the various lot types in the development.

A8.09 Signature Block or Written Confirmation of Acceptance

A signature block may be included for each utility to sign indicating acceptance of the layout as shown. In lieu of a signature box, written acceptance from the utility representative can be provided.

A9.00 Other Drawings

A9.01 Traffic Management Plans

When requested by the Municipality, Traffic Management Plans at a minimum scale of 1:1000 are to be prepared indicating the location and details for all traffic control, information signage

and line painting. Plans are to be in accordance with the OTM Book 7and as approved by the municipality.

A9.02 Drainage Plans

Drainage plans for the storm and sanitary sewer design shall be prepared in accordance with the criteria provided in Sections C and E of this document.

A9.03 Erosion and Sedimentation Control Plans and Tree Protection Plans

Prior to any site disturbance taking place, plans will be required indicating the measures that will be put in place to protect any trees to be preserved and to prevent the migration of any silts from the site or other adverse impacts on the environment. The plans shall clearly indicate the order in which all activities are to take place. The plans shall show the location and details for all tree protection fences, silt control fences, earth or rock check dams, sediment ponds, mud mats and any other measures necessary to protect trees and control silt or other elements that may adversely impact the environment. Topsoil stockpile locations shall also be indicated on the drawings.

To assist with review by the conservation authority, include:

- Identification of who is responsible to install inspect, maintain and remove the control measures
- Identify the inspection and maintenance schedule (how, when, how often i.e. daily/weekly)
- Indicate which control measures are proposed, their location and corresponding OPSD number
- Indicate that it is to be considered a “Living Document” which may be modified in the event the control measures are insufficient
- What measure is taken to protect the outlet from erosion?

A9.04 Detail Drawings

The Municipality’s Standard Drawings shall be used whenever applicable. In the absence of a Standard Drawing the latest revision of the Ontario Provincial Standard Drawings shall be used. Individual details shall be provided by the Developer’s Representative for all special features not covered by any of the above. All details shall be reproduced or drawn on standard size sheets and shall be included as part of the engineering drawings.

A9.05 Landscaping Drawings

Drawings indicating the location and species of street trees, stormwater management pond landscaping, park design, boulevards, open space landscaping, areas of ecological preservation,

restoration, and enhancement recommended by environmental studies, and community mailbox location shall be prepared in accordance with the requirements of the Municipality.

A10.00 Record Drawings & Asset Inventory

A10.01 General

The Record Drawings constitute the original (design) engineering drawings which were accepted by the Municipality and which have been amended to incorporate the construction changes and variances in order to provide accurate information on the works as installed in the development. Submission of Record drawing information shall be accompanied by revised design calculation sheets sealed by the design engineer, which confirm the capacity of the constructed condition of the sewers. Drawings shall be submitted during the maintenance period, prior to issuance of Final Acceptance. Record Drawings shall be prepared in accordance with PEO guidelines.

A10.02 As-constructed Field Survey

The Record Drawing revisions shall be based on a final survey of all the subdivision services and the Developer's Representative's construction records. The final survey shall include a final check of the following items:

i. location of all maintenance holes, including invert and top of cover elevations
ii. distances and pipe slopes between all maintenance holes
iii. location, rim and invert elevations for all roadway and rear lot catchbasins
iv. location and ties to all valve boxes and chambers and any other relevant watermain appurtenances
v. hydrant flange elevations
vi. service elevations at property limits
vii. road centreline elevations
viii. site benchmarks
ix. location of all service connections to all lots and blocks

A10.03 Materials

The Record Drawings must clearly label the installed material. Information for the following installations is required as a minimum:

i. mainline storm, sanitary sewers including service tees
ii. sanitary and storm sewer laterals

iii. watermain

iv. watermain valves and hydrants and service valves

v. maintenance hole, valve chamber and catchbasin frames and covers

vi. precast concrete maintenance holes, catchbasins and valve chambers

A10.04 Drawing Revisions Construction

The original drawings shall be revised to incorporate all changes and variances found during the field survey and to provide ties and additional information to readily locate all underground services.

All sewer and road grades are to be recalculated to two decimal places to reflect the as-built condition.

All house numbers are to be indicated on the As-built Drawings.

All street names, lot numbering, and block identification(s) shall be checked against the Registered Plan and corrected as necessary.

The As-built Drawing revision note(s) shall be placed on all drawings in the revision block and dated based on the date of the surveys.

The Developer's Representative shall be required to explain in writing any major difference between the design and the "Record" data, providing verification that the alteration(s) does not adversely affect the function of the subdivision services.

A10.05 Submission of As-built Drawings

The submission of the Record Drawings in paper and electronic format (PDF and CADD) must be completed before "Final Acceptance" of the subdivision will be granted by the Municipality.

A10.06 Asset Inventory List

Prior to final acceptance of the subdivision, the Developer's Representative will be required to submit to the Municipality a chart in Excel format summarizing the assets which the Municipality will be assuming as part of the subdivision. Include as a minimum the following:

i. total number of maintenance holes

ii. total number of road and rear lot catchbasins including length and size of catchbasin leads

iii. lengths of sewers including description of sewer type and material

iv. length of watermain including size, material, number and size of valves, valve chambers and fire hydrants

v. number and type of traffic signs

vi. number of streetlights

vii. length of roads including description of width

viii. length of sidewalks including description of width

ix. number of street trees including description of species

The materials list should be provided on a street-by-street basis with subtotals for each street and totals for the entire subdivision. The Developer's Representative is to request a template from the Director that will be generated at the time of development.

Closed-circuit television (CCTV) inspections of all sewer lines including video record provided on DVD and printed report are to be submitted to the Director.

A11.00 Survey Control Monuments

Prior to the assumption of the subdivision, the Owner's Ontario Land Surveyor shall establish a network of monuments and benchmarks.

Horizontal control monuments and vertical control benchmarks, shall be established at approved locations to the satisfaction of the Director, using the following criteria:

i. Two horizontal control monuments and two vertical control benchmarks for the first 50 ha (or less) subdivided by the plan, and one additional horizontal control monument and vertical control benchmark for every additional 50 ha (or less) subdivided by the plan.

ii. In addition, every existing horizontal control monument and vertical control benchmark destroyed during subdivision or site plan construction must be replaced.

iii. The new horizontal control monuments and vertical control benchmarks (including replacements) shall be certified by an Ontario Land Surveyor.

iv. The horizontal control monument shall be as per Municipality's Standard Drawing A-08. The location, description and pertinent information with respect to the monuments shall be indicated on all engineering drawings.

A12.00 Excess Soils

Ontario Excess Soils Regulation (O. Reg. 406/19): On-Site and Excess Soil Management requirements are to be met by the Developer.

A Qualified Professional is to complete a workplan, testing, and all other requirements to comply with the regulations.

SECTION B – TRANSPORTATION

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SECTION B – TRANSPORTATION

B1.00 Classifications and Right-of-way Widths

All roadways in new developments shall be classified according to the Transportation Master Plan (2019) which includes the following:

1. Arterial Roads (23m -45m Right-of-way Width)
2. Collector Roads (20m-26m Right-of-way Width)
3. Local Roads (18m-22m Right-of-way Width)

The proposed classification of all streets planned in new development areas shall be confirmed with the Municipality prior to the commencement of the design. Roadways within urban areas are to be designed and constructed to urban cross-sections. Roadways supporting industrial, commercial, and institutional land uses are also to be built to urban design standards.

Typical cross sections can be found in Appendix 3. Note that cross sections are under development and final requirements for each application are to be confirmed with the Director. The municipality remains open to alternative layouts that are deemed to be beneficial for traffic calming, vehicular movement, and maintenance.

Requirements for paved shoulders, multi-use pathways, and other site features are to be confirmed with the Director.

B2.00 Supporting Traffic Studies / Statements

The requirements for a Traffic Impact Study / Statement (TIS) will be agreed upon between the Developer and the Municipality. County input will be required where the development is deemed by the County to have an impact on the County road network. The level of analysis and specific requirements are to be agreed upon by the Developer's Representative, their traffic specialist, the Municipality, and, where applicable, the County.

The TIS should consist of a main document supplemented by technical appendices containing the required detailed analyses. A suggested report structure is as follows:

i. Description of the Proposal (with site plan or plan of subdivision if applicable);
ii. Study Area (with map identifying the study area and site);
iii. Horizon Year(s) and Time Periods for Analysis;
iv. Considerations for compliance with Municipal and County guidance documents including but not limited to; Official Plan, Transportation Master Plan, Cycling Master Plan
v. Existing Conditions (exhibits required);
vi. Background Traffic Demand – Existing and Future Background (exhibits required);
vii. Site Generated Traffic Demands (exhibits required);

viii. Total Traffic Demand – Future Background plus Site Generated Traffic (exhibits required);
ix. Evaluation of Impacts of Site Generated Traffic;
x. Access Location Analysis;
xi. Improvement Alternatives Required to Mitigate Traffic Impacts, including Traffic Impacts for Future Background and Total Traffic with and without Mitigation Measures (tabular summaries); and
xii. Recommendations.

Maps, graphs and tables should be placed adjacent to relevant text.

B3.00 Geometric Design Elements

Designs are to comply with Transportation Association of Canada and Ministry of Transportation Ontario guidelines. Typical Sections for Local, Minor Collector, and Primary Collector Roads are included in Municipality's Standard Drawings B-01 to B-04.

B3.01 Curb Return Radii at Intersections

The curb return radii for all local streets shall allow for traffic movement and snow plowing operations. For retrofit applications consult the Municipality.

B3.02 Daylighting Requirements at Intersections

Daylighting site triangles at all intersection quadrants shall be included in the road allowances to provide for uniform boulevard widths. Specific design features and longer-term planning needs may require larger daylighting triangles. At a minimum, daylighting shall conform to the Comprehensive Zoning By-law as follows:

Table 1 - Daylighting Requirements

Daylighting Requirements	
Local to Local	3 m x 3 m
Local to Collector	3 m x 3 m
Collector to Collector	5 m x 5 m
Collector to Arterial	5 m x 5 m
Arterial to Arterial	5m x 5 m

B3.03 Turning Basins / Cul-de-sacs

Turning Basins / Cul-de-sacs should be avoided wherever possible. When deemed appropriate, they shall be constructed per MTO OPSD 500.010, 500.020, or 500.030. Minimum gutter grades of 0.5% shall be maintained along the flow line of the gutters around the cul-de-sac.

The maximum permissible down gradient into a cul-de-sac is 4%.

B3.04 Temporary Turning Circles and Turnarounds

Generally, temporary turning circles are to be paved with a minimum 50mm thick surface course asphalt. At the sole discretion of the Director, alternatives for short term temporary conditions will be considered. The road structure is to be in accordance with the site geotechnical report.

B3.05 Location of Utilities

The placement of utilities within the road allowance shall be in accordance with Chapter G of this document and the Municipality's Standard Road Cross-Sections Drawings.

B3.06 Community Mailbox Requirements

Community mailboxes shall be placed in locations approved by the Municipality and Canada Post. Community mailboxes shall have direct hard surface access. In urban areas, access is to be to a sidewalk.

B4.00 Traffic Controls

The proposed location and type of all street name signs, traffic control signs, signalization, and pavement markings shall be shown on the Traffic Control Plan (and Landscape Plan). The Traffic Control Plan shall be prepared by a Professional Engineer. All traffic control devices (warning and regulatory signs, street signs, parking restrictions, etc.) shall conform to the Ontario Ministry of Transportation, Ontario Traffic Manuals (OTMs) and Transportation Association of Canada (TAC) guidelines.

B4.01 Signage

All regulatory signs must be installed by the Developer at the completion of the base course asphalt and maintained by the Developer until "Final Acceptance" by the Municipality. All signs indicating parking restrictions are to be installed prior to the first occupancy in residential developments. The Developer will be responsible for installing all street signs and supporting hardware, as well as maintaining all signs in the subdivision until assumption of the subdivision by the Municipality. Temporary street name signs are to be installed by the Developer prior to the issuance of the first building permit in the subdivision. Prior to final assumption, the Developer will install all permanent street name signs. The cost for these signs will be paid by the Developer.

B4.02 Street Name Signs

Location: Street name signs shall be placed on a dedicated post or other non-regulatory signpost at each intersection and shall identify each street at the intersection. The location of

the street name signs is to be shown on the Traffic Control Plan. Street names are typically noted in the subdivision agreement.

Type: Temporary street name signs are to be ordered and installed by the develop. All permanent street name signs are to be ordered through the Municipality.

B4.03 Traffic Control and Advisory Signage

Location: Traffic control and advisory signs shall be shown on the Traffic Control Plan and shall be located in accordance with OTM and TAC guidelines. All traffic control and advisory signs shall be approved by the Municipality.

Type: Traffic control and advisory signs shall conform to the current revised standards of the OTM and TAC. All signs are to be of engineering grade reflective materials.

B4.04 Pavement Markings

Pavement markings for traffic control shall be provided and shall conform to current OTM and TAC standards. All markings are to be completed with approved traffic paint in accordance with OPS specifications.

Any road which intersects an Arterial Road shall have thermal-plastic paint used at the intersection and back to a minimum distance of 100 m from the Arterial Road.

Pavement markings shall be indicated on the plans for all stop bars, pedestrian crossings, centre and lane lines, and as required or directed by the Municipality for all streets.

At a minimum, painted stop bars c/w 15m yellow 'tail' are required at all urban stop intersections.

Pavement markings are to be completed by the Developer.

B5.00 Road Structure Design

B5.01 Road Structure Requirements

The minimum pavement design for all streets shall be as follows:

Table 2- Minimum Road Structure Requirements

Local Road	Arterial/Collector Road
40 mm HL3 or 12.5mm Superpave PGAC 58-34	40 mm HL3 or 12.5mm Superpave PGAC 58-34
50 mm HL8 or 19mm Superpave	60 mm HL8 or 19mm Superpave
150 mm Granular "A"	150 mm Granular "A"
300 mm Granular "B"	450 mm Granular "B"

To confirm the minimum pavement design is sufficient, a qualified Geotechnical Consultant shall be engaged by the Consultant to sample, test and design a suitable pavement section.

Copies of the geotechnical report including all test results and proposed road designs shall be submitted with the engineering drawings. In no case will a pavement design be less than the minimum as noted above.

The Developer's Representative/Geotechnical Consultant shall perform testing and approval of all granular materials at the designated pits prior to placement, as well as performing subsequent in-situ verification tests. OPSS 501 Construction Specification for Compaction and OPSS 310 Construction Specification for Hot Mix Asphalt.

B5.02 Subdrains

The requirements for a sub-drainage system are to be identified in the site geotechnical report. At a minimum 150 mm diameter perforated subdrains, wrapped with a knitted sock geotextile, are to be installed at all catchbasins a minimum three (3) metres up and down chainage below the subgrade level. Subdrains shall discharge into the side wall of maintenance holes, catch basins, and ditch inlets through a 1 m section of nonperforated pipe. Subdrain and outlet pipe connections to existing concrete maintenance holes, catch basins, and ditch inlets shall be cored and grouted to provide a watertight seal.

When a geotextile wrapped trench is specified in the Contract Documents, wrapping of the subdrain with a knitted sock geotextile shall not be required. The Municipality reserves the right to require video inspection of sub-drains.

It will be the responsibility of the Developer's Representative to justify deviation from this standard by submitting a geotechnical report from a licensed Geotechnical Engineering Consultant. Sub-drains may be omitted if it can be shown that the subgrade is sufficiently permeable to ensure adequate drainage of the road base.

B5.03 Hot Mix Asphalt Requirements

Mix designs are valid for the calendar year in which they were prepared. A minimum of ten (10) days before placement of the mix, the Developer's Representative must electronically submit the mix designs to the Director for review and approval. The mix design and Job Mix Formula (JMF) documents submitted at the time of mix design submissions shall be signed, dated, and certified correct by the person accountable for the engineering and management responsibility of the laboratory that conducted the work.

Only mix designs approved by the Director shall be used. It is the responsibility of the Developer to ensure that mixes approved by the Director and meeting all the contract requirements are used. Furthermore, approval of the mix design by the Director does not relieve the Developer's Representative of the responsibility for ensuring the specified Materials and Workmanship.

When requested by the Director, the Developer's Representative shall remove and replace any unapproved mixes with an approved mix at no cost to the Municipality.

B6.00 General Construction Requirements

B6.01 Placing of Base Course and Final Surface Course Asphalt

Requirements that are to be met prior to the placement of base course asphalt are indicated in Appendix 1.

The placement of surface course asphalt shall not commence in any area until all of the following conditions are met:

i. A minimum period of one year has expired from the completion date for the placement of the base course asphalt.

ii. 75% of the dwellings have received Occupancy Permits.

iii. All undeveloped lots are graded generally in accordance with the current and accepted lot grading plans.

iv. Preliminary Approval from the municipality has been received.

v. All deficiencies and settlements have been repaired in asphalt and concrete areas.

vi. Certification of the works has been provided to the Director from the Developer's Representative/Consulting Engineer.

vii. The approval of the Director is obtained in writing.

viii. Favourable weather conditions are present, as defined by OPS specifications.

B6.02 Other Requirements

Whenever it is necessary to cut through an existing Municipality roadway external to the development, the Developer's Contractor will be responsible to obtain a road cut permit from the Director. The placement and compaction of the backfill material and the restoration of the surface pavement shall be done in accordance with the standards and specifications of the Municipality. All road crossings shall be completed by horizontal drilling unless explicitly approved otherwise by the Director. Any open road cut shall be backfilled with non-shrink concrete material. The work shall be under warrantee from cracking and settlement for a period of one year from time of acceptance by the municipality.

Before implementing detours, a Traffic Control Plan (TCP) is to be submitted to the Director for review and approval. For County Roads, a TCP is to be submitted for approval from the County with a copy to the Director. In all cases, the Fire Department, Police Department, Ambulance

Services and School Bus Companies must be notified by the Developer's Representative or its Contractor, in writing, a minimum of three (3) working days prior to implementing the approved TCP. A copy of the notification is to be provided to the Director.

B7.00 Road Structure

Roads are to be constructed to provide a smooth uniform surface and a comfortable ride. Asphalt paving is to comply with OPSS 310 and OPSS 311. Granular base, subbase, surface, and shoulder are to comply with OPSS 314. Subdrains are to comply with OPSS 405.

B8.00 Concrete Curb and Gutter

The construction of concrete curb and gutter, setbacks, gutter outlets, and bullnoses together with the installation of catch basin frames and grates which lie within the flow lines of the curb and gutter system are to be as per OPSS 353.

Concrete curb and gutter conforming to OPSD 600.040 shall be used on all new urban roads subject to the discretion of the Director.

Driveway depressions shall be formed in the curb according to the detail and location as per OPSD 351.010. A mechanical curb cutting machine is not permitted to saw cut driveway depressions (unless specifically approved by the Director).

All curb and gutter are to be protected from damage from heavy equipment and vehicles.

Prior to starting the work, the Developer's Representative is to provide ACI Flatwork Certification per OPSS 353.

B9.00 Sidewalks

Sidewalk construction is to comply with AODA requirements and OPSS 351. Boulevards are to be minimum 1.0m width for snow storage.

Sidewalks are to be installed at locations as shown on the Typical Road Cross-Sections.

The width of sidewalks (not including curb) for all streets shall be a minimum of 1.5 m and a minimum thickness of 125 mm.

At street intersections, the curb and the sidewalk shall be depressed to meet the roadway elevations as per OPSD 310.030

Prior to starting the work, the Developer's Representative is to provide ACI Flatwork Certification per OPSS 353.

B9.01 Tactile Walking Surface Indicators

Tactile Walking Surface Indicators (TWSIs) are to comply with AODA requirements and are to be constructed in accordance with OPSS 351, OPSD 310.030, OPSD 310.031, and OPSD 310.030.

B9.02 Concrete and Asphalt Walkways

Walkways are to comply with AODA requirements and are to be constructed with a hard surface in accordance with OPSS 311 and OPSS 351.

Prior to starting the work, the Developer's Representative is to provide ACI Flatwork Certification per OPSS 351.

B9.03 Multi-Use Pathways (MUP)

Multi-Use Paths (MUPs)are to comply with AODA requirements and are to be constructed in accordance with OPSS 311. The designer is to allow for a wide range of users. MUPs are located off-road or situated in boulevards within the right-of-way.

MUPs are to be designed in accordance with TAC Design Guidelines and OTM requirements.

1. Minimum width is to be 3m with 1.0m clearance on either side.
2. Site specific conditions may require sheet drain or cross drainage. Minimum slope of two (2) percent for drainage is preferred.
3. Surface to be minimum 50mm surface course asphalt.

B10.00 Entrances, Fire Lanes, and Loading Bays

Entrances are to be paved with a minimum of 50mm thick surface course asphalt.

Entrances are to generally comply with OPSD 301.010, OPSD 301.020, and OPSD 301.030 for rural entrances and OPSD 350.010 and OPSD 351.010 for urban industrial, commercial, and apartment entrances and residential entrances respectively. The minimum width of any driveway shall be 3 m with the width governed by the Municipality's Comprehensive Zoning By-law. Curb depressions shall extend 0.3 m beyond each side of the driveway.

The desirable maximum permissible design grade for any residential driveway on private lands shall be 6% (desirable maximum) and the minimum shall be 1%.

Loading bays and fire lanes are to comply with Ontario Building Code requirements.

B11.00 Boulevards

All boulevard areas are to be graded according to the details shown on the Municipality's standard road drawings and to the satisfaction of the Municipality. The final grade of the sod

shall match the finished grade of the top of the concrete curb and sidewalk. Concrete or asphalt boulevards will require the approval of the Director.

All debris and construction materials shall be removed from the boulevard area upon completion of the base course asphalt and shall be maintained in a clean state until the roadway section is completed.

Clean, weed free topsoil shall be placed on all boulevard areas that are to be sodded. The minimum depth of topsoil shall be 100 mm.

Drought and salt resistant sod shall be used for all areas that are to be sodded.

B12.00 Testing

In general, material sampling, testing and reporting is to comply with Ontario Provincial Standards. The Developer's Representative is to submit a reporting plan to the Director for approval. The plan is to include in tabular format the material, standard of acceptance, testing frequency, and mitigating measures to correct deficiencies should they occur.

B13.00 Grade Certification

The Developer's Representative is to submit a certification of grade elevation/crossfall form per OPSS 314 for subgrade, top of granular B, and top of granular A. These forms are to be submitted to the Director prior to paving.

B14.00 Traffic Calming

Refer to the municipalities Traffic Calming Policy for requirements. All works are to be in accordance with the Transportation Association of Canada. The Developer's Representative is to submit a certification of grade elevation/crossfall form per OPSS 314 for subgrade, top of granular B, and top of granular A. These forms are to be

SECTION C – STORM DRAINAGE AND STORMWATER MANAGEMENT

Municipality of North Grenville
Engineering Standards for Design, Approval, and Construction

August 2022

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SECTION C – STORM DRAINAGE AND STORMWATER MANAGEMENT

C1.00 Storm Drainage Policies

This section outlines the policies, design criteria, and applicable parameters for the design and implementation of storm drainage facilities within the Municipality. These policies are to be adhered to in the production of all stormwater management (SWM) facilities, including sewers, surface drainage, related environmental facilities, and water resources components. This is a comprehensive/living document to ensure sustainable development conditions. The Municipality has built in flexibilities in the document. Therefore, it is recommended that the Developer's Representative consult with staff prior to conducting analysis or design.

C1.01 Planning, Policies and Design Criteria

The most current version of the following Ministry of the Environment, Conservation, and Parks (MECP); Conservation Authority guidelines; and Ministry of Transportation policies and standards apply to the design of storm drainage facilities in the Municipality of North Grenville:

i. MECP (i.e., Stormwater Management Planning and Design Manual, March 2003)

ii. Conservation Authority Watershed Development Policies (Rideau Valley Conservation Authority or South Nation Conservation Authority)

iii. existing Watershed or Subwatershed plans within the Municipality

iv. Credit Valley Conservation and Toronto and Region Conservation Authority (Low Impact Development Stormwater Management Planning and Design Guide, 2010)

v. MTO (i.e. Drainage Management Manual, 1997; and Highway Drainage Design Standards, 2008)

The Developer's Representative is also required to confirm design criteria and obtain approvals from any other relevant ministries or agencies (i.e., Ministry of Transportation, Ministry of Natural Resources, Department of Fisheries and Oceans, etc.).

The planning and design of SWM facilities shall be discussed with the Director and the Conservation Authority early in the planning process and shall focus on minimizing the number of pond facilities. Individual on-site SWM facilities are discouraged unless for private industrial and commercial usage. Water quality and quantity control in new development areas are to be provided in Municipality-owned blocks. In the case of infilling proposals, on-site SWM concepts may be considered by the Municipality in conjunction with any potential off-site storm drainage improvements. Off-site storm drainage requirements will be determined during the pre-consultation process.

The planning and design process shall begin with Low Impact Development (LID) features where possible to minimize reliance on larger end-of-pipe facilities and to optimize water balance. Where ponds are used, the planning and design of each pond shall focus on opportunities to

integrate the pond with the surrounding topography and land uses. Ponds are to be created as public amenity features and are to be safe, visible, aesthetic, and accessible to the general public. Opportunities are to be maximized for linkages through the use of trails to larger open space, floodplain areas, or other SWM facilities.

The planning and design of SWM works are to have full regard for riparian rights of both upstream and downstream landowners as well as the potential responses of the receiving waterbody. The Developer must adequately address any change in flow rates, volumes, or water levels that would occur as a result of the development, SWM drainage areas, and/or in-stream works to neighbouring private properties. Written permission from affected landowners must be sought in cases where acknowledged impacts are proposed and governing legislation must be strictly followed.

C1.02 Rainfall Data

The Municipality has adopted the MTO IDF Curve:

(http://www.mto.gov.on.ca/IDF_Curves/terms.shtml)

Intensity/Duration/Frequency (IDF) curves at the intersection of Highway 416 and County Road 43 for the 1:2 to 1:100-year storms.

The City of Ottawa IDF data taken from Ottawa Airport may be considered appropriate for the Municipality of North Grenville where the project area is using background information established with the City of Ottawa data. It is recommended that the Developer's Representative consult with the Director prior to conducting analysis or design to establish the appropriate IDF Curve. Rainfall IDF curve as defined by Equation 1 and defined by Table 1 are to be used.

Equation 1: $I = At^B$

Where: I= Intensity (mm/hr)

A = is the value of the IDF curve at the 1 hr storm duration

T = Time of Concentration (in hrs)

B = The slope for each line on the IDF log-log plots.

Table 1 - Rainfall IDF Curve Equations

Storm	A	B
1:2 year	20.1	-0.699
1:5 year	26.7	-0.699
1:10 year	31.1	-0.699
1:25 year	36.6	-0.699

1:50 year	40.7	-0.699
1:100 year	44.7	-0.699

C1.03 Hydrology and Hydrologic Modelling

The hydrologic evaluation for the distribution and movement of stormwater runoff in both the existing and proposed conditions can be completed using a variety of methods. Care should be taken in the selection and application of a method, with consideration of the advantages and limitations of each method. The methods available for stormwater runoff, including applicable uses, are described below.

Rational Method/Modified Rational Method

The Rational Method is a runoff estimation method based on an empirical formula relating the peak flow rate to the drainage area, rainfall intensity and a runoff coefficient. The Rational Method is typically used to design storm sewers and estimate peak flow rates from small urban areas. Its application should be limited to scenarios where the time of concentration (t_c) is less than 30 minutes and with drainage areas that have direct flow (i.e. no storage within the drainage area). The Rational Method is formulated as follows: Q = 2.78 CiA

Where: Q= Peak Flow (l/s)

C = runoff coefficient

i= Intensity (mm/hr)

A = drainage area (ha)

The Modified Rational Method may be used to design detention storage systems for small sites, generally less than 5 ha. It may also be used where the time of peak storage closely coincides with the time of concentration for the peak flows (e.g. storage above a catchbasin). The volume of required detention storage in an area shall be computed using the table headings as follows:

Time (min)	i (mm/hr)	Q_{actual} (l/s)	$Q_{allowable}$ (l/s)	Q_{stored} (l/s)	V_{stored} (m^3)

Where: Time = time (minutes) starting with 5-minutes and increasing by 5-minute intervals.

i= Intensity (mm/hr) for the storm event being evaluated at that time interval

Q_{actual} = Calculated flow (l/s) using the rational method

$Q_{allowable}$ = Pre-determined allowable flow (l/s)

$Q_{stored} = Q_{actual} – Q_{allowable}$

V_{stored} = required storage in m^3, calculated by converting Q_{stored} to m^3/s and multiplying it by the total amount of seconds at that time interval

The time of concentration (t_c) shall be determined as outlined in Section C1.04.

Single Event Computer Modeling

The estimation of peak design flow rates can be done using computer model simulation. Computer analyses are best suited to large urban areas, rural areas, and designing SWM facilities. Generally accepted computer modeling software is: Visual Otthymo, SWMHYMO, PCSWMM, EPASWMM, and AutoDesk Storm and Sanitary Analysis. Other programs may be considered as acceptable, but it is recommended to consult with the Director ahead of modelling to confirm if there is an acceptable level of understanding (for review purposes).

A computer model requires the input of a variety of design parameters including the design storm. The design storm is used to generate a runoff hydrograph to determine how an area will respond and perform. Numerous types of design storms can be used ranging from historical storms to IDF curve-derived storms. When choosing a design storm, the designer should perform a sensitivity analysis using various storms and use the one that is most conservative.

When using a design storm, the designer must be careful in choosing the right storm time step. The storm's duration should be greater than twice the basin's time of concentration. A time step that is too small may overestimate peak flows. Should it be required to maintain a storm time step less than 10 minutes, consideration should be given to averaging the peak intensities to a 10-minute or greater average.

The applicable design storms are summarized below.

Chicago

The Chicago storm distribution was developed by C.J. Keifer and H. Chu and is based on 25 years of rainfall record in the City of Chicago and is widely used in the Eastern Ontario area. This storm distribution, which is derived with IDF curves, is generally applied to urban basins where peak runoff rates are largely influenced by peak rainfall intensities.

In general, the time step for this type of design storm should not be less than 10 minutes for most urban applications. The duration of the storm should also be chosen carefully, as it will have an impact on the peak flows. In general, it is recommended to use a 3-hour, 4-hour, or 6-hour duration, with consideration that the storm's duration should be greater than twice the basin's time of concentration.

SCS Type II

The Soil Conservation Service of America (now known as Natural Resource Conservation Service) developed the SCS Type II distribution in 1973 for applications in agricultural and rural areas and is commonly used in the Eastern Ontario area. The SCS storms are generally

applicable to undeveloped or rural basins where peak flow rates are largely influenced by the total depth of rainfall. The designer should use both the 12-hour and 24-hour storm to see which one has the greater impact. SCS storms are also checked when the peak volume is at issue in the urban area, suggest using the 6-hour storm.

Regional Frequency Analysis/Single Station Frequency Analysis

As noted in the Ministry of Transportation Drainage Management Manual 1997 (MTO DMM 1997) Chapter 8, Regional Frequency Analysis methods utilize regional watershed and climatic characteristics to calculate peak flows. They are easy to apply, require limited data, and are widely used for ungauged watersheds. They are some of the most accurate methods available for analysis of medium to large rural watersheds (drainage area of 2+ km^2) with design flow return periods up to 100 years. The most common of these methods are:

- The Modified Index Flood Method (MTO DMM 1997)
- The Northern Ontario Hydrology Method (MTO DMM 1997)
- Ministry of Natural Resources and Forestry Index Flood Method (Ontario Flow Assessment Tool User Guide)

The MTO DMM 1997 identifies Statistical frequency analysis is one of the basic approaches available to determine the magnitude of a design flood. With this method, annual floods recorded at a stream gauging station are statistically correlated to provide a reasonably accurate means of estimating a design discharge.

The method involves interpretation of past stream flow data and derivation of a probability of occurrence by fitting a data series into a theoretical probability distribution. The discharge corresponding to the required design frequency may then be read from the distribution function curve. The most common of these methods are:

- Common Probability Distributions
- Transposition of Flood Discharges

Care should be taken when selecting a Regional or Single Station Frequency Analysis method since there are many limitations to each method. It is recommended to calculate flows using a variety of different applicable methods and select the appropriate flow based on calibration where possible.

C1.04 Key Hydrologic Parameters

The following provides guidance with respect to selecting various computational and modeling parameters. [1]

Time of Concentration/Inlet Time

The time of concentration (tc) is the time it takes for a drop of water from the hydraulicly farthest point in a drainage area to reach the downstream location where the flow is being calculated. The time of concentration of overland flow component (sheet flow) and for channel flow component is additive. As noted in the MTO DMM 1997 Chapter 8, if the design storm duration is less than tc, the runoff will be less than maximum since not all of the watershed area will be contributing.

There are several methods available to determine tc. Two recommended approaches are:

- the Airport formula (runoff coefficient < 0.4)
- the Bransby Williams formula (runoff coefficient > 0.4)

Details regarding these methods can be found in the MTO DMM 1997 Chapter 8. Other tc methods will be acceptable if a description confirming the appropriate application of the method is provided by a qualified engineer.

In storm sewer design, the overland component is referred to as the inlet time. The inlet time is defined as the time it takes for flow to reach the first inlet (CB at the upper end of the system) from the furthest point in the inlet's sub-area. The time of concentration is then computed as the sum of the inlet time and the travel time within the conduit. The inlet time is a critical parameter that can have significant impact on the amount of flow being generated.

A minimum inlet time of 10 minutes is to be used for all land uses and lot grading configurations. For the sizing of catch basin leads connecting back yard drainage structures to the street sewer, the inlet time is to be 15 minutes.

Hydrologic Soils Group

Four Hydrological Soil Groups are defined by the SCS method:

Group A (low runoff potential): Soils having a high infiltration rate even when thoroughly wetted and consisting mainly of deep, well to excessively drained sands or gravel. These soils have a high rate of vertical water transmission.

Group B: Soils having a moderate infiltration rate when thoroughly wetted and consisting mainly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C: Soils having a slow infiltration rate when thoroughly wetted and consisting mainly of soils with a layer that impedes downward movement of water or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

Group D (high runoff potential): Soils having a very slow infiltration rate when thoroughly wetted and consisting mainly of clay soils with a high swelling potential, soils with a permanent high-water table, soils with a clay pan or clay layer at or near the surface and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

A breakdown of the soils type, description and associated soils group is located in Table 2.

Table 2 - Hydrologic Soils Group General Soil Type

Soil Type and Soil Description	HSG
Sandy, Sandy Loams and Gravels: Overlying Sand, Gravel or Limestone Bedrock: Very Well Drained	A
Sandy, Sandy Loams and Gravels: Overlying Sand, Gravel or Limestone Bedrock: Imperfectly Drained	AB
Sandy, Sandy Loams and Gravels: Shallow, Overlying Percambrian bedrock or Clay Subsoil	B
Medium to Coarse Loams: Overlying Sand, Gravel or Limestone Bedrock: Well Drained	AB
Medium to Coarse Loams: Shallow, Overlying Percambrian bedrock or Clay Subsoil	B
Medium Textured Loams: Shallow, Overlying Limestone bedrock	B
Medium Textured Loams: Overlying Medium Textured Subsoil	BC
Silt Loams, Some Loams: With Good Internal Drainage	BC
Silt Loams, Some Loams: With Slow Internal Drainage and Good External Drainage	C
Clay, Lay Loams, Silty Clay Loams: With Good Internal Drainage	C
Clay, Lay Loams, Silty Clay Loams: With imperfect or poor external drainage	C
Clay, Lay Loams, Silty Clay Loams: With Slow Internal Drainage and Good External Drainage	D

Runoff Coefficients

The runoff coefficient (C), as applied in the Rational Method, accounts for the process of hydrologic abstractions and runoff diffusion. The hydrologic abstractions include interception, infiltration, surface storage, evaporation, and evapotranspiration. Runoff diffusion is a measure of the catchment's ability to attenuate the flood peaks. It is also important to note that the appropriate value of C depends on the magnitude of the storm; higher values may be required for extreme storm events to account for reduced abstraction and diffusion effects.

