DESIGN AND CONSTRUCTION STANDARDS

FOR

THE MUNICIPALITY OF SOUTHWEST MIDDLESEX

2021

SPRIET ASSOCIATES LONDON LIMITED
CONSULTING ENGINEERS

Project No. 220156

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General Requirements

These Standards provide for the standardization of the design and construction of roads, sanitary sewers, storm sewers, watermains, and lot grading in the Municipality of Southwest Middlesex. These standards shall be used in the design and construction of the above-mentioned services. Deviations from these standards will be acceptable only under unusual circumstances and shall be approved in writing by the Municipality. Notwithstanding any provision of the Design and Construction Standards for the Municipality of Southwest Middlesex, these Design and Construction Standards may not apply to capital works undertaken by the Municipality on existing municipal infrastructure designed or constructed to previous standards.

These Standards shall apply to all design and construction projects after land use planning approvals have been finally granted and the proposed development shall comply with the applicable Official Plan policies, Zoning By-law regulations, subdivision and consent approvals and site plan as required for the site. These design and construction submissions may fulfill conditions of approval related to these planning approvals.

For developments prepared subject to these guidelines, the Developer shall retain a Professional Engineer, licensed in the Province of Ontario, for design and preparation of Contract Drawings, Specifications, and Reports.

Approval Process

When a Developer commences a project, they shall proceed by requesting a preliminary consultation meeting with the Municipality. At this meeting, the following shall be discussed:

1. Nature of development
2. Location
3. Size
4. Official Plan, Zoning By-law, subdivision, site plan, consent, or other land use planning approvals
5. Availability of services
6. Requirements for this development, i.e., scope of reports, plans, etc.
7. Any other relevant information

Following the meeting, the Developer shall submit preliminary plans and design criteria for submission to the Municipality to ensure sufficient servicing capacity exists, where applicable. This preliminary information shall identify the following:

1. Proposed entrances/exits and connection to existing streets
2. Any preliminary investigations completed such as soils report, servicing capacities and requirements
3. Any relevant or required reports, soils, hydrogeological, drainage, stormwater management traffic studies, environmental assessments, etc.

After the preliminary information has been reviewed and accepted, the Municipality shall provide a written response setting out deficiencies in the submission or provide written acceptance and direction to proceed with final design and formal submission. Once the preliminary information has been reviewed and accepted by the Municipality, the Developer may proceed with final design.

Approval Process (cont'd)

Formal submission of the development shall include, but not be limited to, the following plans, specifications, and reports:

1. Cover page with key plan locating project within the Municipality
2. Overall area and servicing plans
3. Plans and profiles (Scale 1:250 horizontal, 1:50 vertical) for each street to be constructed as well as any easements, servicing extensions, etc.
4. Storm drainage plan including developed area and any lands tributary to development area, storm water management facilities or low impact development best management practices
5. Sanitary drainage plan showing all areas to be developed as well as any exterior areas tributary to the development where applicable
6. Lot grading plans indicating grading for each lot as well as an overall grading plan showing existing contours and drainage direction within and adjacent to the site
7. Boulevard tree planting plan, landscape plan and street lighting plan
8. Legal survey
9. Any other drawings applicable to the construction of the project shall be submitted such as road cross-sections, rear yard catch basin cross sections, swale details, outlet details, erosion control and pumping station plans and details, etc. with sufficient detail to allow a Contractor to construct the works
10. A detailed site servicing report, geotechnical report, hydrogeological report, servicing report including stormwater management and any other required reports shall be submitted
11. Storm Sewer and Sanitary Sewer design sheets
12. Any other drawing or report, etc. as deemed necessary by the Municipality

Refer to the Municipality's "Standard Formal Engineering Package Submission Checklist" for additional information regarding requirements and expectations related to submissions.

The Municipality shall review the submission package and provide comments and markups to the Developer for revision. The Developer shall then re-submit a revised package to the Municipality for approval. This process shall continue until final approval from the Municipality is obtained. The developer shall enter into a development agreement with the Municipality and shall not commence construction until the agreement is executed and registered on title of the lands, ***and securities have been received by the Municipality***.

In addition to the Municipality's approval, the Developer shall obtain approval, but not be limited to, the following agencies where applicable:

1. Ministry of Environment, Conservation and Parks (M.E.C.P.)
2. Middlesex County
3. Ministry of Natural Resources and Forestry
4. Ministry of Municipal Affairs
5. St. Clair Region Conservation Authority (S.C.R.C.A.) or Lower Thames Region Conservation Authority (L.T.R.C.A).
6. Department of Fisheries and Oceans
7. Ministry of Tourism, Culture and Health
8. Adjacent municipalities where appropriate

The developer shall provide copies of all reports as well as approvals from the agencies to the Municipality.

Approval Process (cont'd)

Prior to construction:

1. Copies of all approvals shall be submitted to Municipality including the Ministry of Environment, Conservation and Parks
2. Plan of Subdivision (or lots) shall be registered
3. Development Agreement shall be executed
4. Security deposits shall be submitted to the Municipality
5. A signed and executed copy of the Contract Documents between the Contractor and Developer shall be submitted to the Municipality

During the construction process the Developer shall:

1. Have the Consulting Engineer provide full-time resident inspection during construction of the works
2. Provide details of material testing, compaction tests, video inspection, pressure and testing, etc.
3. Submit "as-built" drawings of the constructed works in digital and hard copy format

Following construction, the Developer's Consulting Engineer shall provide the Municipality with written certification that the constructed work has been completed in conformance with the approved Contract Drawings.

SECTION 1 - ROADS

1.1 General

All roads shall be designed and constructed in accordance with the current edition of the "Manual of Geometric Design Standards for Canadian Roads" as published by the Roads and Transportation Association of Canada.

The type of internal residential roadways to be provided shall be as specified by the Municipality and shall conform to the applicable standard roadway cross-section for the Municipality.

The width of internal residential roadways with curb and gutter and asphalt pavement is to be not less than 8.0 meters. The width of internal residential roadways without curb and gutter but with asphalt pavement is to be not less than 7 meters plus 1.5-meter shoulders on each side.

Gravel roadways without concrete curb and gutter shall be not less than 10.0 meters.

1.2 Street Classification

Street Classification for residential roadways (rural or urban) shall be based on the traffic volume and number of houses with access onto the street as follows:

Street Auto-Oriented Classification	Estimated Daily* No. of Houses	Traffic Volume
Minor-Local	up to 25	0 - 250
Local	up to 100	0 - 1000
Collector	100 - up	1000 - 3000
Arterial	--	3000 - up

* Traffic volumes are based on trips per household as follows:

Single Family	8-10 per day
Multi-Family	7-9 per day
Apartment	6-8 per day

1.3 Road Allowance, Pavement Widths, Location and Layout

a) The minimum width of road allowances and pavement width is shown below:

Street Classification	Minimum Road Allowance	Minimum Pavement Width
Local & Minor-Local	20.10 m	8.0 m
Collector	26.10 m	9.2 m
Arterial	30.48 m	9.2 m
Industrial	26.10 m	9.2 m

SECTION 1 – ROADS (cont'd)

1.3 Road Allowance, Pavement Widths, Location and Layout (cont'd)

b) SD – 1, SD –2 and SD – 3 show the standard utility locations for residential and industrial roads.

c) Streets shall intersect at right angles with each other.

d) Jogged intersections will not be permitted.

e) Intersections of more than two streets shall not be permitted.

f) Street intersections shall not be closer than 60 m.

g) The maximum length of a cul-de-sac to the turning circle shall be 215 m without a secondary or emergency access. SD – 4 and SD – 5 show typical residential cul-de-sacs and industrial cul-de-sacs, respectively.

h) Local street patterns should be planned to minimize through traffic and also minimize dead ends.

i) The street system should clearly indicate the characteristic nature and function of the road.

1.4 Grades

a) The maximum and minimum vertical road grades are 8% and 0.5% respectively, for new developing subdivisions.

b) Vertical curves are required if the algebraic difference in grades is greater than 1%. The minimum length of the vertical curve shall not be less than 45 m.

c) All roadways shall be crowned on a 2% slope.

d) Road grades at intersections shall not exceed 2% across the intersection.

e) Road shoulders shall be sloped from the edge of roadway at a 4% slope.

f) Boulevards are to be sloped from the property line to the edge of the roadway at 2% to 6%.

1.5 Design and Construction

a) Cross-Sections

Typical cross-sections of residential subdivision streets shall conform to the details shown on SD – 1 and SD – 2. Typical cross-sections of industrial subdivision streets shall conform to the details shown on SD – 3.

SECTION 1 – ROADS (cont'd)

1.5 Design and Construction (cont'd)

b) Pavement and Granular Base

i) The gradation requirements, placing and compaction of granular materials are to conform to the current O.P.S. Specifications, O.P.S.S. 314. Hot-mix, hot-laid asphalt shall conform to the current O.P.S. Specifications, O.P.S.S. 310.

ii) For residential roads the following minimum compacted depths of granular and asphaltic pavement courses shall be provided:

40 mm HL3 Asphaltic Concrete
50 mm HL8 Asphaltic Concrete
150 mm Granular 'A' Base
300 mm Granular 'B' Sub-base

and shall be designed in accordance with the recommendations of a Geotechnical Engineer.

iii) An engineered design for residential, industrial, commercial, and arterial roads based on geotechnical data must be submitted to the Municipality for review.

iv) Compaction
Compaction for earth fill and native backfill material forming the road subgrade shall be 100% Standard Proctor Density.

Compaction for granular materials in base course construction shall be 100% Standard Proctor Density.

Compaction for all asphalt materials shall be 97% Marshall Density.

v) Road Cuts
The edges of all paved and concrete surfaces to remain must be properly saw cut prior to removal.

SECTION 1 – ROADS (cont'd)

1.5 Design and Construction (cont'd)

c) Curb and Gutter

i) Typical concrete barrier curb with standard gutter will be as per OPSD 600.040.

ii) Typical concrete semi-mountable curb with standard gutter will be as per OPSD 600.060.

iii) Typical concrete curb will be as per OPSS 353 - Construction Specifications for Concrete Curb and Gutter Systems. All local and minor local streets will have concrete semi-mountable curb with standard gutter and all other streets will have concrete barrier curb with standard gutter unless otherwise approved by the Municipality.

iv) The concrete curb and gutter is to be placed on a Granular 'A' base of not less than 150mm thick.

v) Concrete shall be 30 MPa at 28 days with 7% ± 1.5% entrained air.

vi) Expansion joints shall be provided every nine (9) meters, at both sides of catch basins at the beginning and end of circular curves, at any abutting sidewalk, setbacks, gutter inlets, or any structure.

vii) Contraction joints shall be provided every 3.0 m.

viii) The use of asphalt curb will not be permitted unless otherwise approved by the Municipality for temporary conditions.

d) Sidewalks

i) Typical sidewalks shall be as per OPSD 310.010, 310.020, and 310.030. See SD – 1, SD – 2, SD – 6 and SD – 7.

ii) Typical concrete sidewalk will be as per OPSS 351 Construction Specification for Concrete Sidewalk.

iii) Sidewalks shall be provided as follows:
- Sidewalks are required on one side for local roads.
- Sidewalks are required on both sides for collector and arterial roads.
- Sidewalks may be required on:
  a) one side of a minor - local road;
  b) both sides of a local street if the street forms a walkway to a park, shopping area or school.
- Sidewalks may be required on one or both sides of cul-de-sacs. This will be reviewed on a case-by-case basis.
- Sidewalks and fencing are required on all walkways as per SD – 9.

iv) Sidewalks shall be minimum of 1.5 m wide and shall be located as shown on SD – 6 and SD – 7.

SECTION 1 – ROADS (cont'd)

1.5 Design and Construction (cont'd)

d) Sidewalks (cont'd)

v) Sidewalks and curbs shall be ramped at street intersections to permit easy passage of wheelchairs, etc. Ramps shall conform to OPSD 310.030.

vi) Concrete shall be 30 MPa at 28 days with 7% ± 1.5% entrained air and not less than 355 Kg/m3 of cement. Maximum slump shall be 70 mm.

vii) All sidewalks to be constructed on a 150 mm minimum thick Granular 'A' bed.

viii) Sidewalks are to be a minimum thickness of 100 mm except across driveways where the thickness shall be 150mm.

ix) Concrete sidewalks in walkways shall be 125 mm thick.

x) Driveways to industrial, commercial or multi-family properties shall be 150 mm thick.

xi) Expansion joints shall be provided every 6.0 m. Where the sidewalk abuts a rigid object, construction joints shall be provided every 1.5 m.

xii) Sidewalks shall have a 2% minimum and normal slope towards the road. Gradient in excess of 4% is subject to approval by the Municipality.

xiii) Sidewalks shall have red tactile pad plates at all intersections and elevation changes (steps). Pads shall conform to OPSD 310.033 & 310.039 and shall cover the entire width of the sidewalk.

e) Radii of Curvature

The radii of curvature of the curbs and gutters at the intersections shall be as follows:

i) General

Local streets to:	Local streets	7.5m R
	Collector streets	7.5m R
	Arterial streets	7.5m R
Collector streets to:	Local streets	9.0m R
	Collector streets	9.0m R
	Arterial streets	10.5m R
Arterial streets to:	Local streets	12.0m R
	Collector streets	12.0m R
	Arterial streets	12.0m R

SECTION 1 – ROADS (cont'd)

1.5 Design and Construction (cont'd)

e) Radii of Curvature (cont'd)

ii) Truck Routes

Collector streets to:	Collector streets	15.0m R

Note: a 3.0m daylighting triangle is required at the intersections itemized in ii) above.

Arterial streets to:	Local streets	15.0m R
	Collector streets	15.0m R
	Arterial streets	15.0m R

Note: a 6.0m daylighting triangle is required at the intersections itemized above.

iii) Cul-de-sac

The minimum required radii of curvature of curb and gutters for a residential and industrial cul-de-sac are as per SD – 4 and SD – 5.

f) Driveways

Driveways shall be as per SD – 10.

g) Sub-Grade

The road sub-grade is to be excavated or filled to the required grade over the entire width of the roadway. The sub-grade is to be graded to conform to the required longitudinal grade and crown of the roadway.

h) Engineered Fill

Following the removal of the topsoil and any fill material, the subgrade should be thoroughly proof-rolled and inspected by a Geotechnical Engineer. Any loose or soft zones noted in the inspection should be sub-excavated and replaced with approved inorganic fill.

Grades can then be restored with compacted fill material. Any required fill material should be inspected and approved by a Geotechnical Engineer and should be placed in accordance with the geotechnical engineering recommendations.

SECTION 1 – ROADS (cont'd)

1.5 Design and Construction (cont'd)

i) Structure Design

If required by the Municipality's Engineer, the detail design of the pavement structure shall be submitted. Sub-grade classification and determination of the required thickness of granular base courses and/or asphaltic concrete pavement shall be in accordance with the Asphalt Institute's manual "Equivalent Thickness Method of Flexible Pavement Design". The thicknesses of granular courses and asphaltic concrete shall under no circumstances be less than the minimum thicknesses specified in these standards

j) Double Surface Treatment

On a site specific basis and upon approval by the Municipality, granular roadways may receive double surface treatment in accordance with the current edition of the Ontario Provincial Standard Specification "Special Provision for Application of Bituminous Prime and Double Surface Treatment".

In general, the following requirements conforming to the above specifications are to be met:

a) The preparation of the surfaces to be treated.
b) The application of prime and the supply and application of sand for sand cover.
c) Initial application of binder and the supply, application and rolling of larger-sized coarse aggregate (Gradation "A").
d) Second application of binder and the supply, application and rolling of smaller-sized coarse aggregate (Gradation “B” or "C").

k) Subdrains

Two 150mm dia. pipe sub-drains with a minimum 3-meter length shall be installed opposite to each other (parallel to the curb and gutter), for all catch basins installed.

Pipe sub-drain shall be perforated corrugated polyethylene tubing with knit filter sock conforming to the requirements of OPSS 1840/1860 or perforated CSP (OPSS 1801) and installed in accordance with OPSD 216.03. Bedding and backfill material shall be coarse sand or approved granular material conforming to the requirements of OPSS 405. All sub-drains to have an approved geotextile around them together with an approved end cap.

l) Clearing and Grubbing

All trees are to be removed for such widths as are required for the proper installation of all underground services, the construction of roads and other works as herein provided. All trees are to be removed for a width of at least six (6) meters on each side of the center line of the road allowance and/or roadway. All stumps, shrubs, debris, etc. are to be removed from the entire road allowance.

SECTION 1 – ROADS (cont'd)

1.6 Signing and Markings

a) General

All new subdivision roadways or subdivision boundary roadways may require regulatory or warning signs or pavement markings and will require street name signs at various locations. All plans for signing shall be submitted for approval to the Municipality.

b) Design

i) All regulatory signs shall be supplied and installed in accordance with the current edition of the Ontario Traffic Manual - Book 5.

ii) All warning signs shall be supplied and installed in accordance with the current edition of the Ontario Traffic Manual - Book 6.

iii) All pavement markings shall be supplied and placed in accordance with the current edition of the Ontario Traffic Manual - Book 11.

iv) Street name signs are to be placed at every intersection and are to have double name plates. These signs are to be placed off the street lines in a location that will make the sign easily visible, to be approved by the Municipality.

v) The street plates shall be 14-gauge steel minimum with white enameled 100mm letters in a green background. These plates are to be secured and mounted on galvanized steel posts, 3.5 meters long. These posts are to be driven 1.0 meter in the ground or alternatively, held in position by concrete placed at the bottom of the post.

vi) Street name signs are subject to the approval of the Municipality prior to installation.

c) Materials

i) Regulatory and warning signs will be of the size and materials as outlined in the current editions of the Ontario Traffic Manual - Books 5 and 6.

ii) In rural areas, road name signs shall be 14-gauge steel minimum with white enameled 100mm letters on a 200mm high plate on a blue background. In urban areas, street name signs shall be of 14-gauge steel minimum with white enameled 100mm letters on a 150mm high plate on a blue background. These plates are to be secured and mounted on 50mm diameter galvanized steel post, 3.5m long, driven 1.0m into the ground, or alternatively held in position by concrete placed at the bottom of the post.

iii) Pavement markings shall be applied using durable products such as thermoplastics, two-component cold-reacted materials or tapes as outlined in the current edition of the Ontario Traffic Manual - Book 11.

SECTION 1 – ROADS (cont'd)

1.6 Signing and Markings

d) Installation

All signing shall be installed in accordance with the requirements of the most current editions of the Ontario Traffic Manual and as approved by the Municipality.

1.7 Street Lighting

a) General

All subdivisions shall be provided with streetlights in accordance with the standards in this section.

Proposed lighting layout, specifications, and details are subject to approval of the Municipality and the local hydro utility provider. For Subdivisions abutting collector or arterial roads, special lighting requirements and/or a photometric report may be required to evaluate the intensity of light. The Subdivider's Engineer shall review lighting requirements with the Municipality prior to final design.

Underground wiring shall be used for the electrical distribution system.

Layout of the proposed street lighting, details of relays and photo controls shall be submitted to the Municipality for approval.

Residential roadway lighting will be by LED luminaires. Underground wiring for street lighting will be used. Poles shall be spaced with an average spacing of approximately 35 meters with the first a maximum of 10 meters from the curb of the intersecting street. At the bulb end of cul-de-sac street, one unit is to be installed at the extremity of the bulb and wherever possible in-line with the other units on the streets. All the necessary equipment including standards or poles, lamp switches, and other control mechanics required to provide adequate street lighting according to the current accepted standards of installation laid down by the Municipality of Southwest Middlesex and Roads and Transportation Association of Canada.

Street lighting shall conform to the following minimum:

Average in-service	Horizontal foot-candles
Collector Streets	1.20 ft. candles
Local Streets	0.60 ft. candles
Minor Local Streets	0.60 ft. candles

The lowest foot-candle value on the pavement shall not be less than one-third of the average value.

SECTION 1 – ROADS (cont'd)

1.7 Street Lighting (cont'd)

b) Design

i) Streetlights shall be located in accordance with the Utility Location Drawing SD – 1, SD – 2 and SD – 3.

ii) All lighting systems shall meet the requirements of the current edition of the "Guide for the Design of Roadway Lighting" as published by the Roads and Transportation Association of Canada.

iii) On streets with sidewalks on one side, light poles are to be located on the same side of the street as the sidewalk.

iv) Street light pole placement shall be such that conflicts with proposed watermains and related infrastructure is avoided.

c) Materials

i) Poles: Poles shall be aluminum 7.6 meters long, base mounted or direct burial type and equipped to take post top high pressure sodium luminaires. Concrete poles equipped to take post top high-pressure sodium may be used.

ii) Luminaires: 45-watt LED, post top streetlights complete with photo control.

iii) Wire: The main wire shall be #2 copper type TWU, stranded 600-volt insulation and shall be properly sized for the application under consideration. The standard wiring of luminaires shall be 14/2 bonded type NMD - 3 cable.

iv) Duct: 50mm P.V.C. duct is preferred but 50mm fiber duct may be used as an alternative.

d) Installation

The installation of the electrical wiring, poles, lights and connections will be carried out by a Municipality approved Contractor and the cost of the materials and installation shall be borne by the Developer.

All trenching shall be at a uniform distance from the street line. The minimum depth of cover shall be 0.6 meters over the conductors. When it is necessary to cross the travelled portion of the road, a concrete encased duct or one suitable for direct burial, capped at each end, must be installed at a depth to provide a minimum cover of 1.0 meter.

The size of the main wires to be used in any particular location will be governed by the total length involved, the number and size of lighting units and the location and manner of power supply sources available.

SECTION 1 – ROADS (cont'd)

1.7 Street Lighting (cont'd)

d) Installation (cont'd)

A bare #6, copper ground wire must be installed in the trench where metal poles are used and shall be connected to the ground rod at the supply point. One 3-meter ground rod must be installed at each supply point. Each aluminum pole must be connected to the ground bus using #6 conductor.

The streetlight bus shall be continuous and no splices will be allowed in any trench or duct. A 15-ampere fusing device will be required in each pole to protect individual luminaires. An inline fusing device of 50 ampere capacity shall be required at the supply end of each main feeder run.

Straight duct runs exceeding 12 meters and all duct runs with curves or bends in them shall have a fish wire of #9 galvanized wire installed.

SECTION 2 - SANITARY SEWERS

2.1 General

All subdivisions shall be serviced with sanitary sewers connected to the municipal sanitary sewer system. Consideration will be given on an individual case by case basis for small residential developments where no municipal sanitary sewer system exists (less than 5 lots by severance). All plans of such works shall be approved by the Municipality.

The basic design factors requiring evaluation are water consumption, land use and population trends for the area served. Well-designed and well-constructed sewers may reasonably be expected to have a useful life in excess of 50 years. Accordingly, sanitary sewers are to be designed for a period not less than 50 years.

In general, sewer pipes shall be circular. The use of elliptical pipe shall be subject to the approval of the Municipality.

2.2 Design

a) Sanitary sewers shall be located in accordance with the Standard Utility Location Drawing SD – 1, SD – 2 and SD – 3.

b) The minimum size of sanitary sewer shall be 200 mm in diameter.

c) Sanitary sewers shall be designed in accordance with the design principles recommended in the most current edition of the Ministry of the Environment, Conservation and Parks Guidelines for the Design of Sanitary Sewers. Design computation sheets are to be submitted to the Ministry for approval and shall be in accordance with the design criteria as outlined in Section 2.3 - Sanitary Sewage Flows.

d) Sewer Gradients shall be such that the minimum velocity is 0.6 m/s (i.e. self-cleaning velocity) and the maximum velocity is 3.0 m/s. Accordingly, the minimum grades required to produce a velocity of 0.6 meters per second are as indicated below for sewers up to 600mm in diameter with "n" = 0.013 for pipe sizes up to and including 450mm in diameter and "n" = 0.013 for pipe sizes 525mm in diameter and larger.

Pipe Size – Diameter mm	Min. Grade %	Pipe Size – Diameter mm	Min. Grade %
200	0.33*	450	0.12
250	0.25	525	0.10
300	0.20	600	0.08
375	0.15		

* At the upstream sections of a 200 mm diameter sanitary sewer the slope shall be governed by the number of dwelling units connected:

1 to 5 units	S = 0.70%
6 to 8 units	S = 0.60%
9 to 12 units	S = 0.50%
13 or more units	S = 0.44%

SECTION 2 - SANITARY SEWERS (cont'd)

2.2 Design (cont'd)

e) The minimum depth of cover over the crown of the pipe in residential areas shall be:
Basement Drainage required: 2.75 m

f) The Mannings formula shall be used to design gravity sanitary sewers, as shown in Section 3.1.8.

g) Allowances for hydraulic losses in manholes shall be as shown in Section 3.3.

h) Hydraulics - Forcemains

i) The Hazen-Williams Formula shall be used to design forcemains for peak sanitary sewage flows and is expressed as:

$$V = 0.849\ C\ r^{.63}s^{.54}$$

where V is the velocity in meters per second
C is the roughness coefficient = 120
r is the hydraulic radius in meters
s is the slope of the conduit

ii) Head losses in forcemains shall be computed and submitted to the Municipality for approval. Allowances shall be included for hydraulic losses due to valves, bends and other miscellaneous fittings.

i) Refer to SD-12 "Capacity Factor for Uncertain Development Chart" and SD-13 "Sanitary Sewage Flows – Gross Area Basis".

2.2.1 Leakage

Sanitary sewers shall not exceed the following permissible infiltration and exfiltration rates:

Exfiltration:

a) Up to and including 900mm diameter pipe:
1.4 liters per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour with a 0.6-meter head of water above the highest pipe. The above rate is to be increased by 10% for every additional 0.6-meter head.

b) Greater than 900mm diameter pipe:
2.3 liters per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour with a 0.6-meter head of water above the highest pipe. The above rate is to be increased by 10% for every additional 0.6-meter head.

Infiltration:

a) Up to and including 900mm diameter pipe:
1.1. liters per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour.

SECTION 2 - SANITARY SEWERS (cont'd)

2.2 Design (cont'd)

2.2.1 Leakage (cont'd)

b) Greater than 900mm diameter pipe:
2.3 litres per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour.

The above requirements for pipe sizes up to and including 900mm in diameter conform to the minimum requirements as set by the Ontario Ministry of the Environment, Conservation and Parks. The requirements for pipe sizes larger than 900mm in diameter conform to the requirements of A.S.T.M. Designation C-443 (current edition).

