

**SERVICING STANDARDS
FOR
THE TOWNSHIP OF ZORRA
2021**



**SPRIET ASSOCIATES LONDON LIMITED
CONSULTING ENGINEERS**

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General Requirements

These Servicing Standards provide for the standardization of the design and construction of roads, storm sewers, and lot grading in the Township of Zorra. 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 Township's Engineer. Notwithstanding any provision of the Design and Construction Standards for the Township of Zorra, these design and Construction Standards may not apply to capital works undertaken by the Township on existing municipal infrastructure designed or constructed to previous standards.

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.

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.

All developments must be designed and constructed in accordance with the current version of the MECP design standards. In the event of a discrepancy between this document and MECP standards, the Proponent must contact the Municipality for direction.

Approval Process

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

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

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

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

Approval Process (cont'd)

After the preliminary information has been reviewed and accepted, the Township 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 Township, the Developer may proceed with final design.

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 Township
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. 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
7. 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
8. Boulevard tree planting plan and landscape plan with species selection and planting measurements in accordance with the current Township Tree Planting By Law.
9. Street lighting plan
10. Legal survey
11. A detailed site servicing report, geotechnical report, hydrogeological report, servicing report including stormwater management and any other required reports shall be submitted

The Township and County 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 Township for approval. This process shall continue until final approval from the Township and County is obtained. The developer shall enter into a development agreement with the Township and shall not commence construction until the agreement is executed and registered on title of the lands, ***and securities have been received by the Township.***

Approval Process (cont'd)

In addition to the Township'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. Oxford County
3. Ministry of Natural Resources and Forestry
4. Ministry of Municipal Affairs
5. Upper Thames River Conservation Authority (U.T.R.C.A.)
6. Department of Fisheries and Oceans
7. Ministry of Tourism, Culture and Health
8. Lambton Public Health
9. Adjacent municipalities where appropriate

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

Prior to construction:

1. Copies of all approvals shall be submitted to Township 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 Township
5. A signed and executed copy of the Contract Documents between the Contractor and Developer shall be submitted to the Township

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 Township with written certification that the constructed work has been completed in conformance with the approved Contract Drawings and Specifications.

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

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

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

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	20.00 m	8.0 m
Cul-de-Sac	20.00 m	7.0 m
Collector	26.00 m	9.2 m
Arterial	30.48 m	9.2 m
Industrial	26.00 m	9.2 m

SECTION 1 – ROADS (cont'd)**1.3 Road Allowance, Pavement Widths, Location and Layout (cont'd)**

- b) Intersections of more than two streets shall not be permitted.
- c) Streets shall intersect at right angles with each other.
- d) Jogged intersections will not be permitted.
- e) Street intersections shall not be closer than 60 m.
- f) ZSD – 1, ZSD – 2 and ZSD – 3 show the standard utility locations for residential and industrial roads.
- g) The maximum length of a cul-de-sac to the turning circle shall be 215 m without a secondary or emergency access. ZSD – 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) Road grades at intersections shall not exceed 2% across the intersection.
- d) All roadways shall be crowned on a 2% slope.
- e) Boulevards are to be sloped from the property line to the edge of the roadway at 2% to 6% (10% maximum on approval).
- f) Road shoulders shall be sloped from the edge of roadway at a 4% slope.

1.5 Design and Construction**a) Cross-Sections**

Typical cross-sections of residential subdivision streets shall conform to the details shown on ZSD – 6 and ZSD – 7. Typical cross-sections of industrial subdivision streets shall conform to the details shown on ZSD – 8.

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) An engineered design for residential, industrial, commercial, and arterial roads based on geotechnical data must be submitted to the Township for review.
- iii) For residential roads the following minimum compacted depths of granular and asphaltic pavement courses shall be provided:

50 mm HL3 Asphaltic Concrete compacted to 97% Marshall Density

50 mm HL8 Asphaltic Concrete compacted to 97% Marshall Density

150 mm Granular 'A' Base compacted to 100% S.P.M.D.D

300 mm Granular 'B' Sub-base compacted to 100% S.P.M.D.D

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

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. End cut treatment to be applied prior to asphalt placement.

c) 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.