Runoff coefficients shall be selected based on land use and soil type as noted in Table 3.

Table 3 – Runoff Coefficients

Vegetation: Topography	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Woodland: Flat (0-5% Slope)	0.10	0.17	0.23	0.30	0.33	0.37	0.40
Woodland: Rolling (5-10% Slope)	0.25	0.28	0.32	0.35	0.40	0.45	0.50
Woodland: Hilly (10-30% Slope)	0.30	0.37	0.43	0.50	0.53	0.57	0.60
Pasture: Flat (0-5% Slope)	0.10	0.17	0.23	0.30	0.33	0.37	0.40
Pasture: Rolling (5-10% Slope)	0.16	0.23	0.29	0.36	0.42	0.49	0.55
Pasture: Hilly (10-30% Slope)	0.22	0.29	0.35	0.42	0.48	0.54	0.60
Cultivated: Flat (0-5% Slope)	0.30	0.37	0.43	0.50	0.53	0.57	0.60
Cultivated: Rolling (5-10% Slope)	0.40	0.47	0.53	0.60	0.63	0.67	0.70
Cultivated: Hilly (10-30% Slope)	0.53	0.59	0.66	0.72	0.75	0.79	0.82

Paved or Roofs	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Gravel	0.25	0.33	0.40	0.48	0.55	0.63	0.70
Road Shoulders	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Lakes and Wetlands	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Composite runoff coefficients are to be calculated as a function of both total imperviousness and storm return period. Where development is existing or proposed, the runoff coefficient should be increased as follows:

- For the 1:25-year storm: Add 10% to C value
- For the 1:50-year storm: Add 20% to C value
- For the 1:100-year storm: Add 25% to C value

Where available, serviceability studies will often provide the runoff coefficients for the various types of properties within the study area. Some serviceability studies even provide maximum allowable release rates to storm sewers on a per/ha basis. Where available, the runoff coefficient, imperviousness ratios, or release rates defined in a serviceability study should be used in the design of storm sewers within the specific drainage area. If no such information is available, the designer should derive the coefficients per the methodology outlined in this section.

Imperviousness

There are two types of imperviousness ratios used in hydrologic models:

1. Total imperviousness ratio: which is the total paved/impervious area within a sub-catchment divided by the total sub-catchment area.
2. Directly connected imperviousness ratio: which is the directly connected area within a sub-catchment divided by the total sub-catchment area. The directly connected area is defined as the part of the total impervious area that drains directly to the storm sewer system, i.e. does not flow over pervious/grassed areas before entering the sewer system.

Some hydrologic models require both types of imperviousness ratios as inputs while others require only the directly connected imperviousness ratio. For residential areas with split lot grading, for the sub areas, the total part of the roof area (typically half of the roof area) within the sub area must be included as part of the directly connected imperviousness area.

Antecedent Moisture Condition

Due to the lack of records on soil moisture, the MTO DMM 1997 defines the antecedent moisture condition to be measured based on the premise that soil moisture is depleted at a rate proportional to the amount of storage in the soils.

The CN for a given soil varies with the initial antecedent moisture conditions (AMC). The three initial soil moisture conditions are:

- AMC I - dry
- AMC II - average moisture
- AMC III - saturated

In the Eastern Ontario area, the soil saturation shall be AMC II. For critical infrastructure, the curve numbers shall be converted to AMC III when evaluating flows for design storms greater than the 1:100-year event.

Curve Numbers

Curve Numbers (CN) are used in the SCS method. The Curve Number is a function of soil type, ground cover, percentage of impervious area, and antecedent moisture conditions. The CN's can be found in the Table 4.

Table 4 – Land Use and Associated Curve Numbers

Land Use and Treatment: Condition	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Fallow Straight Row	77	82	86	89	91	93	94
Row Crops Straight Row: Poor	72	77	81	85	88	90	91
Row Crops Straight Row: Good	67	73	78	82	85	87	89
Row Crops Contoured: Poor	70	75	79	82	84	86	88
Row Crops Contoured: Good	65	70	75	79	82	84	86
Row Crops Contoured and Terraced: Poor	66	70	74	77	80	81	82
Row Crops Contoured and Terraced: Good	62	67	71	75	78	80	81
Small Grain Straight Row: Poor	65	71	76	80	84	86	88
Small Grain Straight Row: Good	63	69	75	79	83	85	87
Small Grain Contoured: Poor	63	69	74	78	82	84	85
Small Grain Contoured: Good	61	67	73	77	81	83	84
Small Grain Contoured and Terraced: Poor	61	67	72	76	79	81	82
Small Grain Contoured and Terraced: Good	59	65	70	74	78	80	81
Close-seeded Legumes or Rotation Meadow Straight Row: Poor	66	72	77	81	85	87	89
Close-seeded Legumes or Rotation Meadow Straight Row: Good	58	65	72	77	81	83	85
Close-seeded Legumes or Rotation Meadow Contoured: Poor	64	70	75	79	83	84	85
Close-seeded Legumes or Rotation Meadow Contoured: Good	55	62	69	74	78	81	83
Close-seeded Legumes or Rotation Meadow Contoured and Terraced: Poor	63	68	73	77	80	82	83

Close-seeded Legumes or Rotation Meadow Contoured and Terraced: Good	51	59	67	72	76	78	80
Pasture or Range Flat: Poor	68	74	79	83	86	88	89
Pasture or Range Flat: Fair	49	59	69	74	79	82	84
Pasture or Range Flat: Good	39	50	61	68	74	77	80
Pasture or Range Contoured: Poor	47	57	67	74	81	85	88
Pasture or Range Contoured: Fair	25	42	59	67	75	79	83
Pasture or Range Contoured: Good	6	21	35	53	70	75	79
Meadow Straight Row: Good	30	44	58	65	71	75	78
Woods: Poor	45	56	66	72	77	80	83
Woods: Fair	36	48	60	67	73	76	79
Woods: Good	25	40	55	63	70	74	77
Farmsteads: Small	59	67	74	78	82	84	86
Farmsteads: Medium	72	77	82	85	87	88	89
Farmsteads: Large	74	79	84	87	90	91	92
Fallow	77	82	86	89	91	93	94
Crop and Other Improved Land	66	70	74	78	82	84	86
Pasture or other unimproved lands	58	62	65	71	76	79	81
Woodlots and Forest	50	54	58	65	71	74	77
Impervious Areas	98	98	98	98	98	98	98
Bare Bedrock Surface Flow	98	98	98	98	98	98	98
Bare Bedrock Groundwater Flow	70	70	70	70	70	70	70
Lakes and Wetlands	50	50	50	50	50	50	50
Open Space (Lawns, Golf Courses, Cemeteries, etc.): Poor (grass cover <50%)	68	74	79	83	86	88	89
Open Space (Lawns, Golf Courses, Cemeteries, etc.): Fair (grass cover 50% to 75%)	49	59	69	74	79	82	84
Open Space (Lawns, Golf Courses, Cemeteries, etc.): Good (grass cover >75%)	39	50	61	68	74	77	80
Paved parking lots, roofs, driveways etc.	98	98	98	98	98	98	98
Paved: Curbs and storm sewers (excluding ROW)	98	98	98	98	98	98	98
Paved: Open ditches (including ROW)	83	86	89	91	92	93	93
Gravel (including ROW)	76	81	85	87	89	90	91
Dirt (including ROW)	72	77	82	85	87	88	89
Commercial and Business	89	91	92	93	94	95	95
Industrial	81	85	88	90	91	92	93
Residential average lot size: 1/8 acre [0.05 ha] or less (townhouses)	77	81	85	88	90	91	92
Residential average lot size: 1/4 acre [0.10 ha]	61	68	75	79	83	85	87
Residential average lot size: 1/3 acre [0.13 ha]	57	65	72	77	81	84	86
Residential average lot size: 1/2 acre [0.20 ha]	54	62	70	75	80	83	85

Residential average lot size: 1 acre [0.40 ha]	51	60	68	74	79	82	84
Residential average lot size: 2 acres [0.81]	49	57	65	71	77	80	82
Developing urban areas: Newly graded areas (pervious area only, no vegetation)	77	82	86	89	91	93	94

In cases where more than one land use is within a single drainage area, a weighted curve number is calculated. This weighted value is called the composite curve number (CNc). A commonly applied methodology to calculate a modified CN value (CN*) is based on measured and calibrated values of Ia. This methodology is recommended for application of the SCS Method in the Eastern Ontario area.

Depression Storage/Initial Abstraction

If the intensity of the rainfall reaching the ground exceeds the ground's infiltration capacity, the excess will begin to fill the small depressions on the ground surface. For impervious surfaces, this will occur almost immediately. Once these tiny depressions have been filled, overland flow will start and will contribute to runoff. Depression storage, also referred to as Initial Abstraction, parameters are most often applied when using computer methods. The Initial Abstraction (Ia) can be calculated within a computer model or using the SCS Method.

Infiltration

Rainfall that reaches pervious ground surfaces will initially infiltrate into the upper layer of the soil. With extended periods of dry weather, the infiltration capacity of the soil will approach its maximum capacity; however, this capacity will diminish as the storm progresses and the soil becomes saturated. The Horton Method provides a hydrologic based approach to calculating infiltration rates and is commonly applied in urban drainage models. The Horton infiltration equation defines the infiltration capacity of the soil in time based on a decay function ranging from a initial maximum infiltration rate that changes to a lower limiting rate as the storm progresses and is stated as $f = fc + (f_o - f_c)e^{-k(t)}$

Where: f = infiltration rate at time t (mm/hr)

fc = final infiltration rate (mm/hr)

fo = initial infiltration rate (mm/hr)

k = decay coefficient (t^{-1})

The infiltration parameters based on the infiltration medium is as follows:

Material Type	Dry Soils	Moist Soils

Sandy Soils	254.0	84.7
Loam Soils	152.4	76.2
Clay Soils	50.8	0.6

The time in days for a fully saturated soil to dry completely ranges from 2 to 14 days.

Typically, within the North Grenville area, the default values are:

fc = 13.2 mm/hr

fo = 76.2 mm/hr

k = 0.00115 s^{-1}

Hydrologic Reference Point

Hydrologic reference point(s) are location(s) of importance onsite and/or downstream of a site, in which the drainage area size and peak flow can be compared to ensure no adverse impacts as a result of development. Should negative impacts be demonstrated, changes to the design or mitigation measures are required until adverse impacts are neutralized.

C1.05 Levels of Service

The level of service to be provided by the storm drainage system is listed in Table 5 unless stipulated otherwise. The planning of access routes for emergency services (i.e., police, fire, ambulance) may result in higher levels of service as determined by the Municipality, including a regional storm analysis (e.g. historical storms such as Hurricane Hazel, Timmins Storm, etc.).

Table 5 - Levels of Service for Major and Minor Systems

Item	Levels of Service	Comments
Minor System (Urban) Storm Sewers	1:5-year storm	• Catchbasin density such that sewers capacity largely used during 1:5-year storm • Flow spread onto roadways to meet maximum widths per MTO Highway Drainage Design Standards on collector, atrial, and highway roads
Minor System (Rural) Ditching	1:5-year storm (local roadway) 1:10-year storm (collector or arterial roadway)	• The maximum flow depth shall be 1.0m • The minimum freeboard to the top of subgrade shall be 0.3 metres for ditches and cross-culverts

		• Minimum ditch depth shall allow for the Granular 'B' subbase to fully drain. • The ditch sizing/design shall consider additional shared horizontal requirements (e.g. utilities/streetlights, etc.)
Hydraulic Gradeline	1:100-year storm	• No closer than 0.3 m between 1:100-year storm hydraulic gradeline and the underside of footing • Where sump pumps are required, separation distances to be directed by the Municipality
Major System (Urban) Overland Flow	1:100-year storm	• Large drainage areas may require classification as a floodplain using regulatory storm criteria (Conservation Authority) • overland flow cannot exceed width or flow capacity of right-of-way
Major System (Rural) Ditching	1:100-year storm	• No maximum depth • Unless otherwise acceptable by Municipality, the design of the roadside ditch shall ensure that flow will not spread onto either the shoulder or the travel lane and water shall not extend beyond the right-of-way
Culverts	Per MTO Highway Drainage Design Standards	• Refer to Table 3
SWM Treatment - Quantity Control	25mm, 2,5, 10, 25, 5, and 1:100-year storm	• Post-development restriction to pre-development levels unless otherwise directed by Municipality • At a minimum, projects under the site plan approval process shall show results for the 1:5 and 1:100-year storms • At a minimum, projects under the subdivision approval process shall show results for all storm events listed in the LOS
SWM Treatment - Quality Control (first flush) event	4-hour, 25mm design storm or 1:2-year storm	• Unless otherwise directed by Municipality • In addition to requirements per Regulatory guidelines
Critical Infrastructure	Regional Storm or Greater	• Very special cases to be specified at the discretion of the Municipality

Storm sewers are to be initially sized for the 1:5-year storm as per Table 6. Subsequent hydraulic gradeline analyses and SWM may increase sewer sizes and/or require catchbasin inlet controls to be used.

Table 6 - Level of Service for Bridges and Culverts (per MTO HDDS)

Road Classification	Up to 6 m Span	Over 6 m Span	Check Flow for Scour
Urban Arterial Road	1:50 year	1:100 year	130% of 100 year
Rural Arterial Road Urban Collector Road	1:25 year	1:50 year	115% of 100 year
Local Road	1:10 year	1:25 year	100% of 100 year
Driveways	1:5 year	1:10 year	100% of 100 year

The Municipality may require higher levels of service in areas deemed critical to emergency services, such as near hospitals, etc. The Municipality may accept a lower level of service on low volume roads provided there is sufficient reasoning, no foreseeable changes to the road classification in the 50+ year horizon and supporting evidence of no negative impact upstream and downstream of the crossing.

C2.00 Stormwater Management

The intent of an overall stormwater management design is to provide an independent drainage system capable of conveying, treating, and controlling the stormwater runoff. The treatment system should employ Best Management Practices (BMP's) and Low Impact Designs (LID's) wherever possible. The intent of implementing stormwater BMP's/LID's is to create a design that best addresses the water quality, erosion, and quantity concerns, while maintaining the intended use of the facility.

Stormwater management facilities shall be designed to meet provincial SWM prerequisites as set out by MNRF, MECP or the Conservation Authority. Should LIDs not be possible, the Design Engineer shall give an explanation within the SWM Report, to the satisfactory of the Municipality, addressing the methods reviewed and reason why the methods are not feasible.

SWM facility locations, functions and design criteria shall be confirmed through consultation with the Conservation Authority and the Director. Where Stormwater Master Plans have been completed, the design criteria shall follow the approved Master Plan. SWM facilities are acceptable to the Municipality when the designs are safe, maintainable, integrated with the surrounding landscape, and aesthetically pleasing.

The Municipality concedes the overall design requirements to the most recent provincial direction, as is acceptable to the Conservation Authority. Exceptions to this are in circumstances that involve:

i. matters of public safety and aesthetics
ii. maintenance requirements
iii. protecting the riparian rights of private Landowners
iv. protection of municipal infrastructure
v. conflicts with land use
vi. responses of the receiving water body

In these cases, the Municipality may invoke additional release rate stipulations and design requirements over and above those required by other agencies.

C2.01 SWM Facility Treatment Options

Stormwater BMP's and LID's can be implemented at three different locations in the stormwater system: At the Source, Conveyance, and End of Pipe locations.

The purpose of at-the-source SWM facilities is to capture and treat the water immediately after runoff is generated. A major benefit to including SWM treatment at-the-source is a reduction of size in the stormwater network downstream of the site. Typical examples of at-the-source SWM facilities include, but are not limited to:

i. Rainwater harvesting
ii. Green roofs
iii. Blue roofs
iv. Permeable pavements
v. Soakaways, infiltration, trenches, and chambers
vi. Contour plowing
vii. Superpipe
viii. Rain Gardens

The purpose of conveyance SWM facilities is to treat the runoff prior to the end-of-pipe. A major benefit to including SWM treatment conveyance is a reduction of size of the end-of-pipe facility. Typical examples of conveyance SWM facilities include, but are not limited to:

i. enhance grass swale
ii. dry swale
iii. wet swale
iv. infiltration trenches

End-of-pipe stormwater management facilities receive stormwater from a conveyance system (ditches, sewers) and discharge the treated water to the receiving waters. The purpose of end-of-pipe SWMPs is to control the impacts of development which remain after at-the-source and conveyance controls have been applied. In most cases, new urban developments (unless they are small or of very low density) will require some sort of end-of-pipe SWMP. Typical examples of end-of-pipe SWM facilities include, but are not limited to:

i. wet ponds;
ii. wetlands;
iii. dry ponds;
iv. bioretention
v. filters; and
vi. oil/grit separators

Additional treatment options as well as information regarding the application, limitations, and design calculations can be found in the *Low Impact Development Stormwater Management Planning and Design Guide*, *Version 1.0*, 2010, from the Credit Valley Conservation and the Toronto Region Conservation Authority and *MECP Stormwater Planning and Design Guideline 2003*.

C2.02 SWM Facility Design Features

The Municipality requires integration of SWM facilities (e.g. pond, rain garden, etc.) grading design with the surrounding landscape. The design is to consist of varied contour grading to ensure public safety, provide improved aesthetics, support of a variety of plantings and vegetation and provide passive recreational activities (i.e., walking trails, bike paths, vistas, etc.). Safety aspects must be given special consideration. This includes identifying the use of gentle slopes in areas where passive recreation takes place, an increasing density of appropriate plantings and vegetation on steeper slopes, handrails/guardrails at headwalls, and placing signs which inform of the function and potential hazards of SWM facilities.

C2.03 Safety Features

The Municipality prefers not to unnecessarily require fencing around SWM facilities, but instead to allow for casual public access. Accordingly, public safety must be kept paramount in the design of SWM facilities.

The Municipality may elect to require fencing at the rear of lots backing onto SWM facilities. However, fencing around the perimeter of SWM facility blocks will only be considered by the Municipality when reviewing submissions where there are extenuating circumstances which prevent the above requirements from being met. Specific approval will be required from the

Municipality for consideration of fenced facilities. Where approval for fencing is given by the Municipality, 1.8 m high black vinyl-coated fencing, posts and hardware shall be used.

Specifically, SWM ponds must be designed to meet the following minimum standards and the MECP Guidelines (whichever is more restrictive) unless otherwise stipulated by a governing authority:

i. Maximum permissible side slopes shall be 4:1.

   3:1 side slopes will be considered above the 100-year water level only in situations with extenuating circumstances as determined by the Director.

ii. Berms are to be designed as proper dams (clay core, toe drains, etc.).

iii. Signage to educate and advise public of facility must be erected (refer to Standard Drawing C-01).

iv. Suitable landscape plantings are required to discourage access, break accidental falls, and to provide for both aesthetics and environmental enhancement. Landscaping shall be in accordance with the requirements of the Municipality's Parks, Recreation and Culture Department.

v. Bollards or gates to discourage vehicular access to maintenance road must be installed.

vi. Safety grates shall be provided on all storm sewer inlet and outlet pipes and safety railings shall be provided along the top of all headwalls 600 mm in height or greater.

C2.04 Operational and Maintenance Features

The SWM facility designs are to incorporate features that allow the Municipality to complete the operation and maintenance of the facility. It is strongly recommended that the Developer's Representative arrange a pre-consultation meeting with the Director once a preliminary design has been prepared to discuss maintenance operations and features, specifically clean-out procedures and sediment management and removal.

For SWM ponds these features include:

i. Maintenance road to access bottom of sediment forebay and to access main outlet(s) having a maximum gradient of 10%, minimum width of 3.0 m and minimum inside turning radius of 10.0 m to allow for maintenance vehicle access.

ii. Either a bypass sewer between inlet and outlet or dewatering perforated pipe, equipped with a valve closing clockwise, leading to a dewatering sump (where gravity is not feasible) in the outlet structure. Valve to be easily accessible from the maintenance pathway.

iii. All maintenance vehicle access roads shall be structurally designed to support municipal equipment.

iv. Flow control structures shall be located for easy access, maintenance and cleaning. These must be protected from public access where safety is an issue and must blend readily into the landscape (avoid railings, etc.).

v. Minimum orifice size of 75 mm diameter.

vi. In industrial/commercial areas, a valve shall be provided as part of the normal pond outlet design to enable the normal pond outlet to be closed in case of chemical spills.

C2.05 Operations and Maintenance Manual

A SWM Facility Operations and Maintenance Manual is to be prepared for the Municipality by the Developer's Representative for new SWM facilities. The manual is to describe how each facility operates and the maintenance requirements of the facilities. The manual shall also include estimated yearly maintenance costs for the facilities along with supporting calculations. Any collection system SWM components, such as oil and grit separators are to be included in the manual. The design of the system should minimize operating and maintenance costs.

A list of typical items that should be included in the manual is as follows:

i. Location

ii. Design Drawings

iii. Type of SWM Facilities

iv. Facility Specifics, such as, but not limited to:
   - How the facility works (describe methodology of typical events)
   - Design Values for Facility (volumes, elevations, discharges, design event, over topping, etc.)
   - Detention Time/Draw Down Time
   - Reduced Scale Plan of Facility
   - Access (cleaning ports, valves, etc.)
   - Inspection (what to check, frequency)
   - Sediment (anticipated volume, frequency of removal, disposal, testing)
   - Maintenance (grass cutting, weed control, vegetation replanting, garbage removal, sediment removal, etc.)
   - Annual Cost Estimate for all Maintenance Activities
   - Inspection schedule for the proposed pond

Additional items as per the MECP latest Stormwater Management Planning and Design Manual should also be included as deemed appropriate for the particular facility

C3.00 Stormwater Conveyance

C3.01 General

An evaluation of stormwater conveyance shall be completed to minimize risk to the public safety and confirm the integrity of the conveyance system. Acceptable stormwater conveyance systems vary depending on the zoning, neighbouring conveyance systems and available stormwater outlet. Therefore, it is recommended that the Developer's Representative consult with staff prior to conducting analysis or design. Stormwater conveyance generally falls into three separate categories as described below:

Urban stormwater networks typically include roadway conveyance along the curb, catchbasins and maintenance holes, and sewer pipes. Additional features that may be part of an urban sewer network may include rear-yard drainage swales.

Rural stormwater networks typically include roadside ditches and culverts. Additional features may include side yard drainage swales.

Semi-urban stormwater networks typically include a combination of the rural and urban networks with shallow ditching and small diameter sewers. Urban and rural design parameters apply to all of this design category.

Stormwater networks shall be designed to intercept runoff from external areas naturally draining through development sites.

C3.02 Hydraulic Modeling

The purpose of the hydraulic analysis is to determine whether the stormwater conveyance networks have sufficient capacity to convey the design flow without causing adverse impacts to infrastructure, surrounding lands, and public safety. The hydraulic analysis can be done using the computer model simulation. Generally accepted computer analyses software for urban drainage systems include: StormCAD, PCSWMM, EPASWMM, and AutoDesk Storm and Sanitary Analysis. Generally accepted computer analyses software for watercourse analysis and culverts include HEC-RAS, HY-8, PCSWMM, EPASWMM, CulvertMaster, FlowMaster, and AutoDesk Storm and Sanitary Analysis. Other programs may be considered as acceptable, but it is recommended to consult with director ahead of modelling to confirm if there is an acceptable level of understanding (for review purposes).

C3.03 Urban Stormwater Network Design Parameters

The design of storm sewer network conveyance systems shall follow "dual drainage" principles, which consist of:

i. The minor system shall convey runoff up to and including the 1:5-year design storm (as noted in Section C1.05) under gravity conditions.

ii. The major system shall convey runoff from storms greater than the minor storm up to and including the 1:100-year design storm (as noted in Section C1.05). The design of the major system shall be such that runoff is conveyed within the boundaries of municipal road allowances, blocks or easements.

Storm sewers should be sized to convey the peak minor system design flow in accordance with Manning's equation, whereby the friction slope is assumed the same as the bed slope of the pipe. The sizing of sewers at slopes greater than the critical slope is limited by inlet capacity and not friction slope. At a minimum, the sewer shall be designed with the slopes to meet the minimum velocity shown in Section C4.05. However, the Municipality may consider flatter grades for sewers greater than 1500mm diameter, in special circumstances, provided a minimum velocity of 1 m/s can be attained.

The storm sewer system shall be designed to include capacity for connection of foundation drains or weeping tiles. The storm sewers shall be at an appropriate depth to provide connection to foundation drains, where possible. A hydraulic gradeline analysis shall be completed and submitted for review. Sufficient inlet control devices at appropriate locations shall be determined by the Designer to ensure that the minor system captures not more than its nominal capacity so that gravity flow conditions are maintained in the minor system. Inlet control devices shall be noted on design drawings including flow rate and maximum control elevation and connection details sufficient for construction.

During the major storm event it must be demonstrated that the Hydraulic Grade Line (HGL) for the 100-year storm (as noted in Section C1.05) will be no closer than 0.3m to the finished basement floor elevations of the dwellings, unless otherwise directed by the Municipality. Consult with the Municipality where physical outlet constraints and geotechnical constraints do not allow for the HGL to be below the foundation.

Flow spread onto traveled lanes to meet maximum widths per MTO Highway Drainage Design Standards SD-3 for local, collector, and arterial, roads.

C3.04 Rural Stormwater Network Design Parameters

Roadside ditches capturing stormwater runoff are designed to convey the minor and major system flows in accordance with the MTO HDDS SD-9 and shall consist of:

i. The minor system shall convey runoff from storms up to and including 1:5/1:10-year storm event (as noted in Section C1.05) at a maximum depth of 1.0 m and have a minimum freeboard of 0.3 m to the top of subgrade.

ii. The major system shall convey runoff from storms greater than the minor storm up to and including the 1:100-year design storm (as noted in Section C1.05). There is no requirement for depth and freeboard for the 100-year storm event. The design of the major system shall be such that runoff is conveyed within the boundaries of municipal road allowances, blocks or easements.

The roadside ditch system shall be designed to include capacity for connection of foundation drains or weeping tiles. The ditches shall be at an appropriate depth to provide an outlet for the foundation drains.

In no case shall the velocity in a grass-lined channel exceed 1.5 m/s for the major system flow, unless appropriate channel lining has been designed to resist the erosion.

Roadside ditch physical parameters are listed in Table 7.

Table 7 – Roadside Ditch Physical Parameters

Roadside Ditch Design Parameters	
Maximum Foreslope*	3H:1V
Maximum Back Slope*	2H:1V
Minimum Longitudinal Slope	0.3 %
Base Width - Desirable Standard - Minimum Standard	1.0 m 0 m (V-ditch)
Minimum Ditch Depth for Minor System Design Flow: - Normal Ditch (road at grade or in cut) - Ditch at toe of fill slope	 0.85 m 0.25 m
Distance that roadside ditch invert shall be below the road subgrade elevation - Desirable Standard - Minimum Standard	 0.5 m 0.3 m
*Steeper slopes in rock cut may be acceptable with geotechnical recommendations	

C3.05 Key Hydraulic Parameters

Swales and Open Channels

Swales and open channels can play an important role in both the major overland flow systems and the minor systems. They are to be designed to be aesthetically pleasing, safe, resistant to erosion and easy to maintain. Critical depths and energy to determine channel capacity in the supercritical range are to be considered. Design velocities are to be calculated using Manning's equation. Generally, grassed surfaces are adequate for velocities up to 1.0 m/s to 1.5 m/s and more robust erosion protection is required for velocities beyond this range.

Fences, garden sheds and other flow impediments significantly reduce the flow carrying capacity of swales on private property. Overland flow from public property onto swales on private property is not permitted. Overland flow must be limited to road rights-of-way, walkways and easements, free of fences and other impediments to flow.

Manning's n

The value of the roughness coefficient 'n' used in the Manning's Formula for ditches, swales, and open channels shall be per Table 8.

Table 8 - Acceptable Values for Manning's "n"

Grass Channel (>0.5 m deep)	0.030
Grass Swale (<0.5 m deep)	0.035
Rip-Rap Channel (>1 m deep)	0.045
Rip-Rap Channel (<1 m deep)	0.050

Overland Flow Route

A continuous overland flow drainage route is to be identified on the engineering drawings and grading plans. The extent of any overland ponding at low points is also to be shown on the grading plans. Storm inlets in sag conditions designed to capture and convey the major drainage system is to include a 50% blockage factor in its stormwater runoff capture rate.

Existing Channels/Watercourses

Channel realignment or channel restoration upstream or downstream of a water crossing that will alter the storage or discharge characteristics upstream of the crossing, shall be designed to meet the design standards of the crossing. As a minimum the combined capacity of the watercourse and floodplain shall convey the 25-year Design Flow. The main channel is to be designed to a lower Design Flow such that a stable channel is maintained.

C4.00 Storm Sewer Design

All storm drainage infrastructure, including sewers, maintenance holes, catchbasins, etc., are to conform to the design standards outlined herein and MECP criteria. Should any Provincial standards (i.e., MECP) exceed the Municipality's standards, those standards shall dictate.

C4.01 Peak Flows

The Rational Method is an acceptable method to calculate the peak flow, where it satisfies the criteria identified within Section C1.03. An acceptable alternative is single event computer modeling for peak flow evaluation; however the model results shall be provided in a standard sewer design sheet format.

C4.02 Runoff Coefficients

Composite runoff coefficients shall be calculated as noted in Section C1.04.

C4.03 Time of Concentration

Times of concentration to be used with the Rational Method are to be calculated per Section C1.04.

In situations where relatively large, undeveloped or parkland areas become tributary to a smaller urban drainage system, the lower time of concentration is to be used only where this results in higher flow rates. In these cases, only the lower portion of the undeveloped area would be contributing runoff, as a result of this shorter storm duration, proportional to the square root ratio of the two times of concentration. For example, an urban drainage system, having a time of concentration of 15 minutes, would also drain approximately 70% of a large undeveloped area, having a time of concentration of approximately 30 minutes, draining to that same point (i.e., 15/30 l/2 = 0.7).

C4.04 Pipe Coefficients

Manning's Formula shall be used in determining the capacity of all storm sewers, as outlined above.

The value of the roughness coefficient 'n' used in the Manning's Formula shall be as follows:

i.	Concrete pipe all sizes	0.013
ii.	Concrete Box Culverts	0.013
iii.	Corrugated Steel < 150mm corrugation	0.024
iv.	Corrugated Steel > 150mm corrugation	0.033
v.	Polyvinyl Chloride Pipe (PVC)	0.013
vi.	High Density Polyethylene (smooth inside wall)	0.013

C4.05 Flow Velocities

i. Minimum flow velocity = 0.8 m/sec

ii. Maximum full flow velocity = 4.0 m/sec

C4.06 Minimum Sizes

The minimum size for a storm sewer main shall be 250 mm in diameter.

C4.07 Minimum and Maximum Grades

The minimum and maximum grades for all storm sewers shall be designed to accordance with the flow velocities outlined in Section C4.05 and C3.03. The minimum grade for the first upstream leg shall not be less than 1.0%.

C4.08 Pipe Cover

Typically, a minimum cover of 2.1 m (from future road grade) is required to the top outside edge of the pipe barrel for the storm sewer. However, where specifically approved by the Municipality, minimum cover less than 2.1 m may be provided on storm sewers where servicing limitations exist, subject to the approval of the Director. Installation details are to be provided for consideration.

Where sewer depths exceed 4.5 m, risers are to be utilized and brought to within 2.1 m depth. The maximum allowable depth of sewer with direct lateral connections is 6.0 m measured from centerline of road to the obvert of the sewer Any sewer deeper than 6.0 m will be considered a trunk sewer and a separate shallower local sewer will be required for service connections. The local sewer shall be constructed directly above the truck sewer and common maintenance holes with drop structures shall be utilized.

C4.09 Location

All storm sewers shall be located as shown on the Standard Road Cross-Section. The standard location shall be 1.0 m offset from the centerline of the road allowance.

C4.10 Limits

All sewers shall be terminated at the subdivision limits when external drainage areas are considered in the design with suitable provision in the design of the terminal maintenance holes to allow for the future extension of the sewer.

C4.11 Sewer Alignment

All storm sewers shall be laid in a straight line between maintenance holes unless radial pipe has been designed. The storm sewer vertical alignment shall be designed obvert to obvert.

C4.12 Pipe Crossings

A minimum clearance of 0.30 m shall be provided between the outside of the pipe barrel at the point of crossing for storm and sanitary sewers. A minimum outside clearance of 0.5 m shall be provided for all sewer and watermain crossings in accordance with MECP policies.

In the event the minimum clearances cannot be obtained, the designs must adhere to MECP policies. In addition, the pipes shall be concrete encased to ensure that the pipes are properly bedded.

C4.13 Changes in Pipe Size

No decrease of pipe size from a larger upstream pipe to a smaller downstream size will be allowed regardless of the increase in grade.

C4.14 Sewer Pipe Material

All sewer pipe material shall conform to the List of Acceptable Materials included in Appendix 4 of this document.

C4.15 Pipe Bedding and Backfill

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. Details and types of bedding and backfill are illustrated in OPSD 802.01 and 802.03. The width of the trench at the top of the pipe must be carefully controlled to ensure that the maximum trench width is not exceeded unless a higher class of bedding or higher pipe strength pipe is used. The recommendations of a Geotechnical Engineer will be required in determining strength of pipe required and construction methods to be used.

C4.16 Service Connections

Individual storm service connections are to be provided to all lots for the purpose of connecting foundation drains.

Service pipe material shall conform to the List of Acceptable Materials included in Appendix 4 of this document.

The use of sump pumps is discouraged but will be considered by the Director if they are deemed to be the only viable option available. (Roof leaders shall be directed overland.) The storm sewer system shall be designed such that the 1:100-year storm does not surcharge the sewers or create backwater effects that could surcharge the weeper tiles within 0.3 m of the underside of footing.

C5.00 Maintenance Holes

C5.01 Location

Maintenance holes shall be located at each change in alignment, grade or pipe material, intersections, at all pipe junctions, and at intervals along the pipe to permit entry for maintenance of the sewer.

C5.02 Maximum Spacing of Maintenance holes

Maximum Spacing for Maintenance holes is 120m.

Greater spacing may be permitted for large sewers. Cleanouts may be used only for special conditions and should not be substituted for maintenance holes nor installed at the end of laterals greater than 45m in length.

C5.03 Maintenance Hole Types

Maintenance holes shall be constructed of precast concrete. The standard maintenance hole details as shown on the OPS Drawings shall be used for maintenance holes. In cases where the standard drawings are not applicable, the maintenance holes shall be individually designed and detailed.

Maintenance hole covers shall be the “open” type per OPSD 401.010.

A reference shall be made on all Profile Drawings to the OPSD type and size of all storm maintenance holes.

Precast maintenance holes shall conform to ASTM Specification C478 latest revision.

C5.04 Maintenance Hole Design

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

ii. The maintenance hole shall be centred on the sewer main.

iii. The maximum change in the direction of flow in any sewer maintenance hole shall be no more than 90°. A change of flow direction at acute interior angles will not be permitted.

iv. Safety gratings shall be required in all maintenance holes greater than 5.0 m in depth. Safety gratings shall not be more than 5.0 m apart and shall be constructed in accordance with OPSD 404.020. Where practical, a safety grating shall be located 0.5 m below the drop structure inlet pipe.

v. Maintenance holes should be used at all changes in horizontal alignment and at all changes in vertical grade.

vi. Maintenance holes should be used at all changes in pipe sizes.