2.3 Sanitary Sewage Flows

Sanitary sewage flows shall be based on the following:

a) Daily per capita sewage flows of 350 litres (excluding infiltration allowance) shall be used to compute sewage flows for residential.

b) Tributary population densities in accordance with the recommendations of the Official Plan and Zoning Bylaw.

Residential and Commercial: The population density shall be taken as 60 persons per gross hectare or 80 persons per net hectare.

Industrial: The population density shall be not less than 115 persons per net hectare.

c) Land Use:

The Municipality's official land use plan is to be used to forecast the ultimate probable land use in any particular area.

The net area shall be taken as the gross hectares less the area occupied by roads, parks rights-of-way, etc.

The net area for residential and commercial lands shall be taken as 73 per cent of the gross hectares. The net industrial area shall be taken as 80 per cent of the gross industrial hectares.

d) Sewage flow allowances for industrial and commercial development shall not be less than 22,500 liters per gross hectare per day. Industry shall be required to provide the Municipality with their estimated average and peak daily flow rates.

SECTION 2 - SANITARY SEWERS (cont'd)

2.3 Sanitary Sewage Flows (cont'd)

e) Capacity Factor:

Residential and Commercial - The capacity factor for residential and commercial areas range from 1.55 for 4.0 hectares of net residential or commercial land to 1.00 for 3,000 net hectares.

Industrial - The capacity factor for industrial areas range from 1.55 for 4.0 hectares of net industrial land to 1.00 for 1,600 hectares of net industrial land.

f) i) Peak residential sewage flows shall be based on the "Harmon Formula".

$$M = 1 + \frac{14}{4 + P^{0.5}}$$

Where: P is the tributary population in thousands
M is the peaking factor.

ii) Peak industrial/commercial sewage flows shall be "Harmon" x 0.8

iii) A maximum peaking factor of 4 will overrule where applicable.

g) Infiltration allowance for all types of development shall be as follows:

8640 liters per hectare per day or 0.100 liters per hectare per second

The infiltration allowance shall be approved by the Municipality prior to design of the sanitary sewer system.

2.4 Pipe Materials

Pipe material shall be concrete or polyvinyl chloride (PVC).

i) Concrete Pipe
shall conform to CSA and ASTM Standards manufactured in accordance with the following specifications:

a) Non-Reinforced to CAN/CSA A257.1 (200mm - 600mm dia.)

b) Reinforced to CAN/CSA 257.2

ii) Polyvinyl Chloride (PVC) Pipe - smooth wall (200mm - 600mm inclusive)
shall be certified to CSA B182.1 and CSA B182.2 and conform to ASTM D3034. Pipe sizes 200 mm diameter and larger shall be SDR 35, and less than 200 mm diameter shall be SDR 28 for private drain connections (PDC).

iii) Ribbed Polyvinyl Chloride (PVC) Pipe (200mm - 600mm inclusive)
shall be certified to CSA B182.4 and meet the requirements of ASTM F794.

SECTION 2 - SANITARY SEWERS (cont'd)

2.4 Pipe Materials (cont'd)

2.4.1 Pipe Joints

i) Concrete Pipe
All joints shall be rubber gasket conforming to CSA A257.3 and ASTM C443M-94.

ii) PVC Pipe
Sealing gaskets shall meet the requirements of CSA B182.2 and ASTM F477.
All PVC fabricated and molded fittings shall be CSA certified.

2.5 Maintenance Holes

a) Refer to Section 3.5 regarding maintenance hole specifications.

b) The maximum spacing between sanitary manholes is 120m.

c) Drop structures are required at sanitary maintenance holes where the difference in invert elevations is greater than 600mm. Refer to Section 3.5 regarding OPSD references.

2.6 Private Drain Connections

Refer to Section 5.1.

2.7 Maintenance Hole Losses

Allowances for hydraulic losses in maintenance holes shall be as follows:

Straight through flow	- 0.03 m
22½° change in direction of flow	- 0.04 m
45° change in direction of flow	- 0.05 m
90° change in direction of flow	- 0.08 m

Although the above invert drops will be adequate for sewers flowing at velocities at the low end of the acceptable range, the required drops should be calculated for high velocity sewers.

The allowances indicated above are reasonable for practical design and purposes and shall be used unless a detailed hydraulic analysis indicates otherwise.

2.8 Lateral Inflow

If the lateral inflow is a significant portion of the total flow through the manhole, then provision must be made for increased head loss. In such instances, a detailed hydraulic analysis of the head losses shall be submitted to the Municipality.

SECTION 2 - SANITARY SEWERS (cont'd)

2.9 Pressure Sewers

Head losses in pressure sewers such as forcemains, shall be analyzed and submitted to the Municipality. Losses due to bends, valves and miscellaneous fittings must be taken into account when designing pressure sewers and forcemains.

2.10 Installation

a) The installation of sanitary sewers shall be carried out in accordance with the requirements of Section 3.7.

b) The test pressure for forcemains shall be 700 kPa and may be measured at any point on the forcemains by applying an appropriate connection. The test pressure shall be maintained for at least one hour. The maximum permissible leakage shall not exceed 4.45 liters per mm diameter of pipe per kilometer length of pipe per day.

2.11 Pipe Bedding

Pipe bedding for sanitary sewer pipes shall conform to the standard Bedding Details as per SD – 14, and SD – 15.

2.12 Trench Backfill

In general, trench backfill shall consist of well graded granular material and shall be mechanically compacted in layers. The use of on-site or other materials for trench backfill within existing and/or future roadways will only be permitted if approved by the Municipality in writing. However, the use of on-site or other approved materials for trench backfill outside the limits of the travelled portion of the existing and/or future roadways will be permitted.

2.13 Design Computation Sheet

The design computation sheet incorporating the factors described herein, is to be used for the design of sanitary sewers. A copy of the computation sheet together with a plan of the sewer area, shall be submitted to the Municipality.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT

3.1 Storm Sewers

3.1.1 General

Storm sewers shall be designed in accordance with the design principles as outlined in the most current edition of the Ministry of the Environment, Conservation and Parks Guidelines for the Design of Storm Sewers. Design computation sheets shall be submitted to the Municipality for approval.

The basic design factors requiring evaluation are land use, design frequency, precipitation and runoff coefficient. The storm sewers shall be designed for a period of not less than 50 years and shall be designed to convey the 2-year minor storm event (unless otherwise required) to a sufficient outlet or to a storm water management facility which will control post-development peak flows to pre-development flows including the 2, 5, 25, 50 and 100-year storm events.

In general, sewer pipes shall be circular. The use of elliptical pipe shall be subject to the approval of the Municipality.

The design of storm sewers shall be completed using the attached Rainfall Intensity Duration Curve, Drawing SD – 16. Alternatively, the intensities may be calculated using the following formula for the Intensity-Duration-Frequency relationship and corresponding constants:

$$i = \frac{a}{(t+b)^{\wedge c}}$$

	2 year	5 year	10 year	100 year
a	1290.00	1183.74	1574.382	2619.363
b	8.500	7.641	9.025	10.5
c	0.860	0.838	0.860	0.884

In addition, runoff from major storm events (i.e. 100-year and Regional Storms) shall be accommodated by an overland flow route that has been designed assuming that all of the source controls and storm water conveyance controls have failed.

3.1.2 Estimated Quantity of Storm Runoff

The Rational Formula is to be used to determine the quantity of storm water runoff. The use of other empirical runoff formulae must be approved by the Municipality. The Rational Formula is:

$Q = 2.78\ C\ i\ A$

Where, Q is the storm water runoff in liters per second
C is the runoff coefficient
i is the average rainfall intensity in mm per hour
A is the drainage area tributary to the point under design in hectares.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.1 Storm Sewers cont'd)

3.1.2 Estimated Quantity of Storm Runoff (cont'd)

In order to determine the intensity of rainfall for use in the Rational Formula, the time of concentrations shall be calculated using an approved method such as:

i) The Airport Formula

ii) The Bransby Williams Formula

In the absence of calculations, the following Time of Concentration shall be used:

Flat residential districts	20 minutes or less
Well-developed districts	15 minutes or less
Densely developed districts	10 minutes or less

The use of inlet times other than those indicated above, shall be subject to the approval of the Municipality.

The following runoff coefficients are to be used with the Rational Formula:

Runoff Coeffiecients	
Sources	**Coefficient (C)**
Asphalt, concrete, roof areas	0.90-1.00
Grassed Areas, parkland	0.20-0.35
Commercial	0.75-0.85
Industrial	0.65-0.75
Residential:	
Single Family	0.40-0.45
Semi-detached	0.45-0.60
Row housing	0.50-0.70
Townhouses	
Apartments	0.60-0.75
Institutional	0.40-0.75

In general, infiltration of ground water can be ignored in storm sewer design computations.

3.1.3 Rainfall Frequency and Intensity

Storm sewers are to be designed on the Rainfall-Intensity Duration curves prepared for the Municipality. In general, a two-year rainfall frequency is to be used. For high-value districts and commercial areas, a higher rainfall frequency may be used at the discretion of the Municipality.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.1 Storm Sewers cont'd)

3.1.4 Leakage

Storm sewers shall not exceed the following permissible infiltration and exfiltration rates:

Infiltration:

a) Up to and including 900mm diameter pipe:

1.1. liters per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour.

b) Greater than 900mm diameter pipe:

2.3 liters per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour.

Exfiltration:

a) Up to and including 900mm diameter pipe:

1.4 liters per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour with a 0.6-meter head of water above the highest pipe. The above rate is to be increased by 10% for every additional 0.6-meter head.

b) Greater than 900mm diameter pipe:

2.3 liters per 25mm of conduit barrel internal diameter, per 30 meters of line length, per hour with a 0.6-meter head of water above the highest pipe.The above rate is to be increased by 10% for every additional 0.6-meter head.

The above requirements for pipe sizes up to and including 900mm in diameter conform to the minimum requirements as set by the Ontario Ministry of the Environment. The requirements for pipe sizes larger than 900mm in diameter conform to the requirements of A.S.T.M. Designation C-443 latest edition.

3.1.5 Location

Storm sewers shall be located in accordance with the Standard Utility Location Drawing SD – 1, SD – 2, and SD – 3.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.1 Storm Sewers (cont'd)

3.1.6 Minimum Pipe Size

The minimum size of the storm sewer shall be 250mm diameter. The sewer gradient shall be such that a minimum velocity of 0.9 m/s is attained with the maximum velocity being:

4.6 m/s for 250mm to 825mm diameter sewers
6.0 m/s for 900mm diameter and larger storm sewers

Velocities of sewers deviating from those described herein will require approval of the Municipality.

Pipe Size – Diameter mm	Min. Grade %	Pipe Size – Diameter mm	Min. Grade %
250	0.56	525	0.21
300	0.44	600	0.18
375	0.35	675	0.15
450	0.25	750	0.13

3.1.7 Cover

Minimum depth of cover on storm sewers shall be 1.5m.

3.1.8 Hydraulic Calculations

Hydraulics - Gravity Sewers
Sewers are to be considered as open channels in the selection of hydraulic formulae for design purposes with the exception of pressure systems.

The Mannings Formula shall be used to design gravity storm sewers.

The Manning Equation is expressed as:

$$V = \frac{1}{n} * r^{\frac{2}{3}} * S^{\frac{1}{2}}$$

where V is the velocity in meters per second
r is the hydraulic radius in meters
S is the slope of conduit
n is the roughness coefficient

'n' values for pipes flowing full shall be as follows:
0.013 - polyvinyl chloride (PVC) pipe
0.013 - concrete pipe 100 mm to 450 mm dia.
0.013 - all pipe larger than 450 mm dia.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.1 Storm Sewers (cont'd)

3.1.8 Hydraulic Calculations (cont'd)

Hydraulics - Pressure Sewers

The Hazen-Williams Formula should be used in the design of pressure sewers.

The following "C" values are to be used with the Hazen-Williams Equation:

100	Unlined cast-iron pipe
120	Concrete pipe
140	Cement-lined cast-iron pipe
140	Polyvinyl chloride (PVC) pipe

3.1.9 Maintenance Hole Losses

Allowances for hydraulic losses in maintenance holes shall be as follows:

Straight through flow	- 0.03 m
22½° change in direction of flow	- 0.04m
45° change in direction of flow	- 0.05 m
90° change in direction of flow	- 0.08 m

The allowances indicated above are reasonable for practical design and purposes and shall be used unless a detailed hydraulic analysis indicates otherwise.

Although the above invert drops will be adequate for sewers flowing at velocities at the low end of the acceptable range, the required drops should be calculated for high velocity sewers.

3.1.10 Lateral Inflow

If the lateral inflow is a significant portion of the total flow through the manhole, then provision must be made for increased head loss. In such instances, a detailed hydraulic analysis of the head losses shall be submitted to the Municipality.

3.1.11 Pressure Sewers

Head losses in pressure sewers such as forcemains, shall be analyzed and submitted to the Municipality. Losses due to bends, valves and miscellaneous fittings must be taken into account when designing pressure sewers and forcemains.

3.2 Stormwater Management

3.2.1 General

The basic design factors requiring evaluation are land use, design frequency, precipitation, and runoff coefficient. The storm sewers shall be designed for a period of not less than 50 years.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.2 Stormwater Management

3.2.1 General (cont'd)

When lands are developed, the Proponent is required to implement Stormwater Management (SWM) measures to address water quantity, water quality, downstream erosion or flooding and water balance issues.

Storm sewer systems shall include storm water management facilities and/or measures for both water quality and quantity in accordance with accepted practices as outlined in the most current edition of the publication entitled "Stormwater Management Planning and Design Manual" prepared for the Ontario Ministry of the Environment, Conservation and Parks. Storm water storage requirements for quality control shall be in accordance with Table 3.1 of the above noted Manual with the "Level of Protection" being determined in consultation with the applicable Conservation Authority, the Department of Fisheries (DFO) and the Municipality.

The design of individual stormwater management (SWM) facilities shall apply a 3-hour Chicago Rainfall Distribution using the Atmospheric Environmental Services (AES) intensity chart in Section 2.2.2. All storms provided (i.e. 2,5,10,25,50 and 100 year) shall be evaluated for quantity and quality control purposes.

The Developer's Consulting Engineer is required to valuate all applicable storms and recommend the most appropriate on a case-by-case basis. For each problem (i.e. water quality, flood control, erosion control), a "critical" storm should be selected for design purposes.

A summary of preferred SWM criteria is summarized in the table below:

Water Quality	Enhanced Level of Protection (80% S.S. Removal)
Erosion Protection	No overland discharge until storms greater than 10-year storm event unless released as sheet discharge
Quantity Control	All storms released at or below predevelopment release rates up to 250-year storm event
Low Impact Development	All Low Impact Development Systems must have emergency relief pipes to storm sewers, must be located outside of Road Right of Ways, and must have easements
Small Developments or Expansions	Quantity control may be achieved through lot level grading with an oil and grit separator providing quality control
Large Residential Development (> 50 homes)	Preferred design would include storm sewers and a wet pond(s). Low Impact Development Systems should have limited use and not be installed within road right of way.
Industrial/Commercial and Multi-Residential Developments	Preferred design would include a dry pond with oil and grit separators for sites smaller than 5 hectares and a wet pond for sites larger than 5 hectares

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.2 Stormwater Management

3.2.1 General (cont'd)

Where the stormwater management design standards may lack information or a discrepancy may occur, MECP Best Management Practices shall govern on a case-by-case basis at the discretion of the Municipality.

3.2.2 Quantity and Quality of Storm Water

a) Land Use

The Municipality's Official Plan shall be used to forecast the ultimate probable land use in any particular area. Consideration should be given to the effect of increased urbanization. Planning and development on a watershed or a sub-watershed basis is essential.

b) General

In the absence of watershed/sub-watershed planning, the following principles must be considered in determining water quantity and quality criteria:

i) Post Development flows must be kept to Pre-Development flows for 2-year through 100-year storm return period.

ii) Water Quality control is to be done to the requirements of the M.E.C.P. stormwater management manual and the classification of the downstream receiving body.

iii) Overland flows from storm events greater than a 5-year event must be addressed and conveyed to a sufficient outlet.

The use of computer software programs to determine and evaluate the storm water management facilities, runoff generated, etc. is acceptable provided the program is approved by the Municipality's Engineer. All design parameters and output are to be provided to the Municipality's Engineer by hard copy and on a USB in a format acceptable to the Municipality's Engineer. In addition, a Certificate of Approval is required from the Ministry of the Environment, Conservation and Parks prior to construction being undertaken. The intensities may be calculated using the following formula for the Intensity-Duration-Frequency relationship and corresponding constants.

$$i = \frac{a}{(t+b)^{\wedge c}}$$

	25mm	2 year	5 year	10 year	25 year	50 year	100 year	250 year
a	538.85	1290.00	1183.74	1574.382	2019.372	2270.665	2619.363	3048.22
b	6.331	8.500	7.641	9.025	9.824	9.984	10.5	10.03
c	0.809	0.860	0.838	0.860	0.875	0.876	0.884	0.888

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.2 Stormwater Management (cont'd)

3.2.2 Quantity and Quality of Storm Water (cont'd)

c) Quantity Control Requirements

All proposed developments must restrict their site outflow to equal or less than predevelopment release rates during all storm events. Sites (commercial, industrial) and smaller subdivisions shall include calculations for the 5,10, 25, 100 and 250-year storm events. For larger subdivisions (greater than 50 lots) or large sites (greater than 5 Hectares), calculations shall be for the 5, 10, 25, 50, 100 and 250-year storm events.

d) Target Total Suspended Solids Removal

All proposed developments should receive a minimum level of treatment for enhanced quality protection (80% T.S.S. Removal) unless otherwise approved in advance by the Conservation Authority (copy of approval to be supplied to Municipality).

e) Oil and Grit Separator

The application of Oil and Grit Separators (OGS) or comparable system is limited to developments of 4 Hectares or less. For developments larger than 4 Hectares, an OGS will not be considered adequate water quality protection regardless of how the development is delineated, unless otherwise approved. When an OGS services a private site, the OGS must be located on private lands with consideration for how the owner will access the OGS for regular maintenance. Where the OGS will be assumed by the Municipality, the Developer shall perform regular maintenance of the system as per the Manufacturer's specifications and provide annual maintenance reports to the Municipality for the first five (5) years following OGS installation.

3.2.3 Low Impact Development Systems

a) General Requirements

If the Proponent intends to implement Low Impact Development Systems (LIDS) a list of LID types, locations and extent shall be provided to the Municipality for approval at the predesign submission stage. While LIDS are promoted, they cannot be the sole source of quantity control. In addition to implementing LIDS, both the internal drainage system and Stormwater Management outflows shall be provided through a pipe system and outlet configuration capable of handling a minimum of 20% of the post development inlet flow for a 5-year storm.

b) Infiltration Gallery Requirements

i) No infiltration galleries are permitted within Road Right of Ways.

ii) Permissible locations include infiltration corridors adjacent to Right of Way, parks, pond access areas, rear yards (with easements) and maintenance setbacks to drains.

iii) All infiltration galleries shall have a catchbasin with perforated pipe leads within stone trenches.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.2 Stormwater Management (cont'd)

3.2.3 Low Impact Development Systems (cont'd)

iv) All catchbasins shall have an emergency relief flow outlet to the storm sewer or emergency relief flow pipe system.

v) Leads from road Right of Ways shall be located through rear yard access (preferred) or side yard access with larger lots on each side to account for maintenance requirements. Affected lots will require calculations of basement, underside of footing, and lead elevations.

vi) All galleries and leads within private property shall have adequately sized easements designated for future maintenance.

vii) Each rear yard infiltration catchbasin shall service a maximum of 8 lots.

viii) Not more than 15% of the total lots may have LIDs installed on private properties.

ix) Infiltration Catchbasins shall be located a minimum of 1.5m from any rear property line and 0.6m from a side yard property line.

x) All infiltration catchbasins shall be protected with a permanent sediment measure such as FleXstorm inlet sediment trap or approved equal.

xi) If Low Impact Development Systems are proposed the proponent shall provide the Municipality with a non-refundable deposit for future maintenance (value to be determined on a case-by-case basis).

xii) The proponent shall submit detailed drawings including plan, layout, cross-sections and elevations for exfiltration and emergency relief pipes as well as supporting calculations. Emergency relief leads will require a detail plan and profile including elevations of exfiltration pipes leaving the catchbasins.

c) Groundwater Considerations

If Low Impact Development Systems are a proposed method of Stormwater Management, the proponent is required to prove that there is no risk of contamination to potable groundwater or risk to Designated Vulnerable Areas identified by MECP. A Report from the Hydrogeologist may be required if local wells or shallow groundwater are present in the vicinity of the development.

A Geotechnical Report and Hydrogeology Report stamped by a qualified professional shall be provided to:

i) Support the implementation of Low Impact Development Systems

ii) Confirm that the long-term high groundwater elevation is 1m (minimum) below the invert of the infiltration galleries in all areas.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.2 Stormwater Management (cont'd)

3.2.3 Low Impact Development Systems (cont'd)

d) Maintenance

For developments which implement Low Impact Development Systems, the Stormwater Management Report must include details on maintenance of these systems. Low impact development system maintenance must include the following information:

i) The proponent must provide sediment loading calculations to identify the expected lifespan of all low impact development systems

ii) Detailed instruction for sediment inspection and removal. Specific details for access and property restoration for systems installed outside of Road R.O.W.'s will be required including frequency, landowner notification and anticipated equipment.

iii) Ensure that advanced sediment control measures are implemented and maintained during construction to maximize system service life including additional filtration systems on all catchbasins during construction, regular (weekly) inspection and inspection log documentation of sediment features from an outside party (independent of contractor) and regular removal and disposal of all sediment with extra care taken to ensure no unnecessary sediment enters the system and reduces the system's lifespan.

iv) The proponent shall provide thorough details and instructions on Low Impact Development Systems regarding removals & restoration responsibilities including cost allocations. Details should also be included on how obstruction to maintenance equipment (sheds, landscaping, fencing, etc.) will be prevented within the maintenance easement. Details should include a typical cross-section to show the homeowner the type of installed infrastructure and the typical maintenance and replacement widths required. This information shall be included in a purchaser (Homeowner's) information package and registered on title for future homeowners.

v) A detailed schedule and log included within the Stormwater Management Report to assist the owner in maintaining water quality control measures.

vi) All inlet filter sedimentation protection shall be replaced upon completion of construction to maximize service life.

3.3 Open Channels and Culverts

a) In built-up areas, the installation of pipe sewers or closed conduits, such as box conduits, are the only acceptable means of conveying storm flows to the outlet. The use of open storm channels will only be permitted if economically justifiable and approved by the Municipality.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.3 Open Channels and Culverts (cont'd)

b) The use of open channels shall not be permitted in residential or urbanized areas. Open channels may be permitted, if approved by the Municipality, in industrial or rural areas.

c) For storm flows in excess of 14,000 liters/sec, concrete lined open channel sections or concrete box conduits shall be used in lieu of pipe conduits.

d) Design of open channels and culverts shall be completed using the attached Rainfall Intensity Duration Curve, Drawing SD – 16. Alternatively, the intensities may be calculated using the following formula for the Intensity-Duration-Frequency relationship and corresponding constants.

$$i = \frac{a}{(t+b)^c}$$

See Section 3.2.2 for a, b and c values.

e) Thorough soils investigations and interpretations shall be a prerequisite to the detailed design of the open channel.

f) The Manning Formula shall be used in the design of open channels.

i) For grass-lined channels, 'n' values shall be based on the product of the velocity (V) and the hydraulic radius (r):

V x r	n
<0.5	0.150
0.5 to 1.0	0.120
1.0 to 2.0	0.070
2.0 to 5.0	0.050
5.0 to 10.0	0.035
>10.0	0.030

ii) Side slopes for grass-lined channels shall not be steeper than 3H:1V.

iii) Flow velocities shall be in the following ranges:

- sand, sandy loam, or silty loam
  0.75 m/s to 0.90 m/s

- gravel, or clay material
  0.75 m/s to 1.50 m/s

g) Full details of open channel design including energy dissipation structures shall be submitted to the Municipality.

h) To carry open channel drainage under driveways and across intersections, an appropriately sized culvert shall be used with the minimum size being 375mm in diameter. It may be necessary to increase the culvert size to accommodate higher flows from upstream tributary areas.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.3 Open Channels and Culverts (cont'd)

i) Culverts shall be 2.8mm thick minimum galvanized corrugated steel pipe or H.D.P.E. 320Kpa Bell and Spigot pipe. This material shall conform to the requirements of CSA Standard CAN 3- G401-M81 - Corrugated Steel Pipe Products.

3.4 Pipe Materials

Pipe material shall be concrete, polyvinyl chloride (PVC), or high-density polyethylene (HDPE).

Pipe sub-drains to be corrugated steel pipe or polyvinyl chloride (PVC) pipe.

a) Concrete Pipe shall conform to CSA and ASTM Standards manufactured in accordance with the following specifications:

i) Non-Reinforced to CAN/CSA A257.1 (100mm - 600mm dia.)

ii) Reinforced to CAN/CSA 257.2 (300mm and larger)

b) Polyvinyl Chloride (PVC) Pipe smooth wall (100mm - 600mm inclusive) shall be certified to CSA B182.1 and CSA B182.2 and conform to ASTM D3034. Pipe sizes 200 mm diameter and larger shall be SDR 35, and less than 200 mm diameter shall be SDR 28 for private drain connections (PDC).

c) Ribbed Polyvinyl Chloride (PVC) Pipe (200mm - 600mm inclusive) shall be certified to CSA B182.4 and meet the requirements of ASTM F794.

d) High Density Polyethylene (HDPE) Pipe (200mm-600mm inclusive), for use on storm sewers only, with integral bell and spigot, shall be certified to CSA B182.6.

3.4.1 Pipe Joints

a) Concrete Pipe All joints shall be rubber gasket conforming to CSA A257.3 and ASTM C443M-94.

b) PVC Pipe
Sealing gaskets shall meet the requirements of CSA B182.2 and ASTM F477.
All PVC fabricated and molded fittings shall be CSA certified.

c) HDPE Pipe All HDPE fabricated pipe and molded fittings shall be CSA certified.

3.5 Maintenance Holes

a) Maintenance Holes shall be located at the junctions of sewers and at changes in grade, alignment, or diameter. Maintenance Holes shall be precast concrete conforming to OPSD 701.010 to 701.080.

b) Manhole frames and grates to be in accordance with OPSD 401.010 (Type A).