SECTION 1 – ROADS (cont'd)**1.5 Design and Construction** (cont'd)d) 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.

e) 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 (OPSD 600.060) and all other streets will have concrete barrier curb with standard gutter (OPSD 600.040) unless otherwise approved by the Township.
- iv) 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% \pm 1.5% entrained air.
- vi) Contraction joints shall be provided every 3.0 m.
- vii) 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.
- viii) Use of asphaltic concrete curb will not be permitted unless otherwise approved by the Township for temporary conditions.

f) Radii of Curvature

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

- i) General

Arterial streets to:	Arterial streets	12.0m R
	Collector streets	12.0m R
	Local streets	12.0m R

SECTION 1 – ROADS (cont'd)**1.5 Design and Construction** (cont'd)f) Radii of Curvature (cont'd)

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

ii) Truck Routes

Collector streets to:	Collector streets	15.0m R
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Note: a 3.0m daylighting triangle is required at the intersections itemized in ii) above.

Arterial streets to:	Arterial streets	15.0m R
	Collector streets	15.0m R
	Local 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 ZSD – 4 and ZSD – 5.

g) Sidewalks

- i) Typical sidewalks shall be as per OPSD 310.010, 310.020, and 310.030. See ZSD – 1, ZSD – 2, ZSD – 3, ZSD – 27 and ZSD – 28.
- 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 ZSD – 9.
- iv) Sidewalks shall be minimum of 1.5 m wide and shall be located as shown on ZSD – 6 and ZSD – 7.

SECTION 1 – ROADS (cont'd)**1.5 Design and Construction** (cont'd)g) Sidewalks (cont'd)

- v) Residential subdivisions must include consideration for walkability throughout the development including sidewalk connectivity where phasing is proposed, all to the Township's satisfaction.
- vi) Newly installed sidewalks should have connectivity to existing sidewalk networks.
- vii) Sidewalks and curbs shall be ramped at street intersections to permit easy passage of wheelchairs, etc. Ramps shall conform to OPSD 310.030.
- viii) Concrete shall be 30 MPa at 28 days with $7\% \pm 1.5\%$ entrained air and not less than 355 Kg/m³ of cement. Maximum slump shall be 70 mm.
- ix) Sidewalks are to be a minimum thickness of 100 mm except across driveways where the thickness shall be 150mm.
- x) Concrete sidewalks in walkways shall be 150 mm thick.
- xi) Driveways to industrial, commercial or multi-family properties shall be 150 mm thick.
- xii) All sidewalks to be constructed on a 150 mm minimum thick Granular 'A' bed, unless at driveways where sidewalk shall be constructed on a 300mm minimum thick Granular 'A' bed.
- xiii) 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.
- xiv) Sidewalks shall have a 2% minimum and normal slope towards the road. Gradient in excess of 4% is subject to approval by the Township.
- xv) Sidewalks shall have red tactile pad plates at all intersections, elevation changes (steps). Pads shall conform to OPSD 310.033 & 310.039. Pad shall cover the entire width of the sidewalk.

h) Multi-Use Pathway

- i) Paths shall be minimum 3 meters in width.
- ii) Base shall be composed of 250mm thick Granular 'B' and 150mm Granular 'A' compacted to 100% S.P.M.D.D.
- iii) Granular base shall extend at minimum 200mm beyond the pathway surface edge.
- iv) Surface shall be composed of 75mm of HL3 hot mix asphalt compacted to 97% Marshall Density.
- v) Surface shall be crowned to 2% cross-slope.