C5.05 Grades for Maintenance Hole Frames and Covers

All maintenance holes located within the travelled potion of a roadway shall have the rim elevation set flush to the base course of asphalt. Prior to the placement of the surface course asphalt the maintenance hole frame shall be adjusted to the finished grade of asphalt. Steel

adjusting rings will not be permitted. Temporary asphalt curbs shall be constructed behind all catchbasins at base course asphalt stage.

C5.06 Head Losses through Maintenance Holes

Suitable drops shall be provided across all maintenance holes to compensate for the loss of energy due to the change in flow velocity and for the difference in the depth of flow in the sewers. Hydraulic calculations are required where the change in velocity through a maintenance hole is 0.6 m/s or greater. Refer to Table 9 for minimum drops across maintenance holes.

Table 9 - Minimum Drops Across Maintenance Holes

Maintenance Hole Type	Loss Incurred
Straight Run	Grade of Sewer
45°	0.03m
90°	0.06m

C6.00 Catchbasins

C6.01 Location and Spacing

Catchbasins should be provided at adequate intervals in the sewer system to ensure that the road drainage is able to be intercepted up to the capacity of the storm sewer. The spacing will vary with the road width, grade, crossfall and with the design storm frequency. The spacing will also be affected by the location of pedestrian crossing points, intersections, low points and driveway depressions.

Stormwater management systems using inlet control catchbasins may be designed with less frequent spacing than those below. In such cases, the designer should justify whatever spacing is used.

Table 10 – Maximum Spacing per Pavement Width

Road Gradient (%)	Maximum Spacing
0 to 3	110 m
3.1 to 4.5	80 m
4.5 to 5%	65 m
Over 5%	45 m

A double catchbasin is required where drainage is received from more than one direction, as at a low point, unless overland relief is provided no more than 0.05 m above the catchbasin frame. The Municipality will accept catchbasin sizing based on modeling, provided a 50% blockage factor is applied on catchbasins in sag locations with flow from multiple directions.

All catchbasins at street intersections shall be located on the tangent section of the curb at a minimum of 0.6 m distant from the beginning or the end of the radial portion of the curb.

Catchbasins shall not be located in driveway curb depressions, where possible.

Leads for catchbasins located close to maintenance holes should be connected directly to the maintenance holes.

Catchbasin leads shall be 200 mm diameter for single catchbasins and 250 mm diameter for double catchbasins.

Catchbasin leads shall have a minimum grade of 1%. The desirable gradient is 2%.

Catchbasin inlet control devices are to be approved by the Director.

C6.02 Catchbasin Capture

Calculations to estimate the catchbasin capture to the sewer system are to consider the type of grate, whether the catchbasin is in a "sag", the catchbasin lead diameter and any inlet control device. Capture rates are to consider the depth of flow over the grate based on the depth of flow over the downstream point of relief.

C6.03 Catchbasin Types

Catchbasins must be of the precast type as shown on the OPSD 705.01 or 705.02. Special catchbasins are to be designed and detailed to the satisfaction of the Director.

C6.04 Catchbasin Connections

Table 11 - Catchbasin Connection Type per Minimum Size & Minimum Grade

Type	Minimum Size of Connection	Minimum Grade of Connection
Single Catchbasin	200mm	1%
Double Catchbasin	250mm	1%
Rear Lot Catchbasin	200mm	1%

C6.05 Catchbasin Frame and Covers

All catchbasin frame and covers located in roadways shall be "bike proof". as per OPSD 400.010, 400.020, 400.021, 400.030, 400.050, and 400.100 depending on the intended application.

Rear lot catchbasin frame and covers shall be as per Municipality of North Grenville Standard Drawing C-02, C-03, and C-04.

C6.06 Sumps

All storm structures are required to have sumps. For storm maintenance holes, a sump of 300 mm and for catchbasins (both road and rear yard) a sump of 600 mm is required.

Refer also to Section C4.16 - Service Connections.

C7.00 Culverts and Bridges

C7.01 General

At a minimum, hydraulic calculations for culverts and bridges shall be evaluated using a steady-state modeling program that builds on the flow, tailwater, culvert size, constriction, and Manning's values available to provide the inlet/outlet headwater elevations, as well as the outlet velocity.

Culverts shall be designed in accordance with the criteria in the MTO HDDS 2008 and MTO DMM 1997. Structural culverts and multi-span culverts with a total diameter equal to or greater than 3.0 m, as well as bridges shall be designed in accordance with e MTO HDDS 2008, MTO DMM 1997, and the most recent version of the Canadian Highway Bridge Design Code (CHBDC).

C7.02 Cross-Culverts

The term cross-culvert refers to drainage pipes which provide roadway and upland stormwater runoff conveyance, not on a watercourse, with both ends of the pipe at ground surface.

The minimum inside culvert diameter for a cross-culvert is 600 mm, while the minimum for private entrances is 450 mm. All cross-culverts, including private entrances, conveying only the roadway drainage shall be designed to drain the minor system flow in accordance with Section C1.05 for Minor System (Rural) Ditching. All cross-culverts shall have a minimum freeboard to the top of subgrade of 0.30 m for the minor system.

Riprap aprons per OPSD 810.010 shall be provided on all cross-culverts and where required based on flow characteristics at private entrances.

C7.03 Watercourse Crossings

Watercourse crossings include culverts and bridges which shall be designed to withstand the design flood without endangering the integrity of the structures and without roadway overtopping or embankment failure. A hydraulic assessment will be required to provide an opportunity to verify the minimum size and soffit elevation of the proposed structure, to adequately provide protection against potential scour, and to provide erosion mitigation measures.

The following criteria, summarizes the main hydraulic performance elements for required for culvert and bridge design.

Design Storm

Based on the span of the proposed crossing and the roadway classification the storm event per Section C1.05 shall be selected to complete the hydraulic analysis.

Freeboard

The minimum freeboard is measured vertically from the high-water level for the design flow to the edge of the travelled lane. As stated in Sub-section 3.2.1, HDDS WC-2 and Sub-section 3.2, HDDS WC-7, the minimum freeboard for arterial and collector roadways shall be greater than or equal to 1.0 m. The minimum freeboard for local roadways and private entrances shall be greater than or equal to 0.3 m.

Flood Depth

The flood depth criterion is required for culverts, which is expressed as the ratio of the water depth at the upstream face to the culvert diameter or rise (HW/D). According HDDS WC-7, Sub-section 3.5: for culverts with a diameter or rise less than 3.0 m, the HW/D ratio should be less than or equal to a value of 1.5; for culverts with a diameter or rise 3.0 m to 4.5 m, the HW should be less than or equal to a value of 4.5m; for culverts with a diameter or rise greater than 4.5 m, the HW/D ratio should be less than or equal to a value of 1.0.

Vertical Clearance

According to subsections 3.1 and 3.2.2 (HDDS WC-2), the clearance is measured vertically from the high-water level for the design flow to the lowest point on the soffit. There is no Clearance requirement for Closed-Footing Culverts and Open-Footing Culverts with a non-erodible bottom. For culverts with an erodible bottom, the vertical clearance for structures under an arterial and collector road shall be greater than or equal to 1.0 m, and for a local road shall be greater than or equal to 0.3 m.

Fish Passage

The design storm for calculating fish passage requirements is the 1:2-year storm event.

Velocity

The permissible velocity through culverts/bridges shall not exceed the erosion limit of the native material found both upstream and downstream of the crossing.

Scouring and Armouring

According to HDDS WC-3, Sub-section 3.2.1, scouring and armouring for standard road classifications, erosion protection shall be provided if the outlet velocity is above the permissible value. Riprap stones for protective aprons are designed for a velocity of 1.5 times the average velocity of the Design Flow. The thickness of the apron shall be not less than 1.5 times the median stone size.

Erosion protective aprons shall be provided if the outlet velocity is above the permissible velocity. The maximum permissive flow velocities shall conform to the MTO Design Chart 2.17. A maximum permissive flow velocity of 1.10 m/s has been assumed for design purposes, which conforms to a sand and silt or silty clay for flows carrying fine silt based on the geotechnical reports.

Relief Flow

According to HDDS WC-13, Sub-section 3.2.1, the maximum depth of flow on the roadway shall not exceed 0.3m at the cross section of the road for the Regulatory Flood. In addition, Sub-section 3.2.2 states that the product of the velocity and depth on the roadway shall not exceed 0.8m^2/s.

Ice Flow

According to HDDS WC-11, Sub-section 3.1, the culvert soffit clearance shall be 0.3m above the maximum observed ice/debris build-up plus Winter Flow.

C7.04 Pipe Material

The minimum design service life for culverts shall be as follows: 75 years for watercourse crossings, 50 years for cross-culverts, and 25-year for private entrances. A durability review shall be completed on all crossings where steel pipes may be used to determine whether the estimated material service life (EMSL) of the crossing is greater than the required design service life. The (EMSL) shall be calculated using Section 7.0 of the MTO Gravity Pipe Design Guidelines 2014.

C7.05 Safety End Treatment

Cross-drainage structures that present a traffic hazard shall have safety slope end treatment that matches the foreslope unless already shielded by a roadside barrier. Extending inlets/ outlets beyond the enhanced clear zone in order to eliminate a safety end treatment is permitted provided the roadside ditch can remain within the municipal right-of-way. Safety runner bars are required on pipes larger than 750 mm diameter.

Parallel drainage structures located in a roadside ditch adjacent to the travelled way or within the enhanced clear zone shall have a 3:1 or flatter safety slope end treatment. Cross members are required on pipes 300 mm in diameter or larger.

C8.00 Inlets, Outfalls and Special Structures

C8.01 Inlets

Inlet structures must be fully designed and detailed on the engineering drawings. Inlet grates shall generally consist of inclined parallel bars or rods set in a plane at approximately 18° with the top away from the flow.

Gabions or rip rap shall be provided at all inlets to protect against erosion and to channel flow to the inlet structure.

Precaution must be taken in the design of grating for structures to minimize the risk of entanglement or entrapment of a person.

C8.02 Outlets

The OPSD 804.03 standard headwall shall be used for all storm sewers less than 900 mm in diameter. For sewers 900 mm in diameter and larger the headwall shall be per OPSD 804.040 or individually designed. All headwalls shall be equipped with a grating over the outlet per OPSD 804.05.

Gabions, rip rap, or other erosion protection shall be provided at all outlets to prevent erosion of the watercourse and the area adjacent to the headwall.

C8.03 Safety Railings

Safety railings shall be provided along the top of all headwalls 0.9 m in height or greater. Railings may also be required along shorter headwalls where a risk to pedestrian safety has been identified. The site-specific conditions must be reviewed in determining the requirement for safety railings and must have due regard to public health and safety.

C9.00 Testing

Infiltration or exfiltration testing shall be completed on all sewers at the discretion of the Director. The Director shall be the sole judge of which test/tests are to be undertaken. All testing shall be witnessed by the Developer's Representative with the Director being notified a minimum of 48 hours prior to the test being carried out. The Developer's Representative will be required to certify the results of any tests carried out.

C9.01 Deflection Testing

Deflection tests only need to be completed when a deficiency is noted through CCTV, there is reason for concern, or as required by the Director. Deflection testing is to be completed per OPSS 410.

All sections of pipe that fail the deflection test shall be repaired and retested.

C9.02 Closed-Circuit Television Inspection

All newly constructed storm sewers and rear lot catchbasin leads shall be CCTV inspected upon satisfactory completion of all other testing. The sewers and leads must be CCTV inspected prior to the final placement of top course asphalt, the sewers being considered to be placed on

maintenance and again prior to being considered for Final Acceptance. CCTV inspections are to be carried out no more than 90 days prior to the request for Final Acceptance.

The Municipality will require written confirmation from the Developer's Representative that they have reviewed the videos and have found the sewers to be acceptable and free of all defects. Any deficiencies should be clearly identified in the Engineer's letter and verification that all deficiencies have been rectified must be included in the letter.

A permanent record in electronic format shall be supplied, illustrating a continuous record of the sewer installations, service connection, maintenance holes, etc. A report identifying any unusual or substandard conditions shall also be submitted.

The CCTV inspection shall be carried out by an Operator certified by NAAPI and shall be carried out in accordance with OPSS 409.

All videos, reports and data provided from these inspections shall become the property of the Municipality.

At the discretion of the Director, additional inspections and records may be required prior to "Final Acceptance".

C9.03 In Line Sumps

In line sumps are not acceptable.

C9.04 Infiltration/Exfiltration

Field testing for infiltration/exfiltration for sewer pipe installations in an open cut shall be carried out in accordance with OPSS 410.

C10.00 Private On-Site Stormwater Management Facilities

The Municipality endorses the practice of SWM on private property but cannot accept any assurance that these practices will be properly operated and maintained by the private Landowners. This is particularly applicable to on-site stormwater detention for the purposes of peak flow reduction or water quality improvement. Under specific conditions, on-site SWM can be recognized when sizing downstream works.

For private, on-site stormwater detention, the following conditions apply:

a) "Peak Shaving" detention on parking lots or within landscaped ponds:
    i. unacceptable on residential lots
    ii. cannot reduce downstream detention requirements

iii. can reduce municipal sewer sizes, but only where restricted by small diameter pipe between mainline sewer and a control maintenance hole at property line

b) "Roof Top Detention" in non-residential areas:
   i. can reduce downstream detention requirements
   ii. for hydrologic calculation purposes at master planning stage, assumed flat roof area limited to maximum 15% of gross area of subdivision

The smallest acceptable restriction sewer is 100 mm diameter. Designers should account for the hydraulic losses of the small diameter outlet sewer when sizing any other on-site control devices, such as orifices controlling parking lot detention.

C10.01 On-Site Stormwater Management Guidelines

Except for low/medium density residential sites, drainage from private property is to be self-contained (minor system) and provide the same levels of service as with municipal infrastructure.

Parking lot detention should regard frequency, depth and duration of ponding. Generally, ponding depths should not exceed 0.15 m at the deepest point for the 1:5-year storm event and 0.30 m for the 1:100-year storm. Maximum parking lot drain-down time should be 60 minutes after a 1:100-year storm. Where depths, frequency, or drain-down times do not meet the above guidelines, consideration should be given to using grassed/landscaped areas for deeper, more frequent ponding and parking lots for only the upper registers of ponding.

Underground storage facilities should allow for proper ventilation and maintenance access. As with any buried infrastructure on private property, these facilities must meet the Building Code for the required cover, bedding, etc.

Site Plan Applications should include information on number and type of roof drain restrictions in support of the Stormwater Management Report.

For plans of non-residential subdivisions, the Storm Drainage Area Drawings are to show a table having the following peak design flow rates, labeled accordingly, for each block of land:

i. 1:5-year storm flow (m3/s)
ii. 1:100-year storm flow (m3/s)
iii. permitted discharge to storm sewer (m3/s)
iv. maximum allowable discharge from Block (m3/s)

C11.00 Construction

Storm drainage and stormwater management works are to be constructed in accordance with OPSS 407, OPSS 410, and these engineering standards. For work not covered under these standards, consult with the municipality to confirm requirements.

C12.00 Alternative Design and Construction Techniques

For no-dig and non-standard considerations consult with the municipality to confirm requirements.

SECTION D – WATERMAINS AND APPURTENANCES

Municipality of North Grenville
Engineering Standards for Design, Approval, and Construction

August 2022

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SECTION D – WATERMAINS AND APPURTENANCES

D1.00 Compliance

D1.01 General

Notwithstanding the guidelines and requirements identified herein, the MOECC Watermain Disinfection Procedure is to be met.

D2.00 Hydraulic Design

D2.01 General

All watermains shall be sized to meet the greater of the maximum day plus fire flow or the maximum hour demand. Watermains in subdivisions shall have a minimum of two connections to the existing water network. The Municipality will require a hydraulic analysis for all or any phased portion of the proposed watermain systems. Boundary conditions for modeling purposes shall be obtained from the Municipality or by carrying out on-site hydrant flow tests in consultation with the Municipality.

Separate fire protection and domestic services for private sites will be considered on a case-by-case basis.

D2.02 Fire Flow

Calculations using Fire Underwriters Survey and Ontario Building Code requirements are to be provided.

D2.03 System Pressures

The maximum sustained operating pressure shall not exceed 550 kPa (80 psi). If pressure in a localized area is above this level, a pressure reducing valve shall be installed on each service in that area.

Under normal conditions of maximum hour demand, the pressure shall not drop below 350 kPa (50 psi) at any point in the water system.

Under conditions of simultaneous maximum day and fire flow demands, the pressure shall not drop below 140 kPa (20 psi) at any point in the water system.

D2.04 Flow Design

The Hazen-Williams Formula in accordance with the current MECP (MOECC) design criteria shall be used for the design of water distribution systems.

D2.05 Domestic Demand

Domestic water demand shall be calculated on the basis of an average day consumption rate of 300 L/capita/day, or as directed by the Municipality.

Maximum Day and Peak Hour factors shall be 2.0 and 3.0 respectively, or as recommended by the MECP (MOECC) Guidelines for Drinking Water Systems.

Densities to use in determining expected populations in residential developments.

Table 1 – Density per Type of Dwelling (Persons Per Unit)

Dwelling Type	Density
Single Detached Dwellings	3.4 ppu
Semi-Detached Dwellings	2.7 ppu
Townhouses	2.7 ppu
Apartments	2 ppu

D2.06 Industrial, Commercial and Institutional (ICI) Water Demands

For ICI applications, consult with the municipality regarding demand parameters.

D2.07 Locations

Watermain to be located generally in the opposite lane of the sanitary main with a minimum 2.5 metres of separation. Valves are to be located outside of wheel paths.

D2.08 Depth of Cover

The minimum depth of cover shall be 2.4 m.

D2.09 Horizontal Separation between Sewers and Watermains

Watermains shall be designed to have a minimum clear distance of 2.5 m from any sewer or maintenance hole per MECP (MOECC) guidelines.

D2.10 Watermain Crossing Sewers and Other Utilities

Watermains shall normally cross above sewers with sufficient vertical separation to allow for proper bedding of the watermain (minimum 0.5 m).

When it is not possible for a watermain to pass over a sewer, the watermain passing under the sewer shall have a vertical separation of 0.50 m below the sewer and the top of the watermain. The sewer must be adequately supported to prevent settling and displacement of the joints. See Standard Details D-01 and D-02.

Watermains crossing over or under other utilities must be designed with a vertical separation of 150 mm between the outside edges of the watermain and the utility.

Separations to meet MECP F-6-1 guidelines.

D2.11 Dead-Ends

Watermain distribution system shall be designed in grid patterns and looped to avoid dead-end sections. Dead-end watermains are to be avoided.

In extreme situations, as determined by the Director, where it is determined that dead-end watermains are unavoidable, a fire hydrant shall be installed at the end of the watermain. Water service connections shall be grouped as much as possible at the end of the dead-end watermain or a 50 mm loop shall be constructed as per Standard Detail D-03. Calculations shall be provided to demonstrate that there is adequate water usage during low flow periods to maintain adequate chlorine residual levels at all times within the watermain.

Temporary dead-ends on watermains that are to be extended in the future shall be equipped with a 50 mm blow-off or temporary hydrant, at the end of the watermain per OPSD 1104.030. At the Director's discretion, metered automatic flushers may be required with the cost of all flushed water being borne by the Developer.

D2.12 Location Identification

A tracer wire shall be provided along the top of all watermains to permit field tracing of the watermain. The wire is to be secured to the top of the watermain at every fitting and valve and at intervals not to exceed 3.0 m. All tracing wires shall be 12-gauge, stranded copper wire complete with outer plastic coating.

Tracing wire shall be brought up the outside of each valve box so that continuity of the wire shall be maintained. The tracer wire is to be taped to the valve box every 0.6 m. The end of the tracer wire is to be placed into the inside of the valve box through a slot cut in the valve box no deeper than 0.3 m from the top.

Tracer wire is to be continuous with no joints. Where joints are needed (between rolls) they are to be soldered together plus wrapped in dielectric tape over wrapped with vinyl tape.

Confirmation of the continuity of the tracer wire installation is to be provided in writing by the Owner's Representative as part of the commissioning of the watermain system.

D2.13 Joint Restraint

Mechanical joint restraints are to be installed on bell and spigot joints for all watermains constructed in fill material and at all tees, horizontal and vertical bends, reducers, vertical

bends, hydrants, dead end caps/plugs and valves. All mechanical restraint systems shall be installed with cathodic protection.

Concrete thrust blocks are to be installed on all tees, horizontal and vertical bends, dead end caps/plugs, hydrants and other fittings that stop flow or change direction.

D2.14 Tracer Wire and Splices

Refer to Detail D-04 and D-005 for requirements related to PVC watermain.

D2.15 Flushing Station Requirements

Acceptable flushing station is Kupferle Eclipse No. 8 Post Hydrant.

D3.00 Valve Requirements

D3.01 Type

Unless specified or approved by the Municipality, all valves shall be Mueller resilient wedge gate valves or approved equivalent. Valves shall have a non-rising stem and a 50 mm square operating nut, opening counterclockwise. Refer to Appendix 4 for approved materials.

All valves 400 mm in diameter and larger shall be installed inside valve chambers per Ontario Provincial Standards, and as approved by the Director. These valves shall have flanged ends. A flanged to plain end spacer and a Victaulic coupler shall be installed inside the chamber to permit removal of the valve, if necessary.

D3.02 Size

In all cases, the size of the line valves shall be the same size as the watermain diameter.

D3.03 Number, Location and Spacing

Three valves are required on tee intersections and four valves are required on cross intersections with the valves being placed at a point where the projected street line intersects the watermain. Valves, valve boxes, and valve chambers are preferred in the asphalt when possible. Under no circumstances will valve boxes or chamber lids be permitted in driveways or sidewalks.

Valve spacing along a watermain shall not exceed 300 m, or for every 40 lots, whichever is less.

The Municipality may, at their discretion, require additional valves to be installed beyond the requirements noted above to ensure adequate isolation during construction, to allow for future development connections or to provide adequate isolation of watermains.

D3.04 Valve Boxes and Chambers

All valves on watermains less than 400 mm in diameter shall have three-piece, sliding-type valve boxes.

All valves 400 mm in diameter and larger shall be installed within concrete chambers with covers set flush with the finished grade. The cover and plug shall be aligned over top of the valve operating nut. Where the valve and cover are offset (under extenuating circumstances only), the chamber is to be cored with a valve box for operation.

Any valves deeper than 2.4 m require the operating nut to have a valve stem extension.

All chambers are to have the tracer wire extend up the backside of the steps to the top rung and be securely fastened with tape.

Wherever possible, valve chambers shall be provided with sumps. Otherwise, valve chambers shall be provided with a storm drain connection to the storm sewer. The diameter of the drainpipe shall be 150 mm. Where it is not possible to provide a direct connection to the storm sewer 300 mm x 300 mm x 300 mm sumps shall be provided in the base of the chamber. Valve chambers shall be as per Ontario Provincial Standards, and as approved by the Director.

The requirement for drain valves and air release valves will be determined during the design review process. Fire hydrants should be located at high points in the watermain wherever possible to minimize the requirements for air release valves.

D4.00 Fire Hydrant Requirements

D4.01 Type

Hydrants shall conform to the List of Acceptable Materials included in Appendix 4 of this document.

The hydrant shall have the following features:

- 2- 2 ½ hose connections and pumper connection with 6” mechanical joint inlet elbow. All hose connections to be CSA threaded. Operating components shall be made of durable corrosion proof materials that will not seize and prevent the dependable operation of the hydrant. Materials such as brass and stainless steel or approved equivalent will be accepted. Plated steel components will not be accepted.
- The bonnet shall incorporate a weather shield.
- The upper and lower barrels shall be joined with a breakable flange to allow removal of the upper barrel without excavation.
- Upper and lower operating stems shall be made of 304 stainless steel.

- A frangible stem coupling shall hold the stems together by means of holes drilled through the centre of the stem.

Hydrant marker flags are to be provided – 1 per hydrant.

D4.02 Spacing

Hydrants shall be installed on all watermains with a maximum allowable spacing of 120 m in residential areas and 100 m in industrial/commercial and multi-residential areas. Coverage areas with a radius of 75 m from each hydrant shall be considered when determining hydrant locations in residential subdivisions. Building code requirements are to be considered for private development projects.

D4.03 Branch Valves and Boxes

All hydrants installed on watermains up to and including 300 mm in diameter shall be controlled by a 150 mm diameter branch valve attached to the supply main minimum 1.5m from the hydrant and with an anchor tee. The valve is to be in the roadway.

D4.04 Location of Hydrants

Hydrants shall be located on the projection of a lot line and offset from the street line in accordance with the standard cross-section.

Hydrants shall be 1.50 m minimum distance from the edge of any driveway or house service location and 0.6m from a sidewalk or pathway. Other aboveground utilities such as light standards, transformers or street signs shall not be located any closer than 3.0 m to a hydrant.

The hydrant is to be set at such a height that the distance from the finished ground around the hydrant to the bottom of the flange is between 50 mm and 150 mm.

D4.05 Bedding Requirements

All hydrants shall be installed in accordance with OPSD 1105.010 (as amended), have open drainage holes and be installed with mechanically restrained joints (without thrust blocks). The hydrant base is to be installed in open-graded granular material enclosed with a geotextile fabric to ensure free draining of the boot. In areas of known high water, the hydrant drain holes shall be plugged and the Municipality shall be advised. This is to be reflected on the as-built Drawings.

D4.06 Hydrant Flow Testing

The Developer’s Representative shall carry out a flow test in accordance with the Ontario Fire Code. Following the flow test the Developer’s Representative is to provide a written report to

confirm that the minimum flows and residual pressures will be met when the subdivision is fully developed.

D4.07 Colour

Private hydrants are to be painted fire engine red. Public hydrants are to be painted yellow. All ports are CSA threaded connections.

All paint used on hydrants is to be specifically manufactured for this purpose.

All hydrants are to be painted appropriately at commencement of maintenance and again at assumption.

Reflective rings are not required. Hydrant Bonnet to be painted in accordance with the hydrant flow classification.

Table 2 -Hydrant Flow Classifications are as follows:

Class	Capacity	Colour
Class AA	Rated capacity 5680 L/min (1500 gpm) or greater	Light Blue
Class A	Rated capacity 3785 – 5675 L/min (1000 - 1499 gpm) or greater	Green
Class B	Rated capacity 1900 - 3780 L/min (500 – 999 gpm) or greater	Orange
Class C	Rated capacity less than 1900 L/min (500 gpm) or greater	Red

D5.00 Service Connections

D5.01 General

A single water line shall be installed to service each residential property. Services for other users are to be adequately sized, detailed and identified on the engineering drawings. Services shall be installed according to OPSD 1104.010 and 1104.020.

Service pipes are to be laid at right angles to the watermain and run a straight line from main to property line. There are to be no connections off the service between the main and the municipal property limit.

Services installed using trenchless techniques are to be sleeved.

D5.02 Material

All domestic water service connections shall be constructed of materials conforming to the List of Acceptable Materials included in Appendix 4 of this document.

D5.03 Minimum Size

Single water lines serving only one residence shall be a minimum size of 25 mm in diameter for PEX service and a minimum size of 19mm for copper.

D5.04 Location

Single services shall be provided for all single and semi-detached lots and on-street townhouse units. The location shall be shown on all Plan and Profile Drawings and the Composite Utility Plans.

A minimum clearance of 1.0 m shall be provided from all water services to any storm sewer or catchbasin. If this is not achievable the water service shall be insulated.

Services are to be installed a minimum of 0.5m horizontally from a driveway.

D5.05 Connections to Supply Main

Service connections are to be tapped where possible. Located as per OPSD.

Service saddles are to be used when tapping a watermain.

Where tapping is not possible, connections shall be made by installing a tee on the supply main.

D5.06 Curb Stops and Control Valves

The curb stops on all water services are to be placed at the property line. Curb stops to be brass (lead free) ball valves. Installation and location of curb stops is per OPSD 1104.010 and 1104.020.

The control valve on water services 100 mm in diameter or larger shall be located at the supply main with the valve being secured by means of anchor tees, flanged fittings or tie rods. A second valve of equal size is also to be placed at the property line.

All services require a backflow preventer in accordance with water use bylaws (as amended). Domestic supply lines shall be branched from the main supply lines immediately adjacent to the boulevard on the private side with separate valve stops.

The backflow preventive device is to be designed for the appropriate use by the licensed Professional Engineer for the private development.

D5.07 Water Softeners

The building design is to consider the hardness of the municipal water and provide for water softening within the building system.

D5.08 Existing Services and New Development

If an existing service is to be reused, the condition and size is to be confirmed by the developer before the municipality will allow its reuse. If the service is no longer required, it is to be removed and blanked at the watermain.

D6.00 Materials

D6.01 Watermain Material

Watermain pipe material shall conform to the List of Acceptable Materials included in Appendix 4 of this document.

D6.02 Water Meters

Each dwelling serviced by water shall have a water meter installed, being a Neptune T-10, Ecoder R900i complete with a remote readout device located adjacent to the outside hydro meter. All meter installations and locations are to be completed to the requirements of the Public Works Department.

Larger ICI (Institutional Commercial Industrial) installations will require a meter sized according to the intended use, but of the same make and type. The meter will be a minimum of one size less than the supply line. The purchase of meters is to be coordinated through the Municipality.

A lockable shut of valve is required upstream of the meter.

D7.00 Corrosion Protection

For any installation of water pipe systems, an investigation of the soils conditions shall be undertaken to determine the corrosivity of the native soils and to provide recommendations with regard to corrosion protection.

As a minimum, cathodic protection shall be provided in accordance with Ontario Provincial Standard Drawings.

D8.00 Connecting to Existing Watermains

All connections to existing watermains must be made under the supervision of the Contract Administrator and the Municipal forces.

The Contractor must give the Contract Administrator and the Owner 72-hour notice to make a connection to an existing watermain.

All Swabbing, Disinfection, Pressure Testing and Bacteriological testing must be completed prior to connection to the existing Drinking Water System.

D9.00 Temporary Water Supply

All temporary piping and service connections must be disinfected as per Ontario Watermain Disinfection Procedure and the latest AWWA C-651 by the Developer's Representative, under the supervision of the Municipality before the system is placed into service. Sample test stations must be provided for chlorine residual sampling during commissioning and the service life of the temporary water supply. The locations of the sample test stations are at the Municipality's discretion.

Refer to Standard Drawings D-06 and D-07 connection and commissioning details.

D10.00 Testing Requirements

All watermains shall be tested in accordance with the procedures set out in Appendix 2.

D10.01 Municipal Supervision Requirements

A certified Municipal water operator shall oversee all watermain commissioning requirements including but not necessarily limited to the following:

- Pressure testing
- Swabbing
- Super chlorination
- Flushing
- Sampling

D11.00 Construction

Water infrastructure works are to be constructed in accordance with OPSS 441 and these engineering standards.

SECTION E – SANITARY SEWERS AND APPURTENANCES

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SECTION E – SANITARY SEWERS AND APPURTENANCES

E1.00 Hydraulic Design

E1.01 Confirmation of Capacity

Prior to commencement of any design for sanitary sewage works within the Municipality, the Developer's Representative shall contact the municipality to ensure that adequate external trunk sewer and treatment plant capacity is available for the proposed development.

E1.02 Sanitary Drainage Plan

The sanitary drainage plan shall be drawn to a scale suitable to show all the tributary areas that are being used to determine the design flows.

The design flow in each maintenance hole and length of sewer shall be computed on standard sanitary design sheets. For each area entered on the design sheet, the maintenance hole numbers, size, grade and material of the sewers and the numbers consistent with the detailed plan and profile for each section of the sanitary sewer shall be shown.

E1.03 Domestic Sewage Flows

Peak domestic sewage flows are to be calculated using the methodology outlined in the MECP Design Guidelines for Sewage Works.

The design population for residential developments shall be derived using the proposed Plan of Subdivision and the densities listed as follows:

Table 1 - Density per Type of Dwelling (Persons Per Unit)

Dwelling Type	Density
Single Detached Dwellings	3.4 ppu
Semi-Detached Dwellings	2.7 ppu
Townhouses	2.7 ppu
Apartments	2 ppu

In the absence of a proposed Plan of Subdivision, populations should be estimated based on drainage areas and the land uses identified in the Municipality's Official Plan or Master Servicing Studies.

An average daily per capita flow of 300 L/cap/day shall be used to determine the capacity used in sizing the sanitary sewer system.

An allowance of 0.23 L/s/ha should be used in the design for peak extraneous flows.

E1.04 Industrial/Commercial/Institutional Flows

For ICI applications, discuss proposed demand parameters and obtain concurrence from the municipality. The municipality will require supporting data that justifies selection of the proposed flow rates.

E2.00 Sanitary Sewer Design

E2.01 Location

All sanitary sewers shall be located as shown on the Standard Road Cross-Section. The standard location shall generally be 0.5m offset from the centerline of the road allowance.

E2.02 Pipe Capacities

Comply with MECP Sewer Design Guidelines for minimum pipe slopes and flushing velocities. In the case of partial pipe flow, the actual velocity is to be checked against the minimum allowable velocity at the design flow rate.

E2.03 Flow Velocities

i. Minimum acceptable velocity = 0.6 m/s

ii. Maximum acceptable velocity = 3.0 m/s

E2.04 Minimum Size

The minimum allowable size for a sanitary sewer shall be 250 mm in diameter. 200mm diameter sewers will be considered by the Director in circumstances where future expansion is not realistic.

E2.05 Minimum and Maximum Grades

The absolute minimum and maximum grades for sanitary sewers shall be subject to achieving minimum acceptable velocity at the design flow. The minimum grade for the first upstream leg shall not be less than 1.0%.

E2.06 Minimum and Maximum Depths

The depth of the sewer shall be measured from the final centreline finished road elevation to the top of the sanitary sewer. The minimum depths of sewers for residential areas shall be 2.5 m.

The maximum depth of sewers with direct lateral connections shall be 6.0 m measured from centerline of road to the obvert of the sewer. In cases where deeper sewers are required these

shall be considered trunk sewers and no direct lateral connections will be permitted. Separate local sewers constructed above the trunk sewers will be required for connection of laterals. Maintenance holes are to be common wherever possible with drop structures.

E2.07 Curved Sewers

The use of radius pipe or deflected pipe is not permitted.

E2.08 Limits

All sewers shall be terminated at the subdivision limits when external drainage areas are being considered in the design with suitable provision in the design of the terminal maintenance holes to allow for future extension of the sewer.

E2.09 Sewer and Watermain Crossings

A minimum clearance of 0.30 m shall be provided between the outside of the pipe barrel at the point of crossing for storm and sanitary sewers. A minimum clearance of 0.5 m shall be provided for all sewer and watermain crossings in accordance with MECP (MOECC) policies.

In the event the minimum clearances cannot be obtained, the designs must adhere to MECP (MOECC) policies. In addition, the pipes shall be concrete encased to ensure that the pipes are properly bedded.

E2.10 Head Losses

The minimum drop for inverts in any maintenance hole shall be 0.03 m for sewers turning 45° or less and 0.06 m for any sewer turning 90°. The maximum change in direction permitted for any sewer is 90°.

The obvert of the outlet pipe shall not be higher than the obvert of the inlet pipes at any maintenance hole location.

E2.11 Changes in Pipe Size

No decrease of pipe size from a larger upstream to a smaller downstream will be allowed regardless of the increase in grade.

E2.12 Pipe Bedding

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. Details and types of bedding and backfill are illustrated in OPSD 802.01 and 802.03 (as amended). The width of the trench at the top of the pipe must be carefully controlled to ensure that the maximum trench width is not exceeded unless a higher class of

bedding or higher strength pipe is used. The recommendations of a Geotechnical Engineer will be required in determining strength of pipe required and construction methods to be used.