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.5 Maintenance Holes (cont'd)

c) Maintenance hole spacing shall be as follows:

	Pipe Size	Maximum Maintenance Hole Spacing
i.	Up to 450 mm	120 m
ii.	525 mm to 750 mm	150 m
iii.	over 750 mm	180 m

d) The precast concrete adjustment units used to extend maintenance holes and catch basins shall be in accordance with OPSD 704.010 and OPSS 408. Three courses, minimum, of approved adjustment units are required on precast maintenance holes. The outside and interior faces of all concrete rings should be plastered and troweled smooth with mortar 6mm thick, consisting of one-part masonry cement and 3-parts sand.

e) Maintenance hole steps shall be circular or rectangular aluminum and shall be in accordance with OPSD 405.010 or OPSD 405.020. Steps to be at 300mm centers vertically with 450mm maximum distance from top of maintenance hole to the first step.

f) Aluminum safety landings shall be provided in maintenance holes deeper than 5.0 m from the top of maintenance hole cover to the lowest invert. Details shall be in accordance with OPSD 404.020.

g) All precast maintenance hole section joints shall contain an approved rubber gasket or approved equal. Joints, lifting holes and pipe connections are to be filled with a non-shrink mortar mix.

h) Benching of manholes is to be performed in accordance with OPSD 701.021.

i) A flexible joint shall be provided on all pipes, within 0.3 m of the outside wall of the maintenance hole. Concrete bedding 20 MPa to solid ground and extending to the first pipe joint may be used as an alternate approach.

j) All maintenance holes installed must be a "boot type" KOR-N-SEAL style, or an approved equal.

k) Drop structures are required at maintenance holes where the difference in invert elevations is greater than 900mm for storm sewers and shall be in accordance with OPSD 1003.010 or OPSD 1003.020. Internal drop structures are an acceptable alternative when connecting to existing manholes and shall be according to OPSD 1003.030 and 1003.031 but require site specific approval from the Municipality.

l) Precast Maintenance hole tees may be used in storm sewers 1200 mm in diameter and over. The precast riser sections shall be at least 1200 mm in diameter. Maintenance hole tees shall be bedded on 28 MPa concrete. Full details shall be submitted to the Municipality for approval.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.6 Catch Basins

a) Catch basins shall conform to OPSD 705.010, 705.020, 705.030 and 705.040.

b) Catch basin frames and grates shall conform to the details in OPSD 400.020 and must meet ASTM Designation A-48. Catch basin frames with curb inlet overflow, OPSD 400.090, shall be used for arterial roads and at all low points in the road. Ditch inlet catch basin grate shall conform to OPSD 403.010. Curb inlet catch basin to be in accordance with SD-15.

c) Catch basin leads shall not be less than 250 mm in diameter and shall connect to the storm sewer as shown in OPSD 708.01 or OPSD 708.03.

d) Curb inlet catch basins shall be provided at all low points in the road with single inlet catch basins at intersections. Additional catch basins shall also be provided as follows:

Road Gradient (%)	Maximum Spacing
0.5 to 3.0	90 m
3.1 to 4.5	75 m
Greater than 4.6	60 m

e) The precast concrete adjustments units used to extend maintenance hole and catch basins shall meet the OPSD 704.010 and OPSS 407. Three courses, minimum, of approved adjustment units are required on precast maintenance holes. The outside and interior faces of all concrete rings shall be plastered and troweled smooth with mortar 6mm thick, consisting of 1-part masonry cement and 3-parts sand.

f) All joints, lifting holes, and pipe connections are to be filled with a non-shrink mortar mix.

3.7 Installation

a) Sewer pipe bedding shall conform to the Municipality's bedding standards for gravity and pressure pipe and shall be in accordance with SD – 14 and SD – 15.

b) Approved excavated material may be used for backfill under roads, sidewalks and driveways where an independent soils investigation, carried out by a Geotechnical Engineer, indicates that this is practical. Compacting of the material shall be carried out in accordance with the recommendations of the Geotechnical Engineer.

If the excavated material is unsuitable, the trench shall be backfilled with Granular 'B' material conforming to OPSS 1010 and compacted to 95 percent Standard Proctor Density.

c) Sewer service connections for rigid main pipe sewer shall be in accordance with OPSD 1006.010 and for flexible main pipe sewer shall be in accordance with OPSD 1006.020.

A 50mm x 100mm timber marker stake shall be installed at the end of the private service connection from the invert to 300mm above finished ground. The stake shall be painted brown.

SECTION 3 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

3.7 Installation (cont'd)

d) All installations shall be subject to the inspection, approval and acceptance of the Municipality.

e) All new sewers shall be inspected by means of a closed-circuit television inspection in accordance with OPSS 409 and one copy of the video given to the Municipality for its records. This work shall be performed by an independent inspection company under the supervision of the Municipality and paid for by the Contractor.

f) Ring deflection testing shall be performed on all new pipe sewers constructed using plastic pipe in accordance with OPSS 410.07.15.05. Testing is to take place no sooner than 30 days after the completion of backfilling and installation of service connections and again just prior to the end of warranty.

g) If any utilities or services are encountered during construction, they are to be supported in accordance with the requirements of the various utility companies as applicable.

h) Road surfaces shall be restored to its original condition where existing roads are disturbed, all to the satisfaction of the Municipality.

3.8 Private Drain Connections

Refer to Section 5.1.

3.9 Pipe Bedding

Pipe bedding for storm sewer pipes shall conform to the standard Bedding Details as per SD – 14, and SD – 15.

3.10 Trench Backfill

In general, trench backfill shall consist of well graded granular material and shall be mechanically compacted in layers. The use of on-site or other materials for trench backfill within existing and/or future roadways will only be permitted if approved by the Municipality in writing. However, the use of on-site or other approved materials for trench backfill outside the limits of the travelled portion of the existing and/or future roadways will be permitted.

3.11 Design Computation Sheet

The design computation sheet incorporating the factors described herein, is to be used for the design of storm sewers. A copy of the computation sheet together with a plan of the sewer area, shall be submitted to the Municipality.

SECTION 4 – WATERMAINS

4.1 General

This section presents requirements for the design and construction of water distribution systems. All water distribution systems including watermains, services, private watermains and appurtenances shall be designed and installed to the following:

a) Municipality of Southwest Middlesex Design and Construction Standards
b) Reg. 129/04, 170/03 and any other regulations under the Safe Drinking Water Act and the Ontario Water Resources Act.

Sewers and watermains parallel to one another must be constructed in separate trenches maintaining minimum horizontal and vertical separations of 2.5m and 0.5m, respectively.

4.2 Design of Watermain

The water requirements in the design of the distribution system are to be based on the following three basic needs:

a) Domestic Uses
b) Fire Protection
c) Industrial Uses

Minimum Sizes

The minimum watermain size to be used in the design of watermain systems is 150mm in diameter. A hydrant lateral is to be 150mm in diameter.

4.2.1 Pressure Requirements

Water supply systems should be designed to satisfy the greater of either of the following demands:

a) Maximum day plus fire flow at a minimum pressure of not less than 140kPa (20psi) at a fire hydrant connection.
b) Maximum hourly demand at a pressure not less that 275kPa (40psi) in residential areas and not less than 310kPa (45psi) in industrial areas.

4.2.2 Demands

a) Domestic Demand (Population Range 500-1000)

i) Per capita consumption - 350 liters per capita per day
ii) Maximum Daily Demand Factor - 3.0
iii) Peak Hourly Demand Factor - 4.1

b) Fire Demand

The level of fire protection to be provided will require the approval of the Municipality. In general, the minimum fire flow, as recognized by various fire underwriting groups is 30 liters/sec and to receive credit, the water system must be simultaneously capable of satisfying the maximum day demand.

SECTION 4 – WATERMAINS (cont'd)

4.2 Design of Watermain (cont'd)

4.2.2 Demands (cont'd)

b) Fire Demand (cont'd)

To estimate the fire flow requirements for a particular structure or area of a Municipality, the designer should refer to a guide such as, "Water Supply for Public Fire Protection - A Guide to Recommended Practice", (latest revision) prepared by Fire Underwriters Survey Insurers' Advisory Organization. For further fire related requirements refer to Ontario Building Code and the Ontario Fire Code.

c) Industrial Demand

Industrial water consumption varies considerably and is dependent on the type of industry. If the development under consideration is known, the actual water requirements should be determined prior to the design of the water system.

4.2.3 Materials

a) Materials

i) Ductile Iron Pipe
The use of ductile iron pipe is not acceptable to Municipality.

ii) Asbestos Cement Pipe
The use of Asbestos Cement Pipe is not acceptable to the Municipality.

iii) High Density Polyethylene Pipe (HDPE)
The use of HDPE pipe is only acceptable to the Municipality within proposed directional drilling sections of watermain. See Section 4.3.6.

iv) Polyvinyl Chloride (PVC) Pipe
The Polyvinyl Chloride (PVC) plastic pipe shall be constructed of rigid polyvinyl chloride compound and shall conform to the current AWWA C-900 (CSA B-137.3) or AWWA C909 (CSA B-137.3.1). Polyvinyl chloride plastic pipe shall be Class 150 (SDR 18) for sizes up to and including 300mm diameter. All watermain pipe delivered to site shall be "Factory Capped". For watermains larger than 300mm diameter the type of watermain shall be determined in consultation with the Municipality.

Pipes shall be supplied in standard lengths of not less than 6 meters nor more than 11.6 meters except that short lengths and special adaptors shall be provided as required for completing connections or where ground conditions are such that shorter lengths are necessary. Pipes shall be joined by means of a "Tyton" type rubber ring bell joint which shall be an integral and homogeneous part of the pipe barrel. Rubber rings shall conform to ASTM Specifications D1869. The class and type of pipe shall be stencilled on each length of pipe.

SECTION 4 – WATERMAINS (cont'd)

4.2 Design of Watermain (cont'd)

4.2.3 Materials (cont'd)

a) Materials (cont'd)

Joints shall be bell and spigot with rubber gaskets. The spigot shall be lubricated. A solid 12 gauge TWN copper wire must be supplied along the full length of the pipe to provide electrical continuity for location purposes.

v) Fittings

PVC Pipe

Fittings shall be cast iron with mechanical joint or push-on ends adapted for use in making connection with PVC pipe and in accordance with AWWA C110 and C111. All fittings shall be cement lined in accordance with AWAA C104.

PVC Injection Molded Fittings with push-on joints (for use with PVC and PVCO Pressure Pipe conforming to AWWA C900, CSA 137.3, and AWWA [C909], CSA B137.3.1 having cast iron OD) shall conform to AWWA C907, shall be UL listed and FM approved and shall be certified by the Canadian Standards Association to CSA Standard B137.2.

b) Watermain Valves

All watermain valves shall be gate valves. All valves must be epoxy coated inside and out (minimum of 3mm thickness) and conform to AWWA C550. All valves up to 200mm diameter may be M.J. or push-on joint. Valves 250mm to 400mm diameter must be mechanical joint to allow adequate mechanical thrust restraints.

Gate valves shall be iron body, bronze-mounted, non-rising stem. Gates may be double disc parallel seal or solid wedge. Valves shall be manufactured in accordance with AWWA Standard C500/C509 or other approved specification. Minimum design working water pressure shall be 1.21 MPa (175 psi). "O" rings shall be used for valve stem stuffing box packing.

Valves to open to the LEFT i.e. counter-clockwise and stems fitted with 50mm square operating nut with arrow showing opening direction and have S.S. nuts and bolts.

A 10.9kg zinc anode shall be connected to all watermain valves. Epoxy coated gate valves do not require anodes, unless coating is damaged in the opinion of the Engineer or water operating authority. All valves to have rod extension to 300mm below finished grade.

SECTION 4 – WATERMAINS (cont'd)

4.2 Design of Watermain (cont'd)

4.2.3 Materials (cont'd)

c) Service Pipe

Polyethylene Plastic (25mm – 50mm diameter) - in conformance with ASTM F1282 or CSA B137.1 with a working pressure of 1.10 MPa (160 psi). Where houses are located further than 30m from the main, the size of the water service shall be approved by the Municipality.

Cross linked Polyethylene (PEX) (25mm – 50mm diameter) - potable water service tubing shall be in accordance with AWWA C904, ASTM F876-05, ASTM F877-05, CSA B137.5, and NSF 61. PEX is to be installed with standard copper O.D. brass fittings and stainless-steel inserts and tracer wire for its entire length.

d) Service Curb Stop (No-Lead Brass)

Curb stop and drain for 25mm plastic tubing shall be ball valve type with inlet and outlet plastic tube compression with stainless steel insert and shall be as per approved list.

The curb stop shall be located 300mm from the street line on the Municipality side. SD – 18 shows the orientation of the water service.

Curb stop for 38mm and 50mm plastic tube shall be bronze ball valve with inlet and outlet plastic tube compression.

Curb stop shall open LEFT i.e., counter clockwise.

Curb stops shall include 5.4kg sacrificial zinc anodes to OPSS 702.

Approved Curb Stops (25mm to 50mm)	
Cambridge Brass	Series 202
Ford	FB Series
Mueller	300 TM-Series

e) Service Main Stop (No-Lead Brass)

Main stop to be brass ball style with inlet AWWA thread and outlet flared or compression with two-piece nut and tail.

Main stop for plastic tube shall be brass with inlet AWWA thread. Outlet plastic tube compression. 25mm shall have stainless steel insert. Main stop shall open LEFT i.e. counter clockwise.

Approved Main Stops (25mm to 50mm)	
Cambridge Brass	Series 301
Ford	1000 Series
Mueller	300 TM-Series

SECTION 4 – WATERMAINS (cont'd)

4.2 Design of Watermain (cont'd)

4.2.3 Materials (cont'd)

f) Service Curb Box

All curb stops shall have adjustable service boxes with rods of sufficient length to suit bury of valve. Base shall be cast iron. Cover shall be cast iron with 25mm hexagon brass plug. Service boxes for valves up to 25mm shall be similar to Mueller A726 or approved equal. Services boxes for 38mm and 50mm valves shall be full size valve box and large nut for 50mm C.S. or approved equal.

g) Service Saddle Clamps

Service saddles shall be full body stainless steel. Clamps shall be double strap broad band stainless steel body and shall be as per approved list.

Approved Service Saddles

Romac	Style 304 for 25mm outlets Style 306 for 40 to 50mm outlets
Cambridge Brass	Series 403 for 50mm (Double Bolt) Series 8403, 8405, 8407 Powerseal Series 3412AS/3416AS
Ford	FS 300 Series
Smith-Blair/Rockwell	372
Robar	2616

h) Valve Chambers

A cast iron valve chamber or valve box shall be supplied and installed on every watermain valve and hydrant shut-off valve. Box shall have a minimum internal diameter of 125mm and be adjustable for total length. Box to have attachable base of sufficient size to prevent box bearing on the valve. Cover to be marked WATER. Valve boxes may be the No. 5 Slide Type Valve Box or the No. 5 Screw Type W\No. 6 base as manufactured by EMCO or approved equal.

i) Fire Hydrants

Fire hydrants shall be manufactured in accordance with AWWA Standard C502. Hydrants shall be post type with compression valve control designed for a working pressure of 1.03 MPa (150 psi) and to close with water pressure. Hydrants shall be suitable for a minimum 1830mm trench and shall be supplied with two Standard 64mm hose nozzles and a 100mm pumper nozzle (Storz) with caps. Nozzle threads shall be Ontario Provincial Standards threads.

SECTION 4 – WATERMAINS (cont'd)

4.2 Design of Watermain (cont'd)

4.2.3 Materials (cont'd)

i) Fire Hydrants (cont'd)

Barrel to have ground line flange and designed so that all internal parts can be removed through the top of hydrant. Hydrant barrel to drain automatically when hydrant is closed. Base connection shall be 150mm. Hydrant must be open LEFT i.e., counter clockwise. Hydrants shall be installed 600mm within the road right-of-way. Flange at base of hydrant shall be at 100mm above finished grade.

Hydrants shall be shop painted YELLOW epoxy all over. All field painting shall be carried out in accordance with the AWWA Standards for fire-hydrant designations as indicated in the Hydrant Paint Code.

Hydrants are to be Canada Value Century, self-draining, and with a storz connection. The storz cap is to be black in colour with the top bonnet and body of the hydrant yellow in colour.

Hydrant installation shall include mechanical joint restraint and 10.9kg zinc anodes connected to both gate valve and hydrant barrel. Refer to OPSD-1105.010 for hydrant installation.

Service access to be provided to fire hydrant consisting of 3.0m wide lane of 300mm Granular 'B' and 150mm Granular 'A'. Should the access cross a ditch, a culvert shall be installed to sufficient length with minimum 375mm diameter corrugated steel pipe (C.S.P.) as per OPSD 217.05

j) Sampling Station

Requirement and location of water sampling station(s) shall be determined by the Municipality.

Sampling stations shall be constructed in accordance with the attached Drawing SD – 19.

4.2.4 Hydraulics

The Hazen-Williams Formula is to be used in the design of water distribution systems.

The following values of C (pipe roughness constant) are to be used in the Hazen-Williams equation regardless of material.

C-Factor	Diameter (mm)
100	100-150
110	200-250
120	300-600
130	Greater than 600

SECTION 4 – WATERMAINS (cont'd)

4.2 Design of Watermain (cont'd)

4.2.4 Hydraulics (cont'd)

The Hiram-Mills Formula is to be used in the design of large diameter pipes. If required by the Municipality, an analysis of flow in the pipe network by an approved modelling software shall be submitted.

4.3 Installation

All trench excavation shall be carried out in conformance with the latest requirements of the Occupational Health and Safety Act.

4.3.1 Installation of Pipe and Appurtenances

a) Pipe Deflection

Wherever it is necessary to deflect the pipe from a straight line either in the vertical or horizontal plane, the amount of deflection shall not exceed that required for satisfactory making up of the joint and shall not exceed that recommended by the manufacturer.

Generally, the amount of deflection is not to exceed the following:

	Nominal Pipe Diameter (mm)	Max. Deflection (mm) 5.5m Pipe Length
Mechanical Joint	150	520
	200	390
	250	390
	300	390
Push-On Joint	150	365
	200	365
	250	365
	300	365
	350	300
	400	300
	450	215
	600	215

SECTION 4 – WATERMAINS (cont'd)

4.3 Installation (cont'd)

4.3.1 Installation of Pipe and Appurtenances (cont'd)

b) Pipe Joint

Mechanical joint and/or "Tyton" joint shall be used. The use of poured joint bell and spigot pipe will not be permitted.

Only those methods approved by the manufacturer shall be used in the jointing of mechanical or Tyton joint pipe. Substitution of accessories will not be permitted.

This shall apply to nuts, bolts, follower rings and rubber rings. Lubricants used shall be vegetable soaps, approved by the Contract Administrator.

c) Anchorage for Plugs, Caps, Tees, Bends and Other Fittings

All fittings shall be anchored to prevent movement by providing mechanical joint restraints. No concrete thrust blocks will be allowed without written permission from the Municipality.

Metal hangers, tie rods, or clamps of adequate strength to prevent movement may be used instead of concrete backing by written permission of the Contract Administrator.

d) Electrical Conductivity

It shall be the responsibility of the Contractor to use such materials and methods in making joints as to ensure continuity of electrical conductivity in any IRON watermain piping. Such materials and methods shall be in accordance with the manufacturer's specifications and shall meet with the approval of the Contract Administrator.

4.3.2 Minimum Trench Widths

The following table sets out the minimum trench bottom widths for watermain installation:

Pipe Diameter (mm)	Min. Trench Bottom Width (mm)
150	550
200	600
250	650
300	700

SECTION 4 – WATERMAINS (cont'd)

4.3 Installation (cont'd)

4.3.3 Pipe Bedding

PVC watermain pipe shall be placed on Granular 'A' bedding with a particle size not greater than 20mm.

Bedding shall extend to a minimum depth of 100mm below the pipe barrel and shall be brought up around the pipe to a minimum depth of 300mm above the top of pipe and shall be compacted to 98% modified Proctor Density. The width of Granular 'A' bedding shall be the width of the trench.

Trench backfill is to conform with the requirements as set out for sewers.

4.3.4 Installation of Watermains and Water Services

a) Layout

Watermains are to be located 4.7 meters on the street side of the street line and on the opposite side of the storm sewer. Watermains are to have a minimum depth of cover of 1.7 meters.

b) Watermain Valves

In developments of single family and semi-detached units, valves shall be distributed so that any section of the watermain serving up to sixty (60) units can be isolated by operating not more than (4) four valves.

c) Valve Placement

Shut off valves shall be placed as follows:

- At intersections ('T') at least 2 valves
- At through intersections at least 3 valves

On straight runs at the start of runs, at the end of runs, at all road intersections, and not greater than 1km apart.

d) Location of Service

Main stops shall not be spaced closer than 450mm and shall be tapped at the 2:00 o'clock or 10:00 o'clock positon only and left fully open by the Contractor. Service pipe shall be at a depth of not less than 1700mm and not more than 2000mm below the final grade.

Service connections passing under roadside ditches shall have a minimum of 1700mm cover at all times and shall be installed at a depth of not less than 1850mm at the property line.

SECTION 4 – WATERMAINS (cont'd)

4.3 Installation (cont'd)

4.3.4 Installation of Watermains and Water Services (cont'd)

d) Location of Service (cont'd)

The curb stop shall be located 300mm from the street line on the Municipal side of the line.

On "cul-de-sac" or similar type streets, where it may not be feasible to lay a water service at right angles to the main, the service shall be laid in such a manner that the curb stop and main stop are in a straight line.

e) Installation of Service

A "Goose Neck" shall be formed into the service pipe, "laid over" into a horizontal position. Service pipe shall be continued to the curb stop, which shall be located 300mm from the street line, and on the street side of the property line.

f) Requirements

The main stop, curb stop and curb box are to conform to the requirements of the local Water Operating Authority or as approved by the Municipality. Main stop and curb stop shall open counter clockwise.

The following tapping sizes are not to be exceeded:

150mm main up to 38mm
200mm main up to 38mm
250mm main up to 38mm
300mm main up to 50mm

4.3.5 Dead End

Dead end sections of watermain shall be avoided wherever possible. The sections of watermain shall be looped to provide flow from two directions where possible.

All dead ends are to be equipped with a 50mm diameter blow-off. Blow-off must be operable without necessity of excavating.

Blow-offs must conform to the requirements of the local Water Operating Authority, or as approved by the Municipality.

The Municipality has the authority to evaluate and permit the installation of an un-looped (i.e single source of flow) watermain system, on a case-by-case basis.

SECTION 4 – WATERMAINS (cont'd)

4.3 Installation (cont'd)

4.3.6 Directional Drilling Watermain

a) Pipe Material

Watermain pipe material shall be either H.D.P.E. or P.V.C. pipe. H.D.P.E. pipe shall be in conformance with AWWA Standard C906-99 for PE Pressure Pipe and Fittings 100mm through 1575mm for Water Distribution and Transmission. PE pipe shall be manufactured with resin conforming to Standard PE Code PE3406. PE pipe shall be DR11 Ductile Iron pipe size.

The Polyvinyl Chloride (PVC) plastic pipe shall be constructed of rigid polyvinyl chloride compound and shall conform to the current AWWA C900 or CSA B-137.3 specifications. Polyvinyl chloride plastic pipe shall be Class 150 (DR 18).

Tracer wire shall be 12-gauge TWU multi-strand copper and shall be installed along all watermains at the 12 o'clock position strapped to the pipe at 6 meter intervals. The tracer wire shall be brought to the surface at all fire hydrants, looped twice around the hydrant barrel 100mm below finished grade and fastened by means of washer to a breakaway flange bolt.

PVC pipes shall be jointed by means of either "Royal Cobra Lock System" as manufactured by Royal Pipe Systems, or "Terrabrute" as manufactured by IPEX Inc.

b) Boring Water Service Pipe

In general, the installation of water services under existing roadways shall be performed using trenchless techniques, i.e. boring methods. All required water service installation not crossing under roadways shall be performed using open cut techniques.

In general, the length of auguring or boring shall extend a minimum of three (3) meters beyond the edge of the travelled portion of the roadway on either side, or one (1) meter beyond the edge of shoulder, whichever is greater, unless existing site conditions dictate otherwise and approved by the Municipality.

c) Construction

Directional boring of the PE or PVC watermain pipe shall be carried out under the supervision of a Project Engineer or Superintendent with previous proven experience who shall be in continuous charge of the directional boring operation.

Approved joints to the PVC watermain shall be provided at each end of the PE watermain pipe.

SECTION 4 – WATERMAINS (cont'd)

4.4 Testing

4.4.1 Pressure Test and Allowable Leakage

All tests are to comply with all current provincial regulations and AWWA standards. Contact Municipality a minimum of 48 hours prior to testing.

Allowable Leakage per 1000 Meters of Pipeline at 1035kPa Pressure:

Pipe Diameter (mm)	100	150	200	250	300	400	450
Leakage (Litres/Hour)	4.1	6.15	8.2	10.25	12.3	16.4	18.45

4.4.2 Disinfection

All disinfection testing is to comply with all current provincial regulations, AWWA / AWSI, OPSS standards. Contact Municipality a minimum of 48 hours prior to testing.

4.4.3 PVC Pipe Tracing Wire

Tracer wire shall be installed on all non-metallic watermains, hydrants laterals and water services except where such water service pipe is of copper material. The wire shall be installed in such a manner as to be able to properly trace all watermains, hydrant laterals, and water services without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire. Tracer wire shall be strapped to the top of the pipe at 5 meter intervals.

Approved tracer wire for open cut application:
Copperhead 12.30 BHS
Pro-Trace HS-CCS PE30

Approved Direct Bury Connectors:
SnakeBite Locking Connector LSC 1230
Pro-Trace TW Connector

For trenchless installations refer to OPSS 450. #12 AWG Solid (.0808" diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150lb. average tensile break load, 45 mil high molecular weight-high density Blue polyethylene jacket complying with ASTM-D-1248, 30-volt rating.

All tracer wire welds onto existing cast of ductile iron pipe shall be completely sealed with the use of Chace/Royston Handy Caop IP. In all cases, the pipe is to be properly cleaned and material shall be applied in accordance with the manufacturer's instructions.

SECTION 4 – WATERMAINS (cont'd)

4.4 Testing (cont'd)

4.4.3 PVC Pipe Tracing Wire (cont'd)

All splices or repaired wire connections in the tracer wire system shall be made using waterproof connectors specifically rated for underground applications.

The Contractor shall test the tracer wire for conductivity in the presence of the Operating Authority and/or Contract Administrator. If it is not continuous from valve to valve the Contractor shall, at his expense, replace or repair the wire and redo conductivity test in the presence of the Operating Authority/Contract Administrator.