E3.00 Maintenance holes

E3.01 Location

Maintenance holes shall be located at each change in alignment, grade or pipe material, at all pipe junctions and at intervals along the pipe to permit entry for maintenance to the sewer. The outside wall of any maintenance hole structure shall not be located closer than 1.5 m to a curb. The maintenance holes shall be oriented in such a way that the access cover is offset towards the centerline of the road.

E3.02 Maximum Spacing

The maximum spacing between maintenance holes shall be 120m.

E3.03 Maintenance Hole Types

Maintenance holes shall be constructed of pre-cast concrete. The Ontario Provincial Standard maintenance hole details shall be used for maintenance hole design, where applicable. In all cases where the standard drawings are not applicable, the maintenance holes shall be individually designed and detailed.

A reference shall be made on all profile drawings to indicate the type and size of all sanitary maintenance holes.

Pre-cast maintenance holes shall conform to ASTM Specification C478 latest revision.

Maintenance hole covers shall be the “closed” type per OPSD 401.010.

E3.04 Maintenance hole Design

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

ii. The maintenance hole shall be centred on the sewer main.

iii. The maximum change in the direction of flow in any sewer maintenance hole shall be no more than 90°. A change of flow direction at acute interior angles will not be permitted.

iv. Drop structures shall be used when invert levels of inlet and outlet sewers differ by 0.61m or more. Wherever feasible, sewer systems should be designed to avoid the use of drop structures. Internal drop structures are discouraged and will only be permitted in instances with extenuating circumstances provided approval is obtained by the Director of Public Works or Designate. Precast drop structures are permitted. All drop structures shall be constructed in accordance with OPSD 1003.010 and 1003.020.

v. All sanitary maintenance holes shall be benched as per OPSD 701.021.

vi. Safety gratings shall be required in all maintenance holes greater than 5.0 m in depth. Safety gratings shall not be more than 5.0 m apart and shall be constructed in accordance with OPSD 404.020. Where practical, a safety grating shall be located 0.5 m below the drop structure inlet pipe.

a) Maintenance holes should be used at all changes in horizontal alignment and at all changes in vertical grade.

vii. Maintenance holes should be used at all changes in pipe sizes.

E3.05 Grades for Maintenance hole Frame and Covers

All maintenance holes located within the travelled portion of the roadway shall have the rim elevation initially set flush with the base course asphalt. A maximum of 300 mm height of modular rings shall be permitted on all maintenance holes in new subdivisions.

Prior to the placement of the final course asphalt, the maintenance hole frame shall be adjusted to suit the final surface asphalt elevation (the frame should be shimmed to final grade then sealed).

All maintenance holes constructed in the vicinity of low points or outside of the paved roadway shall have watertight lids.

E4.00 Sanitary Service Connection

E4.01 General

All sanitary sewer connections for single, semi-detached and townhouse lots shall be made with single service pipes. The test fitting shall be 125 mm x 125 mm PVC DR 35 with a threaded plug. The threaded plug shall come with a 40 mm square nut to assist in the operation. Cast iron test fittings are not permitted for sanitary services.

The service pipe shall be extended 1.5 m into the property beyond the property line and capped.

Foundation drain, sump pump leads and roof leaders are not permitted to be connected to the sanitary service.

E4.02 Location

The proposed location of the sanitary sewer service shall be shown on the Plan and Profile Drawings and Composite Utility Plans.

E4.03 Size

Service connections for single family and semi-detached (or linked) units shall be 125 mm in diameter.

Service connections for multiple family blocks, commercial, institutional and industrial areas shall be sized according to the intended use.

E4.04 Connection to Main

The connection to the main sewer shall be made with an approved manufactured tee and are to be watertight. Approved saddles shall be used for connecting to existing sewer mains. Service connections to a maintenance hole are not permitted.

No service connection of a size greater than half the diameter of the main shall be cut into the main sewer. A maintenance hole shall be installed on the main sewer at the intersection of a service connection which has a size greater than half the diameter of the main sewer except as provided below.

A 125 mm or 150 mm service connection will be permitted to connect to a 200 mm and 250 mm main sewer provided an approved manufactured tee is installed and provided the invert of the service connection is above the spring-line of the main sewer.

E4.05 Depth

The depth of the service connections for single family units, semi-detached units and townhouses at the property line measured from the finished centreline road elevation shall be:

i. Minimum: 2.60 m

ii. Maximum: 3.00 m (unless proposed house types require deeper service depths)

Risers shall be used when the obvert depth of the sewer main exceeds 4.50 m. The riser section shall be brought to a depth of 3.0 m maximum.

If the above requirements cannot be met, provide a plan and justification for any deviations to the Director for consideration.

E4.06 Grades

Table 2 - Pipe Size per Minimum and Maximum Grades

Size of Pipe	Minimum Grade	Maximum Grade
125 mm	2%	8%
150 mm	1%	6%

E4.07 Connection to Multiple Family and Other Blocks

An inspection maintenance hole shall be required on the private property (1.5 m from property line to centre of the frame and cover) on all connections to multiple family and other blocks.

E4.08 Connection to Commercial/Industrial Institutional Blocks

An inspection maintenance hole shall be required on private property located 1.50 m from the property line to the centre of the frame and cover.

E5.00 Pipe Materials

E5.01 Sanitary Sewers

Sanitary sewer pipe material shall conform to the List of Acceptable Materials included in Appendix 4 of this document.

E5.02 Sanitary Service Connections

Service pipe material shall conform to the List of Acceptable Materials included in Appendix 4 of this document.

E5.03 Reuse of Existing Sanitary Service Connections

If an existing service is to be reused, the condition and size is to be confirmed by the developer before the municipality will allow its reuse. If the service is no longer required, it is to be removed and capped at the sewer main.

E5.04 Abandonment of Manholes

If an existing manhole is to be abandoned, remove to 1.0m below final grade and backfill with compacted granular material.

E6.00 Testing

E6.01 General

Sanitary mains are not to be connected to the existing system until testing has been completed and accepted.

Infiltration or exfiltration testing shall be completed on all sewers per OPSS 410, the method is at the discretion of the Developer's Representative. All testing shall be witnessed by a representative of the Developer's Representative with the Director being notified a minimum of 48 hours prior to the test being carried out. The Developer's Representative will be required to certify the results of any tests carried out.

E6.02 Deflection Test

Deflection tests only need to be completed when a deficiency is noted through CCTV, there is reason for concern, or as required by the Director. Deflection testing is to be completed per OPSS 410.

All sections of pipe that fail the deflection test shall be repaired and retested.

E6.03 Closed-Circuit Television (CCTV) Inspection

All newly constructed sanitary sewers shall be CCTV inspected upon satisfactory completion of all other testing. The sewers must be CCTV inspected prior to the sewers being considered to be placed on maintenance and again prior to being considered for Final Acceptance. CCTV inspections are to be carried out no more than 90 days prior to the request for Final Acceptance.

The Municipality will require Certification from the Developer's Representative that they have reviewed the videos and have found the sewers to be acceptable and free of all defects. Any deficiencies should be clearly identified in the Engineer's letter and confirmation that all deficiencies have been rectified must be included with the Certification.

A permanent record in electronic format shall be supplied, illustrating a continuous record of the sewer installations, service connection, maintenance holes, etc. A report identifying any unusual or substandard conditions shall also be submitted.

The CCTV inspection shall be carried out by an Operator certified by NAAPI and shall be carried out in accordance with OPSS 409 (as amended).

All files, reports and data provided from these inspections shall become the property of the Municipality.

At the discretion of the Director of Public Works or Designate, additional inspections and records may be required prior to Final Acceptance.

E6.04 In Line Sumps

In line sumps are not acceptable.

E6.05 Infiltration / Exfiltration

Field testing for infiltration / exfiltration for sewer pipe installations in an open cut shall be carried out in accordance with OPSS 410.

E7.00 Construction

Sanitary works are to be constructed in accordance with OPSS 407, OPSS 410, and these engineering standards. For work not covered under these standards, consult with the municipality to confirm requirements.

E8.00 Alternative Design and Construction Techniques

For no-dig and non-standard considerations consult with the municipality to confirm requirements.

SECTION F – LOT GRADING

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SECTION F – LOT GRADING

F1.00 General

These guidelines are provided for guidance in the preparation of drainage plans. Since they are only guidelines, they cannot cover every situation that may be encountered in the field. Direct consultation should be made with the Director when the Drainage Plan Designer feels that deviation from these guidelines is warranted.

It is imperative that the overall initial Draft Plan of Subdivision be laid out with regard to the lot grading criteria outlined in this section. In particular, lots requiring rear yard drainage swales may require extra depth than the adjacent lots to the rear to allow adequate space to create a rear yard amenity area as outlined in this section.

The approval of a Drainage Plan is related to drainage only. It is the responsibility of the Developer's Representative's Engineering and Planning Team to ensure that the Drainage Plan compliments the land and suits the house to be constructed.

F1.01 Objectives

All areas shall be graded in such a way as to provide proper positive drainage, maximum use of land and ease of maintenance.

Grading shall be performed in such a way as to preserve existing trees wherever possible, with the understanding that tree preservation shall not be detrimental to providing for lot drainage.

Drainage flows must be directed away from houses.

Storm drainage is to be directed to approved outlets on public lands and shall not adversely affect adjacent lands.

The use of rear lot catchbasins and retaining walls should be minimized.

F2.00 Lot Grading Criteria

F2.01 Type of Drainage Pattern

i. Back to front drainage is desirable in instances where drainage contributing to each side yard swale is restricted to the lots directly adjacent to the swale and no external flows or flow from the rear yards of neighboring lots is captured by the side yard swale.

ii. Split lot drainage with rear lot catchbasins is required where difficulties in providing side yard swales are encountered.

i. Walkout, back split and front split lots will be permitted where required due to topography constraints. In all cases the grade differential between the front and rear yard specified house grade shall be governed by the sloping required along the side of the building envelope. Grades shall vary from a minimum 2% to a maximum 4:1 urban and 3:1 rural slope and shall be confined to the building side yard area. Lots with a front to rear yard grade differential exceeding 2.5 m are considered extraordinary and will require specific approval from the Municipality.

ii. In determining maximum permissible grade differential between front and rear property line elevations compatibility of house types and impact on adjacent homes will be considered by the Municipality. While these standards do not set out maximum allowable grade differentials the Municipality will limit the grade differential on a site-specific basis based on the particular circumstances unique to each subdivision.

iii. Reduced Setback Lots and Atypical Lots– The specified house grade (SHG) for lots with reduced setbacks, varying terrain, access constraints, etc., should be reviewed by the Designer to ensure lot grading meets the intent of Municipality Standards and sound design practices. The methods identified above for determining SHG elevations may not apply to reduced setback lots and other non-conventional lot types. The Designer will be required to determine the most appropriate SHG for the lot type and may be required to supply more detailed grading plans for individual lots considered by the Municipality to be non-conventional.

F2.02 Details

Show the locations of the following:

i. House

ii. Well

iii. Septic

iv. Footings

v. Top foundation
vi. Development envelope
vii. Pools, patios, decks, etc.
viii. Floodlines
ix. Wetlands
x. Easements
xi. Catchbasins on the lot
xii. Swales
xiii. Sump Pump outlets
xiv. Eavestrough outlets
xv. Directional flow arrows
xvi. Culverts
xvii. Retaining walls

F2.03 Slopes

i. Rear lots shall be graded such that a minimum of 5.0 m of the rear lot depth is to be sufficiently level (2% to 5% slope). This shall be considered to be the rear lot "useable area." For rural lots, reasonable measures are to be taken to provide useable area based on terrain.

ii. The grade difference in the rear lot shall be made up of the following types of slopes:

- Slopes with a gradient between 2% and 5% which is considered "usable area".
- Beyond the "useable area" downward slopes shall have a gradient between 5% and 10%. No downward slopes greater than 10% will generally be permitted except in the following condition: For lots considered to have deep back yards or backing onto open space lands, the Director may permit slopes greater than 10% provided a 0.5 m flat area is provided at the rear limit of the lots.
- The maximum gradient for upward slopes beyond the "useable area" shall be three parts horizontal to one part vertical (3:1). 3:1 slopes shall be permitted to a maximum height of 1.0 m. Slopes not greater than four parts horizontal to one part vertical (4:1) shall be used for heights greater than 1.0 m.

iii. The maximum permissible grade along rear lot line between lot corners shall not exceed 6%.

iv. The minimum slope on driveways shall be 2%. The maximum slope on driveways shall be 8%.

v. All lots shall have a minimum 1.0 m wide unobstructed path draining at a 2% slope away from the house along at least one side of the house. This stipulation is in addition to the 150 mm apron required around buildings and is needed to permit the construction of a walkway to the rear of the house.

vi. A minimum separation of 150 mm shall be provided between brick line and the final ground elevation of all houses.

vii. An undisturbed flat area having a preferred minimum width of 0.5 m shall be provided at the boundary limits adjacent to other properties, in order that the existing boundary elevations shall be maintained. No filling up to or upon private lands shall be tolerated unless written permission is obtained from the adjacent Owner. Where two developments are concurrently underway, the common boundary elevations are to be established to mutually beneficial elevations, agreed to by each party.

F2.04 Swales

i. Swales shall have a minimum grade of 1.5% and maximum side slopes of 3:1. A minimum 0.5% grade can be used with subdrains.

ii. Swales shall range in depth from a minimum of 150 mm to a maximum of 450 mm.

iii. Swales parallel to the rear lot lines shall be located at a distance based on the depth of swale but under no circumstances will the invert of the swale be permitted to be located more than 1.0 m from the rear lot line. In cases where a swale depth greater than 300 mm is required a 2:1 slope will be permitted from the swale invert to the rear lot line.

iv. Drainage flows which are carried around houses are to be confined in defined swales located as far from the house as possible. The depth of these swales should be kept as close as possible to the minimum of 150 mm.

v. The maximum flow allowable in a side yard swale shall be that from three backyards.

vi. Rear Yard Swales (Urban): maximum length of a rear yard swale shall not exceed 60 m.

F2.05 Rear Lot Catchbasins

i. The Municipality has recently changed its policy regarding ownership and maintenance of rear lot catchbasins (RLCBs). Easements in favour of the Municipality will no longer be required for RLCBs and leads. The ownership and maintenance responsibilities for RLCBs and leads on the private side of the street line shall rest with the property owner.

ii. All RLCB grates are to be as per Municipality of North Grenville Standard Drawing C-2 – C-4. The centerline of the catchbasin top is to be 1.2 m from the rear lot line. The catchbasin frame to be set at the elevation of the invert of the lowest swale.

iii. RLCB leads shall be a minimum diameter of 250 mm.

iv. All catchbasin leads are to be located a minimum of 0.6 m from lot line; catchbasin leads to be constructed on one lot.

v. RLCB leads shall be connected directly to maintenance holes whenever possible. The layout of the storm sewer shall have consideration to this requirement to maximize the number of RLCB leads which can connect directly to maintenance holes.

vi. When RLCBs are required, the Designer must consider the impacts that a plugged catchbasin will have with respect to flooding depth and area which will be impacted. The grading design must incorporate allowance for relief outlets in the event that plugging occurs.

F2.06 Sodding and Ground Cover Requirements

Urban front yards are to be completely top soiled and sodded with 100 mm of topsoil and No. 1 Nursery Sod. Urban rear yards and rural lots can be topsoiled and seeded.

F3.00 Retaining Walls

Unless specifically approved by the municipality, retaining walls are to be located on private property and are the responsibility of the property owner. All retaining walls above 1m in height and where otherwise required by applicable codes must be designed by a Professional Engineer. Certification from a Professional Engineer will be required for each wall constructed clearly stating that the wall has been designed to suit the site conditions, that construction of the wall has been inspected by the Engineer and that it has been constructed in accordance with the design. .

F4.00 Lot Grading Certification

Prior to the maintenance period commencing for any aboveground works in the subdivision the Developer's Representative's Engineering Consultant will be required to submit a Lot Grading Certificate for every lot being placed on maintenance. If retaining walls have been constructed on any lot an additional Certificate will be required for each lot with retaining walls.

A certification letter is required from the Developer's Engineering Consultant.

F5.00 Timing for Sodding of Lots and Certification of Grading

Sodding shall be completed on each lot within three months of the date of the issuance of the Occupancy Permit for the lot. If the Occupancy Permit is issued later than October 15, in any year, and prior to March 31, in the subsequent year, the grading and sodding shall be completed by May 31, in the subsequent year.

Lot Grading Certification shall be completed within two months of the date of the issuance of the Occupancy Permit for the lot. If the Occupancy Permit is issued later than October 15, in any year, and prior to March 31, in the subsequent year, the lot grading certification shall be completed by June 30, in the subsequent year.

Prior to sodding any lots within a subdivision, the Developer's Representative is encouraged to arrange a pre-sod inspection with the Municipality's representative.

SECTION G – UTILITIES AND STREET LIGHTING

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SECTION G – UTILITIES AND SITE LIGHTING

G1.00 General

Utilities are to be buried unless otherwise agreed upon with the municipality. The Developer's Representative shall consult with the Director prior to proceeding with the design of the street lighting and utility design for any development for information related planned utility upgrades and other development work in the area that may impact the site utility requirements.

G1.01 Standard Requirements

All primary hydro, gas and communications (cable/fibre optic) lines shall be placed underground in locations as shown on the typical road sections and utility details G-01 and G-02. Design of these utilities shall conform to the regulations of the respective authority. A minimum of two spare utility ducts are to be installed at road crossings.

G2.00 Composite Utility Drawings

All utilities are to be shown on the Composite Utility Plan and to be submitted for the review and approval of the Municipality. This drawing shall be prepared at a scale of 1:500, unless otherwise approved and show all pertinent details of the utilities including street lighting poles, street signage, all above and underground services, Canada Post mailbox locations, driveways and locations of all trees. It is the Developer's Representative's responsibility to ensure there are no conflicts resulting from the design of the various utilities and the municipal roads and services.

All details of any entranceway features and structures within the proposed right-of-way are to be indicated on the Composite Utility Drawing, i.e. the composite utility plan is to clearly demonstrate that the proposed utilities, site features, and municipal infrastructure are not in conflict. The Composite Utility Plan is to be accepted by individual utility agencies presented on the drawing and Canada Post, prior to final acceptance by the Municipality.

G2.01 Separation between Driveway and Street Furniture

A minimum of 1.0 m separation is to be maintained between edge of driveway and all surface utility structures or per utility requirements (whichever is greater) and 1.5m to fire hydrants.

G2.02 Typical Cross-section

The typical cross-section shall be shown on the Utility Drawing.

G2.03 Public Utility Clearance Requirements

Hydro

1. Refer to Hydro One application and connection requirements.

Natural Gas

2. Refer to Enbridge Gas construction requirements.

Communications

1. Typically direct burial but may use concrete encased duct for three or more cables and under roadways at the discretion of the utility company. Consult with appropriate utility.

G3.00 Street Lighting Design

The street lighting system shall be designed by a qualified Consulting Engineer in accordance with the Illumination Engineering Society of North America (IESNA) latest edition recommendations. In addition, all street lighting systems for roadways in the Municipality shall meet the requirements of the Municipality and Hydro One.

The objective in designing street lighting is to provide a uniform distribution of lighting at a level that is adequate for the intended use of the roadway. Roadway lighting for urban streets shall be designed using the values found in ANSI/IES RP-8-21 Recommended Practice: Lighting Roadway and Parking Facilities: Part 1 (fundamentals) and Part 2 (Design).

Table 1 – Approximate Illuminance Values by Road Classification

Road Classifications (IESNA R2 & R3)	Illuminance Values		
	Average Maintained Illuminance Values (Lux)	Foot Candles	Illuminance Uniformity Ratio (Average to Minimum)
Local Urban Residential	5	0.5	6:1
Collector	8	0.8	4:1
Arterial	12	1.2	3:1

*All other Road Classifications not identified above will be considered on an individual basis in accordance with Municipality Requirements.

** Intersections shall have an illumination equal to the sum of the current design levels of the intersecting roadways.

A photometric layout will be required and must include the following information:

1. Lighting levels extending past the property line to the nearest building (light trespass on adjacent residential properties is to be kept to a minimum utilizing full cut-off flat lens luminaires and house-side shields if required).
2. A summary table of the illumination and uniformity values resulting from the design in accordance with parameters indicated in the above table (i.e., average, average to minimum, etc.) shall be provided. In addition to the above noted requirements, the table must show the photometric layout LLF (Light Loss Factor) used when calculating the proposed lighting levels. Lighting drawings and photometric information including statistical data shall be designed/reviewed/approved by a Professional Engineer.
3. In the longitudinal direction, the distance between grid lines should be one-tenth (1/10) of the spacing between luminaries, or 5.0 m, whichever is smaller. At intersections the grid spacing is 2.0 m throughout the calculation area.
4. When establishing the spacing of street lighting within a residential subdivision, consideration must be given for the placement of a streetlight adjacent to the location of community mailboxes.
5. In determining the position of a light standard, the designer shall take into consideration the location of driveways, living room windows and other aspects of a particular site. The objective is to provide a sense of security and to minimize spill and other disturbances to residential properties.
6. The street lighting design submission package is to be submitted to the Municipality.
7. The Developer's Representative shall be responsible for the review/approval of any required shop drawings submitted by the Contractor/supplier for verification or compliance to the lighting design and Municipality specifications.
8. The design shall specify type of pole, conduit, luminaire, lamp wattage and size of conductor being used. Details of pole installation and luminaire(s) wiring are to be provided.
9. Designer shall specify on the drawings the location of transformers, means of streetlight disconnects, power and control centers and other related infrastructure.
10. The engineer shall include specification sheets on luminaires, arms, and poles to be installed as part of submission.

G3.01 Street Light Poles

Poles are to maximum 5.49m (18ft) including light fixture.

Poles are to be Class A, reinforced concrete (cylindrical) direct bury, complete with cast zinc handhole and cover or spun aluminum poles on concrete bases.

Street Lighting Luminaires

Decorative street lighting luminaires are to be post top style per Lumec Serenade DSX LED Series or approved equivalent.

Standard street lighting is to be cobra head LUmec RoadFocus LED Cobra Head series or approved equivalent.

G3.02 Energization of Street Lighting System

The Developer's Representative or Contractor shall arrange with Hydro One for the connection of the lighting system. The develop is responsible for connection fees. The municipality will assume the on-going operating costs upon energization.

SECTION H – EASEMENT REQUIREMENTS

Municipality of North Grenville
Engineering Standards for Design, Approval, and Construction

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Table of Contents

SECTION H – EASEMENT REQUIREMENTS

H1.00 General

Where underground services or utilities are placed outside road allowances or blocks of land under the ownership of the Municipality, permanent easements are required.

Any easements proposed and easement agreement wording that will be included in the legal agreement for utilities, storm sewers, sanitary sewers and watermains shall be reviewed with the Municipality's Director of Public Works or Designate prior to the first submission.

H1.01 Storm, Sanitary Sewer and Watermain Easements

Ideally easements between adjacent lots shall be located on one side of the common lot line. Pipes shall generally be centered on the easement for easements containing one pipe. Easements straddling lots lines may be permitted if deemed appropriate by the Director. The minimum width of all easements shall be determined in consultation with the Director.

Easements are to be of sufficient width to permit excavation of the pipe(s) without the potential for impacting neighbouring structures and to allow for construction activities to be completed within the width of the easement. Geotechnical recommendations will be required from the Developer.

Fencing may be required at the discretion of the Director.

The bearing capacity of native soils must be preserved for all pipes being constructed between proposed buildings. This shall be achieved by:

i. Extending the building foundations to the depth of the underside of pipe adjacent to the building.

ii. Placing the pipe in a sleeve constructed by tunneling.

iii. Installing the pipe by vertical trenching with steel sheeting left in place and cut off 0.3 m above the building foundation. The depth of the steel sheeting below the pipe invert is to be determined by a Geotechnical Engineer. Sufficient struts are to be left in place to ensure that the steel sheeting does not move during the backfilling operation.

The trench excavation and reinstatement or tunneling operation is to be monitored by a Geotechnical Engineer and certification will be required that the soils have the required bearing capacity to support the building being proposed adjacent to the pipe installation.

H1.02 Concrete Encasement

Concrete encasement where required due to special circumstances or as determined to be a requirement at the sole discretion of the Director, shall have a square cross-section with a

concrete thickness of not less than 0.150 m. The concrete shall be 15 MPa strength and vibrated in place.

H1.03 Pipes Constructed in Sleeves

In lieu of concrete encasement of pipes, the Municipality will consider allowing pipes to be constructed in steel sleeves. The specific instances where this will be permitted along with the detailed requirements must be determined in consultation with the Director.

Appendix 1 - Forms and Checklists

Municipality of North Grenville
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Municipality of North Grenville

Preliminary Approval - Checklist
Subdivision Name and Phase
Date

Documentation	Received/ Confirmed	Approved	Comments	Date Received
Engineering report for road subgrade				
Sieve analysis of road sub base (GB)				
Elevations of road sub base (GB) prior to placement of road base (GA)				
Compaction report for road sub base (GB)				
Sieve analysis of road base (GA)				
Elevations of road base (GA) prior to placement of asphalt (HL8)				
Compaction report of road base (GA)				
Service compaction (Bedding, Spring, Cover)				
Water				
Storm				
Sanitary				
Asphalt mix design for base course asphalt (HL8)				
AC content for base course asphalt (HL8)				
Sieve analysis for base course asphalt (HL8)				
Elevations of base course asphalt (HL8)				
Compaction report for base course asphalt (HL8)				
Asphalt mix design for final course asphalt (HL3)				
AC content for final course asphalt (HL3)				
Sieve analysis for final course asphalt (HL3)				
Compaction report for final course asphalt (HL3)				
Elevations of final course asphalt (HL3)				
Curb compaction (GA)				
Curb concrete testing				
Curb concrete cylinder breaks (7 and 28 Day)				
Site Inspection Reports				
CCTV				
Storm				
Sanitary				
Sewer Testing				
Installation of street and traffic signs				
Installation and certification (OLS) of Permanent Grade Control Structure				
Confirmation that all utilities (gas, electric, cable & communication) are installed and operational to the satisfaction of the applicable utility authority				
Engineering Letter of Conformance for completed subdivision works				
Record drawings of completed subdivision works				
Street Light ESA				
Certificate of Substantial Performance				
Statutory Declaration from Owner				

Final Acceptance - Checklist
Subdivision and Phase
Date

Documentation	Received/ Confirmed	Approved	Comments	Date Received
Engineering report for road subgrade				
Sieve analysis of road sub base (GB)				
Elevations of road sub base (GB) prior to placement of road base (GA)				
Compaction report for road sub base (GB)				
Sieve analysis of road base (GA)				
Elevations of road base (GA) prior to placement of asphalt (HL8)				
Compaction report of road base (GA)				
Service compaction (Bedding, Spring, Cover)				
Water				
Storm				
Sanitary				
Asphalt mix design for base course asphalt (HL8)				
AC content for base course asphalt (HL8)				
Sieve analysis for base course asphalt (HL8)				
Elevations of base course asphalt (HL8)				
Compaction report for base course asphalt (HL8)				
Asphalt mix design for final course asphalt (HL3)				
AC content for final course asphalt (HL3)				
Sieve analysis for final course asphalt (HL3)				
Compaction report for final course asphalt (HL3)				
Elevations of final course asphalt (HL3)				
Curb compaction (GA)				
Curb concrete testing				
Curb concrete cylinder breaks (7 and 28 Day)				
Site Inspection Reports				
CCTV				
Storm				
Sanitary				
Sewer Testing				
Installation of street and traffic signs				
Installation and certification (OLS) of Permanent Grade Control Structure				
Confirmation that all utilities (gas, electric, cable & communication) are installed and operational to the satisfaction of the applicable utility authority				
Engineering Letter of Conformance for completed subdivision works				
Record drawings of completed subdivision works				
Street Light ESA				
Certificate of Substantial Performance				
Statutory Declaration from Owner				

Appendix 2 – Watermain Testing Requirements

Municipality of North Grenville
Engineering Standards for Design, Approval, and Construction

August 2022

1.0 Purpose

This procedure describes the steps that should be taken by the Operator in Charge (OIC) when a watermain is being commissioned. This procedure complies with the Ministry of the Environment, Conservation and Parks (MECP or "the Ministry") Watermain Disinfection Procedure, dated August 1, 2020, as dictated by Drinking Water Works Permit 159-201. This document gives an overview of the steps the Operator in Charge (OIC) should follow when commissioning a new watermain. For details, consult the Ministry's Watermain Disinfection Procedure. In cases where this SOP differs from the Watermain Disinfection Procedure, follow the most stringent practice.

2.0 Definitions and Abbreviations

Appurtenance includes a valve, valve chamber, hydrant, hydrant lead, flow meter, curb stop, maintenance access point, personnel access opening or other minor accessory part of a watermain

AWWA – American Water Works Association

Connection – means all watermain and Appurtenances installed between an existing watermain and a new or future watermain/appurtenance.

COC – Chain of Custody

DWS – Drinking Water System

kPa – kilopascals

OIC – Operator in Charge

L = liters

L/h = liters per hour

MECP – Ontario Ministry of the Environment, Conservation and Parks

Microbiological Sampling – means that, at a minimum, *Escherichia coli* and Total Coliforms are tested by Caduceon and the Operator tests immediately for free chorine and turbidity.

mg/L – milligrams per liter

Potable Water – means water that is fit for human consumption. In most cases this will be water produced by the Kemptville Drinking Water System.

PSI – pounds squire inch

SDS – Safety Data Sheets

SDWA – Ontario Safe Drinking Water Act

SOP – Standard Operating Procedure

3.0 Health and Safety

There are identified hazards to complete this task. Use caution when working around the following:

Pressurized watermains

Traffic, review Traffic Control Plan provided by Contractor

Sodium Hypochlorite, review SDS

Sodium Thiosulphate, review SDS

4.0 Background

The Ministry's Watermain Disinfection Procedure references AWWA Standard C651 and they should be followed in conjunction with this SOP. When there is a discrepancy between the different procedures, follow that instructions that are the most stringent.

5.0 Procedure

5.1 Operator in Charge

The OIC must be onsite throughout the commissioning.

5.2 Backflow Prevention

Follow Section 4.8.9 of AWWA Standard C651 and CSA Standard B64.10. The water and wastewater division has three CSA-certified high hazard reduced principle backflow preventers. The backflow preventers must be field tested by a certified backflow prevention tester the same day that they are used. If a backflow preventer is relocated within the same day, testing is only required for the first installation of the day provided that the backflow preventer is relocated by an Operator who will guard against damage during transit and re-installation.

Brooks and Cryderman is typically the Contractor that tests the backflow prevention devices. Contact the Contractor at least 24 hours before the backflow preventers are going to be used. Contact information can be found on the DWQMS Essential Services and Supplies list in the DWQMS Operational Plan, Appendix C.

5.3 Fill Watermain

Fill the watermain with potable water and open all associated hydrants and curbstops to bleed all the air out of the pipe.

5.4 Hydrostatic Testing

5.4.1 Hydrostatic Testing Responsibilities

The contractor performs the pressure test. The Operator in Charge inspects the pressure test.

5.4.2 AWWA C605-21

As per AWWA C605-21, Section 9.3, the following must be adhered to when pressure testing the watermain:

- The test must be at least two hours long
- The hydrostatic pressure must be at least 1.5 times the planned working pressure for the main. Industry standard is 1035 kPa (150 psi).
- Do not exceed the rated pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance to the test section. Refer to manufacture specifications for the pressure rating.
- Allowable leakage is measured using the makeup water: the volume of water required to maintain the pressure within 34 kPa (5 psi) of 1035 kPa (150 psi). The formula for the allowed quantity of makeup of water to maintain the required

pressure is: $Q_m = \frac{LD\sqrt{P}}{795{,}000}$

Where:

Q_m = quantity of makeup water, in L/h

L = length of pipe section being tested, in m

D = nominal diameter of the pipe, in mm

P = average test pressure during the leakage test, in kPa.

Example 1: The make up water allowance for 305 meters of 150 mm pipe pressure tested at an average of 1030 kPa would be calculated as follows, where:

L= 305 meters

D = 150 mm

P = 1030 kPa

$Q_m = \frac{(305 \times 150) \times \sqrt{1035}}{795{,}000}$

Q_m = 1.85 L/h

A Makeup Water Allowance Calculator is available in excel on the w drive at the following location: W:\Water Distribution System\Water Main Installations & Connections

The following is the makeup water allowance for common pipe sizes used in the Kemptville DWS distribution system, see tables 4a and 4b in AWWA C605-21 for more:

Table 1: Makeup water allowance (L/h) per 305 meters (50 joints) of PVC pipe

Test Pressure (kPa/psi)	Nominal Pipe Diameter (mm/inches) 100/4	150/6	200/8	300/12
1035/150	1.2 L/h	1.8 L/h	2.4 L/h	3.6 L/h

5.4.3 Instructions for Measuring the Makeup Water

To measure the makeup water used during pressure testing, take the following steps:

- Use a positive displacement pump, calibrated water reservoir, and a calibrated pressure gauge. *Note that the pressure gauge should be installed on the line connecting the pump to the watermain section to be pressure tested not the pump itself.

- Pressure test at 150psi/1035kPa: run the pump to maintain the pressure within 5 psi of the test pressure.

- observe the pipe, fittings, and appurtenances for visible leaks and/or movement of the pipe.

- measure the amount of water (in liters per hour) that must be pumped out of the makeup water reservoir to maintain the 150psi/1035kPa test pressure. This is your makeup water.

- calculate the allowable makeup water using the formula above and compare against the amount measured during the actual test or compare the amount measured during the actual test against the allowable make up water rates in Table 1.

Example 2: Imagine you are pressure testing 305 meters of 150mm pipe to 1035 kPa over two hours. At the end of the test, you measure the quantity of make up water used from the reservoir. The quantity of water used was two liters (2 L). You divide the

quantity of water used by the duration of the test (2 h) to determine that the make up water used was 1L/h (2L÷2h=1L/h). As per the AWWA standard (see Example 1 in this section or Table 1), the allowable make up water for that length and size of pipe is up to 1.8L/h so the watermain passes the pressure test.

5.5 Swab

5.5.1 Swabbing Responsibilities

The contractor will swab the watermain. The Operator in charge will inspect the swabbing.

5.5.2 Swabbing Requirements

Swab the watermain with a minimum of three swabs using potable water. Use swabs that are two inches larger than the pipe to be swabbed. Two swabs of each size are kept in stock. Continue to swab until clean. If more swabs are needed, Wolsley is the typical supplier.

5.6 Disinfect the Watermain/ Super Chlorinate

5.6.1 Responsibilites when Disinfecting the Watermain

The contractor supplies the equipment to disinfect the watermain. The Operator in Charge disinfects the watermain.

5.6.2 Disinfection Requirements

Using the continuous feed method, super chlorinate the watermain to a minimum of

25mg/L to a maximum of 50mg/L. Each hydrant must be flushed until super chlorinated water has reach the ports on the hydrant. Let sit for at least 24 hours to provide adequate contact time.

5.7 Test Free Chlorine Residual

5.7.1 Responsibilities when Testing the Chlorine Residual

The Operator in Charge takes and analyzes the free chlorine residual.

5.7.2 Testing Requirements

After a minimum of 24 hours, test the free chlorine residual. Test the residual at the start, middle, and end of the main to monitor for droppage in all areas. The maximum allowable decease in chlorine concentration is 40% of the initial chlorine concentration to a maximum decrease of 50 mg/L.

Example: If the watermain is superchlorinated to 50 mg/L, the free chlorine residual after 24 hours must be at least 30 mg/L (50×0.4 = 20, 50-20 = 30mg/L).

The disinfection procedure must be repeated until the free chlorine residual is within the allowable decrease limits.