4.4.4 Soil Testing

Soil samples shall be taken on each street to identify soil class and resistivity for pipe design.

4.5 Fitting and Joint Restraints

All fittings shall be installed with mechanical restraints.

Restraint devices to meet or exceed the minimum requirements of ASTM F 1674-96, be UL listed and FM approved. Restraining glands (100 to 300mm) to be manufactured of high strength ductile iron conforming to the requirements of ASTM A536, Grade 65 45 12 m (min) (400 to 600mm) shall be manufactured of structural steel conforming to the requirements of ASTM A36. Pipe joint restraints shall be designed for the same design, test and surge pressure ratings as the pipeline in accordance with AWWA-M23 PVC pipe design and installation.

All restraints are to be installed as per the manufacturer's specifications and torqued using a calibrated torque wrench. If the contractor uses power equipment during installation, it shall be set so as not to over torque the bolts. Final torqueing of bolt shall be done using a torque wrench set to the proper torque.

a) Restraining PVC / PVCO Pipe to PVC Injection Moulded Fittings

100mm (4") to 300mm (12")	Clow 360C EBAA Iron Series 2600 Sigma PV-LOK Model PWPF Star PVC 3500 PF with Series 1200 bell follower Uni-Flange Series UFR 1369 Star 1200G2 (Harness)

SECTION 4 – WATERMAINS (cont'd)

4.5 Fitting and Joint Restraints (cont'd)

Approved Restrainers for PVC AWWA C900 and PVCO AWWA C909 Pressure Pipe

b) Restraining PVC / PVCO Pipe Standard Bell and Spigot Push On Joints

100mm (4") to 300mm (12")	Clow 390C EBBA Iron Series 1900 Sigma PV-LOK PWP Star PVC 3500C Series Uni-Flange Series UFR 1399 Star 1100G2 (Harness)

c) Restraining PVC / PVCO Pipe to PVC Mechanical Joint Fittings

100mm (4") to 300mm (12")	Clow 300C Clow Tuf Grip EBBAA Iron Series 19MJ00 Sigma PWM Sigma PV-LOC SLC Star PVC 3500 Series Star All Stargrip Series 4300 Uni-Flange 1500 Star 1000GS Clow Tyler Dual Wedge Tuf Grip

Approved Restrainers for PVC AWWA C900 DR25 PR165 Pressure Pipe 400mm to 600mm

a) Restraining PVC AWWA C900 DR25 Pipe to PVC Injection Moulded Fittings

400mm (16") to 600mm (24")	Clow 360C EBAA Iron Series 2500 Sigma PV-LOK Model PWPF Star Series 1200C Uni-Flange Series 1390

b) Restraining PVC AWWA C900 DR25 Pipe Standard Bell and Spigot Push On Joints

400mm (16") to 600mm (24")	Clow 390C EBBA Iron Series 2800 Sigma PV-LOK PWP Star Series 1100 Uni-Flange Series 1390C

SECTION 4 – WATERMAINS (cont'd)

4.5 Fitting and Joint Restraints (cont'd)

Approved Restrainers for PVC AWWA C900 DR25 PR165 Pressure Pipe 400mm to 600mm (cont'd)

c) Restraining PVC AWWA C900 DR25 Pipe to Mechanical Joint Fittings

400mm (16") to 600mm (24")	Clow 300C EBBAA Iron Series 2000PV Romac Series 470MJ Sigma PV-LOC PWM Star Series 1000C Uni-Flange 1500

4.6 Cathodic Protection

All Cast Iron (CI) or Ductile Iron (DI) fittings shall be protected with 14.5 kg. (32 lb.) high purity magnesium anode. The anode shall be attached to the fitting using a Cadwell and coated with mastic (Handy Cap IP).

All curb stops shall be protected with a 5.5 kg. (12 lb.) high purity zinc anode. Anode shall be attached to the curb stop using the electrical thaw nut. Fire hydrants shall be protected using 14.5 kg. magnesium anode attached using Cadwell.

Epoxy coated gate valves do not require cathodic protection unless, in the opinion of the operating authority or engineer, the epoxy coating is compromised.

All exposed nuts and bolts shall be protected using Denso Paste, Mastic and Tape. All pipe and/or fitting restraints and rods shall be protected using Denso paste, mastic and tape.

SECTION 5 - LOT SERVICING AND LOT GRADING

5.1 Lot Servicing

a) General

The servicing of all lots is to be in accordance with the standards set out in this section. Before any work is to commence in the Municipality right-of-way, approval must be given by the Municipality.

b) Sanitary Private Drain Connections

i) Pipe materials shall conform to Section 2.4.

ii) The installation of private drain connections shall meet the standards set out in Section 2.6.

iii) Each property will be provided with a private drain connection of a minimum diameter of 125 mm having a minimum slope of 2%, as per SD – 20.

iv) SD – 18 shows the orientation of the private drain connections.

v) Private drain connections to industrial, commercial, or high-density residential properties shall not be less than 150 mm diameter with an inspection manhole placed 1 – 2m within property line onto private property.

vi) Roof water leaders shall not be connected to the sanitary PDC. Connection of foundation weeping tiles to the sanitary sewer is prohibited.

c) Storm Private Drain Connections

i) Pipe materials shall conform to Section 3.4.

ii) The installation of the private drain connections shall meet the standards set out in Section 3.8.

iii) Each property will be provided with a private drain connection of a minimum diameter of 100 mm having a minimum slope of 2%, as per SD – 20.

iv) SD – 18 shows the orientation of the private drain connections.

v) Private drain connections to industrial, commercial or high-density residential properties shall not be less than 150 mm diameter with an inspection manhole placed 1 – 2m within property line onto private property.

vi) Roof water leaders shall not be directly connected to the storm sewers. Direct connection of foundation weeping tiles, as well as perimeter foundation tiles and sump pump discharge to the storm sewer is prohibited. Weeping tiles may be connected to the Storm Sewer in accordance with the Storm Sewer use by-law or pumped above the foundation elevation prior to connection into the storm PDC.

SECTION 5 - LOT SERVICING AND LOT GRADING (cont'd)

5.1 Lot Servicing (cont'd)

d) Water Services

Refer to Section 4 - Watermains, OPSD-1104.010 and OPSD-1104.020.

e) Driveways

i) All driveways shall meet the requirements shown in SD – 10.

ii) If a concrete driveway is installed, expansion joints are to be installed at the property line, at both sides of the sidewalk and at the curb.

iii) Driveways are to be designed and installed perpendicular to the roadway.

iv) No part of the driveway shall encroach upon the property boundaries when extended from the edge of the right-of-way to the roadway.

f) Utilities

i) All other utilities are to be installed in accordance with the standards of the utility company.

ii) Refer to SD – 18 for the location of required services and utilities.

5.2 Lot Grading

a) General

All subdivisions shall be graded in accordance with these specifications and the details shown on SD – 21. Lot grading plans shall be prepared by the developer and approved by the Municipality along with the subdivision servicing drawings.

Existing elevations and grading details to be shown shall include sufficient area of adjacent lands to define total drainage patterns.

In the case of single lot applications, grading details shall be shown on a site plan to include sufficient area of adjacent lands to define total drainage patterns.

b) Lot Grading Specifications

i) Yard surfaces shall have a minimum slope of 2% (in special cases 1% to be approved by the Municipality).

ii) Drainage flows shall be directed away from foundations.

iii) Drainage flows which are carried around houses are to be confined in defined swales located as far from the houses as possible.

iv) Where possible, it is preferred to have lots drain to the front of the property, rather than to a rear yard catch basin.

SECTION 5 - LOT SERVICING AND LOT GRADING (cont'd)

5.2 Lot Grading (cont'd)

b) Lot Grading Specifications (cont'd)

v) Ground elevations at buildings shall be 300mm above any adjacent downstream overland flow routes.

vi) The desirable side yard swale depth is 225 mm. The minimum allowable depth shall be 150 mm. The maximum swale depth is to be variable, but dependent on location and safety considerations.

vii) The minimum major/rear yard swale depth is 300mm, located a minimum 1.5m from rear property line with minimum 4H:IV slope.

viii) The minimum rear yard swale depth is 150mm, located a minimum 1.5m from rear property line with minimum 4H:IV slope.

ix) Grades:

- Minor swales - provides drainage for up to four lots
- The minimum grade shall be 2% (special cases 1% to be approved by the Municipality).

x) Major/rear yard swales - provide drainage for more than four lots

- The minimum grade shall be 2% (special cases 1% to be approved by the Municipality).

xi) The maximum flow in a rear yard swale shall be that from 16 back yards, depending on lot size and grade. The maximum length of a rear yard swale to a rear yard catch basin shall be 80 m. The maximum area contributing to the rear yard swale shall be 1.0 ha. The maximum flow in a rear yard swale which is discharged directly onto the road allowance, is that from six backyards.

xii) The maximum flow allowable in a side yard swale shall be that from four back yards.

SECTION 6 – CONSTRUCTION CONTRACT DOCUMENTS

6.1 General

All contract drawings are to be on the Municipality's Standard drawing size which is 559mm x 914mm. The Municipality's Standard title block is to be used and placed in the lower right-hand corner of the sheet. All drawings are to be signed and sealed by a Professional Engineer at the location provided in the title block. All drawings shall be submitted in an electronic format, AutoCAD 2018 and a pdf version. Base drawings are to be located in UTM17 North, NAD83.

6.2 Drawing Standards

All drawings must meet the following standards:

a. North shall be shown on all drawings to the top or to the right.

b. All elevations shall be to Geodetic Survey of Canada Datum.

c. A legend shall be used to indicate services as shown in SD – 22.

d. Existing conditions are to be drawn with a lighter pen than the proposed construction.

e. The zero chainage shall start at the projection of an intersecting street's center line. Chainages shall be indicated at maximum 25m stations. Where possible, the profile must be a vertical projection of the plan. Calculated chainages of the beginning and ending of horizontal or vertical curves must be noted on the plan and profile.

f. All revisions to original drawings must be recorded in a revision block and dated.

6.3 Drawings to be Submitted

The following drawings are to be submitted when applicable. (3 complete sets.)

a) Cover Sheet

The cover sheet shall indicate the following:

i) A list of drawings included in the Contract Set
iii) A Key Plan showing the location of the proposed development (scale 1:5000 or 1:10,000)
iii) The project title and the name and address of the Owner and the Consulting Engineer

b) Master Plan - Services to be constructed

A drawing showing all services to be constructed using a scale of 1:1000.

SECTION 6 – CONSTRUCTION CONTRACT DOCUMENTS (cont'd)

6.3 Drawings to be Submitted (cont'd)

c) Lot Grading Plans

The lot grading plan shall meet the following requirements:

i) Indicate north by an arrow on the plan.

ii) Basic Plan:
   i) scale 1:250
   ii) show all existing and proposed lot numbers
   iii) indicate all lots that are semi-detached (SD) or back split (BS)
   iv) show all lot frontages and depths
   v) show all street names
   vi) show all sidewalks to be constructed by the Subdivider

iii) Elevations that are to be shown on the Grading Plan include:
   i) all elevations are to be Geodetic
   ii) final center line of road elevation every 25 m
   iii) final ground elevations at lot corners and house corners
   iv) for single lot applications, the difference between the building sill elevation and the center road elevation shall be shown. The rear lot difference to sill elevation shall also be shown.
   v) existing ground elevations are to be shown by means of spot elevations and contours. These contours shall extend a minimum of 25 m beyond the limit of the plan

iv) Drainage Information
   i) show the location and direction of flows of swales by means of arrows. At least one arrow is to be shown at the rear of each lot, with swale centerline elevations noted at minimum along all property lines.
   ii) show the location and direction of overland flow routes by means of bold arrows.
   iii) show the location and direction of swales by means of waved arrows.
   iv) show all proposed rear lot catch basins, leads and easements.

See Drawing SD – 22 for typical arrows.

d) General Plan - Sanitary Sewer System
A drawing showing the Sanitary Sewerage System and Areas to a scale of 1:1000, including Sanitary Design Sheet.

e) General Plan - Storm Drainage System
A general plan to a scale of 1:1000 showing the Storm Drainage System and Drainage Areas, including Storm Design Sheet.

f) General Plan - Water Distribution System
A drawing showing the existing and proposed water distribution system to a scale of 1:1000.

SECTION 6 – CONSTRUCTION CONTRACT DOCUMENTS (cont'd)

6.3 Drawings to be Submitted (cont'd)

g) Plan and Profile
A plan and profile drawing for each street in the subdivision and all rear yard catch basin leads. These drawings shall include all pertinent information as deemed necessary by the Municipality, including all proposed individual lot services. The location and brief description of soil investigations shall be shown on the plan and profile drawings. (Boreholes)

Scale - Horizontal	1:250
Vertical	1:50

h) Detailed Drawings

The detailed drawings shall include all details necessary for the proper construction of the works. It will be the Developer's responsibility to ensure that the Contractor is provided with the miscellaneous details included in these Servicing Standards and other various details for the completion of the project.

Detail drawings are to show details of manholes, catch basins, curb and gutters, sidewalks, road allowance cross sections, headwalls, open channel cross sections and other special structures.

In general, detail drawings of watermain and sewer appurtenances are to be drawn to a scale of 1:20 and in no case less than 1:50. Except for the details of bedding cross sections for sewers and watermains, all other details are not to be shown on the same drawings as for plan and profile, but on separate drawings.

i) Typical Road Cross-Section

j) General Plan - Street Lighting
A general plan to a scale of 1:1000 showing the proposed street lighting layout.

6.4 Contract Specifications

In general, contract specifications are to be printed on standard 8.5" x 11" paper. The following sections should be included in the specifications:

Information to Tenderers

Form of Tender

General Specifications

Special Provision (Supplementary Specifications)

General Conditions

SECTION 7 – "AS-CONSTRUCTED" DRAWINGS

7.1 General

On completion of the work and prior to the assumption of services by the Municipality, final "as-constructed" are to be submitted to the Municipality for the above and below ground services (plan and profile) and details of special structures as required by the Municipality. The scales of these drawings are to be as indicated under Section 6 – Construction Contract Documents.

The drawings must be revised to show the services as they were actually constructed. The completed works shall be on a USB and must be of a quality acceptable to the Municipality.

The Municipality shall be provided with one USB and two sets of prints of all the "as-constructed" drawings used for the project.

7.2 Drawing Requirements

The following details shall be shown on the Contract Drawings and shall be amended to indicate the "as-constructed" locations of all services:

a. Street names

b. Registered plan numbers, lot numbers, and/or Municipal number, lot lines, street lines, frontages, and easements

c. Ties to property bars for all water services (0.2m accuracy)

d. The location and elevation shown on the profile of all services encountered while undertaking the work (0.2m location accuracy, 0.02m elevation accuracy)

e. The location on plan of all services (0.2m accuracy)

f. The full details for all services i.e., sizes, grades, materials, elevations, etc.

g. The chainage of private drain connections measured from the nearest downstream manhole (0.2m accuracy)

h. Center line road profile (25m minimum intervals)

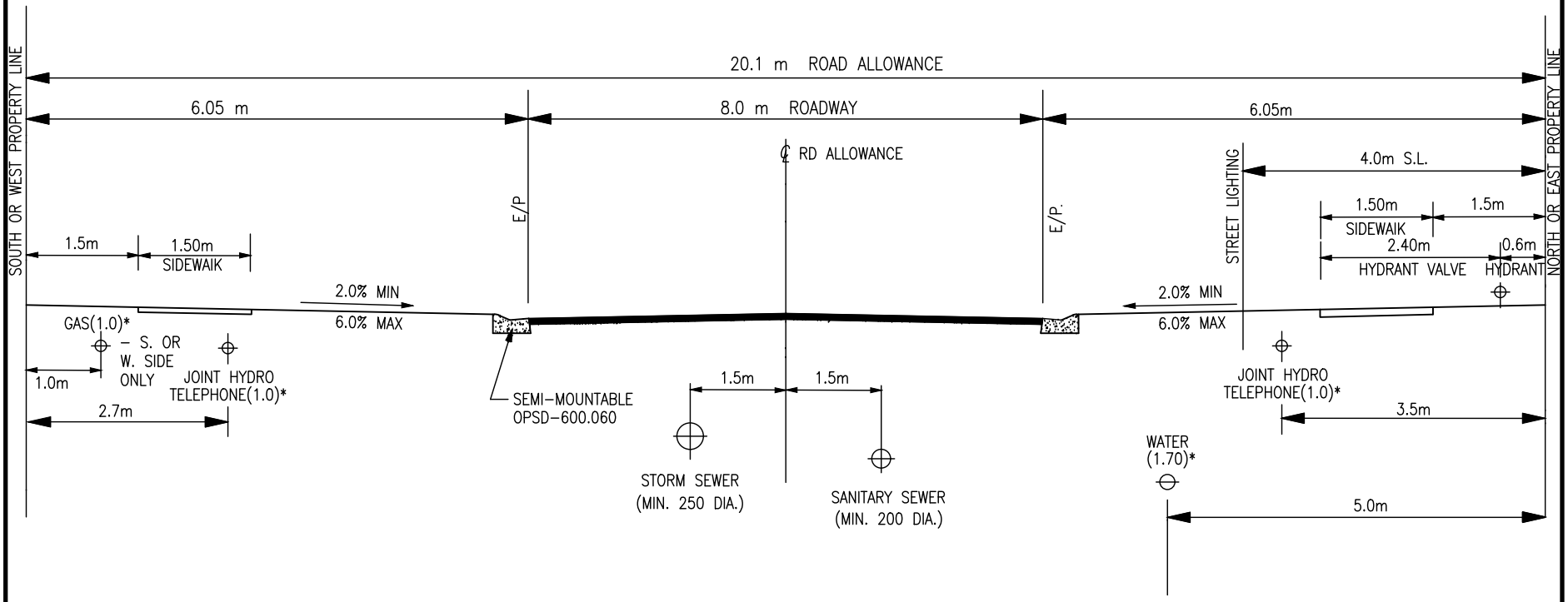
i. A note on each plan and profile drawing stating that "All elevations related to Geodetic Benchmark No. :_____ Elevation _____

j. The digital as-constructed drawing should be geo-referenced shape files and include all items such as water, sanitary sewer, storm sewer and roadwork

LIST OF STANDARD DRAWINGS

Municipality of Southwest Middlesex

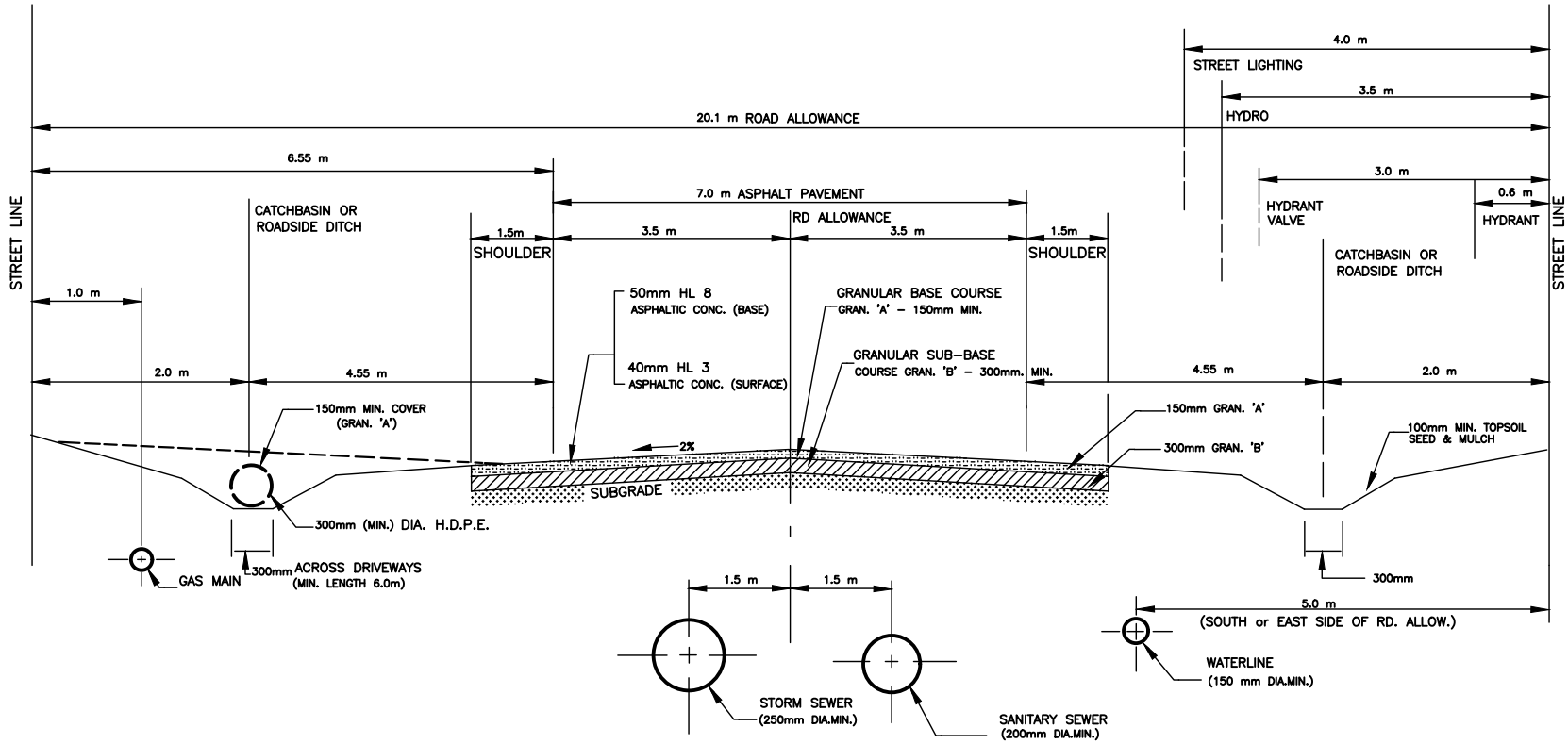
Standard Drawing	Description
SD – 1	Utility Locations for Residential Roads
SD – 2	Standard R.O.W. Residential Asphalt - Ditches
SD – 3	Utility Locations for Industrial Roads
SD – 4	Standard for Circular Cul-de-Sac
SD – 5	Industrial Cul-de-Sac
SD – 6	Collector/Arterial Roadway Residential
SD – 7	Local Roadway Residential
SD – 8	Industrial Roadway
SD – 9	Walkway Details
SD – 10	Standard Single and Double Entrance Driveway
SD – 11	Standard for Street Curve
SD – 12	Capacity Factor for Uncertain Development
SD – 13	Sanitary Sewage Flows Gross Area Basis
SD – 14	Pipe Beddings Detail (1 of 2)
SD – 15	Pipe Bedding Detail (2 of 2)
SD – 16	Rainfall Intensity-Duration Curve for Storm Sewer Design
SD – 17	600x840 Precast Concrete Curb Inlet Catchbasin
SD – 18	Lot Servicing
SD – 19	Water Sampling Station
SD – 20	Private Drain Connections at Street Line
SD – 21	Typical Lot Drainage Plan
SD – 22	Plan and Profile Legend
SD – 23	Standard Mechanical Joint Offset Installation Using Tiebolt Couplings
SD – 24	Typical Restraint Details
SD – 25	Insulation of Watermain and Offsets
SD – 26	Minimum Easement Width



NOTES:

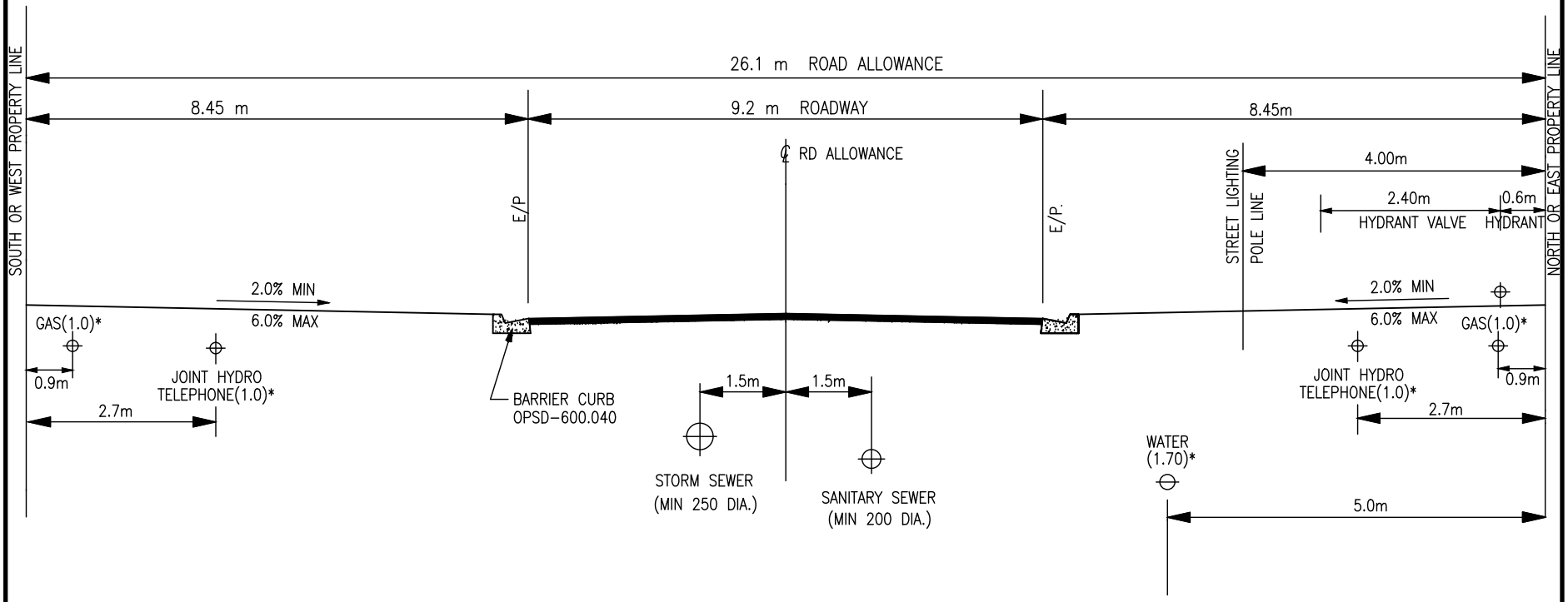
- –* MINIMUM DEPTH OF COVER SHOWN BELOW GROUND
- – ALL DIMENSIONS IN METERS UNLESS SHOWN OTHERWISE
- – WATERMAINS AND SANITARY SEWERS TO BE LOCATED ON NORTH OR EAST SIDES
- – STORM SEWERS TO BE LOCATED ON SOUTH OR WEST SIDES
- – TELEPHONE,HYDRO,AND LIGHTING TO BE LOCATED ON COMMON POLE