5.8 Flush Watermain

5.8.1 Flushing Responisibilities

The Operator in Charge in responsible for flushing and dechlorination.

5.8.2 Flushing Requirements

After the watermain has been appropriately disinfected, flush the watermain using a municipal hydrant ensuring that every hydrant has been flushed to clear all super chlorinated water. Dechlorinate the water to 0 mg/L using Sodium Thiosulphate before any of the flushed water enters the storm water system. Flush the watermain until the free chlorine residual is consistent with the average residual in the distribution system.

5.9 Microbiological Sampling

5.9.1 Sampling Responsibilities

The Operator in Charge takes the samples and submits them to Caduceon.

5.9.2 Sampling Requirements

Collect samples for microbiological testing (E. coli, Total Coliforms, and HPC) as per AWWA C651, 5.1.1.2: one sample from as close as reasonably possible to the beginning of the main, one sample for every 1200 ft (370 m) of the new water main, plus one set from the end of the line and at least one from each branch greater than one pipe length. Use a COC that specifies that that the sampling results are **not reportable** under the Safe Drinking Water Act, SDWA.

24 hours later, collect additional samples from same sites as initial sampling.

If results come back clear, final hookup can be completed. If results are unsatisfactory, flush again and resample. The resample must include two consecutive samples 24 hours apart. If samples are once again unsatisfactory, repeat the super chlorination (Section 5.6).

5.10 Final Hookup/Connections

5.10.1 Final Hookup Responsibilities

The Contractor is responsible for performing the tie in. The Operator in Charge is onsite to assist as needed.

5.10.2 Connections Equal to or Less than One Pipe Length (Generally ≤ 6m)

Follow Section 4.10.1 of AWWA C651 while ensuring that the Connection remains isolated from the DWS except while being flushed or sampled, until satisfactory results are received from the Microbiological sampling.

5.10.3 Connections Great than One Pipe Length (Generally > 6m)

Follow Section 4.10.2 of AWWA C651 with the exception of a connection that is greater than one meter and up to 40 meters and:

a. Crosses a transportation corridor and closing the corridor could result in significant community impacts, or

b. Cannot be constructed to within one pipe length of the existing watermain due to the potential for destabilizing an existing thrust block.

If either condition a. or b. are present, follow the procedure under 1.1.4.2 of the Ministry's Watermain Disinfection Procedure.

After hookups are completed, pressure test joints from final connection.

5.11 Flush Main and Final Microbiological Sampling

After the final hookup, the Operator in Charge flushes watermain until all the air is out and an adequate free chlorine residual is achieved. Collect a final microbiological sample from the hydrant that was used for flushing. This sample is considered to be **reportable** under the SDWA.

5.12 Documentation

Fill out the Watermain Commissioning Report Form and send a copy along with copies of the COC's to the Water Wastewater Compliance Coordinator.

If the commissioning is being completed on a newly constructed watermain, inform the Water Wastewater Compliance Coordinator of the date the watermain was commissioned so they can add it to the required Form 1.

6.0 References

- Allowable Makeup Water Calculator
- AWWA Standard C651 – Disinfecting Watermains
- AWWA Standard C605 Underground Installation of PVC and PVCO Pressure Pipe and Fittings
- Book 7: Ontario's Traffic Control Manual.
- Kemptville DWS Drinking Water Works Permit
- OHSA: Occupational Health and Safety Act – the act that governs how work is to be done in Ontario.

- AWWA Safety Talk for Working Under Pressure
- SDS for Sodium Hypochlorite
- SDS for Sodium Thiosulfate
- The Ontario Ministry of the Environment, Conservation and Parks, Watermain Disinfection Procedure, August 1, 2020.
- Watermain Commissioning Report Form
- WHMIS: Workplace Hazardous Material Information System – Canada's Hazard Communication Standard for dealing with hazardous goods.

7.0 Revision History

Revisions to this procedure are documented in Table 2, Revision History.

Table 2: Revision History

Document Section	Ver-sion #	Details of Amendments	Date	Author (Initials)
All	1	Original Release	2021/12/07	A.E.S

Watermain Commissioning Report	
North Grenville	**WATER AND WASTEWATER DIVISION**
Title: Watermain Commissioning Report	Original Release Date: 2021/09/16 (AS)
Kemptville DWS	Last Revision: 2021/09/16 (AS)

*For detailed instructions follow SOP WD-308

Date:	Time:
Location:	
Inspector/Operator:	
Contractor Representative(s)	
ECA #:	

Watermain Information

Size of Main:	Pipe Material:	Length Tested:
Is there an air gap at both ends? ☐ Yes ☐ No		
Live Tap Performed? ☐ Yes ☐ No If checked **yes**, cleaned with a 1% Cl_2 solution ☐ Yes ☐ No		
Backflow Preventer: High Hazard? ☐ Yes ☐ No		Tested? ☐ Yes ☐ No

Pressure Testing

*Follow AWWA 605-21 and use the Makeup Water Allowance Calculator

Pressure Test performed by:	
Start Time:	End Time:
Pressure during Test:	Makeup Water Used (L/h):
Makeup Water Allowance:	
☐ PASS ☐FAIL	

Swabbing

Date of Swabbing:	
Swabbing performed by:	
Number of Swabs Used:	Number of Swabs Retrieved:

Super Chlorination

*Maximum allowable decrease in chlorine concentration is 40% of the initial chlorine concentration

Date of Super chlorination:	Super chlorination performed by:

Initial Chlorine Residual:	Time:
Final Chlorine Residual:	Time:
Chlorine Residual After 24 Hours:	Time:
☐ PASS ☐FAIL	

Flushing

*Flushed water must be dechlorinated before it enters the stormwater system/the environment

Date of Flushing:	Flushing completed by:
Chlorine Residual at Start:	Flushing Time:
Chlorine Residual at Finish:	Flushing Duration:

Microbiological Sampling Results

Initial Samples *one at the start on the new watermain, one for every 1200 ft (370 m) of new main, plus one set from the end of the line and at least one from each branch greater than one pipe length.

Samples Taken by:	Date:
Chain of Custody attached?: ☐ Yes ☐ No	
Certificate of Analysis attached? ☐ Yes ☐ No Certificate Number:	

Secondary Samples *24 hours after initial sampling, upstream and downstream.

Samples Taken by:	Date:
Chain of Custody attached?: ☐ Yes ☐ No	
Certificate of Analysis attached? ☐ Yes ☐ No Certificate Number:	

Final Connection

Final Connection Parts cleaned with 1% Sodium Hypochlorite Solution? ☐ Yes ☐ No	
Connected date/time:	Connection performed by:
Valves Opened date/time:	Water Turned on by:

Comments

Appendix 3 – Standard Drawings

Municipality of North Grenville
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NMSD

Detail Number	***Detail Name***
A-01	Subdivision Notice Signage
A-02	3 Rail Post And Rail Fence
A-03	2 Rail Post And Rail Fence
A-04	Chainlink Fence
A-05	Single Chainlink Gateway
A-06	Double Chainlink Gateway
A-07	P Gate Detail
A-08	Horizonal Control Monument
B-01	18m Right Of Way
B-02	20m Right Of Way
B-03	26m Right Of Way
B-04	20m Right Of Way Rural
C-01	SWM Facility Warning Sign
C-02	Catchbasin - 'T' For Rear Yard, Ditched Pipe And Landscape Applications
C-03	Catchbasin - Elbow For Rear Yard, Ditched Pipe And Landscape Applications
D-01	Commissioning New Watermains Physically Isolated From System
D-02	Watermain Crossing Below Sewer
D-03	Watermain Crossing Above Sewer
D-04	Tracer Wire Installation PVC Watermain
D-05	Waterproofing Of Splices
D-06	Typical Temporary Water Connection Schematic
G-01	Utility Layout Plan Section

NOTICE

100mm TEXT

THE ROADS AND OTHER MUNICIPAL SERVICES WITHIN THIS SUBDIVISION HAVE NOT YET BEEN ACCEPTED OR ASSUMED BY THE MUNICIPALITY OF NORTH GRENVILLE. USE AT OWN RISK.

38mm BOLD TEXT

INQUIRIES AND COMPLAINTS SHOULD BE DIRECTED TO:

38mm TEXT

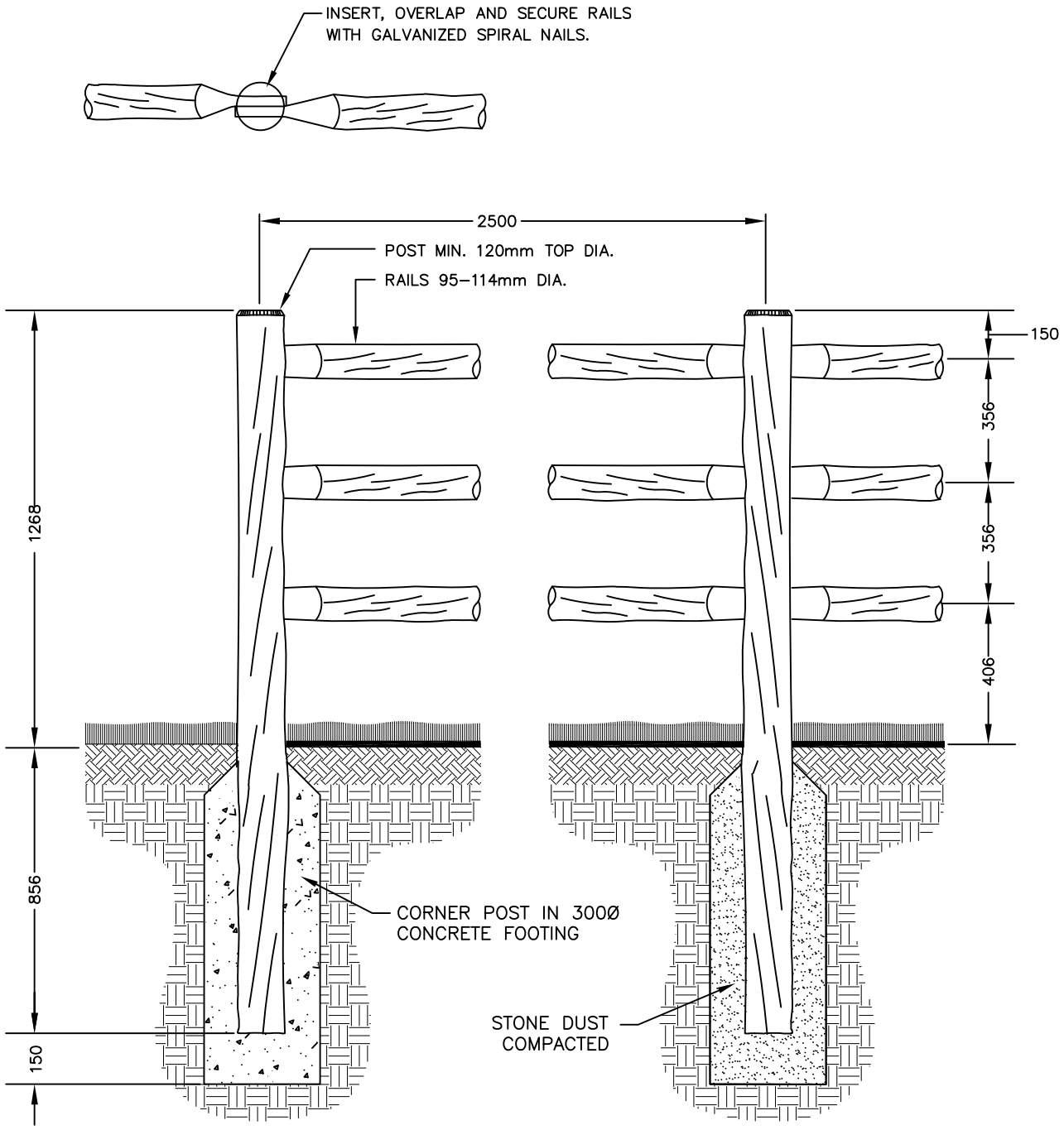
(IDENTIFY DEVELOPER OR DEVELOPER'S CONSULTING ENGINEER)

MUNICIPALITY OF NORTH GRENVILLE

75mm TEXT

SIGN DIMENSIONS 1.2m X 2.4m
ALL LETTERS TO BE BLACK ON WHITE BACKGROUND

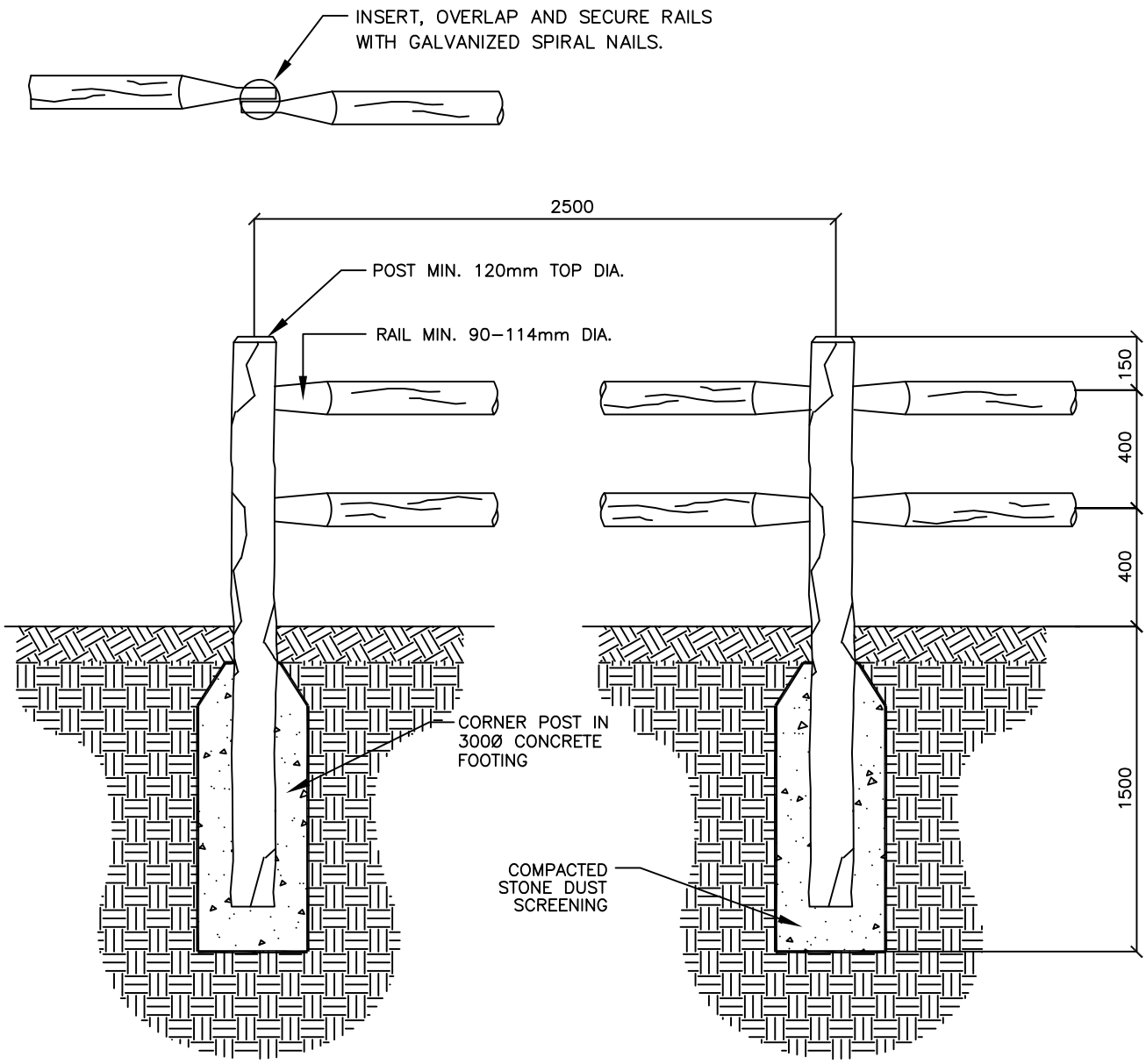
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	SUBDIVISION NOTICE SIGNAGE	Date: 04/05/22
		Date: Rev. None
		Dwg No. A-01



NOTES:

1. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
2. POST AND RAILS TO BE WELL–PEELED CEDAR, WITH NO PEELER MARKS.
3. CORNER AND END POSTS TO HAVE MINIMUM 25 x 100mm OBLONG HOLES FOR RAILS. LINE POSTS TO HAVE MINIMUM 64 x 100 OBLONG HOLES FOR RAILS
4. SOURCE OF FENCING TO BE APPROVED BY THE MUNICIPALITY OF NORTH GRENVILLE.

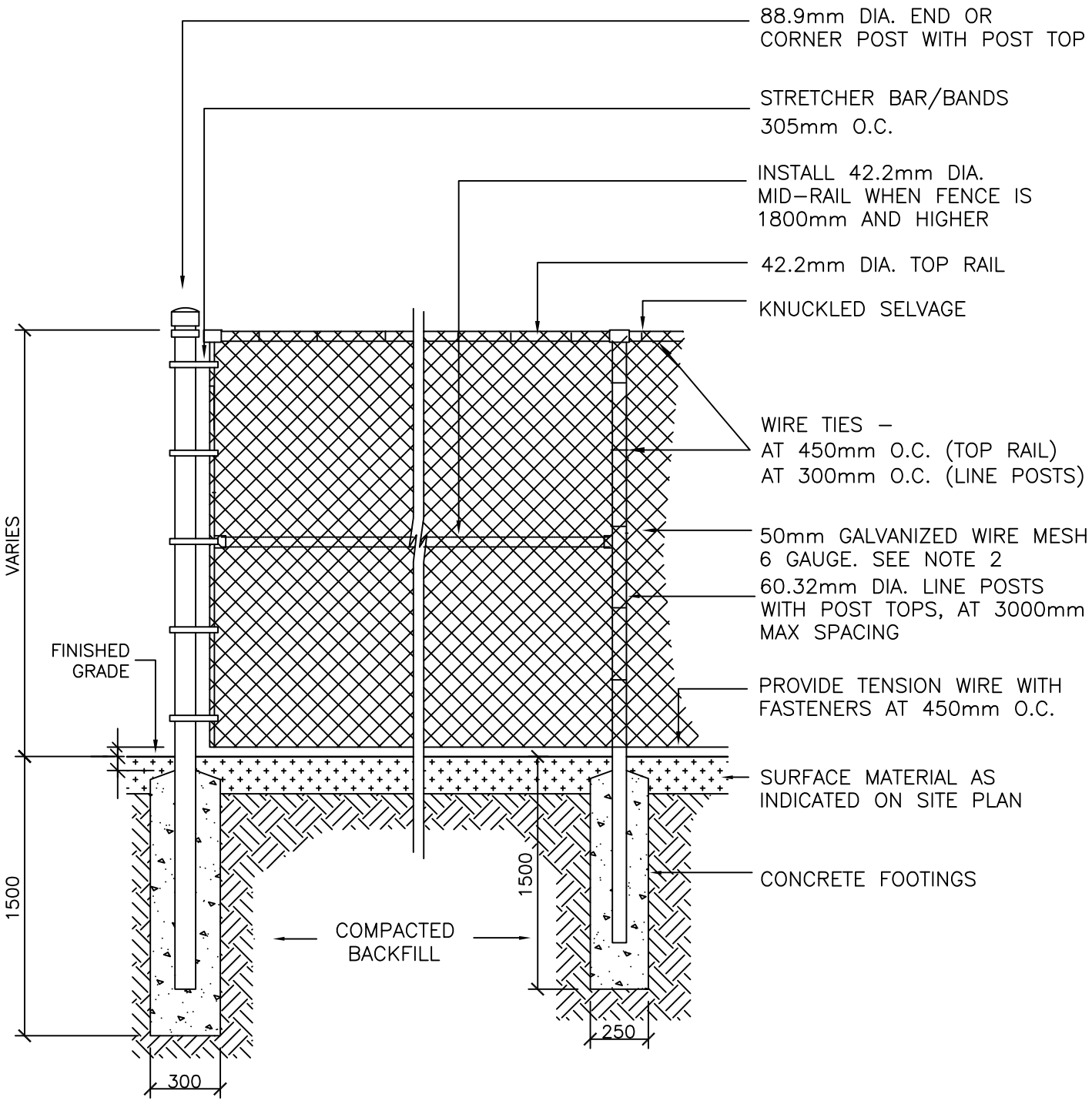
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	3 RAIL POST & RAIL FENCE DETAIL	Date: 11/04/22
		Date: Rev. None
		Dwg No. A-02



NOTES:

1. POST AND RAILS TO BE WELL PEELED CEDAR, WITH NO PEELER MARKS
2. CORNER AND END POSTS TO HAVE MINIMUM 25 x 100 OBLONG HOLES FOR RAILS
   LINE POSTS TO HAVE MINIMUM 64 x 100 OBLONG HOLES FOR RAILS
3. SOURCE OF WOOD FENCING TO BE APPROVED BY THE MUNICIPALITY OF NORTH GRENVILLE
4. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS OTHERWISE NOTED
5. CONCRETE FOOTING SHALL BE CSA 30MPa CLASS F–1

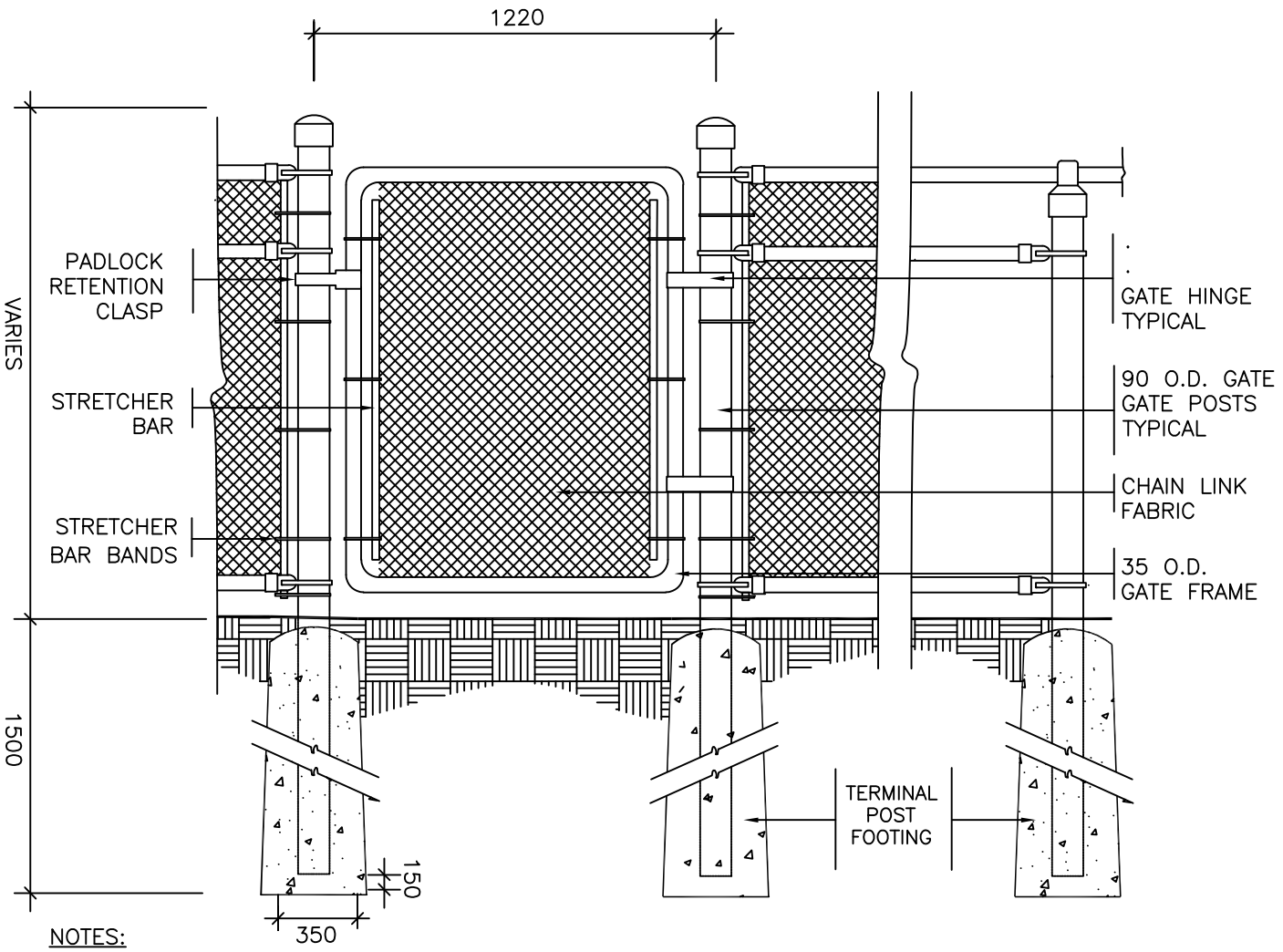
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	2 RAIL POST AND RAIL FENCE	Date: 11/04/22
		Date: Rev. None
		Dwg No. A-03



NOTES:

1. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. IF FENCE IS TO BE BLACK VINYL, THE FENCE SHOULD BE 9 GAUGE GALVANIZED WIRE CORE WITH BLACK VINYL COATING TO PROVIDE A TOTAL OF 6 GAUGE THICKNESS.
3. POSTS, RAILS AND ALL OTHER HARDWARE SHOULD BE ELECTROSTATIC PAINTED.
4. CONCRETE FOOTING SHALL BE CSA 30MPa CLASS F-1.
5. HEIGHT TO BE CONFIRMED WITH MUNICIPALITY.

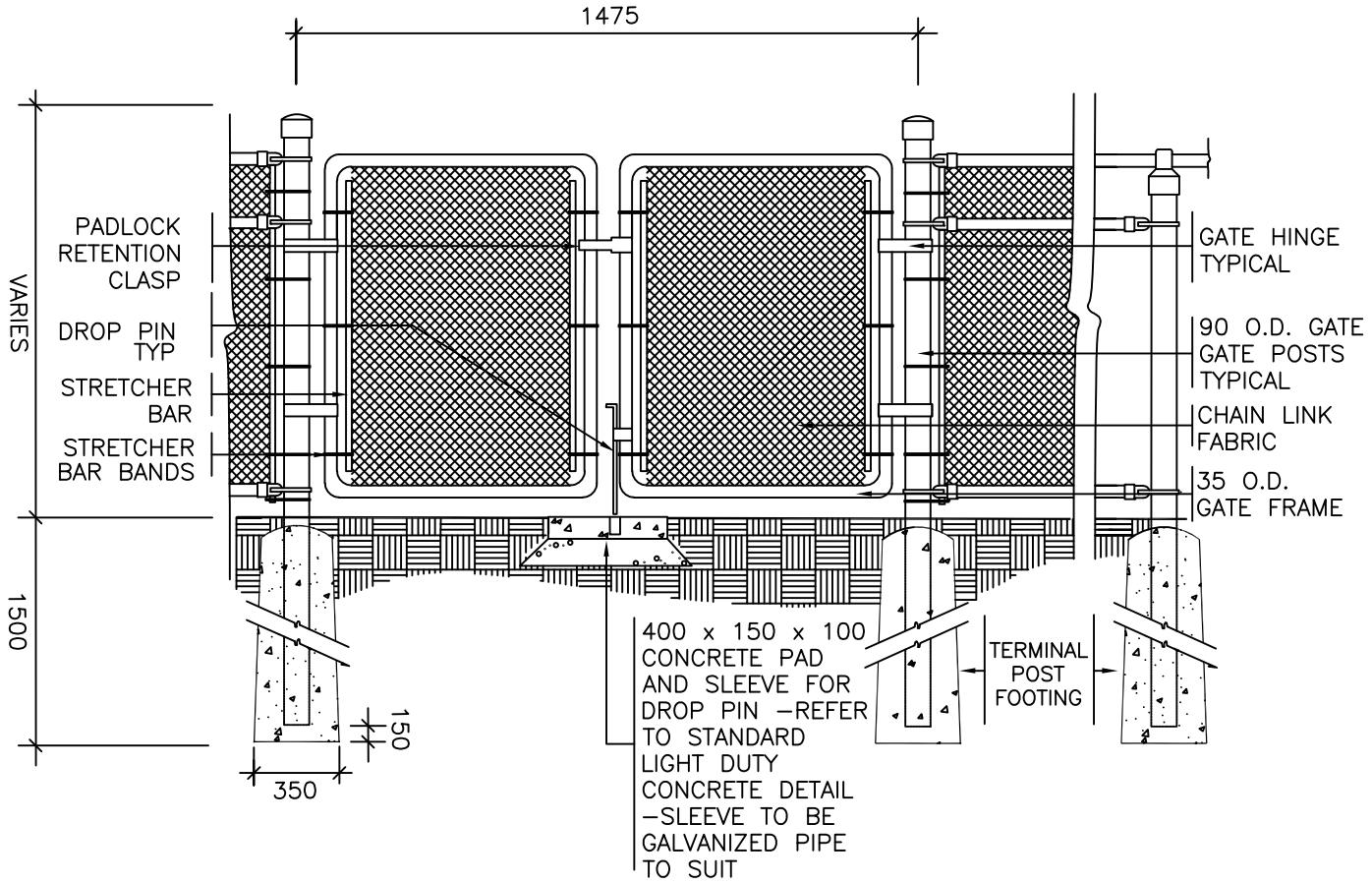
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	CHAINLINK FENCE	Date: 11/04/22
		Date: Rev. None
		Dwg No. A-04



NOTES:

1. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. GATE FRAMES SHALL BE CONSTRUCTED OF 33 O.D. GALVANIZED STEEL PIPE, SHOP BENT, WELDED. AND GROUND SMOOTH.
3. STRETCHER BARS TO BE 5 x 19 MINIMUM.
4. STRETCHER BAR BANDS 300 O.C., 6 x 19 MINIMUM.
5. CHAIN LINK FENCE TO BE BLACK VINYL COATED, 38 WOVEN MESH, 6 GAUGE O.D. OF 9 GAUGE GALVANIZED STEEL CORE FASTENED TO LINE POSTS, TOP RAIL, MID RAIL, INTERMEDIATE RAIL, AND BOTTOM RAIL, AND GATE FRAME WITH 3.5 (9 GAUGE) KNUCKLED FASTENERS.
6. PADLOCK RETENTION CLASPS TO BE INSTALLED.
7. FINISH OF FABRIC AND TIES TO MATCH ADJACENT FENCE.
8. ALL FENCE POSTS, GATE FRAMES, AND RAILS TO BE GALVANIZED SCHEDULE '40' PIPE.
9. NO PLASTIC FITTING OR COMPONENTS ARE TO BE USED.
10. WELD ALL JOINTS.
11. HEIGHT TO BE CONFIRMED WITH MUNICIPALITY.

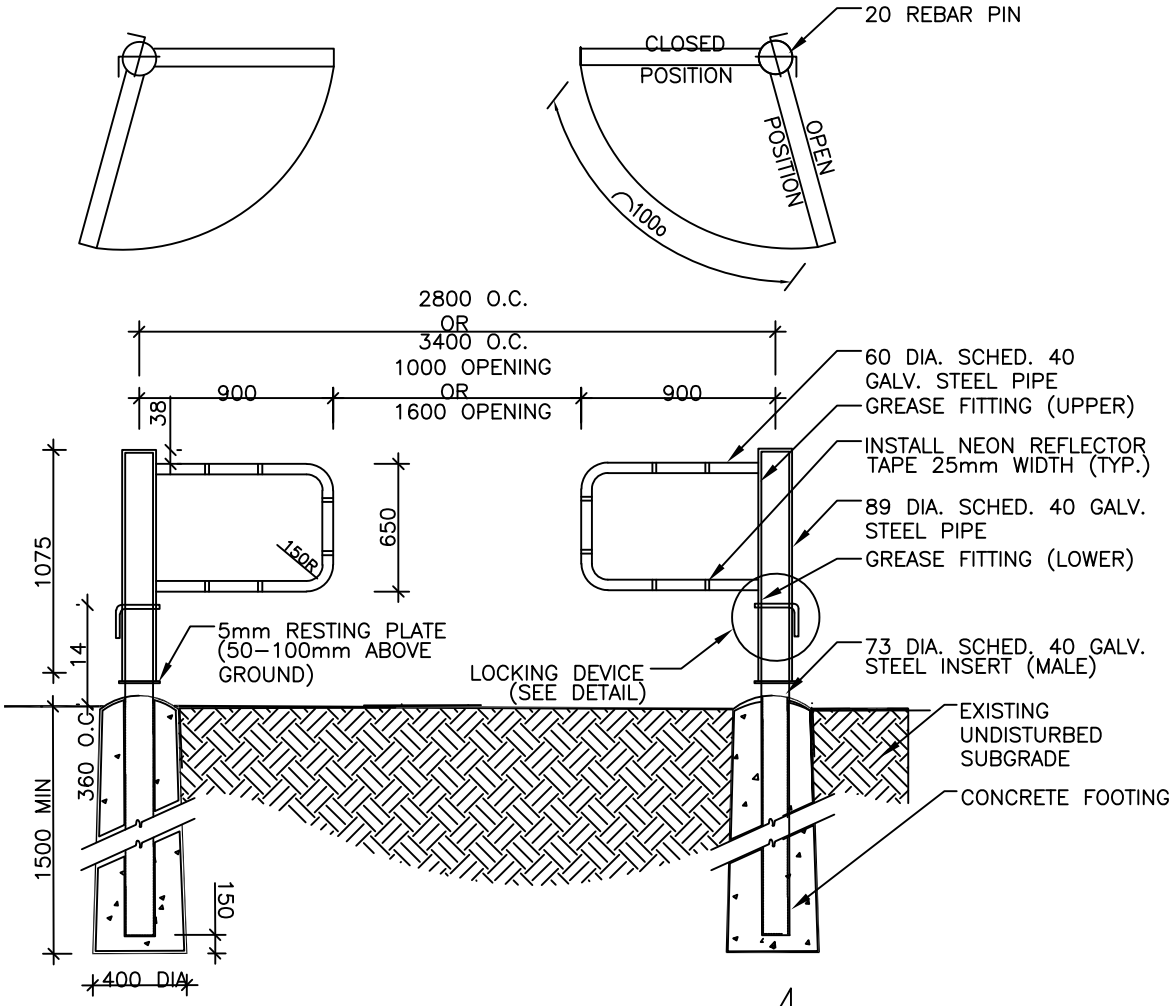
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	SINGLE CHAINLINK GATEWAY	Date: 11/04/22
		Date: Rev. None
		Dwg No.A-05

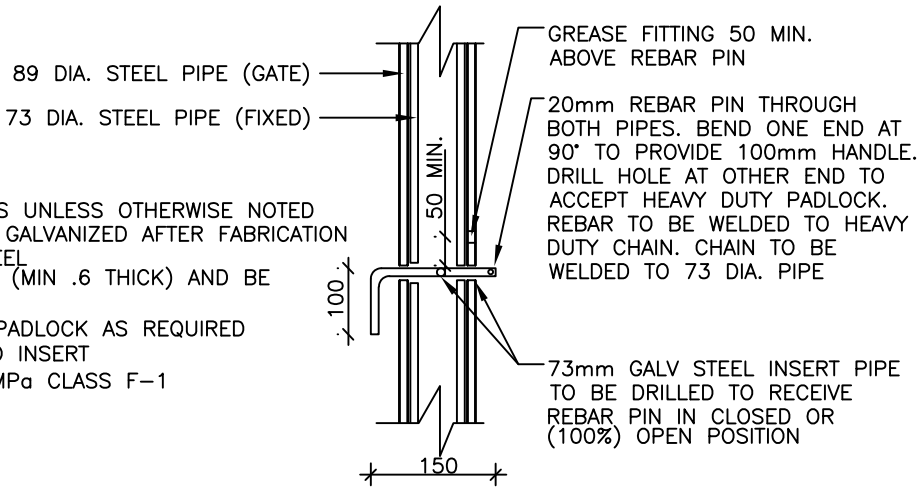


NOTES:

1. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. GATE FRAMES SHALL BE CONSTRUCTED OF 33 O.D. GALVANIZED STEEL PIPE, SHOP BENT, WELDED AND GROUND SMOOTH.
3. STRETCHER BARS TO BE 5 x 19 MINIMUM.
4. STRETCHER BAR BANDS 300 O.C., 6 x 19 MINIMUM.
5. CHAIN LINK FENCE TO BE BLACK VINYL COATED, 38 WOVEN MESH, 6 GAUGE O.D. OF 9 GAUGE GALVANIZED STEEL CORE FASTENED TO LINE POSTS, TOP RAIL, MID RAIL, INTERMEDIATE RAIL, AND BOTTOM RAIL, AND GATE FRAME WITH 3.5 (9 GAUGE) KNUCKLED FASTENERS.
6. PADLOCK RETENTION CLASPS TO BE INSTALLED.
7. FINISH OF FABRIC AND TIES TO MATCH ADJACENT FENCE.
8. ALL FENCE POSTS, GATE FRAMES, AND RAILS TO BE GALVANIZED SCHEDULE '40' PIPE.
9. NO PLASTIC FITTING OR COMPONENTS ARE TO BE USED.
10. WELD ALL JOINTS.
11. HEIGHT TO BE CONFIRMED WITH MUNICIPALITY.