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
UTILITY LOCATIONS FOR RESIDENTIAL ROADS 20.1m ROAD ALLOWANCE	
FEBRUARY 2021	SD – 1



STANDARD RIGHT–OF–WAY CROSS–SECTION FOR RESIDENTIAL STREETS WITH ASPHALTIC CONCRETE PAVEMENT AND ROADSIDE DITCH

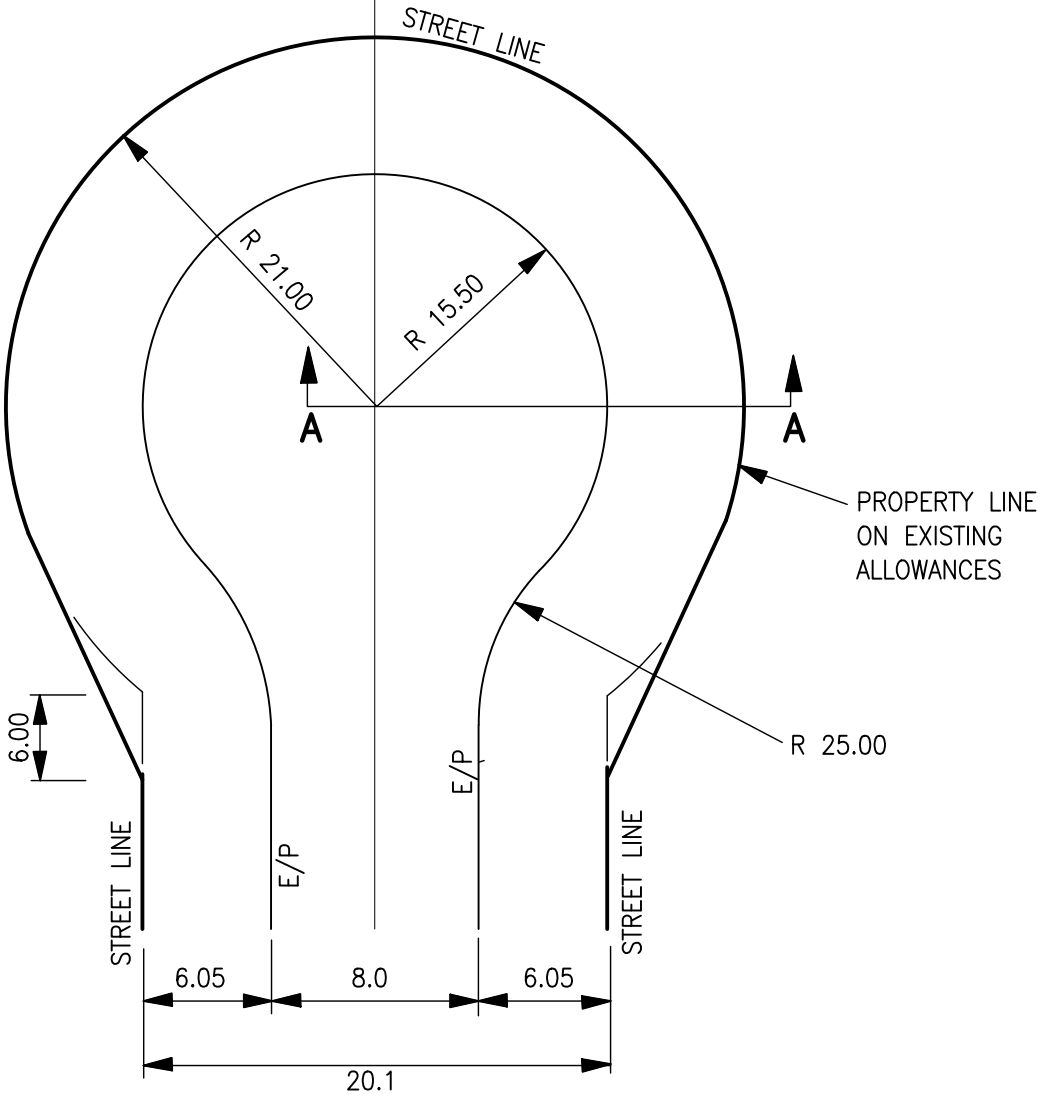
MUNICIPALITY OF SOUTHWEST MIDDLESEX	
STANDARD R.O.W. RESIDENTIAL ASPHALT – DITCHES	
FEBRUARY 2021	SD – 2

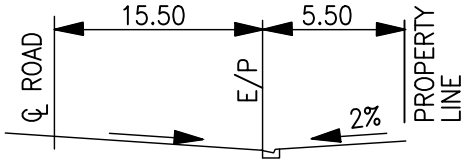


NOTES:

- -* MINIMUM DEPTH OF COVER SHOWN BELOW GROUND
- - ALL DIMENSIONS IN METERS UNLESS SHOWN OTHERWISE
- - WATERMAINS AND SANITARY SEWERS TO BE LOCATED ON NORTH OR EAST SIDES
- - STORM SEWERS TO BE LOCATED ON SOUTH OR WEST SIDES
- - TELEPHONE,HYDRO,AND LIGHTING TO BE LOCATED ON COMMON POLE

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
UTILITY LOCATIONS FOR INDUSTRIAL ROADS 26.1m ROAD ALLOWANCE	
FEBRUARY 2021	SD – 3



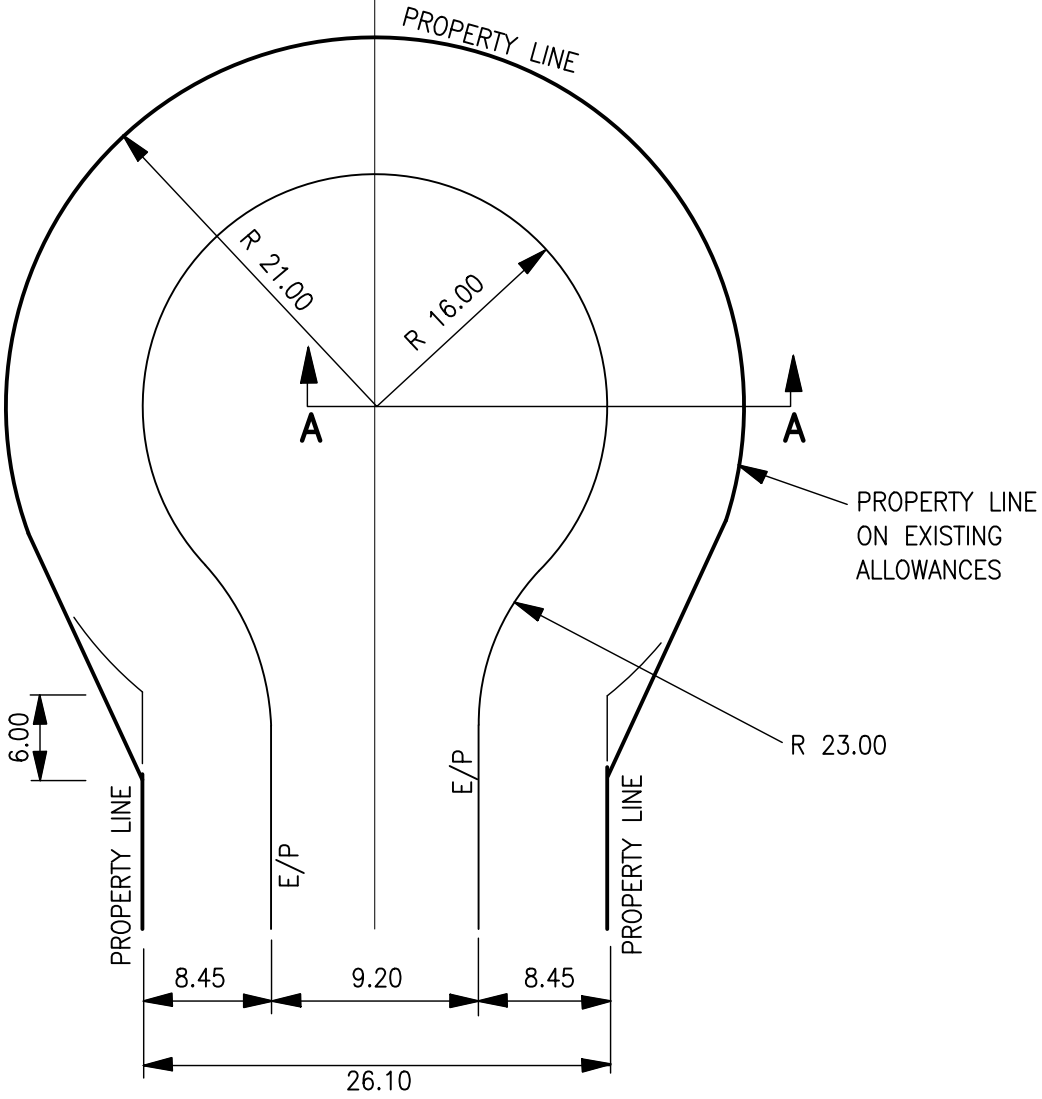


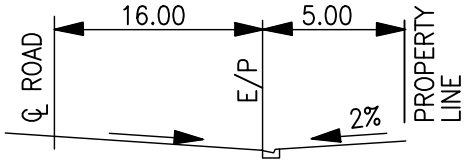
SECTION A–A

NOTES:

1. ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE
2. A 1.50 m WIDE SIDEWALK SHALL BE INSTALLED IF DIRECTED BY THE MUNICIPALITY
3. CURB AND GUTTER PER OPSD–600.060

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
STANDARD FOR CIRCULAR CUL–DE–SAC	
FEBRUARY 2021	SD – 4



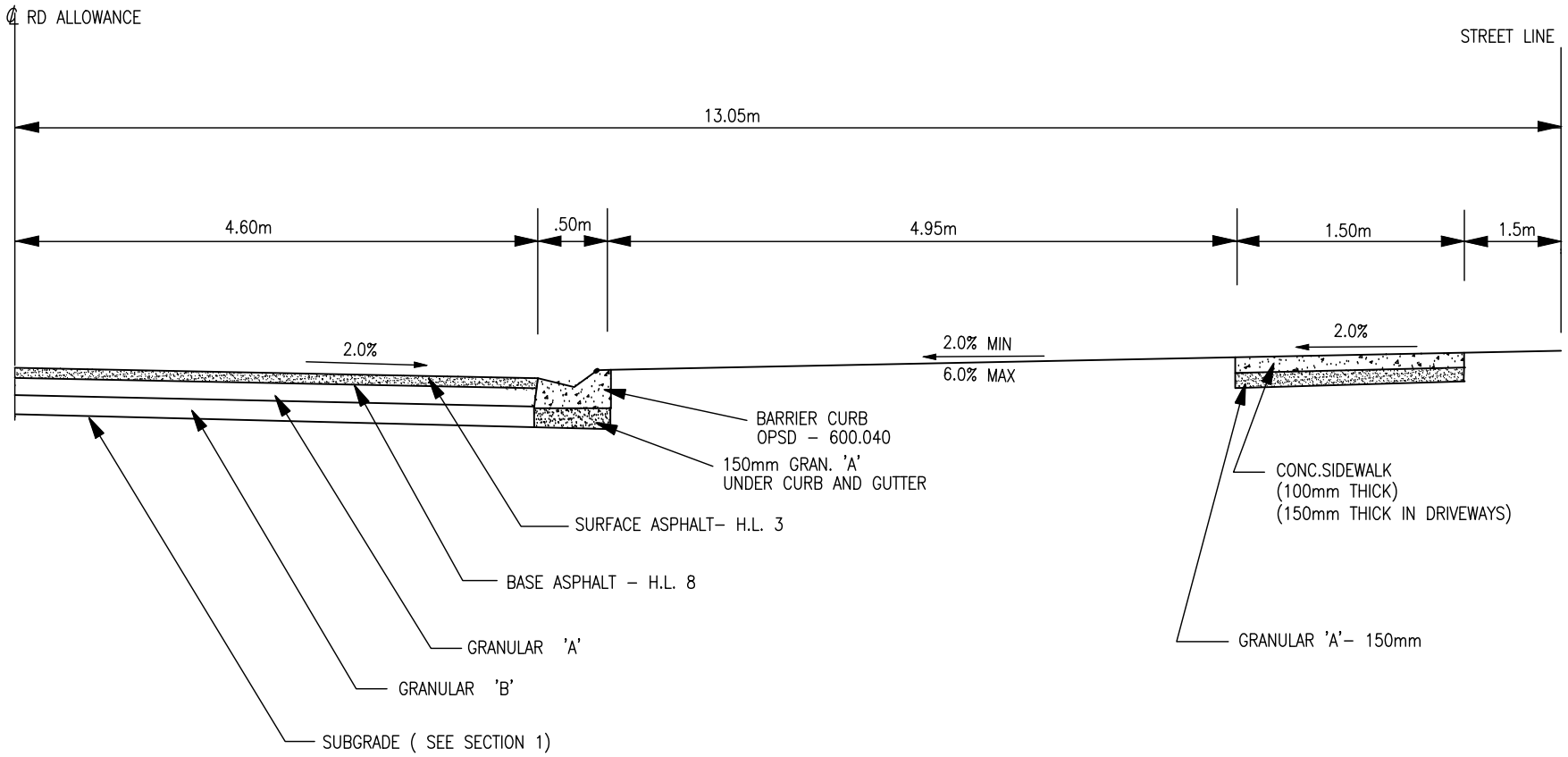


SECTION A–A

NOTES:

1. ALL DIMENSIONS IN METRES UNLESS SHOWN OTHERWISE
2. CURB AND GUTTER PER OPSD–600.040

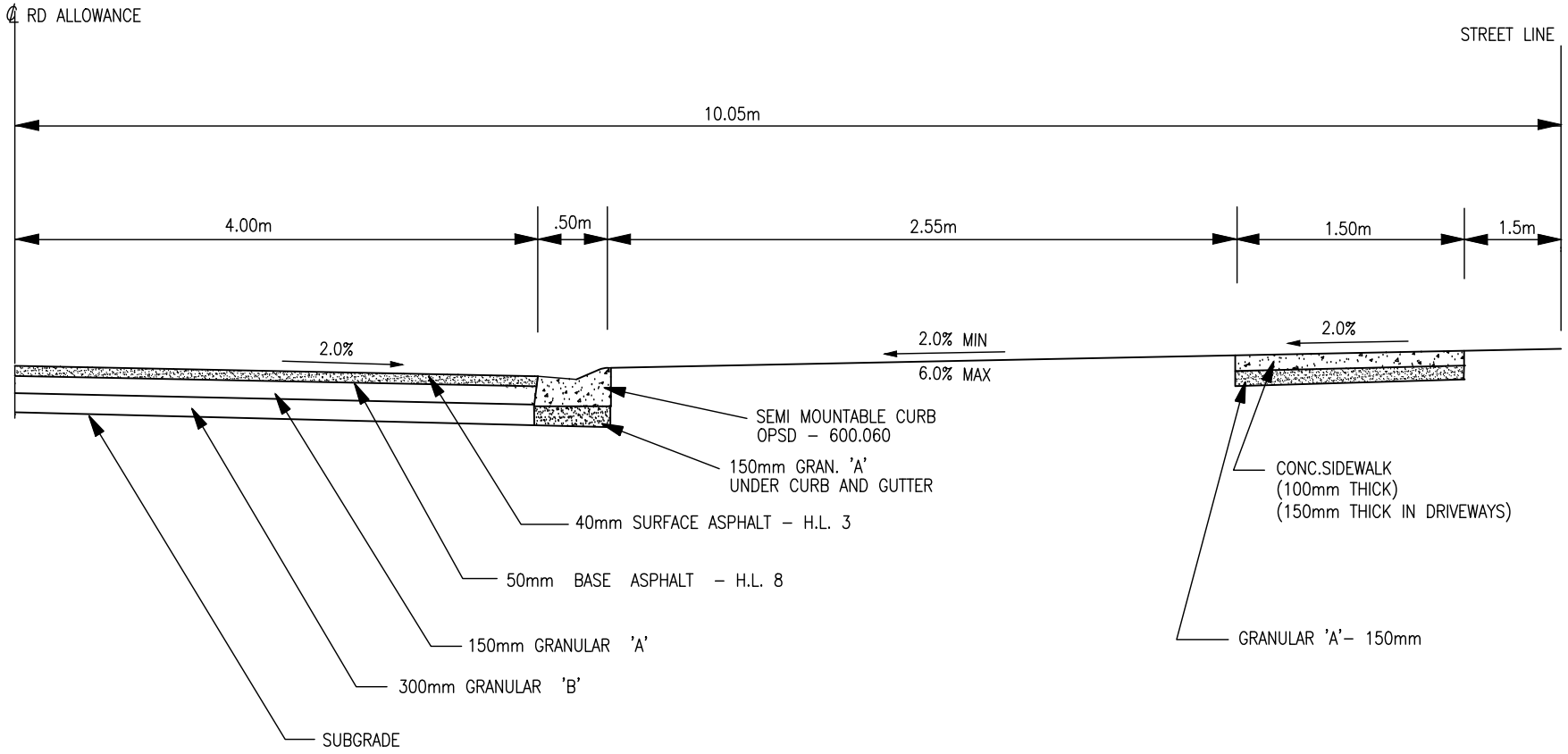
MUNICIPALITY OF SOUTHWEST MIDDLESEX	
INDUSTRIAL CUL–DE–SAC	
FEBRUARY 2021	SD – 5



NOTES:

1 – SEE SERVICING STANDARDS
2 – CROWN OF ROAD TO BE 2%.
3 – 2% OF CROSSFALL TO BE USED IN SIDEWALK CONSTRUCTION.(MAX. 4%)
4 – CONCRETE FOR CURBS AND SIDEWALKS TO BE 30 mpa AT 28 DAYS.
5 – ALL ASPHALT TO BE COMPACTED TO 97% MARSHALL DENSITY.
6 – ALL GRANULAR MATERIALS TO BE COMPACTED TO 100% S.P.M.D.D.

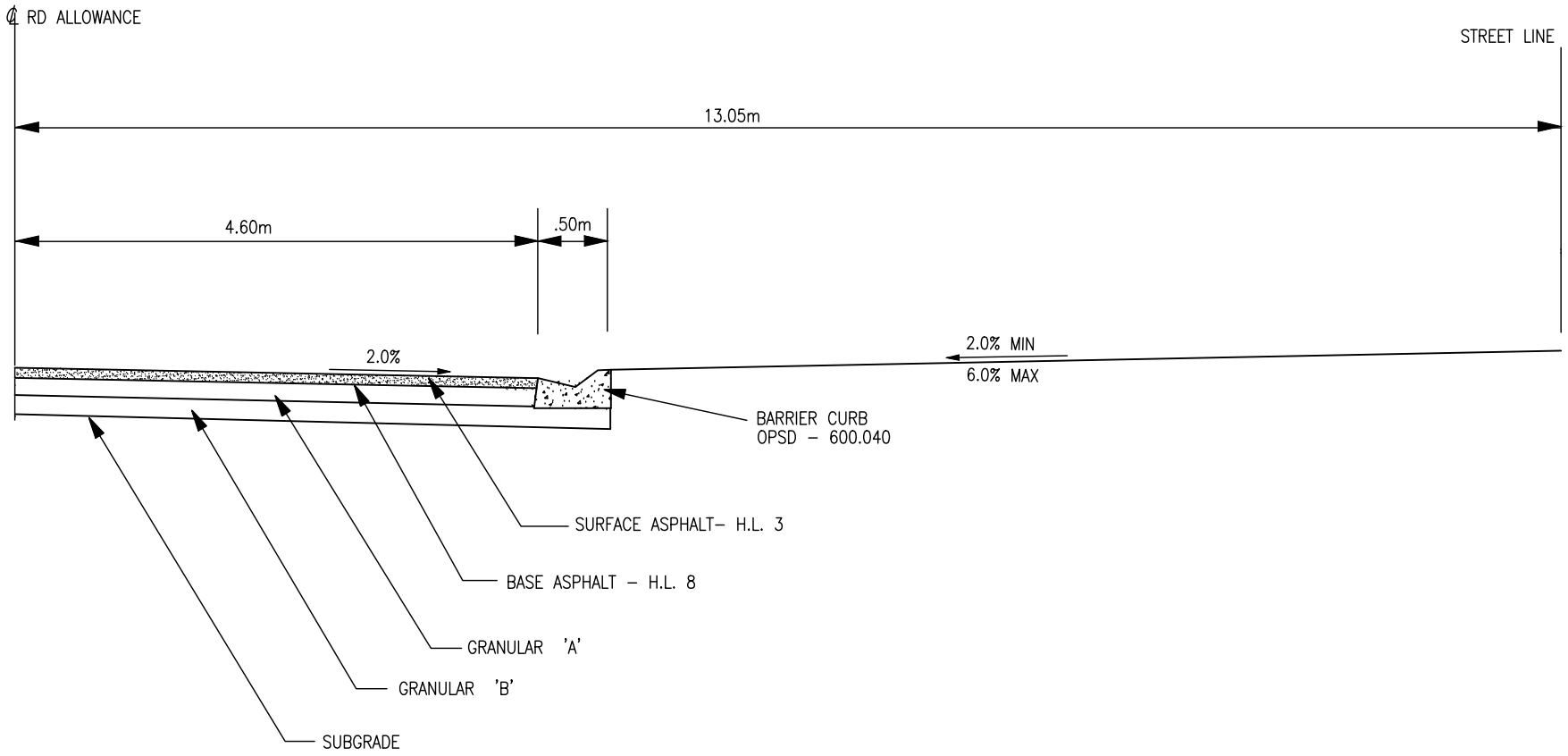
MUNICIPALITY OF SOUTHWEST MIDDLESEX	
COLLECTOR / ARTERIAL ROADWAY RESIDENTIAL 26.1m ROAD ALLOWANCE	
FEBRUARY 2021	SD – 6



NOTES:

1 – SEE SERVICING STANDARDS
2 – CROWN OF ROAD TO BE 2%.
3 – 2% OF CROSSFALL TO BE USED IN SIDEWALK CONSTRUCTION.(MAX. 4%)
4 – CONCRETE FOR CURBS AND SIDEWALKS TO BE 30 mpa AT 28 DAYS.
5 – ALL ASPHALT TO BE COMPACTED TO 97% MARSHALL DENSITY.
6 – ALL GRANULAR MATERIALS TO BE COMPACTED TO 100% S.P.M.D.D.

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
LOCAL ROADWAY RESIDENTIAL 20.1m ROAD ALLOWANCE	
FEBRUARY 2021	SD – 7



NOTES:

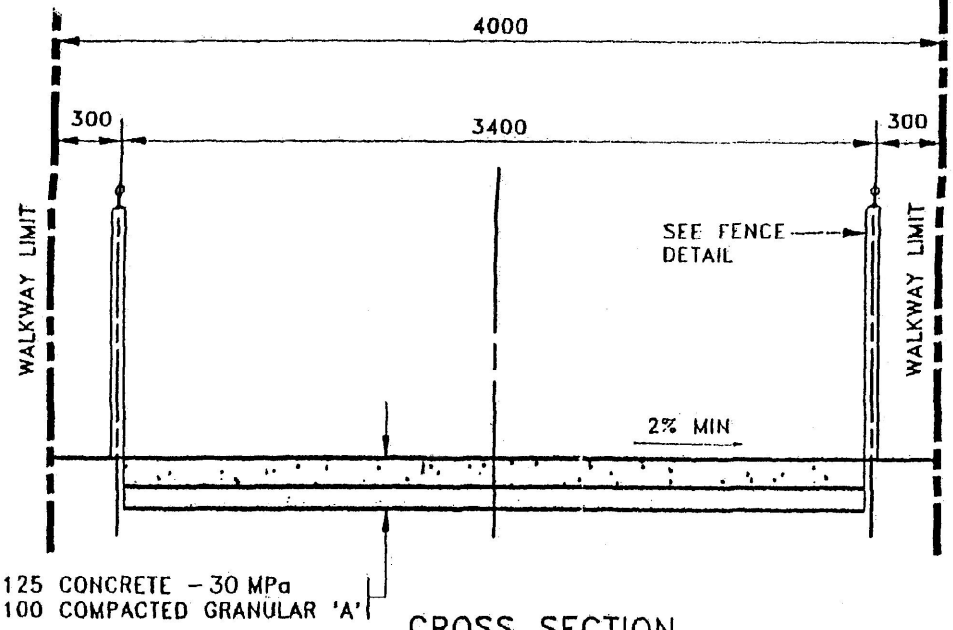
1 – SEE SERVICING STANDARDS.
2 – CROWN OF ROAD TO BE 2%.
3 – 2% OF CROSSFALL TO BE USED IN SIDEWALK CONSTRUCTION.(MAX 4%)
4 – CONCRETE FOR CURBS AND SIDEWALKS TO BE 30 mpa AT 28 DAYS.
5 – ALL ASPHALT TO BE COMPACTED TO 97% MARSHALL DENSITY.
6 – ALL GRANULAR MATERIALS TO BE COMPACTED TO 100% S.P.M.D.D.