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	DOUBLE CHAINLINK GATEWAY	Date: 11/04/22
		Date: Rev. None
		Dwg No. A-06





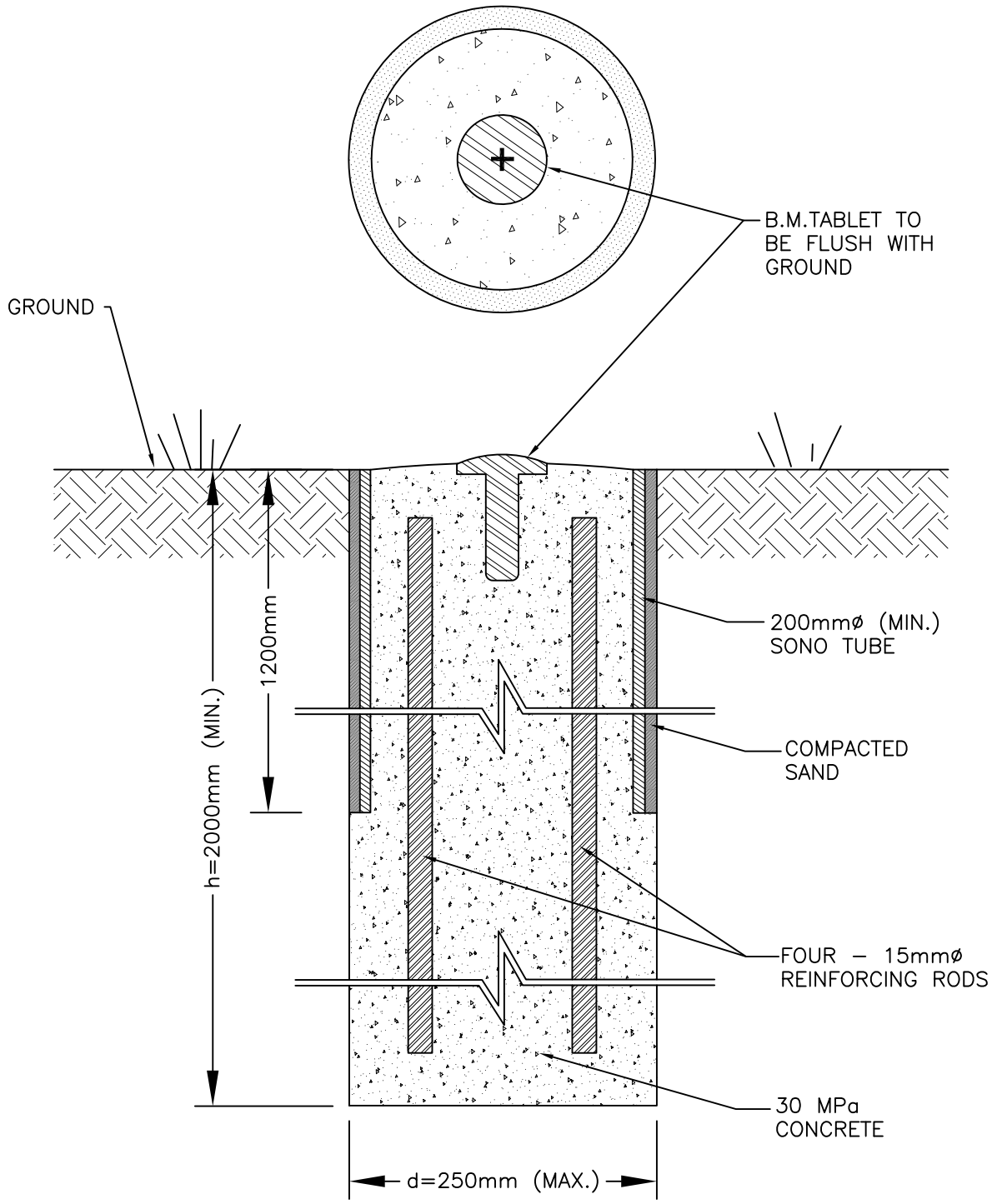
NOTES:

1. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
2. ALL PIPE AND COMPONENTS SHALL BE GALVANIZED AFTER FABRICATION
3. ALL PIPE SHALL BE SCHEDULE 40. STEEL
4. ALL JOINTS TO BE CONTINUOUS WELDS (MIN .6 THICK) AND BE GROUND SMOOTH
5. CONTRACTOR TO SUPPLY HEAVY DUTY PADLOCK AS REQUIRED
6. 5MM RESTING PLATE TO BE WELDED TO INSERT
7. CONCRETE FOOTING SHALL BE CSA 30MPa CLASS F–1

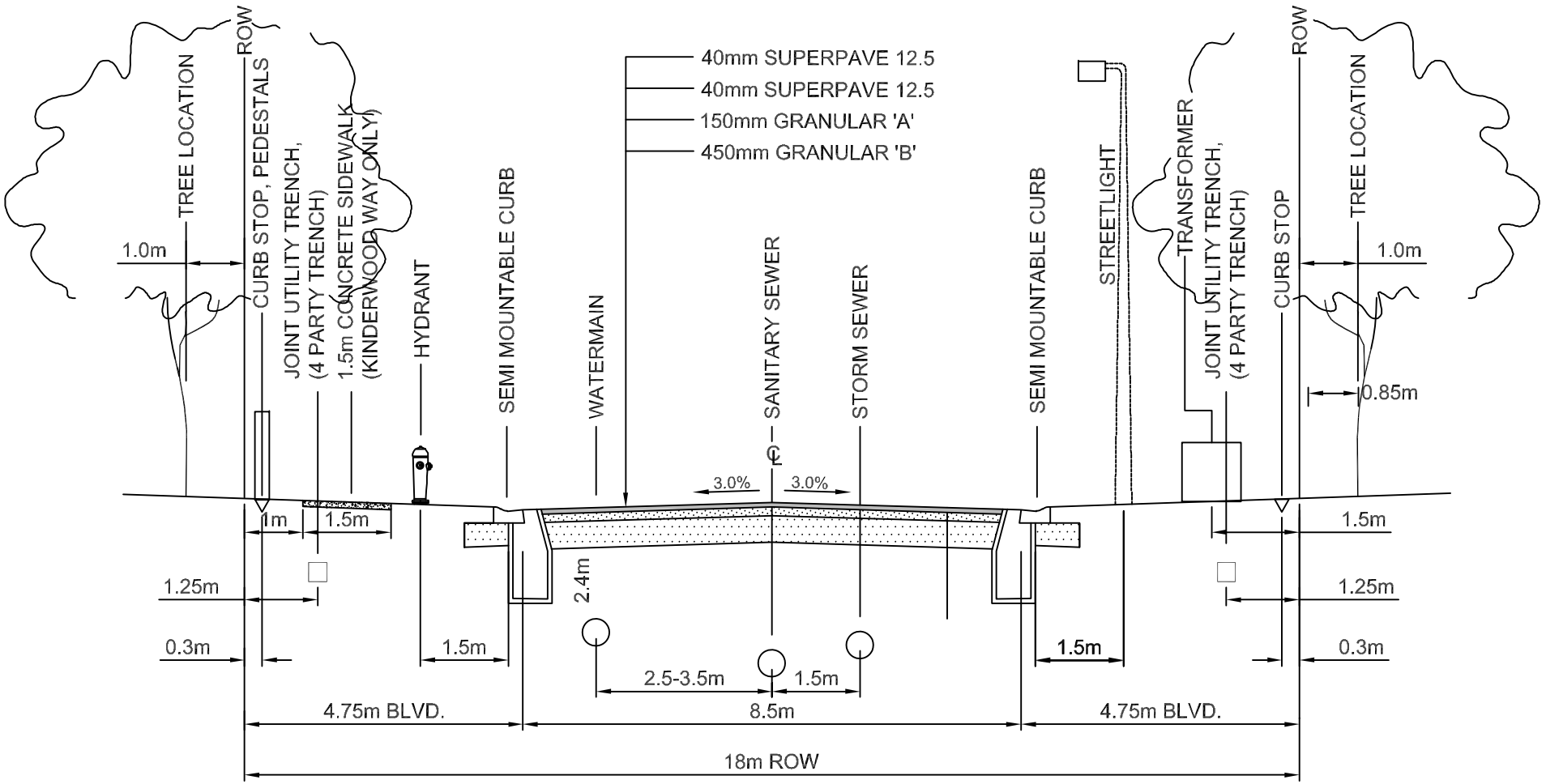
LOCKING DEVICE

1. LOCKING PIN TO BE GALVANIZED AFTER BENDING

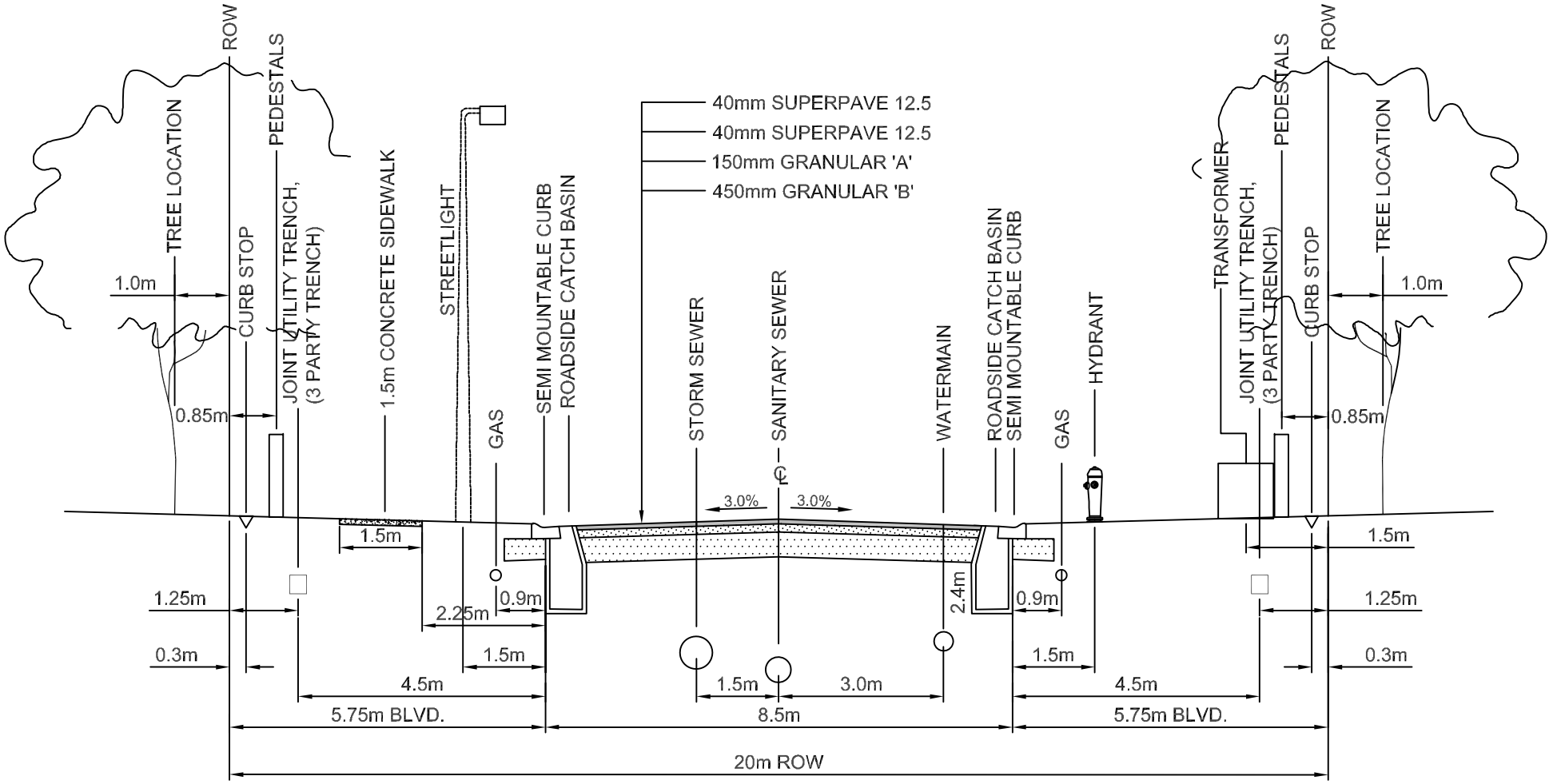
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	P GATE DETAIL	Date: 11/04/22
		Date: Rev. None
		Dwg No. A-07



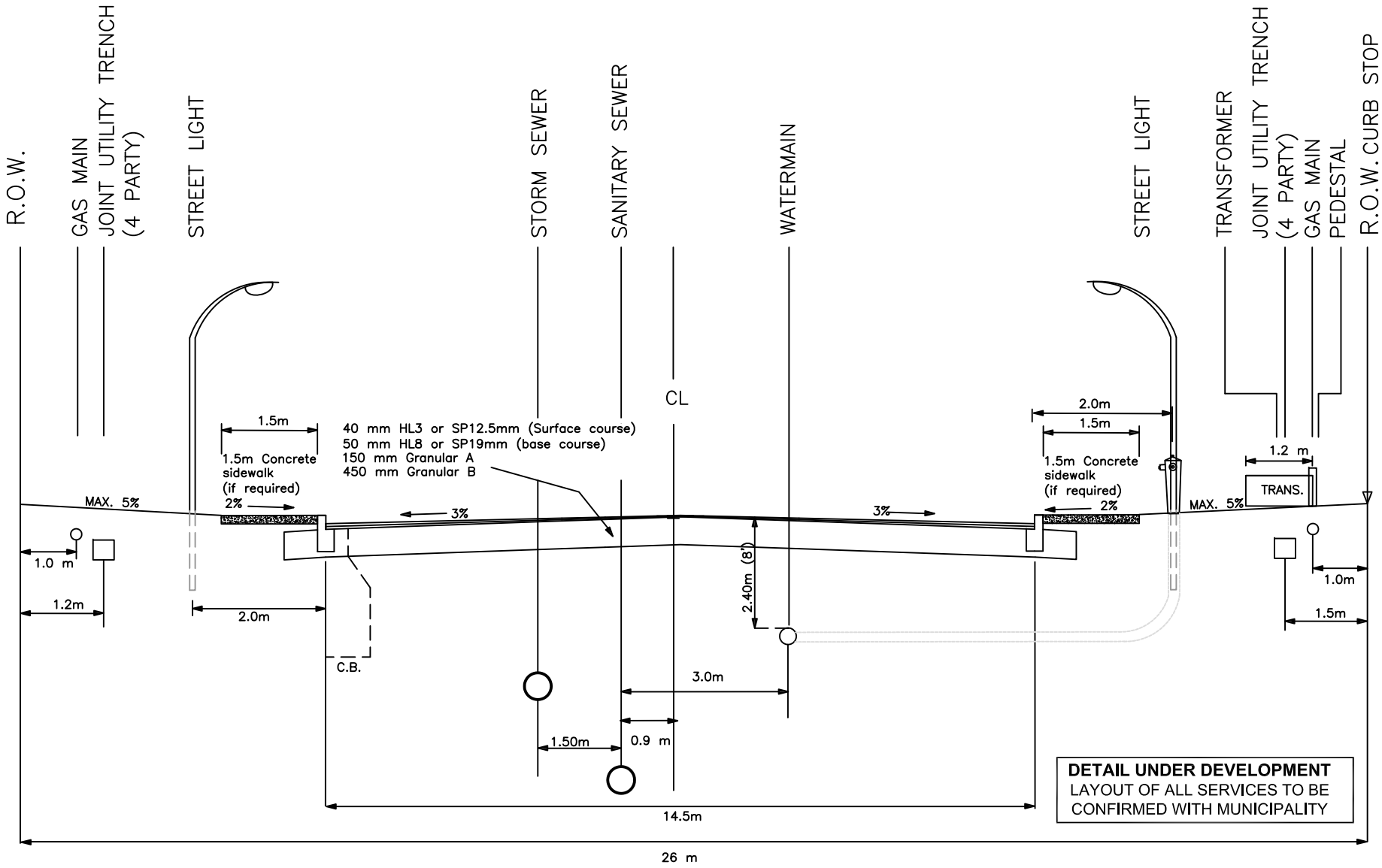
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	HORIZONTAL AND VERTICAL CONTROL MONUMENT	Date: 11/04/22
		Date: Rev. None
		Dwg No. A-08



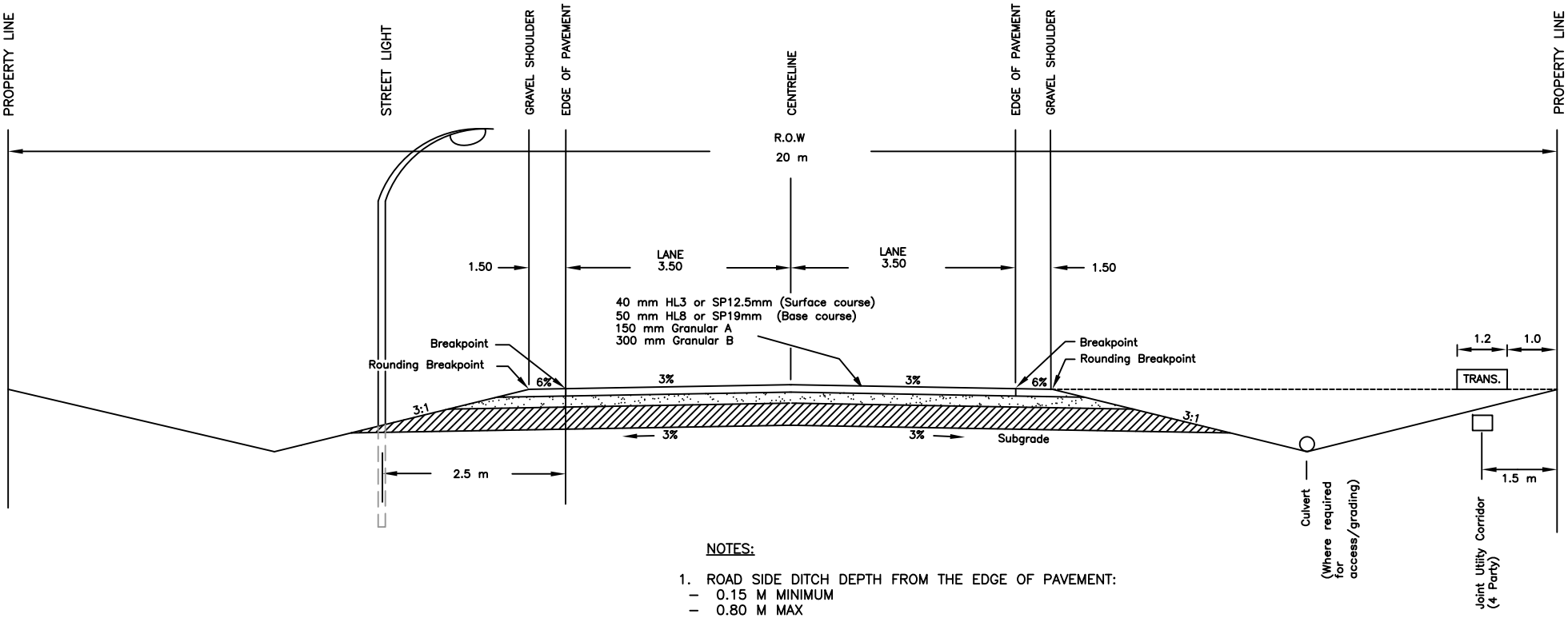
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	UTILITY LOCATIONS 18m (60') RIGHT OF WAY	Date: 11/04/22 Date: Rev. None Dwg No. B-01



Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	UTILITY LOCATIONS 20m RIGHT OF WAY	Date: 11/04/22 Date: Rev. None Dwg No. B-02



Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	UTILITY LOCATIONS 26m RIGHT OF WAY	Date: 11/04/22 Date: Rev. None Dwg No. B-03

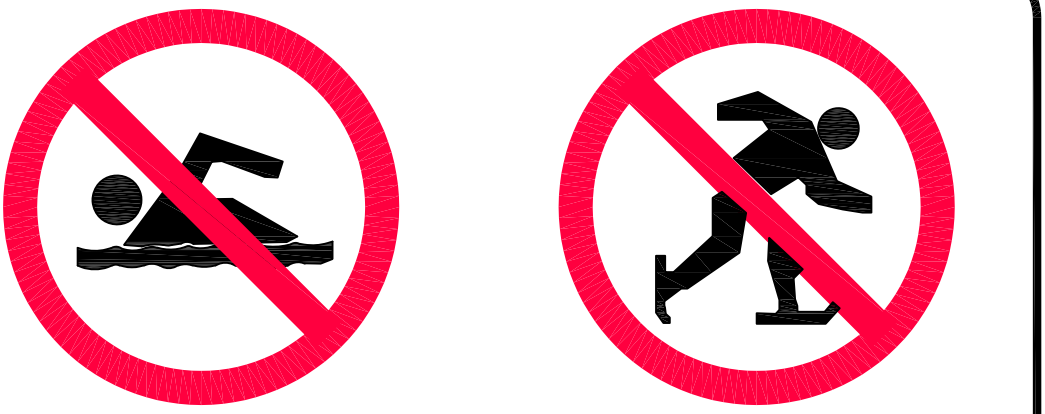


NOTES:

1. ROAD SIDE DITCH DEPTH FROM THE EDGE OF PAVEMENT:
   - 0.15 M MINIMUM
   - 0.80 M MAX
2. IN ACCORDANCE WITH THE ABOVE THE DITCH CENTER LINE. MAY RANGE FROM 2.0m – 4.0m FROM THE EDGE OF PAVEMENT.
3. BACK SLOPE TO MATCH EXISTING GRADE AT MAX 3:1 SLOPE.
4. DITCHES TO BE SEEDED AND MULCHED 150mm MIN.
5. PAVED SHOULDER REQUIREMENTS TO BE CONFIRMED WITH MUNICIPALITY.

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	TYPICAL RURAL ROAD CROSS SECTION 20m RIGHT OF WAY	Date: 11/04/22
		Date: Rev. None
		Dwg No. B-04

CIRCLE AND STRIKETHROUGH LINE TO BE RED



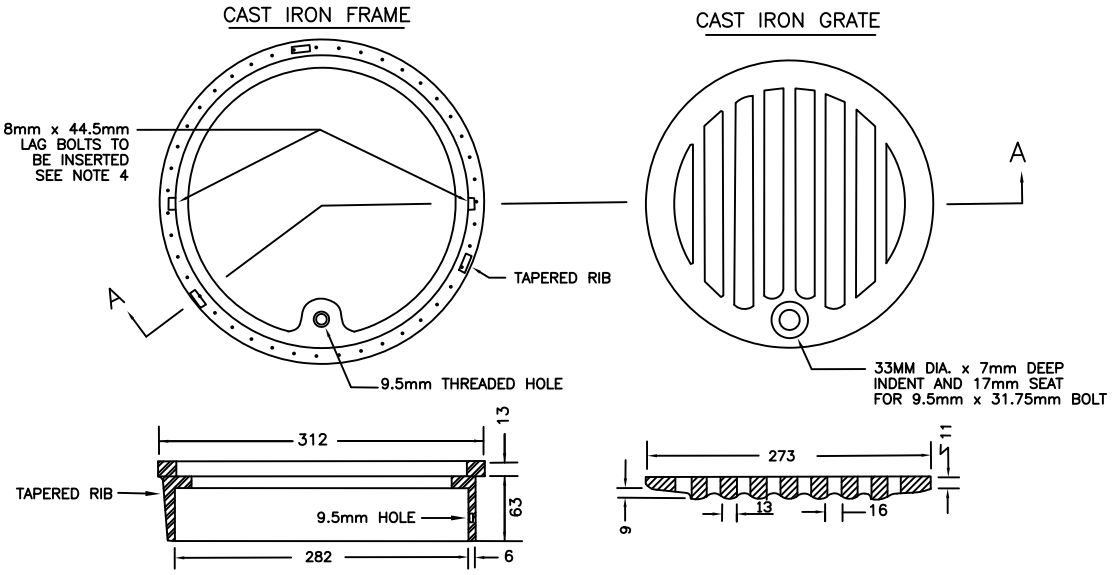
WARNING

HAZARDOUS CONDITIONS
NO TRESPASSING

THIS STORMWATER
MANAGEMENT FACILITY
POND CONTAINS FEATURES
WHICH MAY BECOME
HAZARDOUS UNDER
CERTAIN CONDITIONS.
HAZARDS CAN INCLUDE
FLUCTUATING WATER
LEVELS AND THIN ICE.

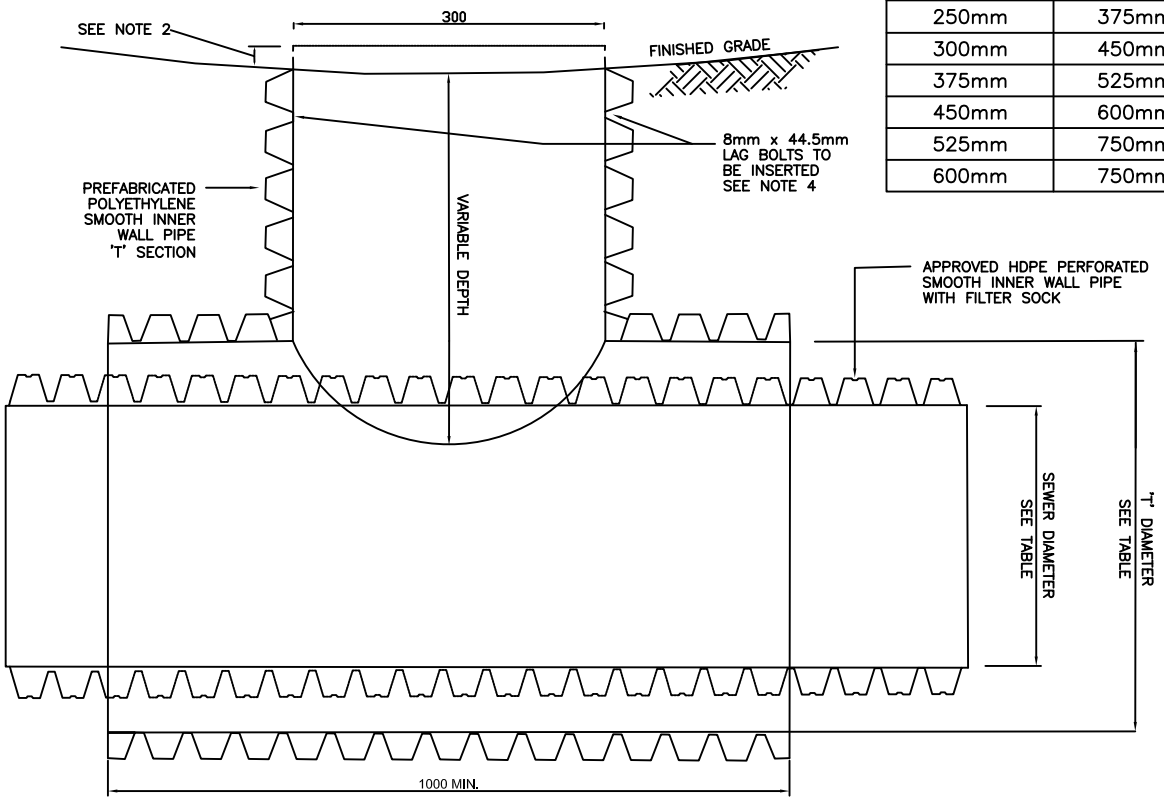
MUNICIPALITY OF NORTH GRENVILLE

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	SWM FACILITY WARNING SIGN	Date: 04/05/22
		Date: Rev. None
		Dwg No. C-01



SECTION A – A

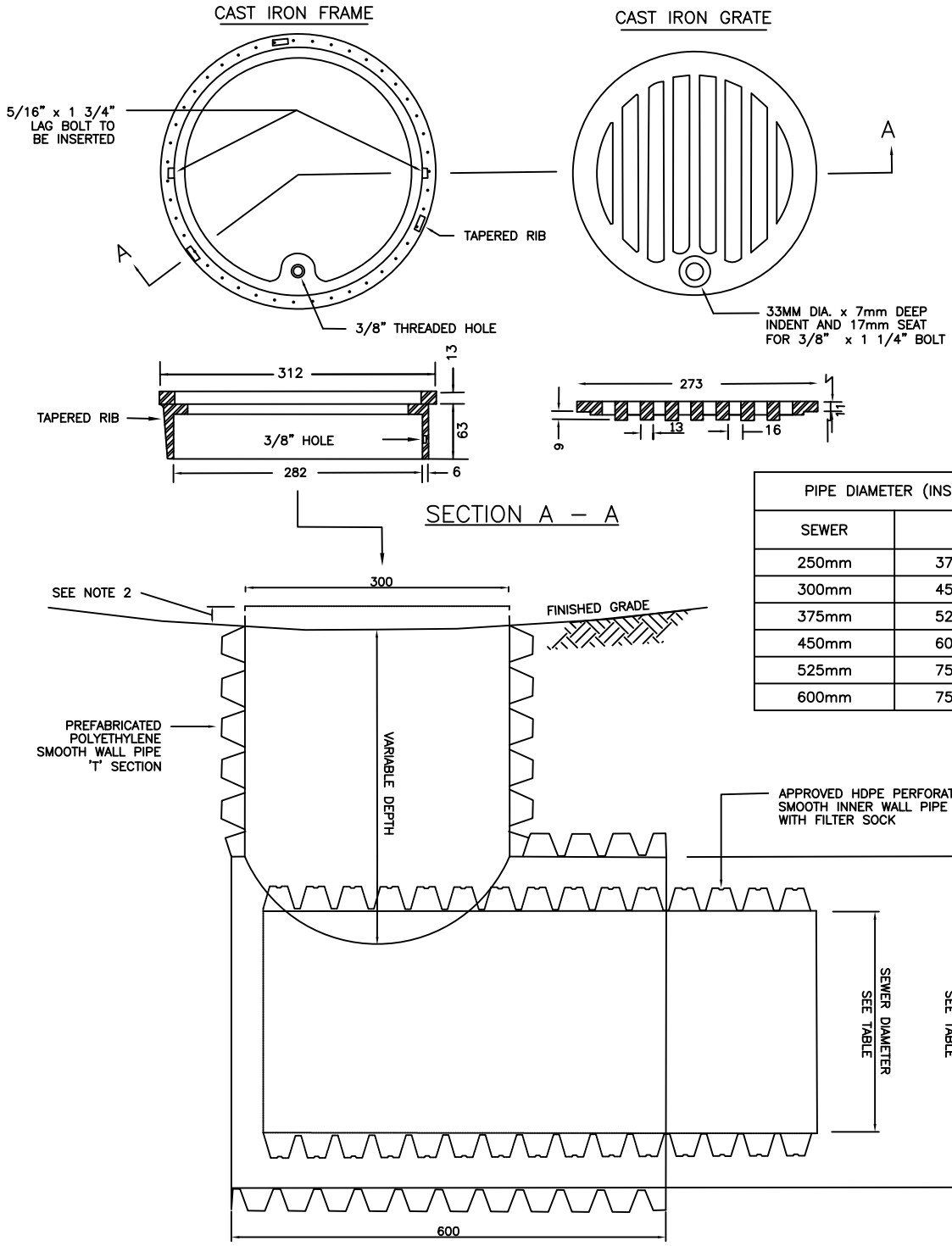
PIPE DIAMETER (INSIDE)	
SEWER	'T'
250mm	375mm
300mm	450mm
375mm	525mm
450mm	600mm
525mm	750mm
600mm	750mm



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN.
2. FOR DITCHED PIPE APPLICATIONS TOP OF CB SHALL BE MIN .5CM ABOVE BOTTOM OF THE DITCH/SWALE AND BE LOCATED MIN. 2M FROM EDGE OF PAVEMENT.
3. WHEN NON PERFORATED PIPE IS USED, MATCH THE 'T'S HORIZONTAL OPENING DIAMETERS TO THE PIPE DIAMETER AND CONNECT WITH MANUFACTURER RECOMMENDED CONNECTION SLEEVE.
4. CAST IRON FRAME TO BE SECURED TO PIPE WITH 2 LAG BOLTS AS SHOWN

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	CATCHBASIN – 'T' FOR REAR YARD, DITCHED PIPE AND LANDSCAPE APPLICATIONS	Date: 11/04/22
		Date: Rev. None
		Dwg No. C-02

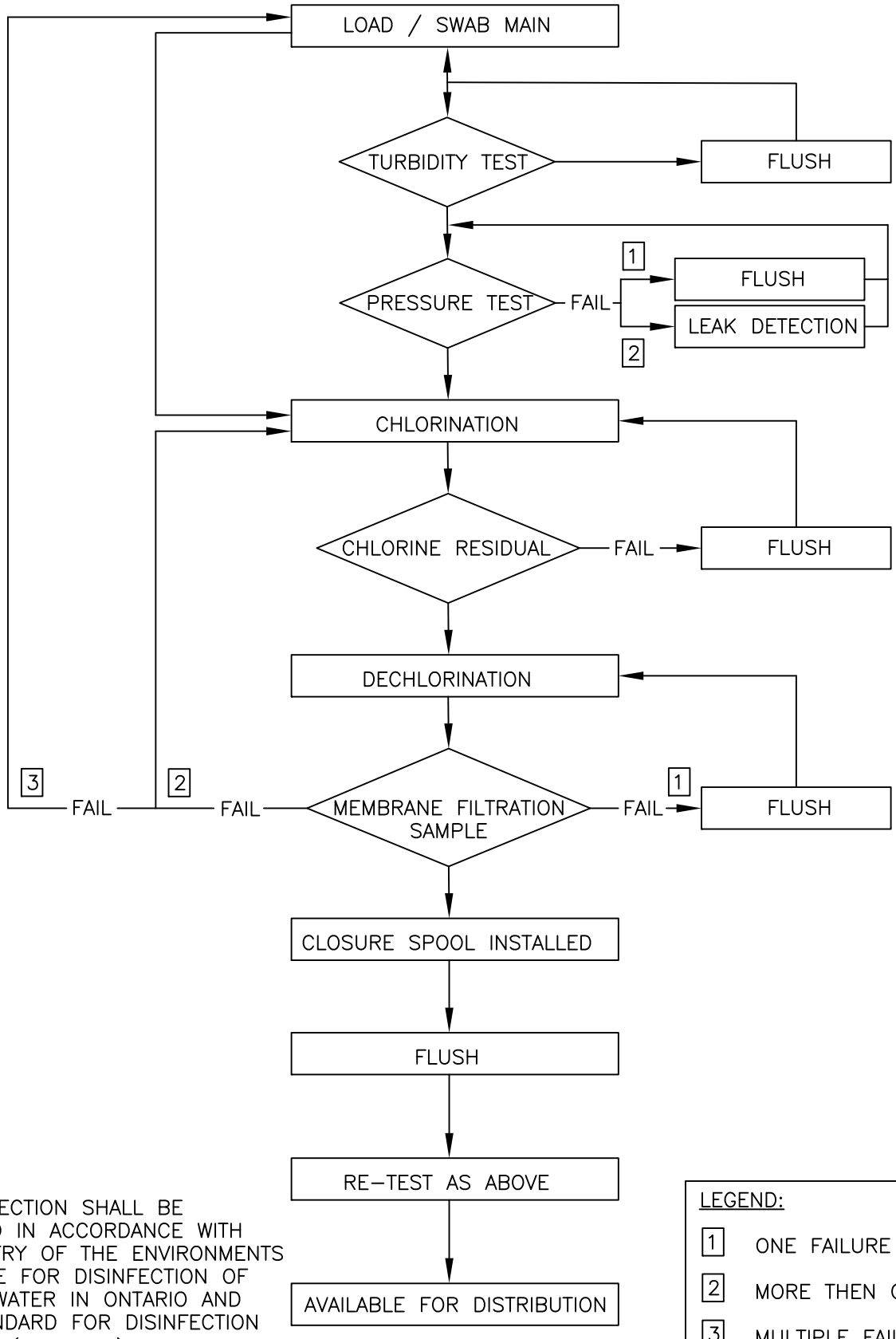


PIPE DIAMETER (INSIDE)	
SEWER	'T'
250mm	375mm
300mm	450mm
375mm	525mm
450mm	600mm
525mm	750mm
600mm	750mm

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN.
2. FOR DITCHED PIPE APPLICATIONS TOP OF CB SHALL BE MIN .5CM ABOVE BOTTOM OF THE DITCH/SWALE AND BE LOCATED MIN. 2M FROM EDGE OF PAVEMENT.
3. WHEN NON PERFORATED PIPE IS USED, MATCH THE 'T'S HORIZONTAL OPENING DIAMETERS TO THE PIPE DIAMETER AND CONNECT WITH MANUFACTURER RECOMMENDED CONNECTION SLEEVE.

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	CATCHBASIN – ELBOW FOR REAR YARD, DITCHED PIPE AND LANDSCAPE APPLICATIONS	Date: 11/04/22
		Date: Rev. None
		Dwg No. C-03



NOTE:

ALL DISINFECTION SHALL BE COMPLETED IN ACCORDANCE WITH THE MINISTRY OF THE ENVIRONMENTS PROCEDURE FOR DISINFECTION OF DRINKING WATER IN ONTARIO AND AWWA STANDARD FOR DISINFECTION WATERMAIN (C651-99)

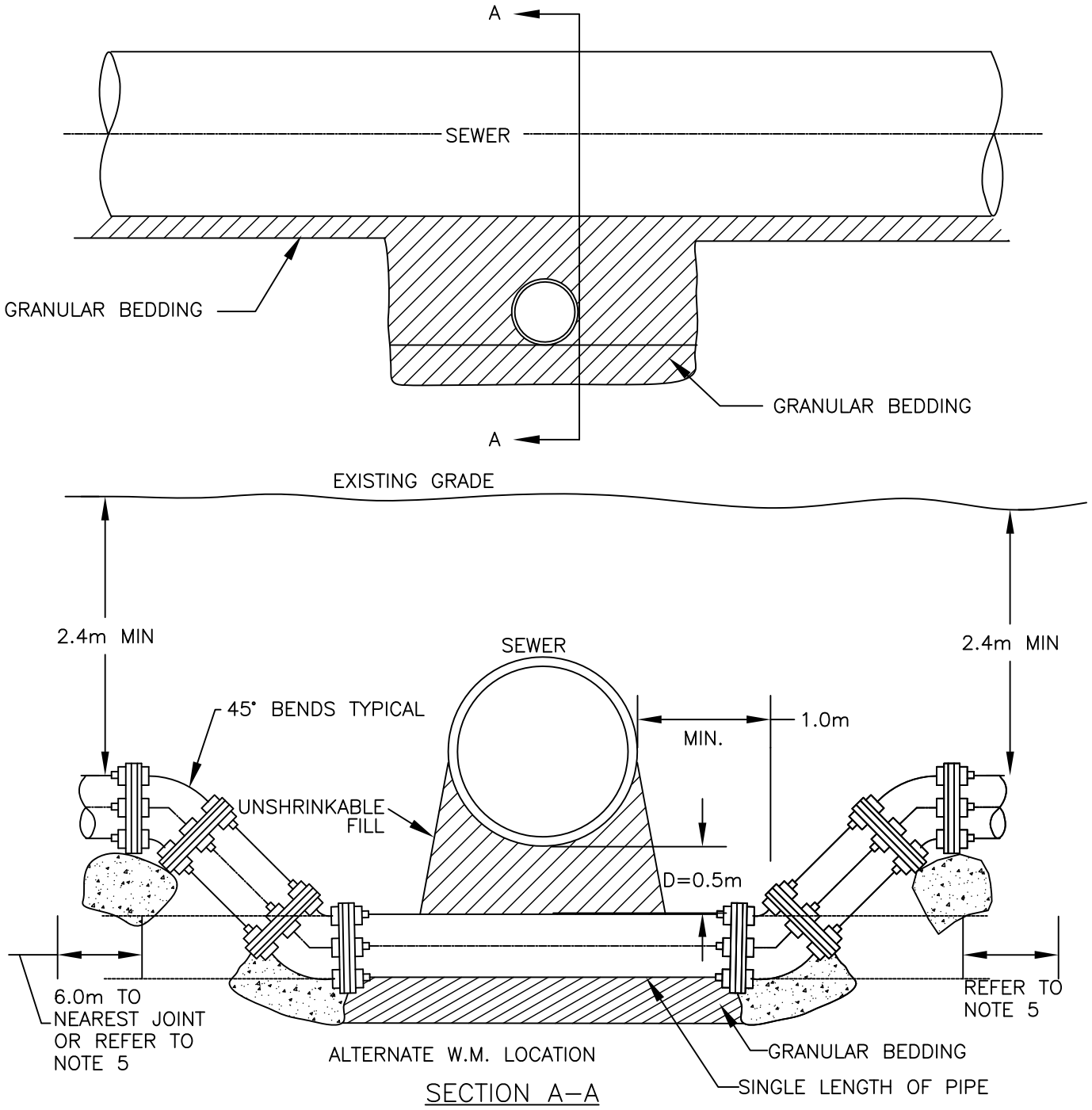
LEGEND:

1 ONE FAILURE

2 MORE THEN ONE FAILURE

3 MULTIPLE FAILURES

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	COMMISSIONING NEW WATERMAINS PHYSICALLY ISOLATED FROM SYSTEM	Date: 11/04/22
		Date: Rev. None
		Dwg No. D-01

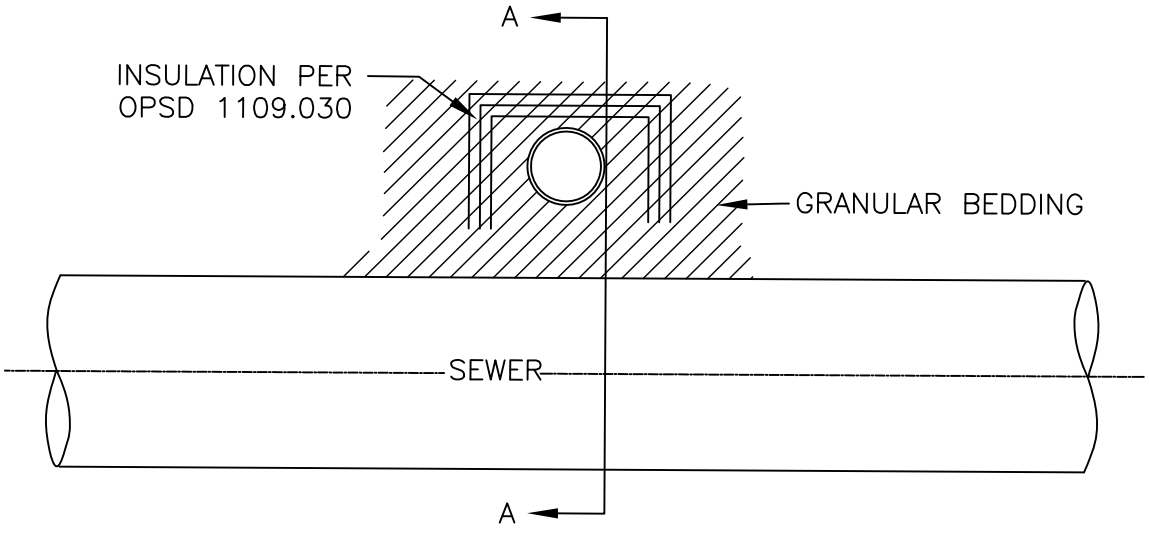


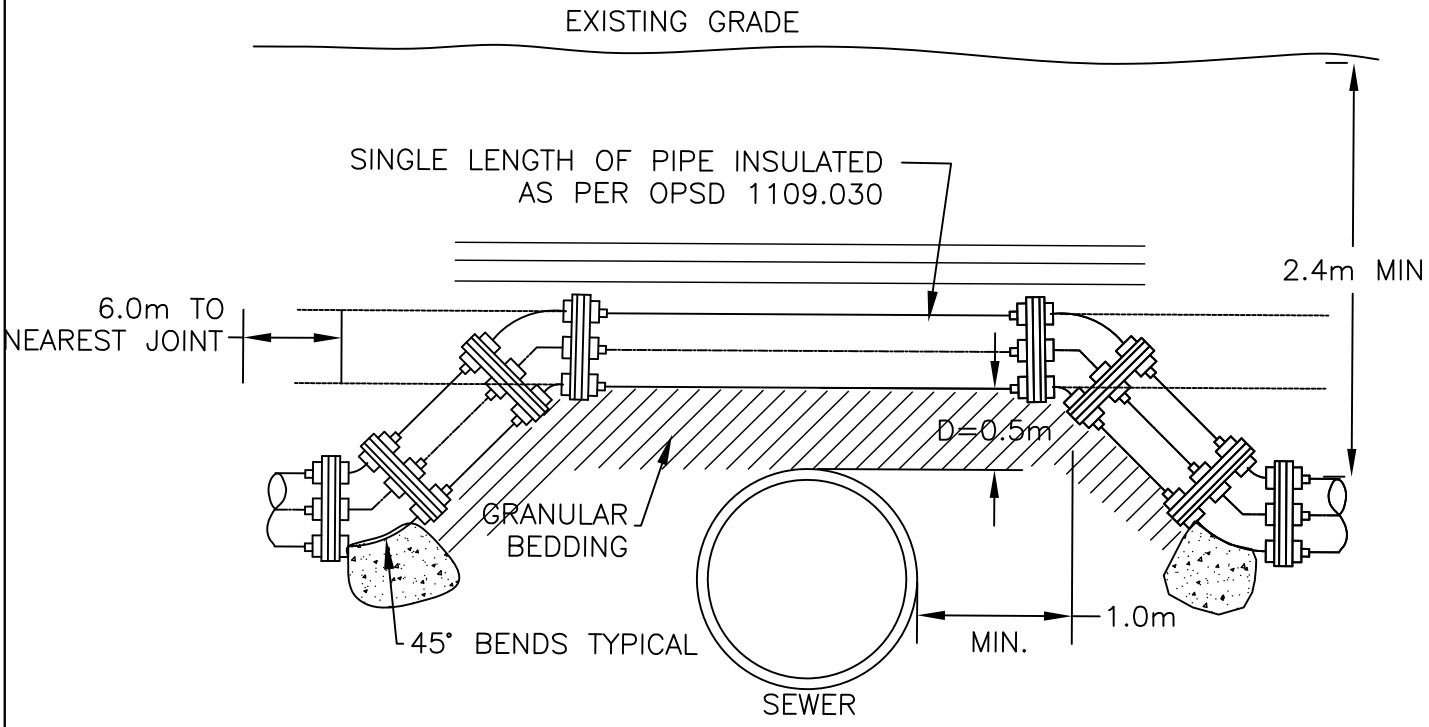
SECTION A–A

NOTES

1. BARREL TO BARREL SEPARATION SHALL BE 500mm MIN.
2. THRUST BLOCKS FOR MAINS LARGER THAN 400mm SHALL BE AS PER DESIGN.
3. FOR 300mm & 400mmø MAINS, BENDS SHALL BE MAX. 22½°.
4. CONCRETE SHALL BE 20Mpa.
5. RETAINING RINGS AND /OR THREADED RODS TO BE USED AT ALL JOINTS WHERE CONCRETE THRUST BLOCKS CAN NOT BE UTILIZED AND WHERE COUPLING CONNECTIONS ARE MADE LESS THAN 6.0m FROM THE JOINT.
6. THIS STANDARD APPLIES TO WATERMAINS 100mm TO 400mmø (NOMINAL)

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	WATERMAIN CROSSING BELOW SEWER	Date: 11/04/22
		Date: Rev. None
		Dwg No. D-02



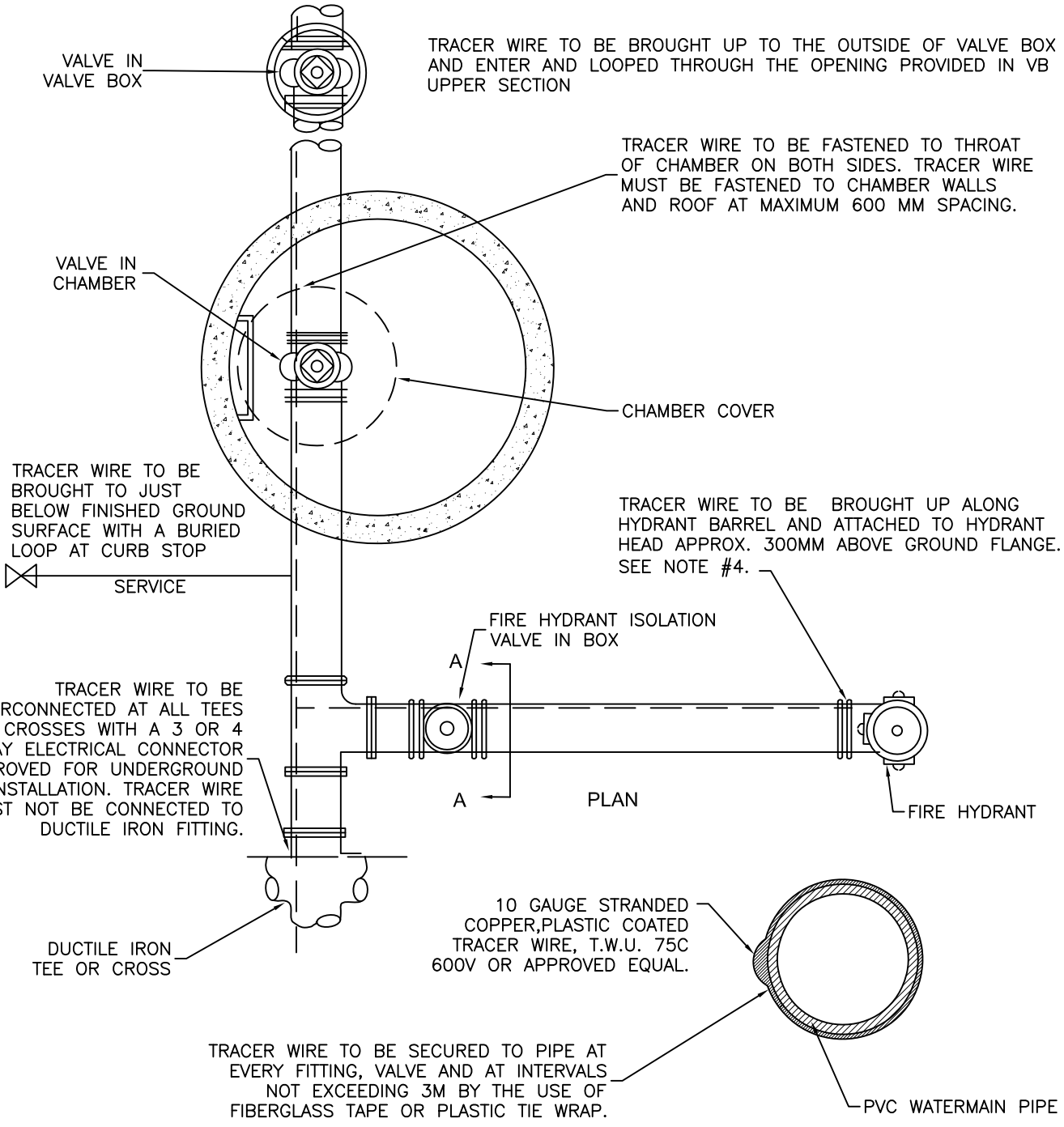


SECTION A–A

NOTES

1. BARREL TO BARREL SEPARATION SHALL BE 500mm MIN. 1°.
2. FOR 300mm & 400mmø MAINS, BENDS SHALL BE MAX. 22 2
3. RETAINING RINGS AND /OR THREADED RODS TO BE USED AT ALL JOINTS.
4. CONCRETE THRUST BLOCKS WILL NOT BE USED FOR TOP OF LOOP.
5. THIS STANDARD APPLIES TO WATERMAINS 100mm TO 400mmø (NOMINAL)
6. INSULATION TO BE INSTALLED FULL LENGTH WHERE WATERMAIN HAS LESS THAN 2.4m COVER.

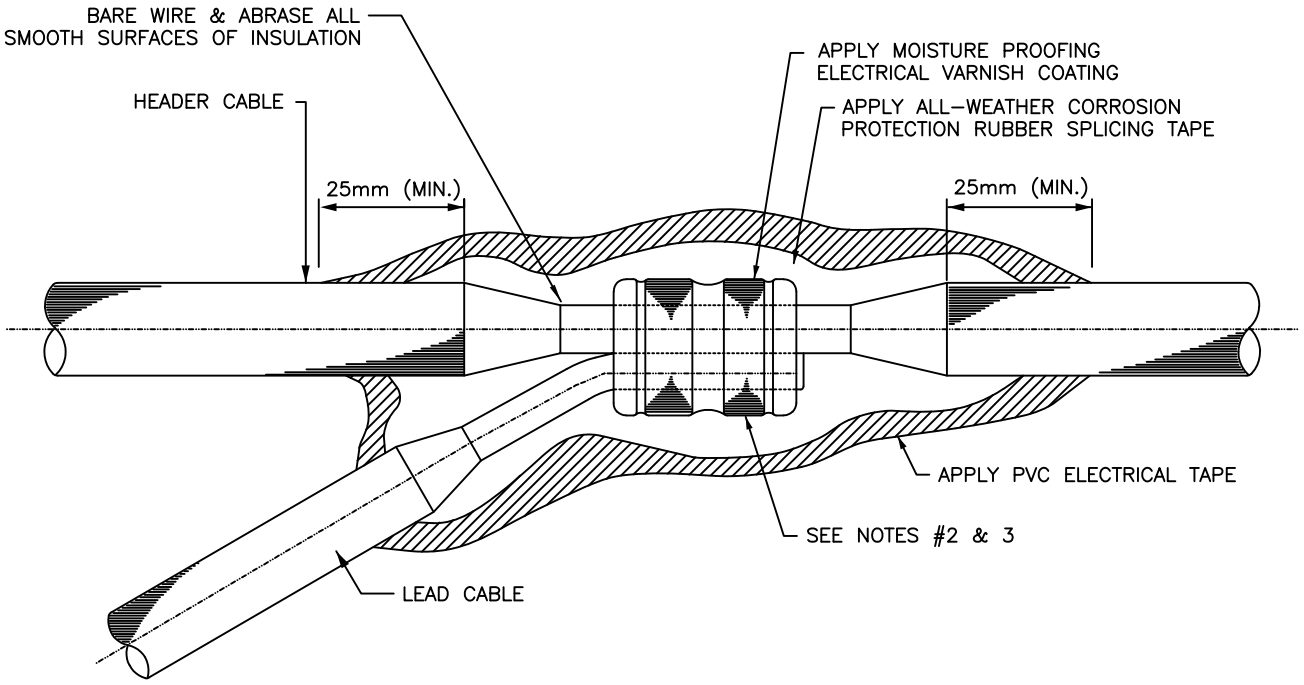
Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	WATERMAIN CROSSING ABOVE SEWER	Date: 11/04/22
		Date: Rev. None
		Dwg No. D-03



NOTES:

1. ALL CONNECTIONS MUST BE WATERPROOFED.
2. SPLICING OF TRACER WIRE IS NOT ALLOWED UNLESS SPECIFIED OR APPROVED.
3. TRACER WIRE CONTINUITY OF CURRENT MUST BE TESTED AND VERIFIED.
4. TRACER WIRE AT HYDRANT SHALL BE BROUGHT TO THE SURFACE AND TIED AROUND BARREL.
5. FOR PVC TO DUCTILE IRON CONNECTIONS THE TRACER WIRE MUST BE ATTACHED TO THE DUCTILE IRON PIPE BY CADWELD.
6. TRACER WIRE TO CONNECT TO ALL COPPER SERVICE CONNECTIONS AT OR NEAR MAIN STOP. INSTALL BRASS CONNECTOR TO COPPER PIPE AND FASTEN TRACER WIRE TO CONNECTOR.

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	TRACER WIRE INSTALLATION PVC WATERMAIN	Date: 11/04/22
		Date: Rev. None
		Dwg No. D-04



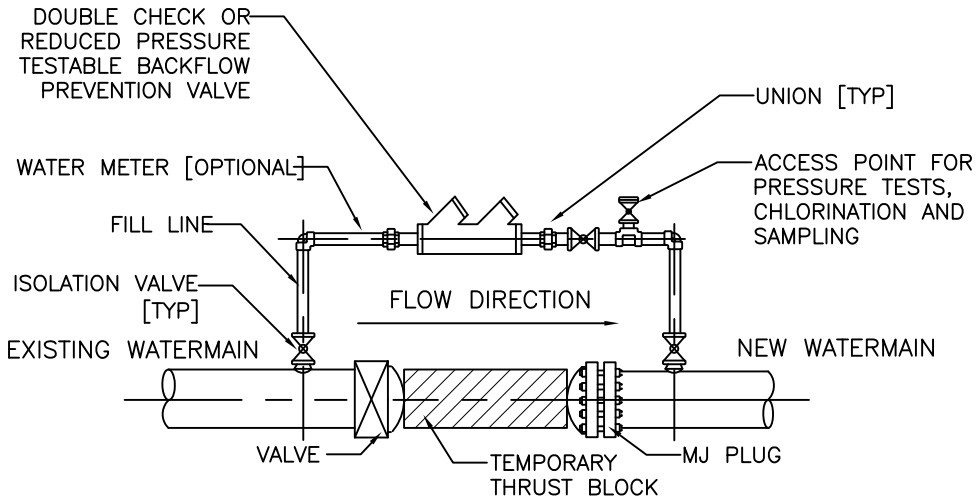
NOTES:
1. SEE BELOW FOR WIRE SPECIFICATIONS.
2. C–TAP, THERMITE WELD OR COPPER SPLIT BOLT.
3. INSTALL C–TAP OR SPLIT BOLT USING APPROVED TOOL

TRACER WIRE SPECIFICATIONS
– 10 GAUGE STRANDED COPPER,PLASTIC COATED TRACER WIRE, T.W.U. 75C 600V OR APPROVED EQUAL.

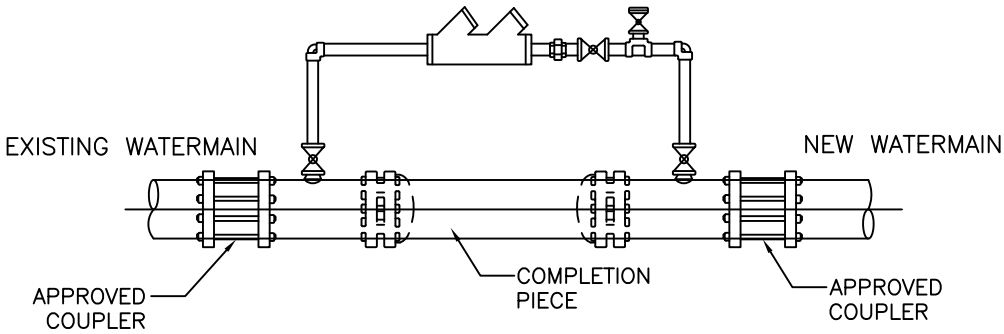
ANODE WIRE SPECIFICATIONS
– AWG #10/7 STRAND COPPER CABLE HAVING RWU–90 INSULATION.

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	WATERPROOFING OF SPLICES	Date: 11/04/22
		Date: Rev. None
		Dwg No. D-05

BACKFLOW PREVENTION VALVE ASSEMBLY



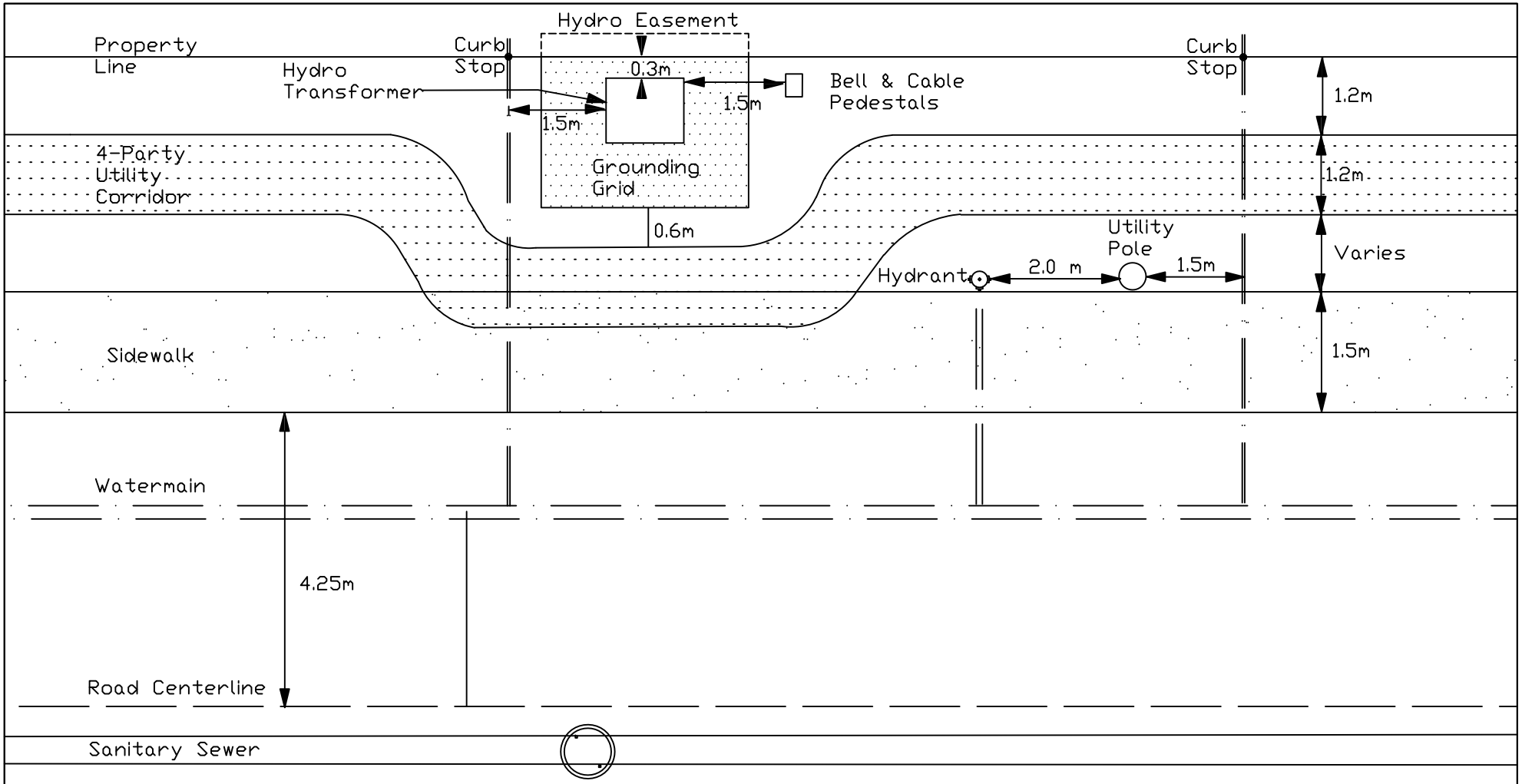
WATERMAIN COMPLETION ASSEMBLY



NOTES:

1. THE BACKFLOW PREVENTION VALVE ASSEMBLY SHALL BE REMOVED DURING WATERMAIN PRESSURE TESTS.
2. THE FINAL CONNECTION OF THE WATERMAIN SHALL BE COMPLETED ONLY AFTER AUTHORIZATION BY THE MUNICIPALITY.
3. THE WATERMAIN SHALL BE DRAINED BY CONTROLLED MEANS. SUFFICIENT TRENCH DEWATERING CAPACITY SHALL BE USED WHEN THE EXISTING AND NEW WATERMAINS ARE DRAINED PRIOR TO THE FINAL CONNECTION TO ENSURE NO BACKFLOW IN EITHER WATERMAIN. DECHLORINATION MUST COMPLY WITH AWWA 651–05 REGULATIONS.
4. THE WATERMAIN SHALL BE CUT BACK TO REMOVE THE TAPPING POINTS OF THE BACKFLOW PREVENTION VALVE ASSEMBLY.
5. ALL NEW PIPING AND APPURTENANCES PLACED IN THE CONNECTION SHALL BE THOROUGHLY DISINFECTED WITH 12% SOLUTION OF SODIUM HYPOCHLORITE OR EQUIVALENT.
6. ON NON–METALIC WATERMAINS, THE TRACING WIRE SHALL BE CONNECTED TO THE COUPLER ONLY IF THE COUPLER IS NOT IN CONTACT WITH A METALIC WATERMAIN OTHERWISE TERMINATE TRACER WIRE WITH AN ANODE.
7. A PHYSICAL SEPARATION MUST BE MAINTAINED AT ALL CONNECTION POINTS OF NEW WATERMAINS TO THE EXISTING SYSTEMS UNTIL BACTERIOLOGICAL TEST HAVE PASSES. A SAMPLING TAP MUST BE PROVIDED AT THE END OF EACH BRANCH OR STUB.
8. ONLY MUNICIPAL STAFF SHALL OPERATE MUNICIPALITY OWNED VALVES.
9. THIS DETAIL IS FOR SCHEMATIC INFORMATION ONLY. THE ACTUAL CONFIGURATION USED MUST SATISFY THE INTENT OF THIS DRAWING.