MUNICIPALITY OF SOUTHWEST MIDDLESEX

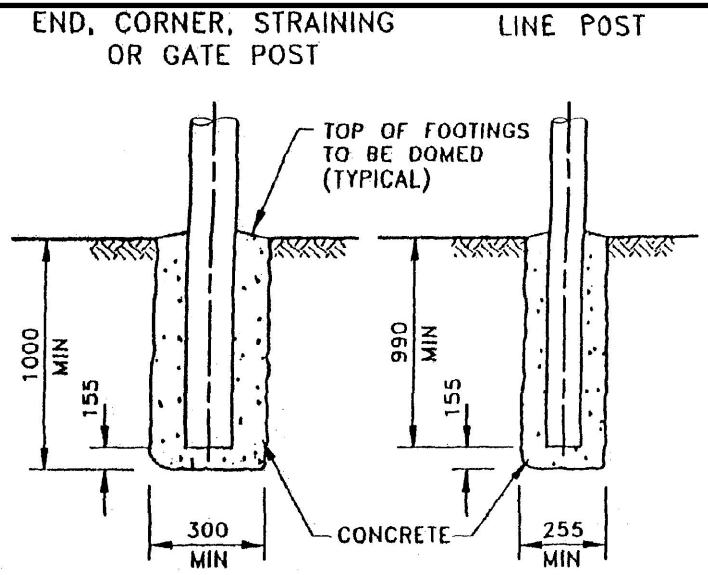
INDUSTRIAL ROADWAY

26.1m ROAD ALLOWANCE

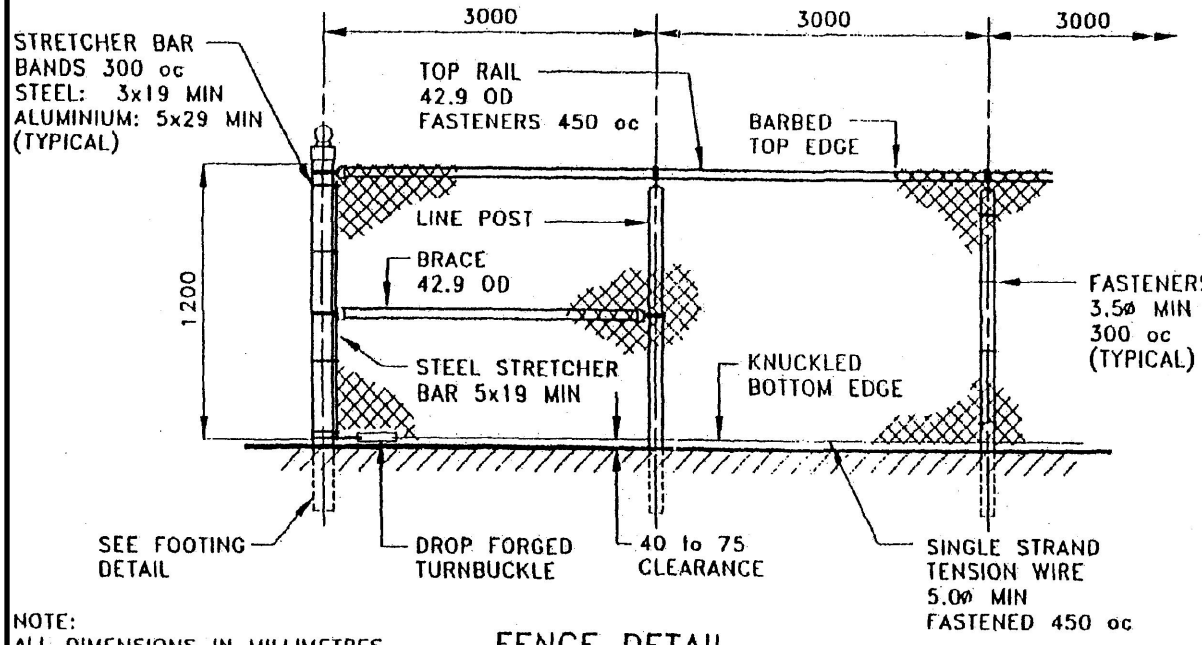
FEBRUARY 2021 | SD – 8



CROSS SECTION



FOOTING DETAIL



FENCE DETAIL

NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS SHOWN OTHERWISE

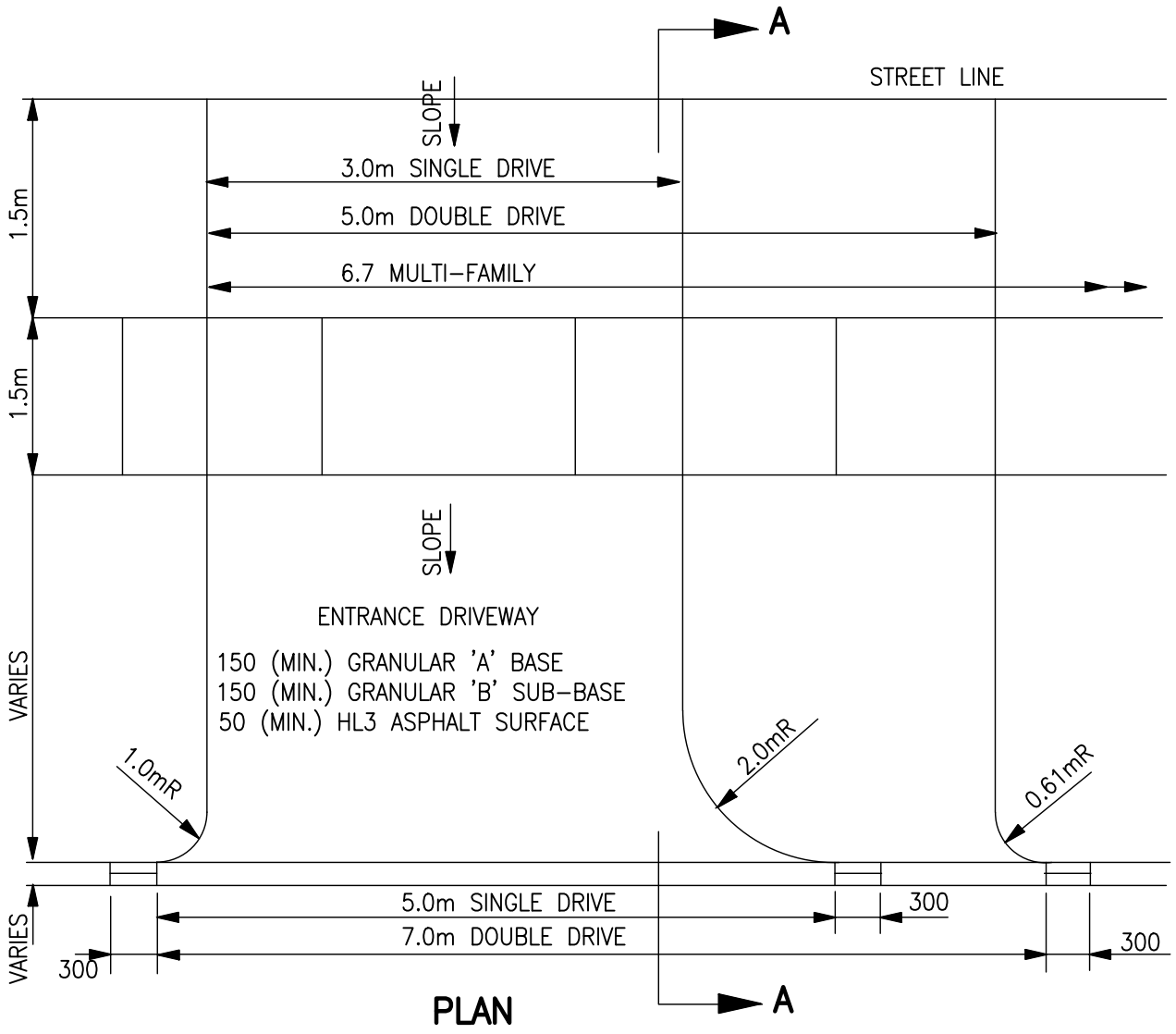
POST DETAILS			
DESCRIPTION	OD	LENGTH	
		STANDARD	RET. WALL
LINE	60.3	2700	2000
END, CORNER, STRAINING AND GATE (WITH 5.5m MAX OPENING)	88.9	2900	2300
GATE (WITH 10.0 MAX OPENING)	114.3	2900	–

MUNICIPALITY OF SOUTHWEST MIDDLESEX

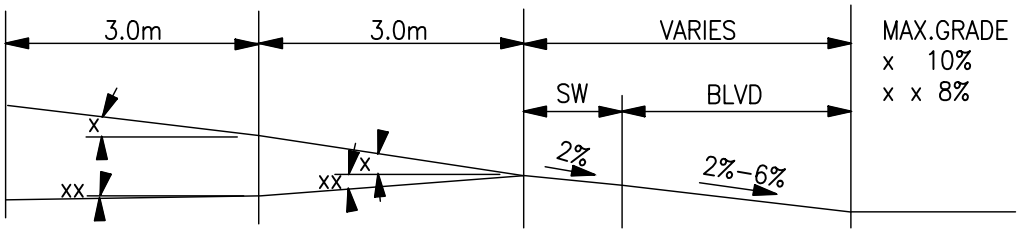
WALKWAY DETAILS

FEBRUARY 2021

SD – 9



PLAN

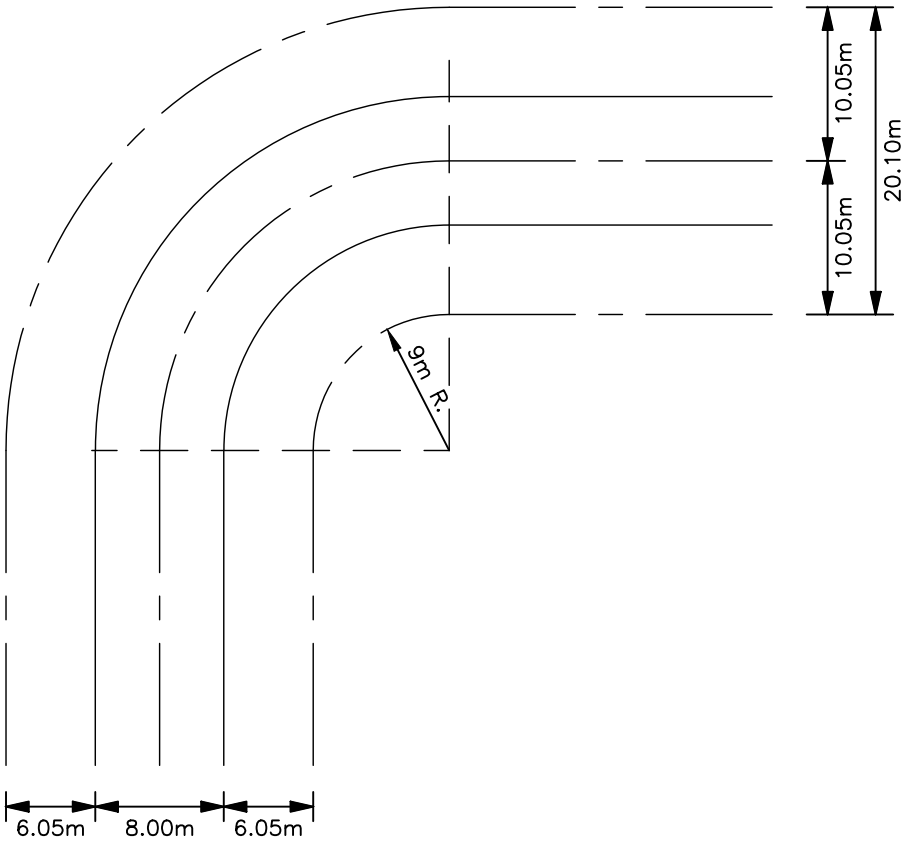


SECTION A-A

NOTES:

1. RADII OF MULTI-FAMILY DRIVEWAYS AT CURB SHALL BE: INGRESS 3.0m, EGRESS 1.8m.

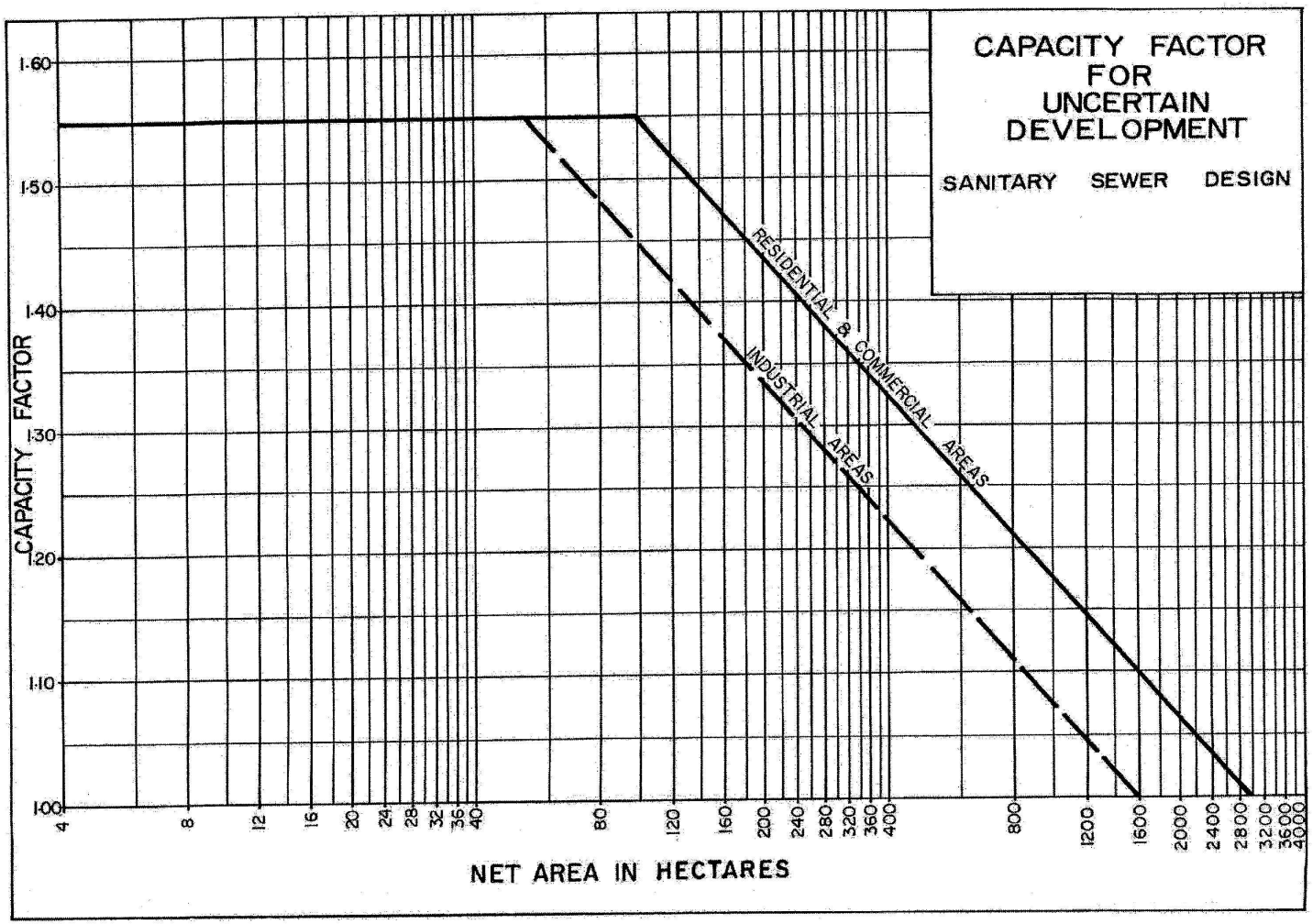
MUNICIPALITY OF SOUTHWEST MIDDLESEX	
STANDARD SINGLE AND DOUBLE ENTRANCE DRIVEWAY	
FEBRUARY 2021	SD – 10



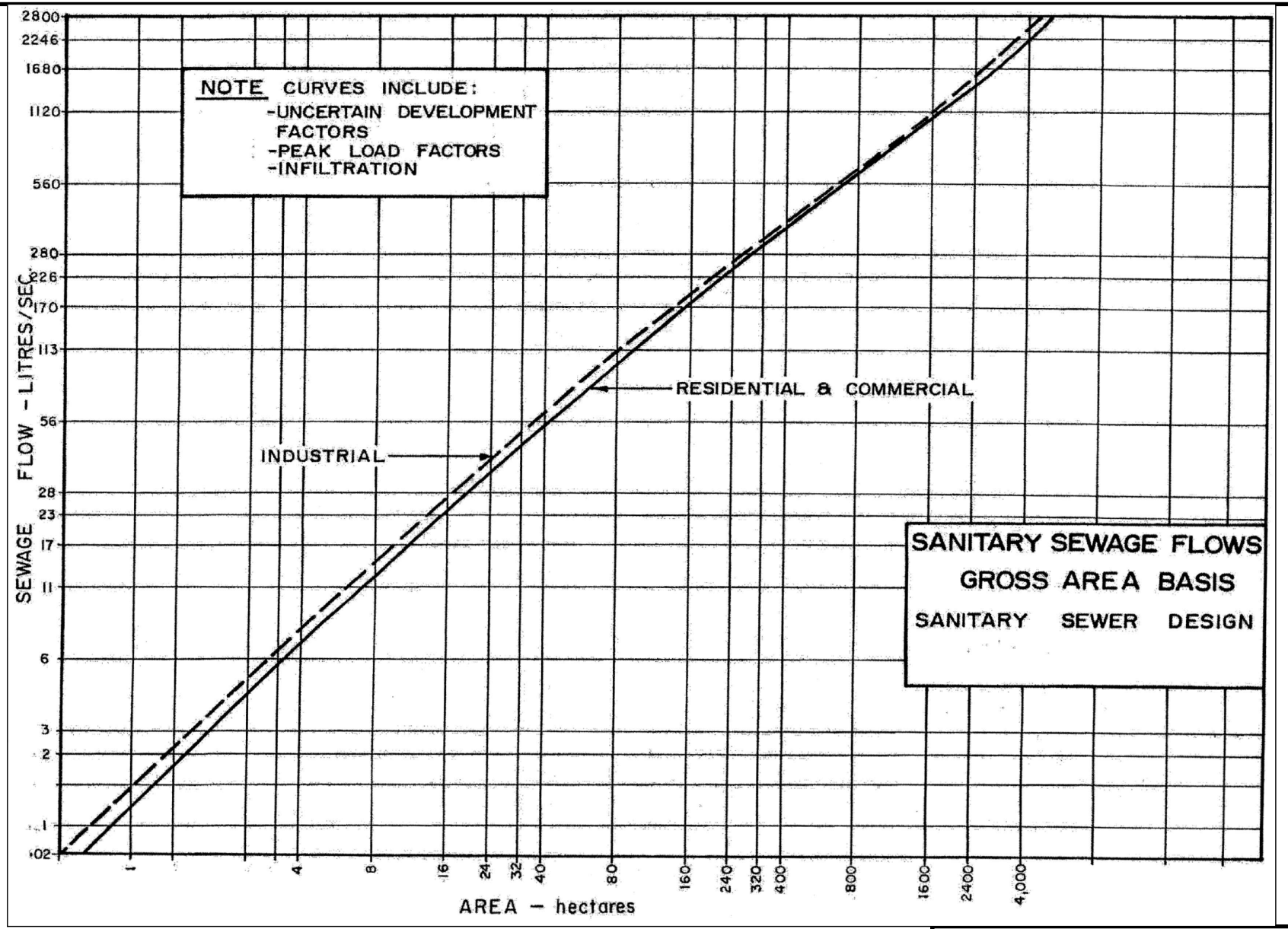
NOTES:

ALL DIMENSIONS SHOWN ARE MINIMUM REQUIREMENTS.

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
STANDARD FOR STREET CURVE	
FEBRUARY 2021	SD – 11



MUNICIPALITY OF SOUTHWEST MIDDLESEX	
CAPACITY FACTOR FOR UNCERTAIN DEVELOPMENT SANITARY SEWER DESIGN	
FEBRUARY 2021	SD – 12



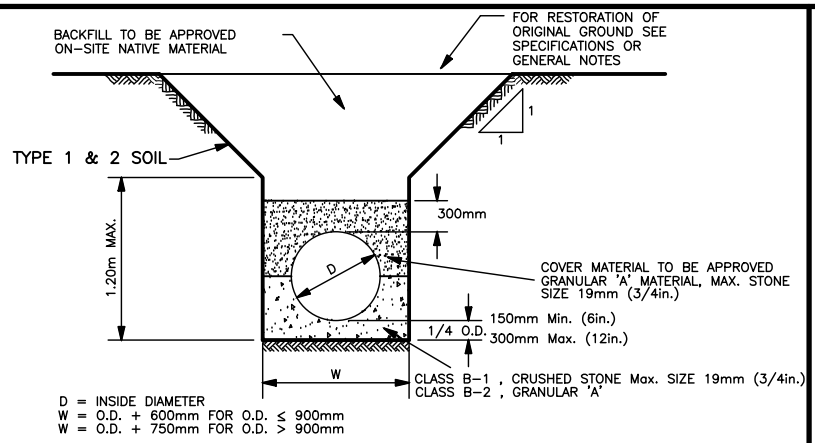
MUNICIPALITY OF SOUTHWEST MIDDLESEX

SANITARY SEWAGE FLOWS GROSS AREA BASIS

SANITARY SEWER DESIGN

FEBRUARY 2021

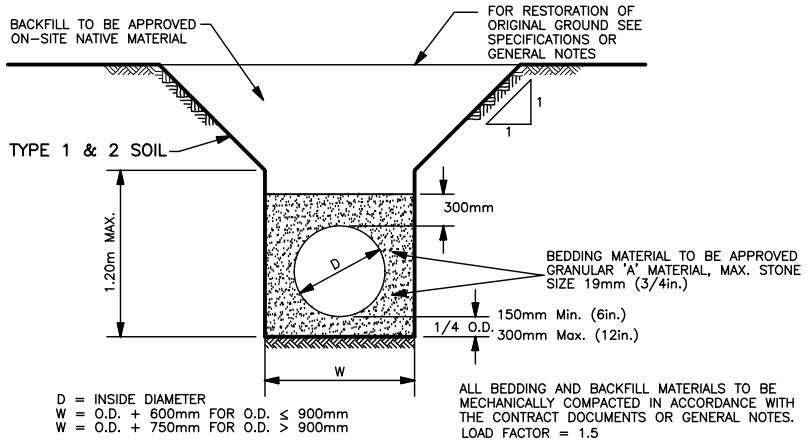
SD – 13



ALL BEDDING AND BACKFILL MATERIALS TO BE MECHANICALLY COMPACTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS OR GENERAL NOTES.
LOAD FACTOR = 1.9

BEDDING DETAIL FOR RIGID SEWER PIPE CLASS B

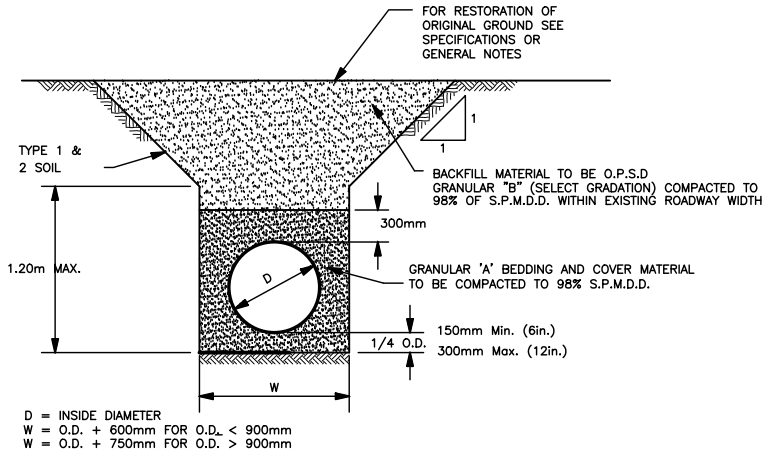
N.T.S.



ALL BEDDING AND BACKFILL MATERIALS TO BE MECHANICALLY COMPACTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS OR GENERAL NOTES.
LOAD FACTOR = 1.5

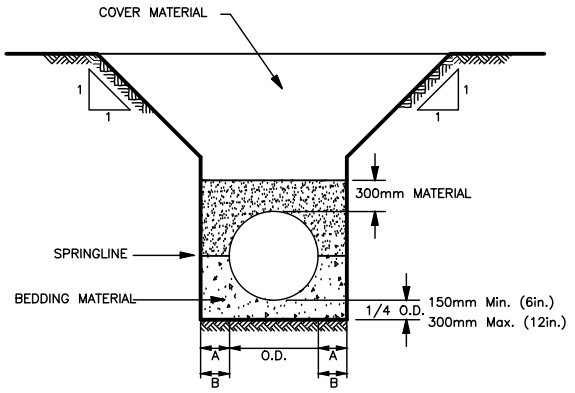
BEDDING DETAIL FOR RIGID SEWER PIPE CLASS C

N.T.S.



BEDDING DETAIL FOR TYPICAL FLEXIBLE SEWER PIPE AND WATERMAIN

N.T.S.



A – 300mm MINIMUM FOR PIPE 100mm TO 900mm O..D.

B – 375mm MINIMUM FOR PIPE GREATER THAN 900mm O.D.

TRENCH DIMENSIONS FOR TYPICAL SEWER AND WATERMAIN INSTALLATION

N.T.S.

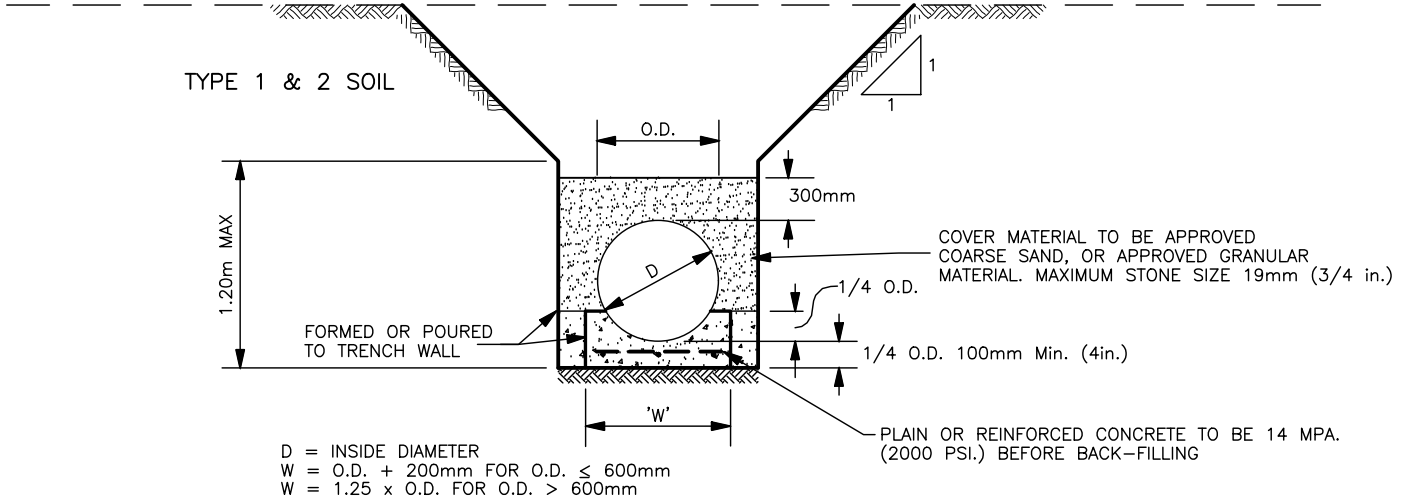
MUNICIPALITY OF SOUTHWEST MIDDLESEX

PIPE BEDDING DETAILS

(1 OF 2)

FEBRUARY 2021

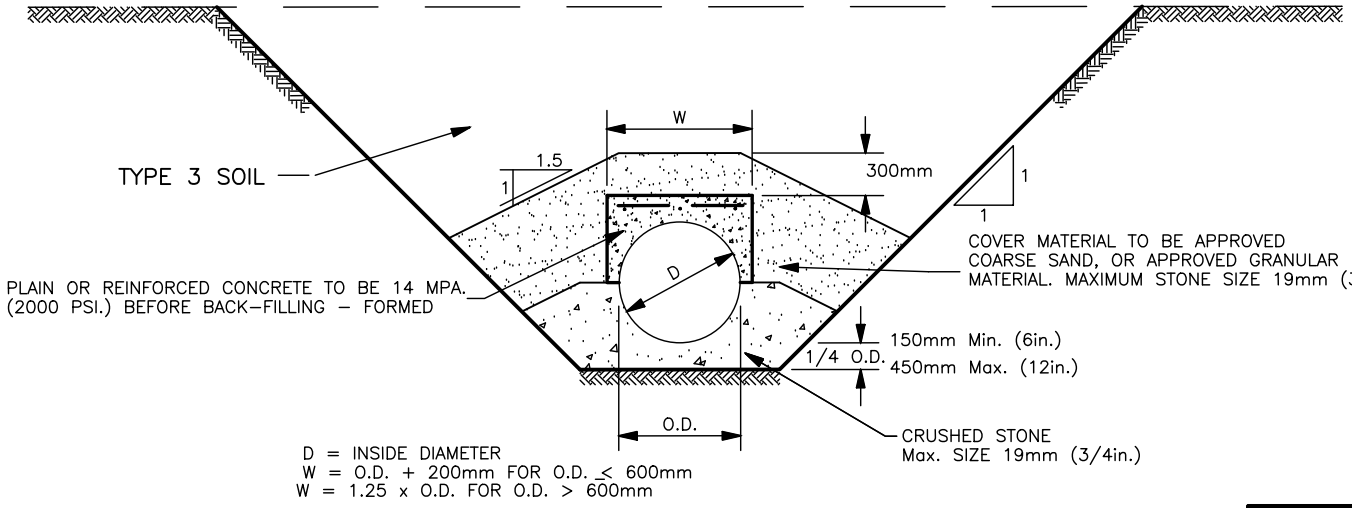
SD – 14



BEDDING DETAIL FOR CLASS A – 1

N.T.S.

ALL BEDDING MATERIALS TO BE MECHANICALLY COMPACTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.



ALL BEDDING MATERIALS TO BE MECHANICALLY COMPACTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

BEDDING DETAIL FOR CLASS A – 2

N.T.S.

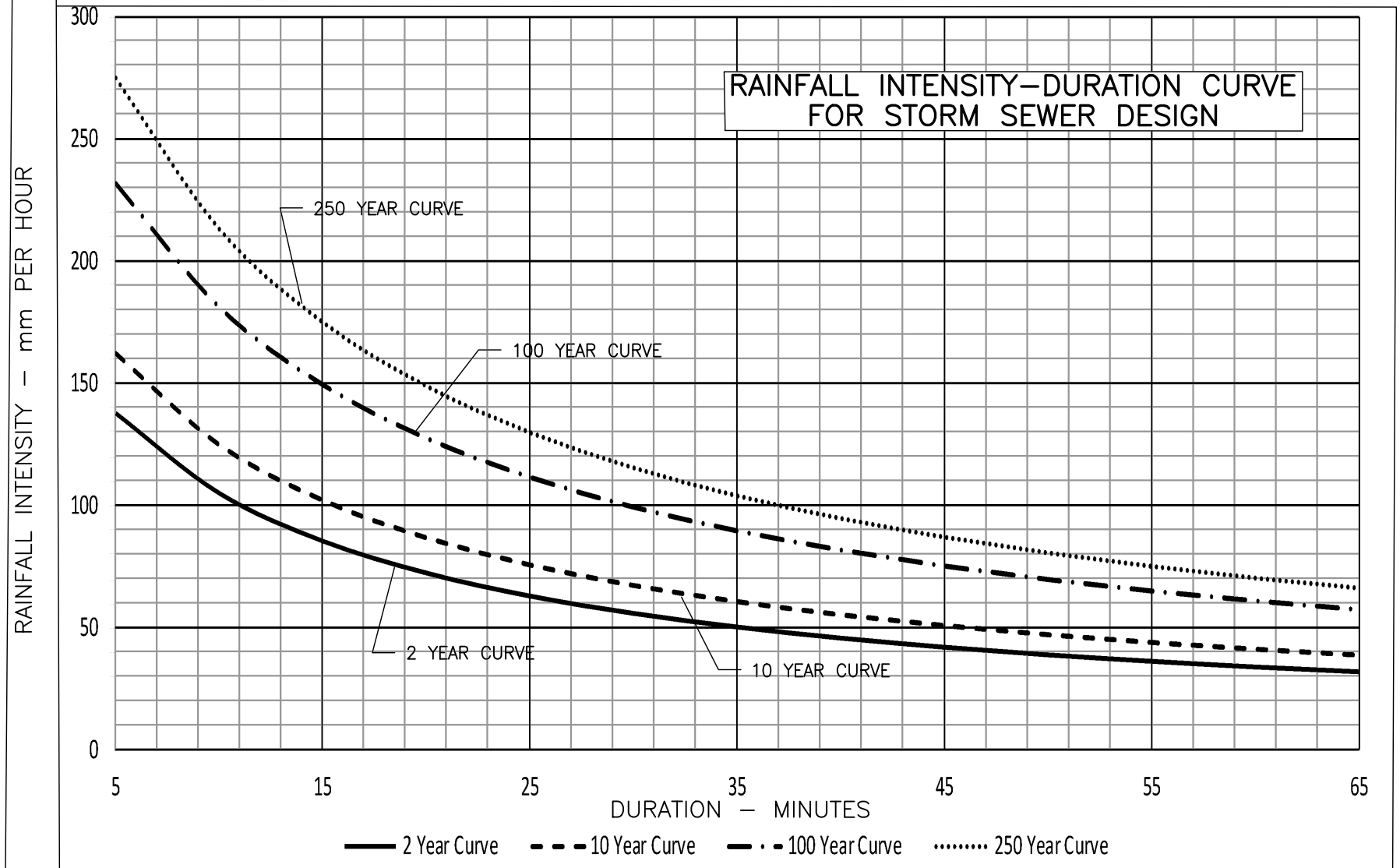
MUNICIPALITY OF SOUTHWEST MIDDLESEX

PIPE BEDDING DETAILS

(2 OF 2)

FEBRUARY 2021

SD – 15



MUNICIPALITY OF SOUTHWEST MIDDLESEX

RAINFALL INTENSITY–DURATION CURVE FOR STORM SEWER DESIGN

FEBRUARY 2021

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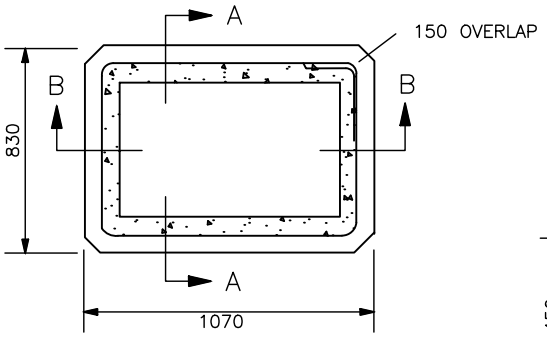
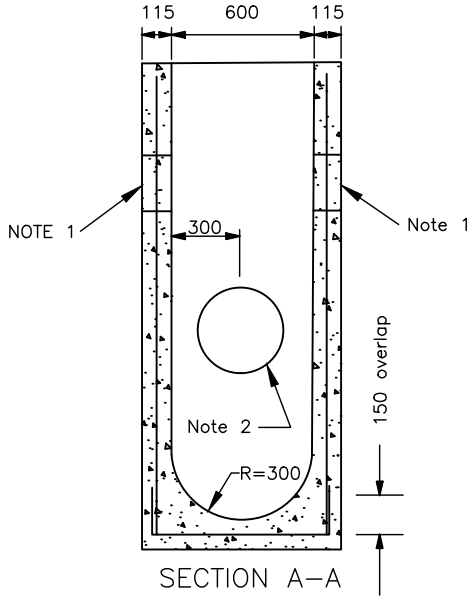
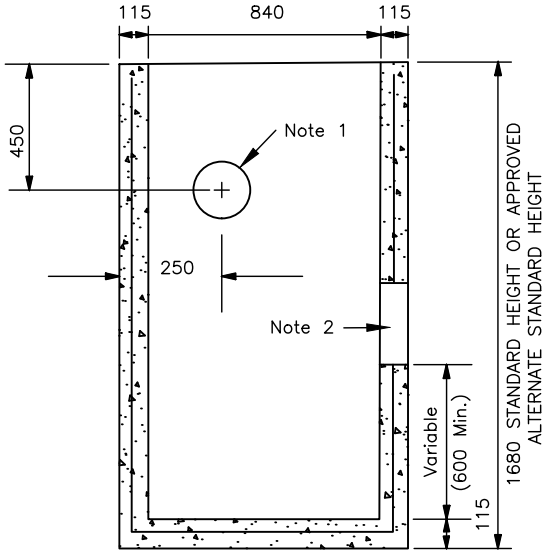


PLAN



SECTION A–A



SECTION B–B

A. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.

NOTES:

1. 200mm dia. knockout to accommodate subdrain. Knockout to be half wall thickness from the outside.
2. Outlet hole size 400mm dia. location as required.
3. All reinforcing steel bars to be 15. Reinforcing steel shall have 50mm cover.
4. Granular backfill to be placed and compacted to a min. thickness of 300mm all around.
5. Adjustment units shall be installed as per OPSD–704.010.
6. Class of concrete: 30Mpa at 28 days.
7. Refer to OPSD–400.09 for catch basin cast iron curb inlet overflow plate details.

MUNICIPALITY OF SOUTHWEST MIDDLESEX

600x840 PRECAST CONCRETE CURB INLET CATCHBASIN

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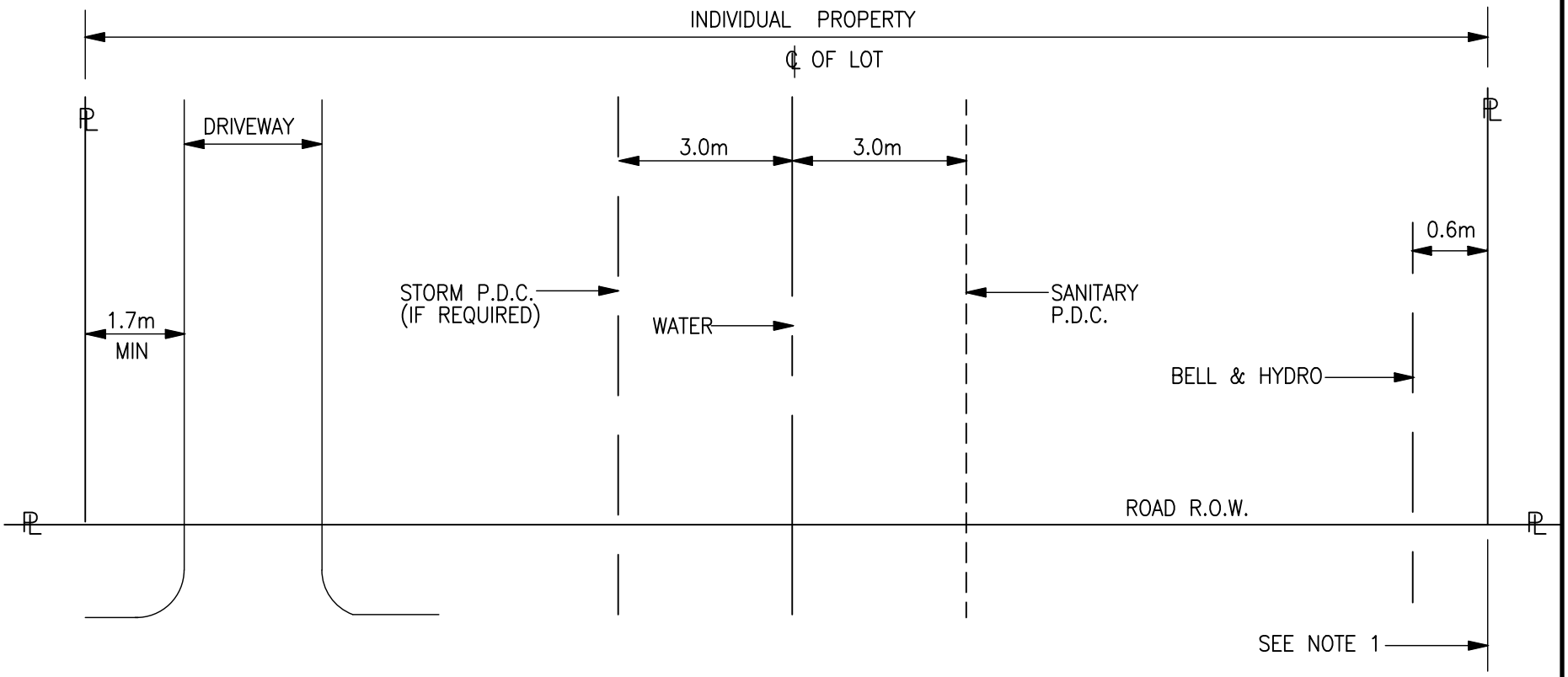

NOTES:

1. ALL HYDRANTS,PADMOUNTS TRANSFORMERS AND STREET LIGHT POLES ARE TO BE INSTALLED ON LOT LINES ONLY AND IN ACCORDANCE WITH SD–2.
2. DRIVEWAY SHALL BE LOCATED ON THE OPPOSITE SIDE OF THE LOT TO THAT OF A PADMOUNTED TRANSFORMER.
3. WATER SERVICES SHALL BE INSTALLED ON THE CENTRELINE OF SINGLE LOTS, AND 1.0m TO THE RIGHT AND LEFT OF CENTERLINE FOR SEMI–DETACTED LOTS.
4. SANITARY P.D.C. SHALL BE INSTALLED 3.0m RIGHT OF CENTERLINE FOR SINGLE LOTS AND 3.0m RIGHT AND LEFT OF CENTERLINE FOR SEMI–DETACHED LOTS.
5. BELL AND HYDRO TO BE INSTALLED IN COMMON TRENCH 0.6m FROM EITHER PROPERTY LINE.

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
LOT SERVICING	
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Notes:

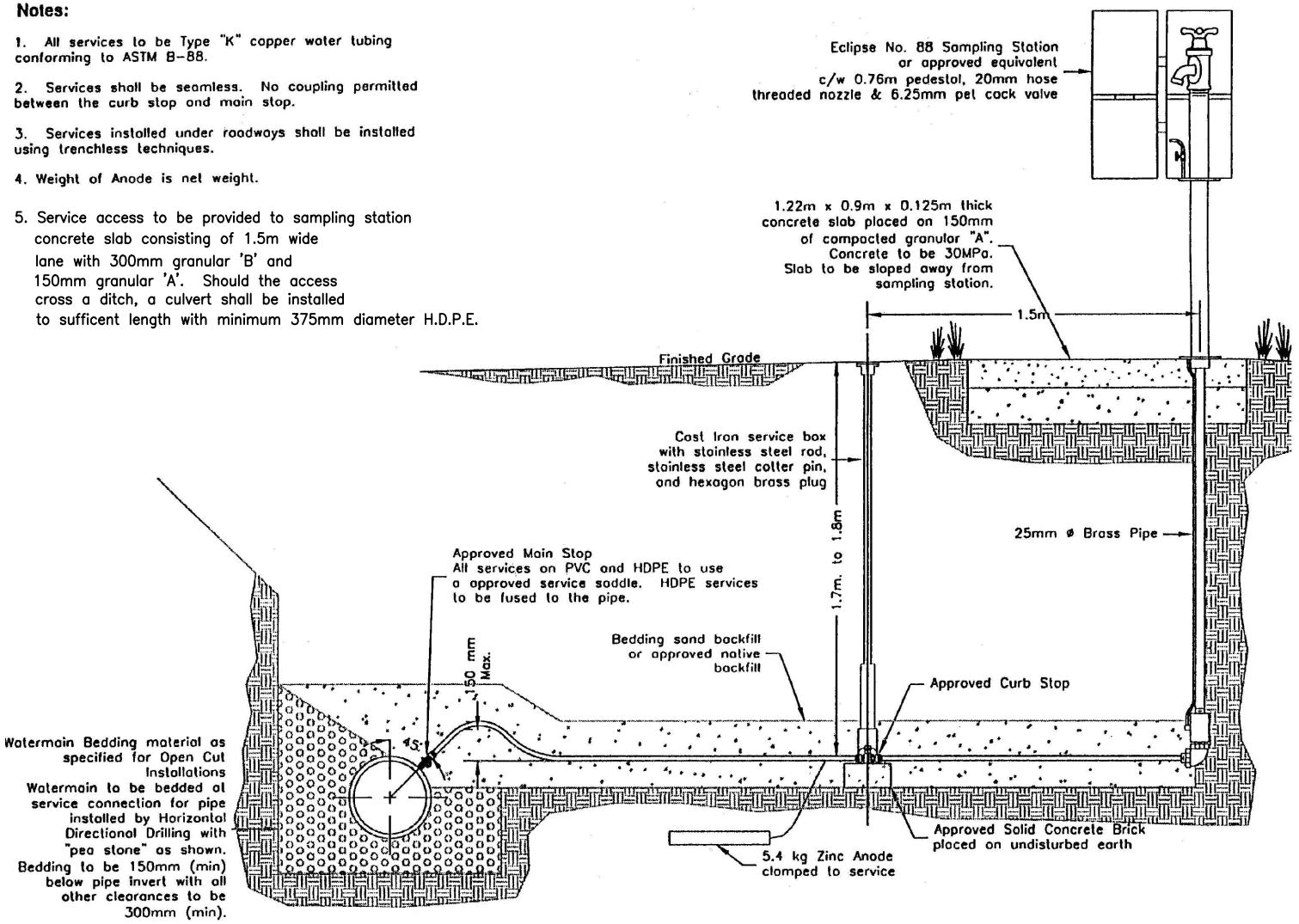
1. All services to be Type "K" copper water tubing conforming to ASTM B-88.

2. Services shall be seamless. No coupling permitted between the curb stop and main stop.

3. Services installed under roadways shall be installed using trenchless techniques.

4. Weight of Anode is net weight.

5. Service access to be provided to sampling station concrete slab consisting of 1.5m wide lane with 300mm granular 'B' and 150mm granular 'A'. Should the access cross a ditch, a culvert shall be installed to sufficent length with minimum 375mm diameter H.D.P.E.



MUNICIPALITY OF SOUTHWEST MIDDLESEX

WATER SAMPLING STATION

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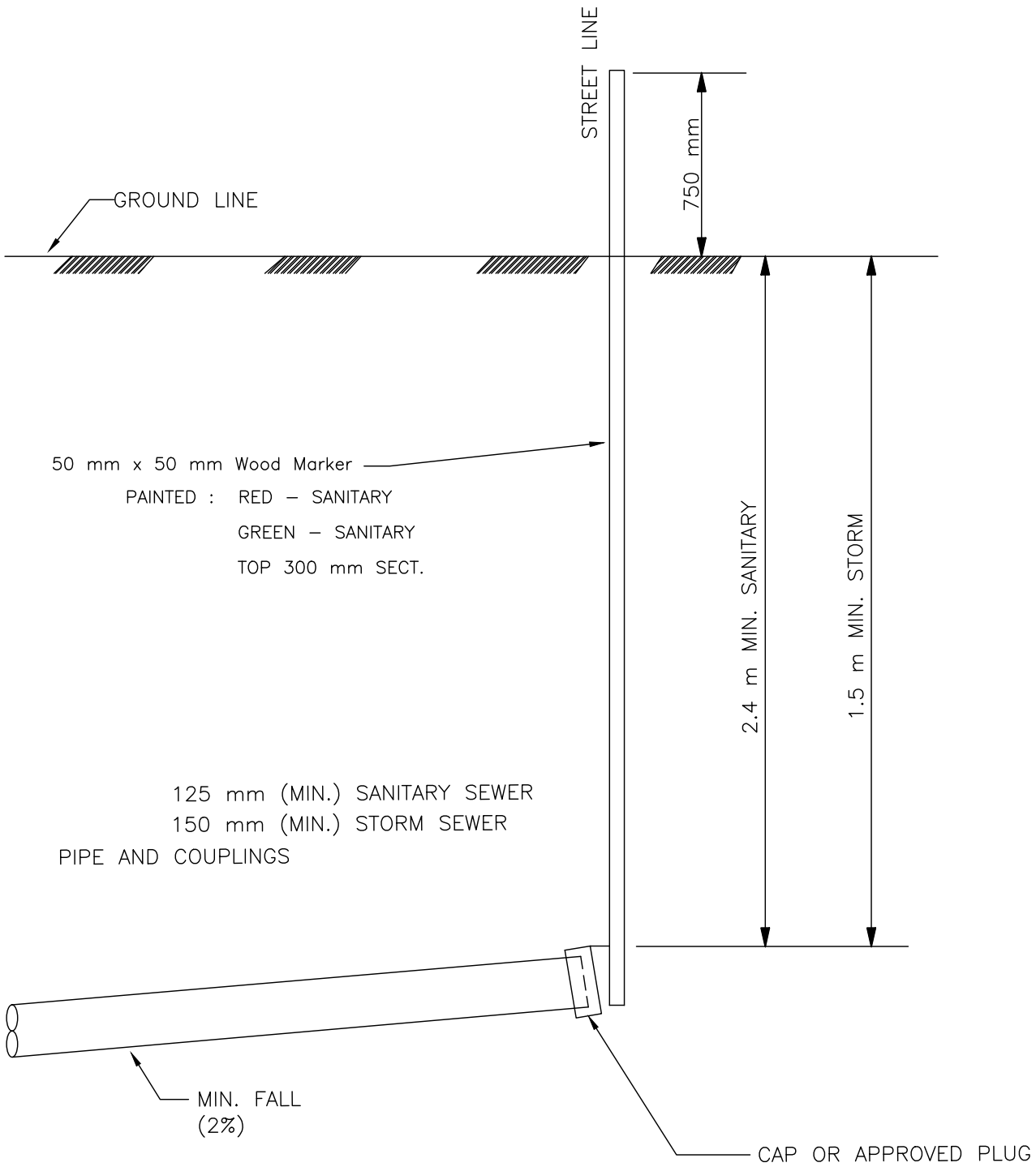