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	TYPICAL TEMPORARY WATER CONNECTION SCHEMATIC	Date: 11/04/22
		Date: Rev. None
		Dwg No. D-06



NOTES:
1. DIMENSIONS SHOWN ARE MINIMUM ACCEPTABLE CLEARANCE, UNLESS OTHERWISE NOTED
2. 0.5 M VERTICAL SEPARATION IS REQUIRED BETWEEN WATERMAINS AND ALL OTHER UTILITY INSTALLATIONS TO ALLOW FOR PROPER BEDDING OF THE WATERMAIN AND SUFFICIENT CLEARANCE TO CONDUCT REPAIRS

Drawn:	MUNICIPALITY OF NORTH GRENVILLE	Scale: NTS
North Grenville	UTILITY LAYOUT PLAN SECTION	Date: 11/04/22
		Date: Rev. None
		Dwg No. G-01

Appendix 4 – Approved Materials

Municipality of North Grenville
Engineering Standards for Design, Approval, and Construction

August 2022

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

- Maintenance Holes and Catch Basins
- Miscellaneous Metals
- Frames and Covers
- Sewer Pipe and Fittings
- Culverts / Miscellaneous

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

- Valve Boxes and Chamber
- Pipe Materials
- Fire Hydrants
- Valves
- Water Meters
- Tapping Sleeves and Repair Clamps
- Service Tubing and Components
- Cathodic Protection
- Pavement Insulation for Watermains and Sewers

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

MAINTENANCE HOLES AND CATCH BASINS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Grab Bars and Safety Tees	Aluminum		MSU Mississauga –	
Seals and Wall Sleeves for Wall Penetrations	Waterproof, flexible, S/S nuts and bolts		APS – PSI –	Innerlynx Link Seal with Century-Line sleeves
Push-in Gaskets (Flexible Pipe to MH Connections)	Flexible, no metallic straps		Blackthorn – Hamilton Kent – Press-Seal –	Push-in Dura-Seal Tylox HKT-CS Kwik Seal
Cast-in-Place Gaskets (Flexible Pipe to MH Connections)	Flexible, no metallic straps		Blackthorn – Hamilton Kent – Press-Seal –	Dura-Seal III, III-NV Tylox, FT, XT, Dual Seal II Econo Seal
Cast-in-Place Gaskets (Concrete Pipe to MH connections)	Flexible, no metallic straps		Hamilton Kent –	Tylox WT+
Connectors (Concrete and Flexible pipe to MH connections)	Flexible, 316 S/S straps where applicable	Up to 825 mm diameter	NPC/Trelleborg – Press-Seal –	Kor-N-Seal II (316 S/S special order required, wedge style) PSX Direct Drive (316 S/S special order)
Waterproof Seal for Rigid Pipe Penetrations	Flexible, hydrophilic		SIKA –	Hydrotite SS, Hydrotite DSS, Leakmaster sealant
Non-Shrink Grout for Around MH Openings	Non-metallic, non-corrosive		SIKA –	212 HP
Gaskets for MH Joints	Isoprene, for round precast concrete MH		Hamilton Kent – Press-Seal –	Tylox Superseal (white or green stripe) RFS
Gaskets for MH Joints	Nitrile, for round precast concrete MH joints		Hamilton Kent – Press-Seal –	Tylox Superseal (orange or yellow stripe) RFS Nitrile For applications with hydrocarbon contaminated soils.
Sealant for Non- Circular Precast Concrete Structure Joints	controlled expansion, butyl rubber based with hydrophilic compounds	W14.1	Conseal – SIKA –	CS-231 Waterstop Hydrotite CJ
Waterproofing Membrane	Rolls for large surfaces	W14.1	Sealtight – SIKA –	Mel-Rol Sikadur Combiflex SG

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

MAINTENANCE HOLES AND CATCH BASINS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Round MH Structures	Reinforced concrete,OPSS 1351, OPSD 701.010,	1200 mm diameter	Forterra – M-Con Products – Pre-qualified CPCQA members	With or without drop pipe.
Round MH Structures	Reinforced concrete, OPSS 1351, OPSD 701.011, monolithic base	1500 mm diameter	Forterra – M-Con Products – Pre-qualified CPCQA members	With or without drop pipe.
Round MH Structures	Reinforced concrete, OPSS 1351, OPSD 701.012, monolithic or slab base	1800 mm diameter	Forterra – M-Con Products – Pre-qualified CPCQA members	With or without drop pipe.
Round MH Structures	Reinforced concrete, OPSS 1351, 701.013, slab	2400 mm diameter	Forterra – M-Con Products – Pre-qualified CPCQA members	With or without drop pipe.
Round MH Structures	Reinforced concrete, OPSS 1351, 701.014, slab	3000 mm diameter	Forterra – M-Con Products – Pre-qualified CPCQA members	With or without drop pipe.
Round MH Structures	Reinforced concrete, OPSS 1351, 701.015, slab	3600 mm diameter	Forterra – Pre-qualified CPCQA members	With or without drop pipe.
Box MH Structures	Reinforced concrete, OPSS 1351, monolithic or slab base	All sizes	M-Con Products – Pre-qualified CPCQA members	With or without drop pipe.
Catch Basin Structures	Reinforced concrete, OPSS 1351, OPSD 705.010, 705.020 Alternate B, for mainline applications	All sizes	Forterra – M-Con Products – Pre-qualified CPCQA members	

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

MAINTENANCE HOLES AND CATCH BASINS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Catch Basins Structures and Tees (Ditches and Rear Yard Applications)	OPSS 1351; reinforced concrete, PVC, or HDPE	All sizes	Forterra – M-Con Products – Pre-qualified CPCQA members ADS – Armtec – Hancor – Ideal – Nyloplast – Soleno –	Boss series Ditch and rear yard drainage use only. Not to be used on sewer mains.
Vortex Inducing Drop Structure Inserts	For drop pipe insert applications over 6	All sizes	IPEX –	Vortex Flow Inserts
Internal Drop Pipe Tees	With flapper	All sizes	IPEX –	

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

MISCELLANEOUS METALS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Wall Anchors for Landings	Heavy duty adhesive anchors		Hilti –	HVA
Landing Gratings and Ladders	Aluminum, FRP, or S/S		Borden – Fibergrate – MSU Mississauga –	B#8 FRP Ladders and Platforms
Sewer Plugs	For plugging abandoned sewer services		Deblo –	Deblo Sewer Plug

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

FRAMES AND COVERS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Square Surface Inlet Catch Basin Covers	OPSS 1850		Bibby Ste. Croix – East Jordan – Sigma –	For replacement on existing square frames only.
Rectangular CB Frames and Covers	OPSS 1850		Bibby Ste. Croix – Cedar Infrastructure – East Jordan – Sigma –	For replacement on existing round CB structures only.
Surface Inlet CB Frame and Round Cover	OPSS 1850, fish style		Bibby Ste. Croix – Cedar Infrastructure – Domcast – East Jordan – Sigma –	
Self Leveling Surface Inlet CB Frame and Cover	For OPSD 705.010 or 600 mm round CB's, OPSS 1850, fish style		Suatac –	S24C-F, S24CB, S24D-SQ (adapter for OPSD 705.010 boxes)
Self Leveling Surface Inlet CB Frame and ADS Compliant Cover	For OPSD 705.010 or 600 mm round CB's, OPSS 1850, modified fish with openings meeting ADS requirements		Suatac –	S24C-A, S24CB, S24D-SQ (adapter for OPSD 705.010 boxes)
Curb Inlet CB Frame and Cover	For OPSD 705.010 boxes, OPSS 1850		Bibby Ste. Croix – Domcast – East Jordan –	
Curb Inlet CB Maintenance Hole Frame and	For maintenance hole structures, OPSS 1850		Bibby Ste. Croix – East Jordan –	

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

FRAMES AND COVERS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Sanitary Maintenance Hole Covers	OPSS 1850, 14-20 mm covers		Bibby Ste. Croix – Cedar Infrastructure – Domcast – East Jordan – Govind Steel – Sigma – PCHG – Star Pipe Products – Suatac –	 201314 MH8006OT S30C-SA
Storm Maintenance Hole Covers	OPSS 1850, 14-20 mm covers		Bibby Ste. Croix – Cedar Infrastructure – Domcast – East Jordan – Govind Steel – Sigma – PCHG – Star Pipe Products – Suatac –	 201313 MH8006OT-1 S30MC-ST
Maintenance Hole Lid Plugs	Rubber, 25 mm diameter, watertight		Cretex – Or plug supplied by lid manufacturer	Style 1
Regular Maintenance Hole Frames	OPSS 1850		Bibby Ste. Croix – Cedar Infrastructure – Domcast – East Jordan – Govind Steel – Sigma –	
Watertight Sanitary MH Frame and Covers	Watertight, secured gasket	Per manufacturer's drawings	East Jordan –	Campression 41420049W01

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

FRAMES AND COVERS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Watertight Storm MH Frame and Covers	Watertight, secured gasket	Per manufacturer's drawings	East Jordan –	Campression 41420050W01
Self Leveling Maintenance Hole Frame and Guide Frame Units	MS-14.2, OPSS 1850	Per manufacturer's drawings	Bibby Ste. Croix – East Jordan – PCHG – Star Pipe Products – Suatac –	Autostable C-54M 3028, AJ745 201311 MH8006R, MH8006G S30MC Frames and covers are not interchangeable between manufacturers.
Frame and Covers for Raised Maintenance				Not to be in vehicle, cyclist, or pedestrian path of travel.
Retrofit Trench Drains (For Storm Drainage Channels)	HDPE or polymer concrete, for storm drainage channels	All sizes	ABT – ADS – Zurn Industries –	Polydrain Duraslot (150 mm slot height) Z886 Perma-Trench Retrofit applications by City only, not for use in roadway.
Retrofit Trench Drain Grates (For Storm Drainage Channels in Roadway)	Removable and fixed ductile iron slotted grates, long opening perpendicular to traffic, H-20 loading, end grate removable for flushing and all others		ABT – ADS – Zurn Industries –	Polydrain 500 series Duraslot (150 mm slot height) Z886 HDD, HR Retrofit applications by City only.

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

SEWER PIPE AND FITTINGS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Reinforced Concrete Sewer Pipe	OPSS 1820, round	All diameters	Manufacturers pre- qualified by CPCQA	
Reinforced Concrete Sewer Pipe with Cored Tees	OPSS 1820, gravity systems, round, maximum branch size 375 mm	All diameters	Forterra – M-Con Products –	
Prestressed Concrete Cylinder Pipe	AWWA C301	All diameters	Decast – Forterra –	
Reinforced Concrete Non- Cylinder Pipe	AWWA C302, joints rated at 55 PSI minimum	All diameters	Decast – Forterra –	
Pretensioned Concrete Cylinder Pipe	AWWA C303	All diameters	Forterra –	
PVC Sewer Pipe	CSA B182.2, CSA B182.7, OPSS 1841, SDR 28 or SDR 35, regular and nitrile gaskets	All diameters	Diamond – IPEX – NAPCO Pipe – National Pipe/Plastics – Next Polymers – Northern Pipe –	Diamond PVC Sewer Ring-Tite, Enviro-Tite Gasketed Sewer Pipe DURALOC For applications where minimum separation requirements are met.
PVC Sewer Fittings	PSM PVC, CSA B182.2, OPSS 1841, SDR 28 or SDR 35, regular and nitrile gaskets	All diameters	Diamond – Galaxy Plastics – Harco – IPEX – NAPCO Pipe – Next Polymers – Northern – Pro-Line –	Diamond PVC Sewer Fittings PVC Gasketed Sewer Fittings . Ring-Tite Gasketed Sewer Fittings DURALOC . PVC Gasketed Sewer Fittings Non-pressurized applications on sewer

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

SEWER PIPE AND FITTINGS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Sewer Pipe (Applications with Inadequate Separation)	OPSS 1841, with joints capable of 345 kPa minimum, regular and nitrile gaskets; PSM PVC, CSA B182.2/CSA 182.7, or CSA B137.3 or AWWA C302	All diameters	Decast – Forterra – IPEX – NAPCO Pipe – . . Next Polymers – . . Northern –	AWWA C302 AWWA C302 Ring-Tite, Series Pipe, Enviro-Tite Gasketed Sewer Pipe, IPS Series Pressure Pipe AQUALOCK PVC Series Pipe, DURALOC PVC 1120 Series 160, 200 For parallel common trench applications with inadequate horizontal or vertical separation. Blue watermain pipe is not acceptable.
Sewer Pipe (River crossings and HDD Applications)	PVC or HDPE	All diameters	Infra Pipe Solutions – IPEX – . NAPCO Pipe – Performance Pipe –	Sclairpipe Fusible, Terrabrute CR (300 mm maximum dia.) Cobra Lock (300 mm maximum dia.) Driscoplex 4000 PVC shall be green or white. HDPE shall have green stripes.
PVC Forcemain Pipe	CSA B137.3, SDR 21, 26, 32.5, or 41, regular and nitrile gaskets	All diameters	IPEX – NAPCO Pipe – Next Polymers – Northern – 	Series Pipe IPS Series Pressure Pipe AQUALOCK PVC Series Pipe PVC 1120 Series 160, 200 Blue watermain pipe is not acceptable.
PVC Forcemain Fittings	PVC, CSA B137.3, SDR 21, 26, 32.5, 41, regular and nitrile gaskets	All diameters	IPEX – NAPCO Pipe – Next Polymers –	Cycle Tough 4000 IPS Series Pressure Pipe AQUALOCK PVC Series Pipe Blue watermain fittings are not acceptable.
HDPE Forcemain Pipe	OPSS 1842		CPChem – Imperial – Infra Pipe Solutions –	Driscoplex 4000, Performance Pipe Thermolene Schlairpipe Blue striped pipe is not acceptable.

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

SEWER PIPE AND FITTINGS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
HDPE Forcemain Fittings	Electrofusion, butt, socket, sidewall, and MJ adapter		GF Piping Systems – Approved HDPE Pipe Manufacturers	
Concrete Forcemain Pipe	AWWA C301, AWWA C302, or AWWA C303		Decast – Forterra –	(C301 and C302 only)
Sewer Service Pipe	PSM PVC, CSA B182.2, OPSS 410, OPSS 1841, SDR 28, regular and nitrile gaskets	100, 135, and 150 mm	Diamond – IPEX – NAPCO Pipe – National – Next Polymers – Northern	Diamond PVC Sewer Ring-Tite, Enviro-tite Royal Seal, Gasketed Sewer Pipe . DURALOC
Sewer Service Pipe Fittings	22.5º radius bends, controlled settlement joints; PSM PVC CSA B182.2 OPSS 410 and 1841, SDR 28, regular and nitrile	100, 135, and 150 mm	IPEX –	Ring-Tite
Couplings for Sewer Service Pipe (Connections to Existing Services)	ASTM C 425, ASTM C 1173, 316 S/S clamping bands, EPDM, SBR, and nitrile rubber		Fernco – Mission –	Flexible Couplings (316 S/S) Flex-Seal (316 S/S) Rehab projects only.
Corrugated HDPE Pipe	OPSS 1840, 170 kPa minimum	150 mm	ADS – Armtec – Ideal – Soleno –	Single-wall corrugated Big “O” Tubing, Boss 1000 Drainage Tubing, Challenger 1000 Drainage Pipe, Solflo For road subdrainage use. Not for sewer main use.

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

SEWER PIPE AND FITTINGS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Interior Smooth Walled HDPE Pipe and Fittings	Polyethylene CSA B182.8 or CSA 182.6, OPSS 1840, 320 kPa minimum	100-900 mm	ADS – Armtec – Ideal – Soleno –	N-12 Boss 2000, Boss Poly-Tite Challenger 2000, 3000 Solflo Max For ditch pipe, rear yard, and landscape drainage applications. Not for sewer main use.
Rubber Gasketed Inserts	Flexible service connections for reinforced concrete pipe	All sizes	Galaxy – IPEX – Uroplast –	Core-Bell Concrete Adapter PVC CSA B182.1 saddle Universal, old style curved gasket only
Sealant (for bell insert type service connections)	Watertight, thermoplastic, elastomeric, and synthetic resins, for seal between service pipe bells and host concrete pipe		Tapecoat -	TC Moldable Sealant

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

CULVERTS AND MISCELLANEOUS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Round Precast Culvert	Reinforced concrete, OPSS 1820		Manufacturers prequalified by CPCQA	
Box Precast Culvert	Reinforced concrete OPSS		Manufacturers prequalified by CPCQA	
HDPE Culverts Dual Wall Pipe	OPSS 1840, OPSD 806.02, CSA B182.8, 320 kPa or greater, soil-tight or water-tight joints	500-900 mm	ADS – . Armtec – Ideal – Soleno –	N-12 WT IB, N-12 ST IB (both for CSA 320 kPa) Boss 1000, 2000 Challenger 2000, 3000 Solflo, Solflo Max
Closed Profile Wall HDPE Culvert Pipe or Liner	OPSS 1840, ASTM 894-98, OPSD 806.021, welded joints	500 to 760mm (RSC160), 840 to 2130mm (RSC 250), 2290 to 3050mm (RSC 400)	Infra-Pipe Solutions –	Weholite
Corrugated Steel Round Culvert	Aluminized type 2, CSA G401, OPSS 1801, OPSD 805.010	2.0 mm thick for under 600mm dia., 2.8 mm for 600 to 1000 mm. dia., 3.5 mm for over	Armtec – Atlantic Industries – Canada Culvert –	Hel-Cor Corrugated Steel Pipe Steelcor Pipe
Corrugated Steel Round Culvert	Polymer laminated, CSA G401, OPSS 1801 ASTM A929, ASTM A742, OPSD 805.010	2.0 mm thick for under 600 mm dia., 2.8 mm for 600 to 1000mm dia., 3.5 mm for over 1000 mm	Atlantic Industries – Canada Culvert –	Corrugated Steel Pipe Steelcor Pipe

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

CULVERTS AND MISCELLANEOUS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Corrugated Steel Pipe Arch Culvert	Aluminized type 2 CSA G401, OPSS 1801, OPSD 805.020	2.0 mm thick for under 600 mm dia., 2.8 mm for 600 to 1000 mm dia., 3.5 mm for over 1000 mm	Armtec – Atlantic Industries – Canada Culvert –	Hel-Cor Corrugated Steel Pipe Steelcor Pipe
Corrugated Steel Pipe Arch Culverts	Polymer laminated, CSA G401, OPSS 1801, ASTM A929, ASTM A742, OPSD 805.020	2.0 mm thick for under 600 mm dia., 2.8 mm for 600- 1000 mm dia., 3.5 mm for over 1000 mm	Atlantic Industries – Canada Culvert –	Corrugated Steel Pipe Steelcor Pipe
Spiral Rib Round Pipe	Aluminized type 2, CSA G401, OPSS 1801	2.8 mm thick	Armtec – Atlantic Industries –	Ultra Flo Hi-Flo (temporary pending certification)
Spiral Rib Round Pipe	Polymer laminated, CSA G401, OPSS 1801, ASTM A929, ASTM A742	2.8 mm thick	Armtec – Atlantic Industries –	Ultra Flo Hi-Flo (temporary pending certification)
Spiral Rib Arch Pipe	Aluminized type 2, CSA G401, OPSS 1801, OPSD	2.8 mm thick	Armtec – Atlantic Industries –	Ultra Flo Hi-Flo (temporary pending certification)
Spiral Rib Arch Pipe	Polymer laminated CSA G401, OPSS 1801, ASTM A929, ASTM A742, OPSD	2.8 mm thick	Armtec – Atlantic Industries –	Ultra Flo Hi-Flo (temporary pending certification)
Precast Concrete Headwalls	Alternate to OPSD 804.030	Pipe or culvert diameter 300-900 mm	M-Con Products – Forterra –	E-1 G-4

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

CULVERTS AND MISCELLANEOUS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Precast Concrete Headwalls	Alternate to OPSD 804.020	Pipe or culvert diameter 975-1500 mm	M-Con Products –	E-2
Precast Concrete Headwalls	Alternate to OPSD 804.040		M-Con Products – Forterra –	E-3 G1, G2, G3
1 Inlet Control Devices with Orifice and Trap	Slide type for OPSD 705.010 square CBs	83 mm minimum orifice dia.	Canadian Control Devices – CANUS Plastics – IPEX – Pedro Plastics –	. CCD-1FP, CCD-2FA; with trap SW Tech Odor Trap Square CB Tempest HF SWR-1 Applications in the ROW only.
2 Inlet Control Devices with Orifice and Trap	Slide type for 600 mm diameter round CBs	83 mm minimum orifice dia.	Canadian Control Devices – CANUS Plastics – IPEX –	CCD-1FP, CCD-2FA; with adaptor and trap SW Tech Odor Trap Round CB Tempest HF with round adapter plate
3 Inlet Control Devices with Vortex and Trap	Slide type for OPSD 705.010 square CBs	Vortex type, minimum flowrate 6 l/s	ACG/Hydro Intl. – CANUS Plastics – IPEX – J. Meunier Hydrovex – Mosbaek –	Reg-U-Flo Vortex Valve: SMXH SW Tech Vortex Square CB Tempest LMF FV-VHV-1-O CEV
4 Inlet Control Devices with Vortex and Trap	Slide type for 600mm round CBs	Vortex type, minimum flowrate 6 l/s	ACG/Hydro Intl. – . CANUS Plastics – IPEX – J. Meunier Hydrovex – Mosbaek –	Reg-U-Flo Vortex Valve: SMXH with adaptor SW Tech Vortex Round CB Tempest LMF with round adapter plate FV-VHV-1-O with Adaptor CEV with adapter
5 Plug Type Inlet Control Devices with Orifice and without Trap	Plug or slide type for round or square CB's, diamond with slot sizes A to F, round 83, 94, 102, 108, 127, 152 and, 178 mm orifices	83 mm minimum dia.	Canadian Control Devices – . CANUS Plastics – . IPEX – . Pedro Plastics –	CCD-1FP, CCD-2FA; with adaptor for round CBs SW Tech Round and Diamond with Slot Orifices, Sliding Plate and plug types, for square and round catch basins MHF, MHF with round adapter plate mounting (Round Orifice)

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

CULVERTS AND MISCELLANEOUS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
6 Inlet Control Devices without Trap	Vortex plug type for OPSD 705.010 square CBs	Minimum flowrate 6 l/s	ACG/Hydro Intl. – Hydrovex –	Reg-U-Flo: SH, SXH VHV, SVHV Replacement in ROW only.
7 Inlet Control Devices with Orifice and Trap	Slide type for 600mm round CBs without sump	83 mm minimum dia.	CANUS Plastics – IPEX –	SW Tech Shallow Sump (SFC) Round CB
8 Inlet Control Devices with Orifice and Trap	Slide type for OPSD 705.010 square CBs without sump	83 mm minimum dia.	CANUS Plastics – IPEX –	SW Tech Shallow Sump (SFC) Square CB
9 Inlet Control Devices with Vortex and Trap	Slide type for 600mm round CBs without sump	Minimum flowrate 6 l/s	CANUS Plastics –	SW Tech Shallow Sump Vortex (SSV) Round CB
10 Inlet Control Devices with Vortex and Trap	Slide type for OPSD 705.010 square CBs without sump	Minimum flowrate 6 l/s	CANUS Plastics –	SW Tech Shallow Sump Vortex (SSV) Square CB
Concrete Adjustment Units	Reinforced Concrete , OPSS 1351; for curb inlet CB's	All sizes	Manufacturers prequalified by CPCQA	Curb inlet catchbasin applications only
Sealant for HDPE Units	Waterproof, butyl rubber, ASTM C- 990, AASHTO M-198	Caulk or rope	Conseal – Hamilton Kent – Press-Seal –	CS-102 Kent Seal Butyl Sealant Pro-Stik, EZ-Stik
Adhesive for EPP and EPS Units	Polyether, ASTM C920, type S, grade NS, class 35	Caulk or rope	Chem Link – UGT –	M-1 Structural Adhesive Secure N Seal

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

CULVERTS AND MISCELLANEOUS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Non-Woven Geotextile (Separation or Drainage Asphalt Overlay)	Non-woven class I, grab tensile 445N minimum, A.O.S. 0.19 to 0.212 mm, OPSS 1860		Armtec – Carthage – Contech – Layfield Geo – Maccaferri – Mirafi – Propex/SI – SRW – Terrafix – Thrace-Linq – Hanes Geo – Nilex – Soleno –	160 FX40HS C40NW LP 4 Mactex MX140 140NC Geotex 401 NW4 270R 130EX N04.5 4546 TX-70
Non-Woven Geotextile (Separation or Drainage)	Non-woven class II, grab tensile 660N minimum, A.O.S. 0.15 to 0.212 mm, OPSS 1860		Armtec – Carthage – Hanes Geo – Layfield Geo – Maccaferri – Mirafi – Nilex – Propex/SI – Soleno – SRW – Terrafix – Thrace-Linq –	200 FX 50HS N06 LP 6 Mactex MX225 160N 4551 Geotex 501 TX-170 NW6 360R 150EX

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

CULVERTS AND MISCELLANEOUS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Woven Geotextile (Separation or Stabilization)	Woven class I geotextile, grab tensile 800N minimum, A.O.S. 0.300 to 0.425 mm, OPSS 1860		Armtec – Carthage – Hanes Geo – Layfield Geo – Maccaferri- Mirafi – Nilex – Propex/SI – Soleno – SRW – Terrafix – Thrace-Ling –	835 FX-55 Terratex GS LP 200 Mactex MXW9 500X 2002 Geotex 200ST 2002W SS5 24-15 GTF 200S
Woven Geotextile (Separation or Stabilization)	Woven class II, geotextile grab tensile 1100 minimum, A.O.S. 0.300 to 0.425 mm, OPSS 1860		Armtec – Carthage – Hanes Geo – Layfield Geo – Maccaferri – Mirafi – Nilex – Propex/SI – Soleno – SRW – Terrafix – Thrace-Ling –	845 FX 65 Teratex HD LP 315 Mactex MXW13 550X 2004 Geotex 250ST 2004W SS6 200W GTF 250
Tactile Walking Surface Indicators	MS-23.2	All sizes and radii	ADA Solutions – Advantage Cast Iron – Bibby Ste. Croix – East Jordan – Ironped – Neenah – Star Pipe Products –	Irondome . Safety Detection System Duralast

APPROVED SEWER AND MISCELLANEOUS PRODUCTS LISTING

CULVERTS AND MISCELLANEOUS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Pothole Patching Products	Hardens using pressure from traffic, all season, all weather, 2-year shelf life minimum		Perma Patch –	Perma Patch
Bicycle Counter Handhole Boxes & Covers	Polymer Concrete Open Bottom Custom Lid	300 x 300 x 300 mm	Channell – Old Castle/Synertech –	GLB121212 S1212B12FA, S1212HFAOA01
Flexible Bollards for Cycling Lanes	Light, flexible, reflective, UV protected; post style, colour, size, sheeting grade, base and anchors as specified	As specified	Develotech – IRS –	Cyclo-Zone Delineator Tuff Post
Traffic Loop Sealant			3M –	5000

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

VALVE BOXES AND CHAMBERS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Valve Boxes	130 mm slide type, with floating / adjustable tops and 1568 mm bottoms resting on guide plates	130 mm diameter, 2400 mm assembly length	Bibby Ste. Croix –	7353, 7347, 7374, 7375, 7339, 738B, 738C
			Domcast –	DF8560, DF8530, DF8512, DF8518, DF8507, DF8514, DF8502D
			Sigma –	VB-5262, VB-5401, VB5512, VB-5518, VB4500, VB9191-D, VB6500-D
			Star Pipe Products –	VB514-60B, VBDF514D, VBDF514EX12, VBDF514EX18, VBDFGP, VB514APT, VB514APTL

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

PIPE MATERIALS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Ductile Iron Pipe	AWWA C-150, special thickness class	100-400 mm	Canada Pipe – McWane Ductile –	To be supplied with end caps and tamper evident seals.
PVC Pipe	AWWA C-900, CSA B137.3, DR 18	100-400 mm,	IPEX – . NAPCO Pipe – National Pipe & Plastics- Next Polymer –	Blue Brute (100-300 mm), Centurion (400 mm) . . Aqualoc To be supplied with end caps and tamper
PVCO Pipe	AWWA C-909, CSA B137.3, pressure class 235	100-400 mm	IPEX –	Bionax To be supplied with end caps and tamper evident seals.
Joint Lubricant	NSF 61, for gasketed pipe		Dymar Chemicals- Whitlam Plumb Pro - Or product specified by pipe manufacturer meeting NSF 61	Dymalube 10 Blue Lube
Restrained Coupling for High Deflection (Connections to Existing Watermains) *(Municipal use only)*	Two bolts, wide range for DI, CI, and PVC	100-300 mm	Krausz –	Hymax Grip
Straight Couplings for High Deflection Connections to Existing Watermains *(List for Municipal supply tenders)*	Two bolts, AWWA C-219, for DI, CI, and PVC pipe	100-600 mm	Krausz – Romac –	Hymax Coupling, 2000 Macro HP Extended Range Coupling
Gaskets	AWWA C-111, NSF 61; SBR, EPDM, NBR, or FKM; gasket material to be clearly identified, for mechanical joints and flanges		A.R. Thomson Group – Durlon – Garlock – Spec. Rubber Products Star Pipe Products – US Pipe – . Or products specified by fitting manufacturer meeting AWWA C-111 and	TORUSEAL SBR, EPDM, NBR, FKM 7910 NBR 3505, 3760-U, Stress Saver XP SBR, EPDM, NBR SBR Full Face Flange-Tyte, and Tyton SBR, Neoprene, EPDM, NBR, FKM

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

FIRE HYDRANTS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Hydrants	Three-way compression, AWWA C-502	1980-2850 mm buried length	AVK – Clow Canada – Mueller –	2780 Nostalgic Heritage Brigadier M-67B Super Century
Hydrant Markers	Polycarbonate, UV protected, nozzle mount, yellow body	1219 mm long	Flexstake – Lakeshore Hydrant–	C804

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

VALVES				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Gate Valves	Resilient seat or wedge, AWWA C-509	100-300 mm	AVK – Clow Canada – M&H – Mueller – Watts –	Series 45 Full Wall F6100 4067 A-2362 NRS
Tapping Valves	Resilient seat or wedge, AWWA C-509, MJ x Flange	100-300 mm	AVK – Clow Canada – Mueller –	Series 45 Full Wall F6114 T-2362-19

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

WATER METERS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Water Meters	Positive Displacement, AWWA C-700	20, 25, 40, 50 mm	**Neptune Technology –**	**T10** 25 mm and smaller shall have non-ferrous frost bottoms.
Water Meters	Turbine, AWWA C-701	75, 100, 150 mm	Neptune Technology –	Nep-Turb
Water Meters	Compound, AWWA C702	75, 100, 150, 200 mm	Neptune Technology –	Nep-Tru/Flo
Water Meters	Fire Service, AWWA C703	150, 200, 250 mm	Neptune Technology –	HP Protectus III

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

TAPPING SLEEVES & REPAIR CLAMPS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Tapping Sleeves	Epoxy coated or S/S sleeve with all stainless fasteners, for CI/DI and PVC	100-400 mm	Alex Ayoutte – Clow Canada – Ford Meter Box – Smith-Blair – Mueller – Robar – Total Piping Solutions –	. TS-100 FTS No. 622 H-620 6906 Triple Tap (100-300 mm)
Tapping Sleeves	Stainless steel; for CI, DI, and PVC pipe	100-400 mm	Total Piping Solutions –	Triple Tap (100-300 mm)
Repair Clamps	Stainless steel, single band	150-300 mm	Clow Canada – Ford Meter Box – Robar – Smith-Blair –	D76 R F1-xxx-16, FS1-xxx-16 5616 Type 261 Minimum clamp length 400 mm.
Repair Clamps	Stainless steel, double band	75-127mm	Mueller – Robar – Smith-Blair –	500, 510, 520, 530 5626 Type 262 Minimum clamp length 400 mm.

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

SERVICE TUBING & COMPONENTS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Service Saddles	For PVC pipe, stainless steel, single band, double bolt, widths	50-300 mm	Cambridge Brass – Ford Meter Box – Robar – Romac – Smith-Blair –	8407 FS3138 2616 DB 305, 306 376
Service Saddles with Integrated Main Stop	For PVC pipe, stainless steel, single band, double bolts		Cambridge Brass –	8417
Service Posts	Telescopic, MW-19.8	19-25 mm, 2350-2650 mm length	Clow Canada/Bibby Ste. Croix/Trojan Industries – Mueller – PCHG – Star Pipe Products –	. D-1, D-1P, VSB 1 A-726 D1 12D1 - OT
Service Posts	Telescopic, MW-19.8	38-50 mm, 2350-2650 mm length	Clow Canada /Bibby Ste. Croix/Trojan Industries – Mueller – PCHG – Star Pipe Products –	. VSB 2 A-728 D2 12D2 - OT
Main Stops	Standard AWWA inlet x compression, plug or ball valve	19 mm	Cambridge Brass – Ford Meter Box – Mueller –	301NL-A3HE3, 302NL-A3HE3 F1000-3TW-Q-NL, FB1000-3TW- Q-NL H-15008NPB, B-25008NPB; both c/w elec. connection
Main Stops	Standard AWWA inlet x compression, plug or ball valve	25 mm	Cambridge Brass – Ford Meter Box – Mueller –	301NL-A4HE4, 302NL-A4HE4 F1000-4TW-Q-NL, FB1000-4TW- Q-NL H-15008NPB, B-25008NPB; both c/w elec. connection
Main Stops	Standard AWWA inlet x compression, plug or ball valve	38 mm	Cambridge Brass – Ford Meter Box – Mueller –	301NL-A6HE6, 302NL-A6HE6 FB1000-6TW-Q-NL H-15008NPB, B-25008NPB; both c/w elec. connection

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

SERVICE TUBING & COMPONENTS

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Main Stops	Standard AWWA inlet x compression, plug or ball valve	50 mm	Cambridge Brass – Ford Meter Box - Mueller –	301NL-A7HE7, 302NL-A7HE7 FB1000-7TW-Q-NL H-15008NPB, B-25008NPB; both c/w elec. connection
Curb Stops	Compression x compression, ball valve	19mm	Cambridge Brass – Ford Meter Box – Mueller –	202NL-H3HE3 B44-333TW-Q-NL B-25209NPB with elec. connection
Curb Stops	Compression x compression, ball valve	25mm	Cambridge Brass – Ford Meter Box – Mueller –	202NL-H4HE4 B44-444TW-Q-NL B-25209NPB with elec. connection
Curb Stops	Compression x compression, ball valve	38mm	Cambridge Brass – Ford Meter Box – Mueller –	202NL-H6HE6 B44-666TW-Q-NL B-25209NPB with elec. connection
Curb Stops	Compression x compression, ball valve	50 mm	Cambridge Brass – Ford Meter Box – Mueller –	202NL-H7HE7 B44-777TW-Q-NL B-25209NPB with elec. connection
Couplings	Compression x compression	19 mm	Cambridge Brass – Ford Meter Box – Mueller –	118NL-H3H3 C44-33-NL, C44-33-Q-NL H-15403NPB
Couplings	Compression x compression	25 mm	Cambridge Brass – Ford Meter Box – Mueller –	118NL-H4H4 C44-33-NL, C44-33-Q-NL H15403NPB
Couplings	Compression x compression	38 mm	Cambridge Brass – Ford Meter Box – Mueller –	118NL-H6H6 C44-66-NL, C44-66-Q-NL H15403NPB
Couplings	Compression x compression	50 mm	Cambridge Brass – Ford Meter Box – Mueller –	118NL-H7H7 C44-77-NL, C44-77-Q-NL H15403NPB
Water Service Tubing (New Installations or Rehab)	Copper type K, AWWA C-800, certified ASTM B88, CTS	19-50 mm	Cerro – Great Lakes Copper –	

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

SERVICE TUBING & COMPONENTS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Water Service Tubing (New Installations Only)	PEX, AWWA C-904, SDR 9	19-50mm	IPEX – Rehau –	Blue 904 Municipex

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

CATHODIC PROTECTION				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Magnesium Anodes	MW19.9, M-9- 14, M-17-20, M-32-22	13 kg, 22 kg, 50 kg	Anode Casting Corrpro (Canada) – Dow – Exothermal – Galvotec – US Magnesium – Packaging Bren Tech. – Corrosion Services – ICCC – Integrity Anode Corp – Maple Agencies (Exothrml)	
Zinc Anodes	MW-19.9, Z-12- 24, Z-24-48	13 kg, 25 kg	Anode Casting Bren Tech – Canada Metal (Western) – Corrpro Canada – Exothermal – Integrity Anode Corp – Packaging Bren Tech – Canada Metal (Western) – DC Corrosion Corporation – ICCC – Integrity Anode Corp – Maple Agencies (Exothrml)	
Ground Clamps and Header Wires	UL467 listed for direct burial, solid bronze, for connecting anodes to copper	13-38 mm	Blackburn –	JD (13-25 mm)

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

CATHODIC PROTECTION

PRODUCT	TYPE	SIZE	MANUFACTURER	MODEL NUMBER/NOTES
Ground Clamps and Header Wires	UL467 listed for direct burial, solid bronze, for connecting anodes to copper services	32-50 mm	Blackburn –	J2D
Thermite Welders	Connections for CI and DI pipe	#10/7 stranded wire to 100 mm diameter and larger	Erico – Thermoweld –	CAHBA-IG M156
Thermite Welders	Connections for steel pipe	#10/7 stranded wire to 100 mm diameter and larger	Erico – Thermoweld –	CAHAA-1G M100
Thermite Powder Cartridges	For CI and DI		Erico – Thermoweld –	CA 25XF19 25PCI
Thermite Powder Cartridges	For steel		Erico – Thermoweld –	CA 15 15P
Thermite Weld Protective Barriers			Tapecoat/Royston – Thermoweld –	Handy Cap IP Thermocap
Test Stations (Flush Mounted)			Cott Manufacturing – Handley Industries –	Street Fink 4” Test Stations
Test Stations (Post Mounted)			Cott Manufacturing – Handley Industries –	Big Fink 4” Test Stations
Petrolatum Primer	AWWA C-217		Denso – ICCC/Rustrol – Petro Coating Systems – SCAPA – Trenton –	Denso Paste Petro Wrap Paste Petro Primer Renwrap 327 Primer Wax-Tape Primer

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

CATHODIC PROTECTION				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Petrolatum Tape	AWWA C-217		Denso – ICCC/Rustrol/Trenton – Petro Coating Systems – SCAPA –	Densyl Tape Petro Wrap LT Anti-Corrosion Tape, #1 Wax Tape PetroTape, Petro Overwrap Tape Renwrap 330, 330L Joint WrapTape, 355-15 Outerwrap
Petrolatum Molding Mastic			Denso – ICCC/Rustrol – Petro Coating Systems – SCAPA –	Profiling Mastic Petro Wrap Moulding Mastic PMULST Renwrap 331 Moulding Tape
Flange Isolation Kits	Full face gasket, full length sleeve, isolation washers		APS – Central Plastics – GPT (PSI) –	

APPROVED WATER DISTRIBUTION PRODUCTS LISTING

PAVEMENT INSULATION FOR WATERMAINS AND SEWERS				
PRODUCT	**TYPE**	**SIZE**	**MANUFACTURER**	**MODEL NUMBER/NOTES**
Extruded Grade A Polystyrene Insulation Boards	Grade A, 275 kPa compressive strength minimum, OPSS 1605, ASTM C578 Type VI	600 mm x 2400 mm, minimum 50 mm thick	Dow Chemical – Owens Corning Canada –	HI 40 Foamular 400
Extruded Grade B Polystyrene Insulation Boards	Grade B, 400 kPa compressive strength minimum, OPSS 1605, ASTM C578 Type VII	600 mm x 2400 mm, minimum 50 mm thick	Dow Chemical – Owens Corning Canada –	HI-60 Foamular 600
Polystyrene Board Adhesive			Dow Chemical – Or products specified by insulation board manufacturers	All-Weather Adhesive
Factory Applied Polyurethane Foam	Per manufacturer's specifications	Custom fabricated	Urecon –	