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
PRIVATE DRAIN CONNECTIONS AT STREET LINE	
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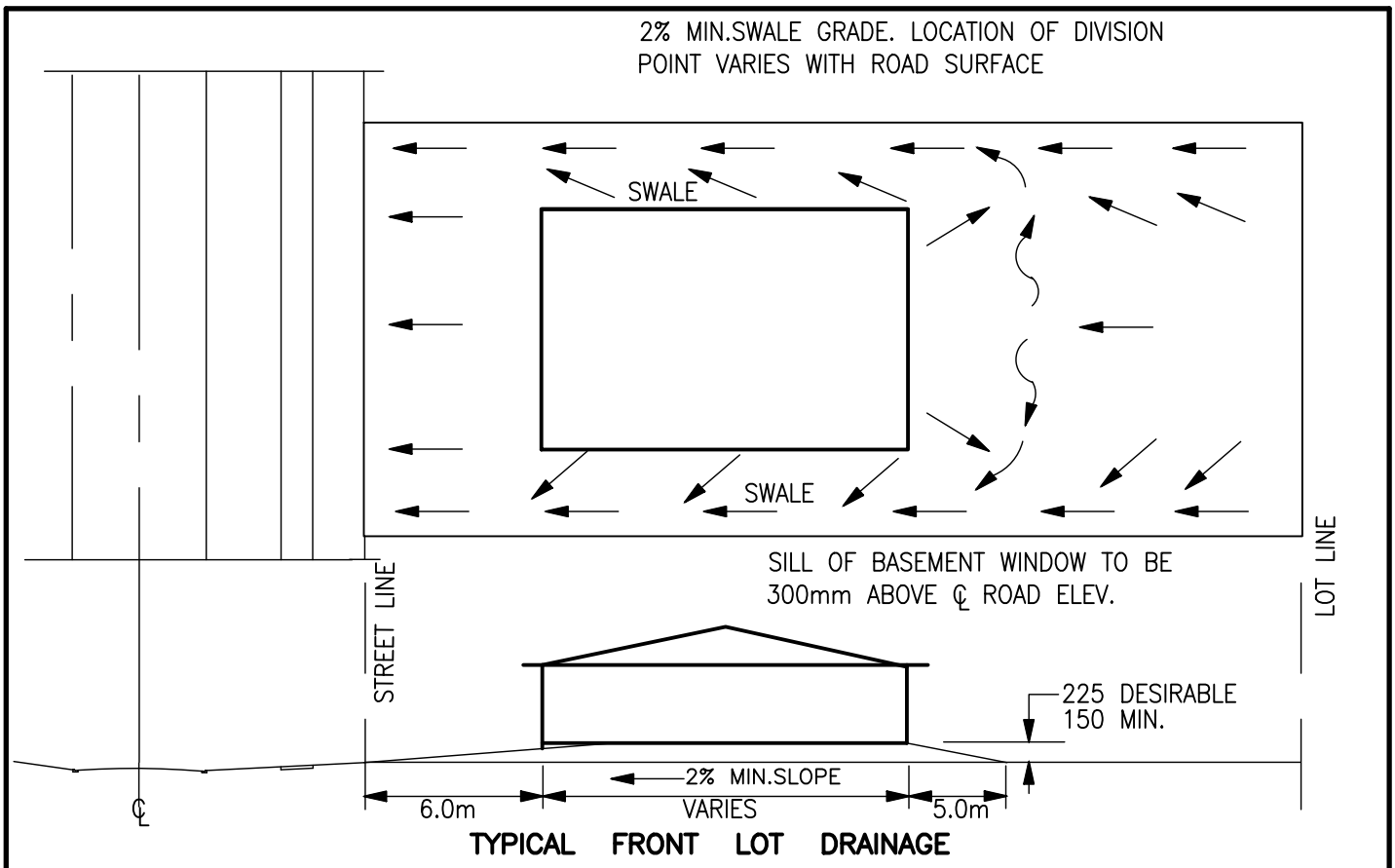
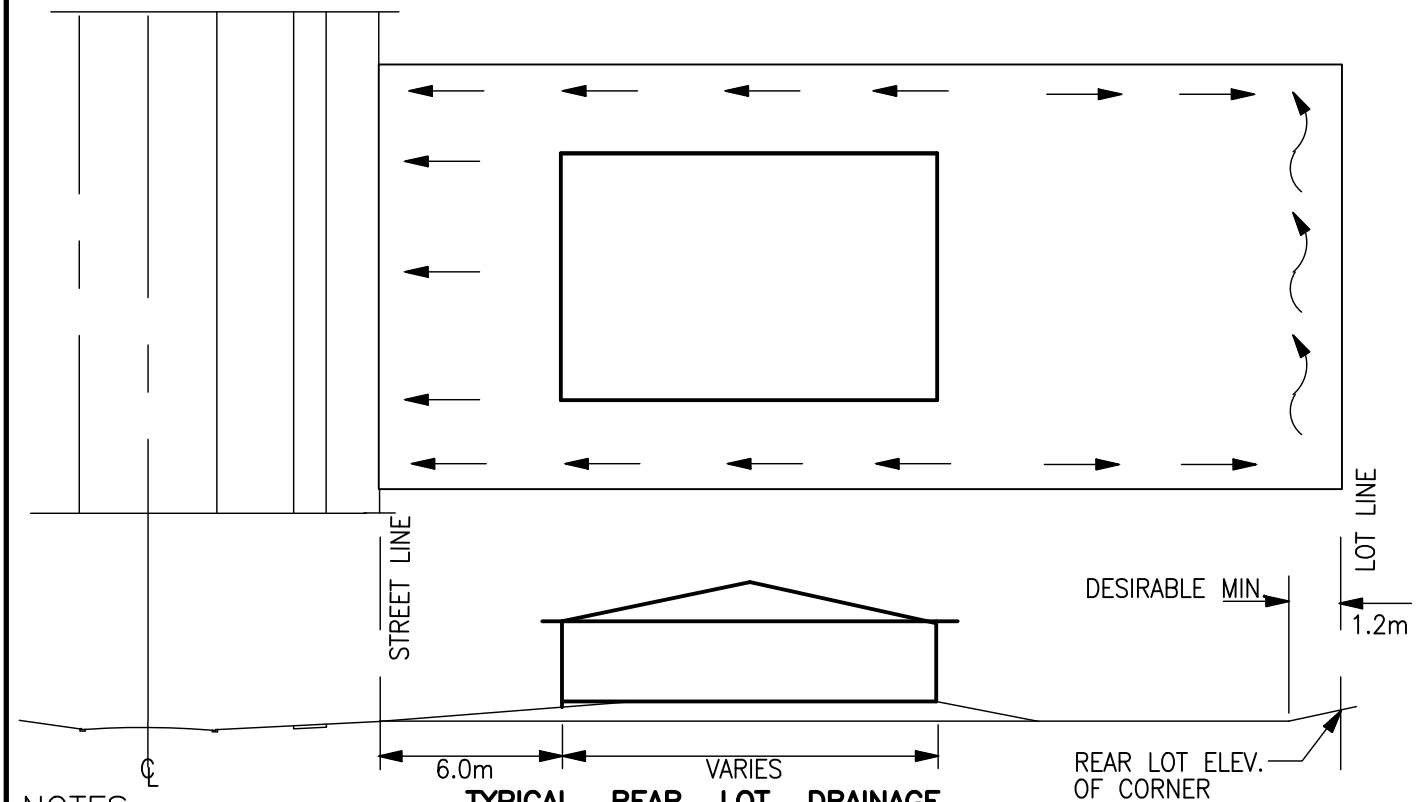


TYPICAL FRONT LOT DRAINAGE



TYPICAL REAR LOT DRAINAGE

NOTES:

MININUM LOT DIMENSIONS, FRONT YARD DEPTHS, AND SIDE YARD WIDTHS TO BE IN ACCORDANCE WITH ZONING BY–LAW.

MUNICIPALITY OF SOUTHWEST MIDDLESEX

TYPICAL LOT DRAINAGE PLAN

FEBRUARY 2021

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LEGEND:

STORM SEWER	STORM
SANITARY (OR COMBINED) SEWER	SANITARY
WATERMAIN	WATERMAIN
WATER VALVE	WV
GAS MAIN	GAS MAIN
GAS VALVE	GV
BELL CABLE (UNDERGROUND)	BTUC
HYDRO CABLE (UNDERGROUND)	HUC
HYDRO, BELL, UTILITY POLES	H.P. B.P. U.P.
GUY ANCHOR	
TREE	
HEDGE, BUSH	
HYDRANT	HYD
CATCH/CURB INLET/DITCH INLET BASIN	C.B. C.I.C.B. D.I.C.B.
BUILDING	
FENCE	
EXISTING MANHOLE	MH
PROPOSED MANHOLE	MH
PROPERTY BARS	SIB IB RIB
RADIUS	R
BEGINNING/END OF CURVE	BC EC
NORTH/SOUTH STREET LINE	NSL SSL
BOREHOLE	BH
BENCH MARK	BM or GBM or TBM
HYDRO TOWER	
CULVERT	
DIRECTION OF FLOW/MINOR SWALE	
MAJOR/REAR YARD SWALE	
OVERLAND FLOW ROUTE	

MUNICIPALITY OF SOUTHWEST MIDDLESEX

PLAN AND PROFILE LEGEND

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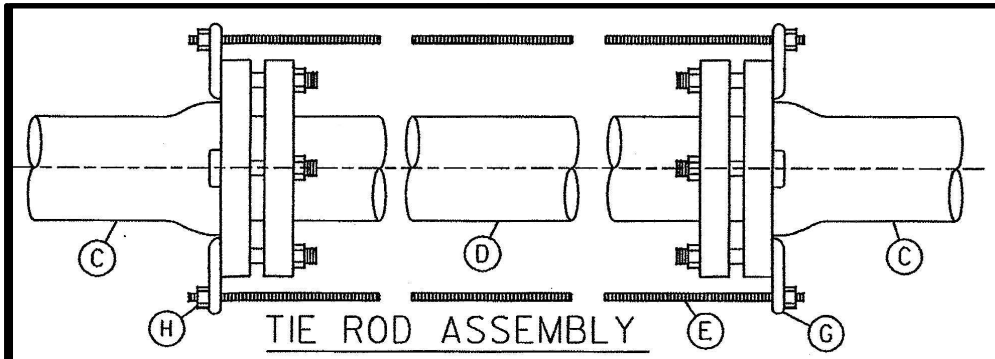
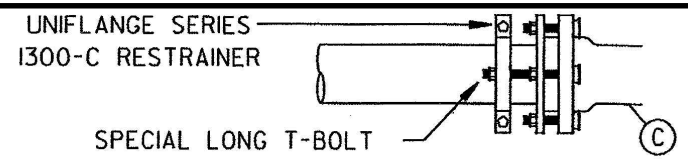


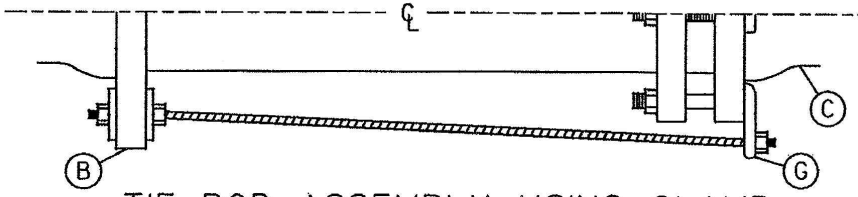
TIE ROD ASSEMBLY

FOR D.I. AND P.V.C. PIPE



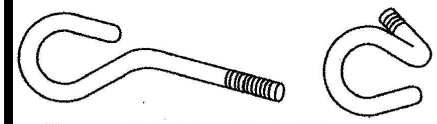
RESTRAINER ASSEMBLY

FOR P.V.C. PIPE

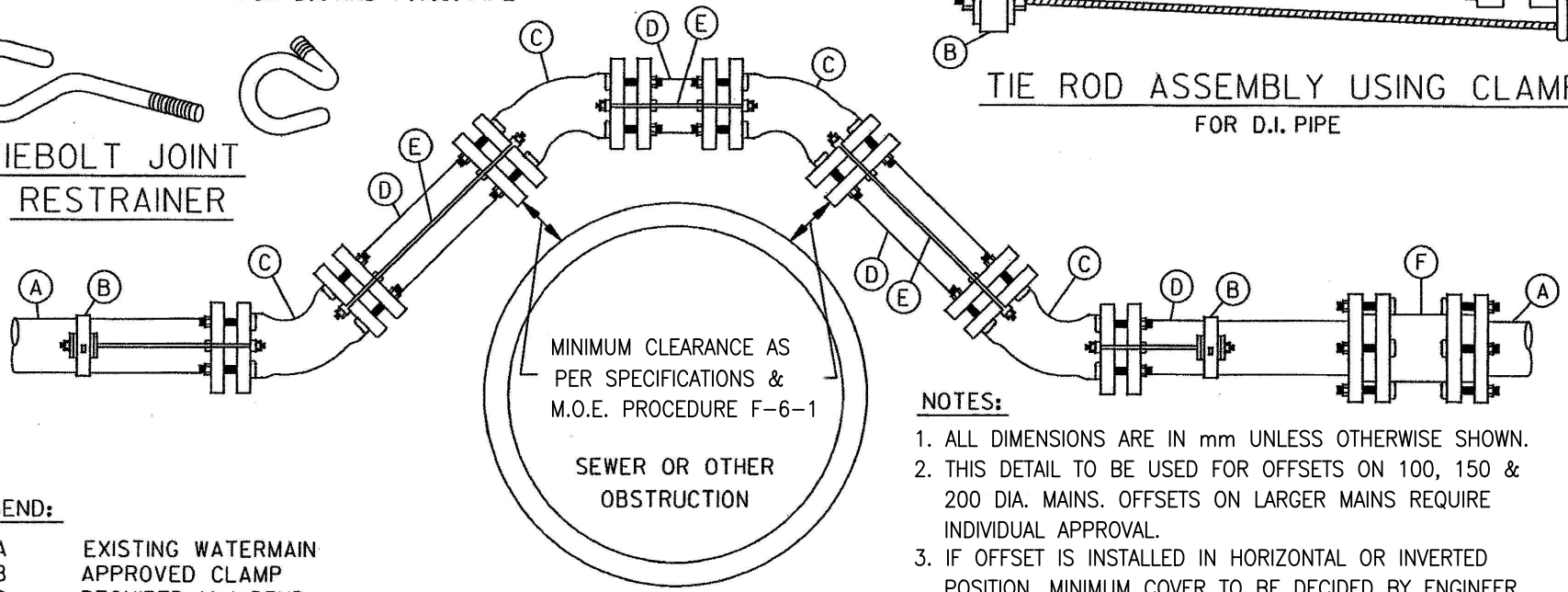


TIE ROD ASSEMBLY USING CLAMP

FOR D.I. PIPE



TIEBOLT JOINT RESTRAINER



LEGEND:

A	EXISTING WATERMAIN
B	APPROVED CLAMP
C	REQUIRED M.J. BEND
D	FILLER PIECE
E	APPROVED TIEROD (THREADED COR-TEN STEEL)
F	M.J. SLEEVE
G	APPROVED TIEBOLT JOINT RESTRAINER
H	APPROVED TIENUT

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SHOWN.
2. THIS DETAIL TO BE USED FOR OFFSETS ON 100, 150 & 200 DIA. MAINS. OFFSETS ON LARGER MAINS REQUIRE INDIVIDUAL APPROVAL.
3. IF OFFSET IS INSTALLED IN HORIZONTAL OR INVERTED POSITION, MINIMUM COVER TO BE DECIDED BY ENGINEER.
4. ONE PAIR OF 20mm DIA. RODS FOR 100, 150 & 200 DIA. PIPE.
5. COVER TIEBOLT ASSEMBLY WITH DENSO PASTE MASTIC AND TAPE ALL TO MANUFACTURER'S SPECIFICATIONS.
6. ALL RESTRAINERS MUST BE APPROVED BY THE MUNICIPALITY OF SOUTHWEST MIDDLESEX.

MUNICIPALITY OF SOUTHWEST MIDDLESEX

STANDARD MECHANICAL JOINT OFFSET INSTALLATION USING TIEBOLT COUPLINGS

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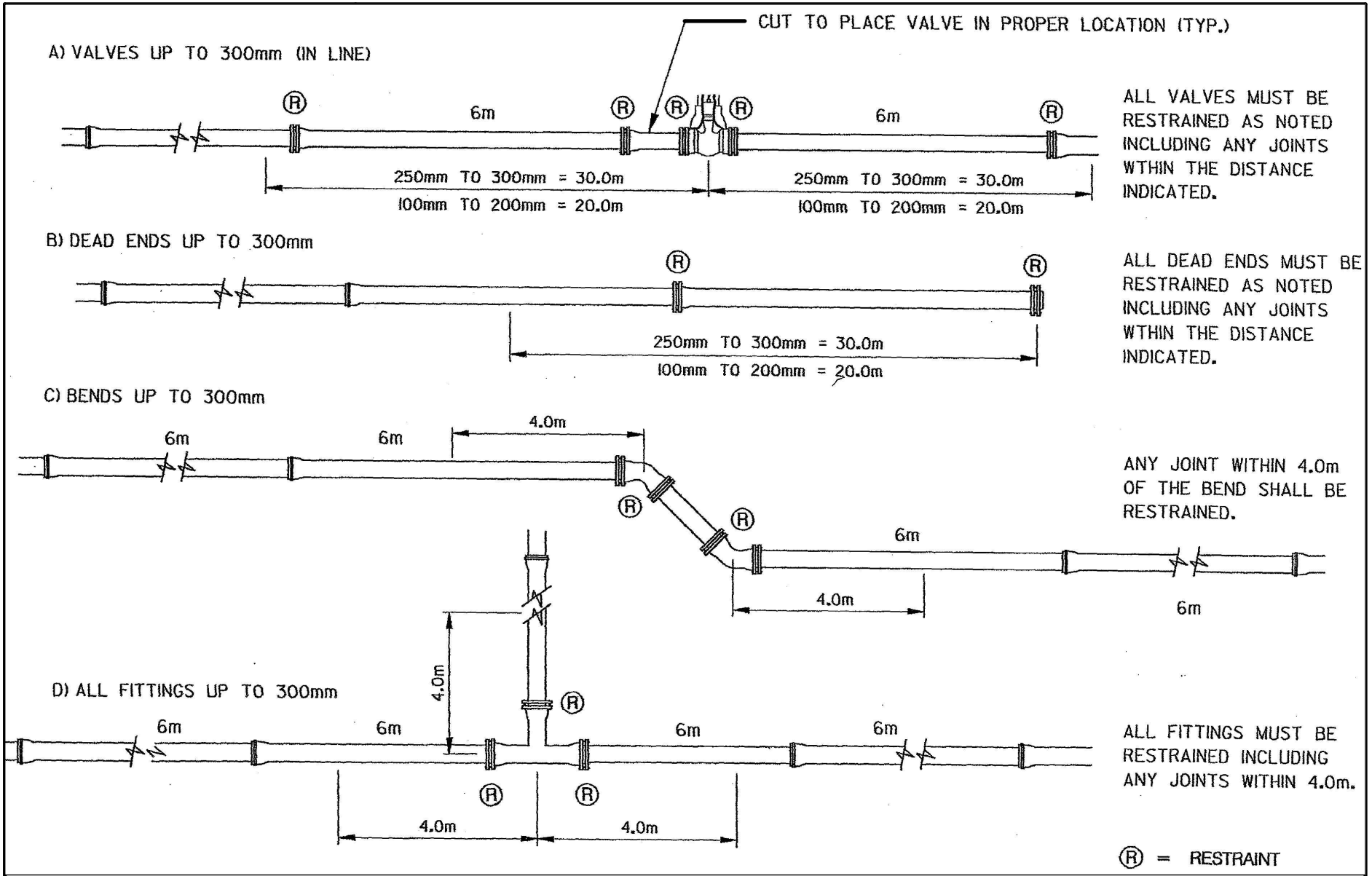

MUNICIPALITY OF SOUTHWEST MIDDLESEX

TYPICAL RESTRAINT DETAILS

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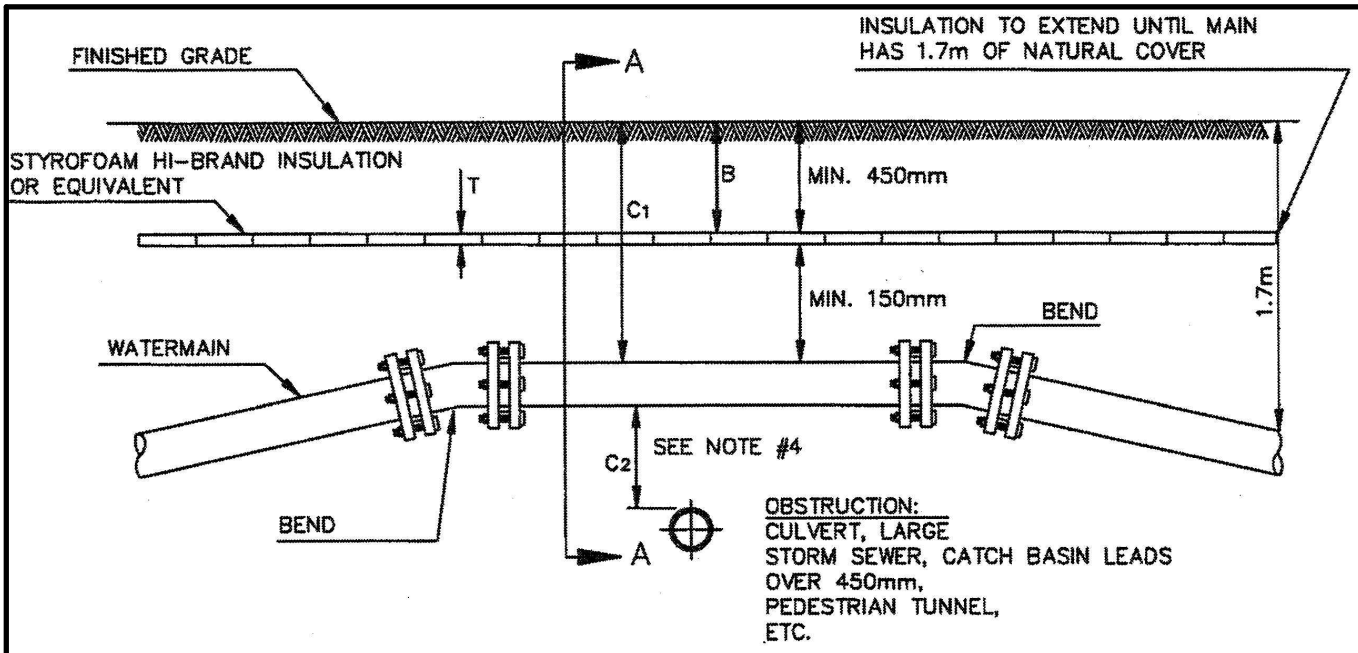
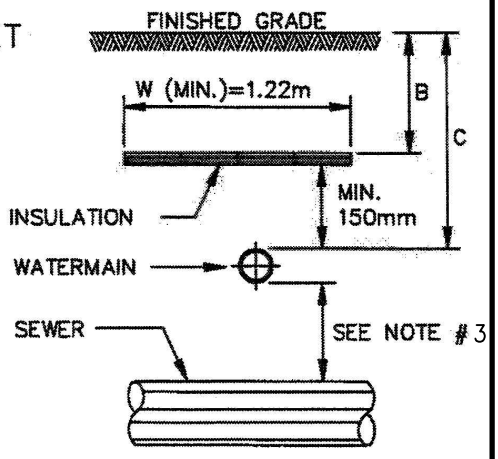


ELEVATION OF JOINT DEFLECTION OFFSET



SECTION "A – A"

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SHOWN.
2. MINIMUM COMPRESSIVE STRENGTH OF INSULATION TO BE 690kpa. INSULATION SHALL BE INSTALLED IN THICKNESS REQUIRED, IN STRICT ACCORDANCE WITH THE INSULATION MANUFACTURER'S DIRECTIONS. INSULATION SHALL BE INSTALLED OVER 150mm OF FINE GRANULAR FILL SCREEDED SMOOTH.

   BUTT INSULATION TIGHTLY TOGETHER WITHOUT GAPS, STAGGER END JOINTS IF MORE THAN ONE LAYER USED.

   TO HOLD IN PLACE, SKEWER INSULATION BOARD TO GROUND WITH 200mm HARDWOOD SKEWERS, MIN. 6mm DIA. AND 200mm LONG. 2 SKEWERS PER BOARD.

   IF 2 LAYERS OF INSULATION ARE USED, SKEWER ONLY THE TOP LAYER THROUGH THE FIRST LAYER USING A SKEWER 150mm LONGER THAN THE COMBINED THICKNESS OF THE 2 LAYERS OF INSULATION. INSERT SKEWERS AT APPROXIMATELY 30° ANGLE.

   PLACE AT LEAST 200mm OF FINE GRANULAR FILL OVER INSULATION BEFORE USING COMPACTION EQUIPMENT.
3. MIN. CLEARANCE AS PER SPECIFICATIONS.

INSULATION THICKNESS		INSULATION WIDTH	
C(m)	T(mm)	B(m)	W(m)
0.60	75	0.45	2.44
0.75	75	0.60	1.83
0.90	50	0.75	1.54
1.09	50	0.90	1.22
1.20	25		
1.35	25		
1.50	25		

MUNICIPALITY OF SOUTHWEST MIDDLESEX

INSULATION OF WATERMAIN AND OFFSETS

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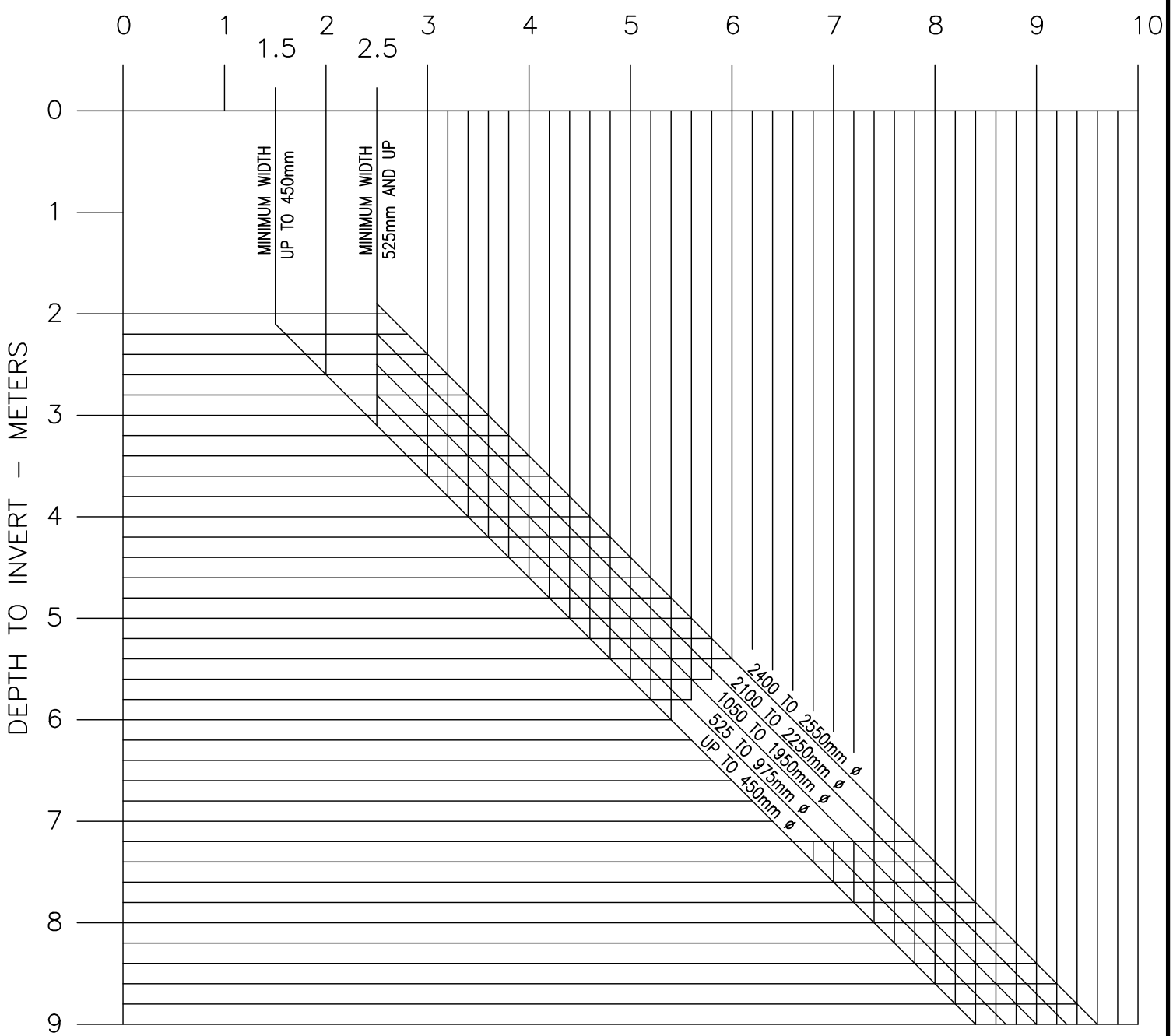

NOTES:

1. MINIMUM EASEMENT WIDTH MEASURED FROM C/L OF SEWER PIPE EG: 675mm DIAM. SEWER WITH INVERT 3.9m BELOW FINISHED SURFACE ELEVATION. WIDTH OF EASEMENT REQUIRED = 3.6m EACH SIDE OR A TOTAL WIDTH OF 7.2m.
2. THROUGH FIELDS, OPEN SPACE, ETC 9.1m AND 3.0m ON ONE SIDE OF SEWER C/L AND 6.1m ON THE OTHER, OR AT LEAST 3.0m WIDER THAN THE MIN WIDTH OBTAINED FROM THIS CHART, AS REQUIRED BY THE MUNICIPAL ENGINEER.

MUNICIPALITY OF SOUTHWEST MIDDLESEX	
MINIMUM EASEMENT WIDTH	
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