SECTION 1 – ROADS (cont'd)**1.5 Design and Construction** (cont'd)h) Multi-Use Pathway (cont'd)

- vi) The asphalt edge shall be neatly tamped at a 45 degree angle.
- vii) Adjacent surfaces shall be level with the surface edge and slope away from the path edge at a slope no greater than 2% for at minimum 0.5 meters.
- viii) Paths shall have a solid 100mm wide yellow line painted down the center.
- ix) Paths shall have a minimum 1.2 meter lateral separation from the face of existing curb or from edge of the travelled portion of the adjacent roadway if curb is not present.
- x) Paths shall have a minimum 1.2 meter separation from any slope greater than 2:1 and a height difference greater than 0.6 meters.
- xi) Paths shall have 1 meter lateral separation from posts or poles.

i) Driveways

Driveways shall be as per Section 5.1 f).

j) Structure Design

If required by the Township'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.

k) 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.

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 Street Lighting**a) General

All subdivisions shall be provided with street lights in accordance with the standards in this section. Street light design must be submitted to and approved by ERTH.

Proposed lighting layout, specifications, and details are subject to approval of the Township 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 Township prior to final design.

Layout of the proposed street lighting, details of relays and photo controls shall be submitted to the Township 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 Township of Zorra 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.

Underground wiring shall be used for the electrical distribution system.

SECTION 1 – ROADS (cont'd)**1.6 Street Lighting** (cont'd)b) Materials

- i) Poles: Poles shall be USI Cambridge decorative concrete poles in Midnight Lace, or an approved equivalent, 7.6 meters long, base mounted or direct burial type and equipped to take approved cobra head, post top or lantern style LED luminaires at the discretion of the Township.
- ii) Luminaires: Luminaires shall be cobra head style 55W or 80W Philips Roadview, post top style 80W Urbanscapes or Metroscapes, or lantern style 80W Philips Townview, or an approved equivalent at the discretion of the Township.
- iii) Wire: The main wire shall be #6 copper type TWU, stranded 600 volt insulation and shall be properly sized for the application under consideration. The standard wiring of luminaires shall be 12/2 bonded type NMWU - 3 cable.
- iv) Duct: 50mm P.V.C. duct is preferred.

c) Design

- i) Street Lights shall be located in accordance with the Utility Location Drawing ZSD – 1, ZSD – 2 and ZSD – 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.

d) Installation

The installation of the electrical wiring, poles, lights and connections will be carried out by a Township 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 rigid PVC 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.

SECTION 1 – ROADS (cont'd)**1.6 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 plate at the supply point. One ground plate must be installed at each supply point. Each aluminum pole must be connected to the ground bus using #6 conductor.

The street light 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. A disconnect device of 50 ampere capacity shall be required at the supply end of each main feeder run.

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.

Straight duct runs exceeding 12 meters and all duct runs with curves or bends in them shall have a fish wire of ¼" poly rope.

1.7 Signing and Markingsa) 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 Township's Director of Public Works.

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 Township's Road Superintendent.

SECTION 1 – ROADS (cont'd)**1.7 Signing and Markings** (cont'd)b) Design (cont'd)

- v) Street name signs shall be 14 gauge steel minimum with white enameled 100mm letters in a green background. These plates are to be secured and mounted on 50mm diameter 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 Township prior to installation and must be in accordance with the current version of the Township's Asset Naming Policy #400-03 and the name must be from the current version of the Township's Name Registry.

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) 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.
- iii) In rural areas, road name signs shall be 14 gauge steel minimum with white enameled 100mm letters on a 200mm high plate on a green 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 green 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.

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 Township's Road Department.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT

2.1 Storm Sewers

2.1.1 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 Township's Engineer 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, 100 and 250-year storm events.

In general, sewer pipes shall be circular. The use of elliptical pipe shall be subject to the approval of the Township's Engineer.

The design of storm sewers shall be completed using the attached Rainfall Intensity Duration Curve, Drawing ZSD – 15. Alternatively, the intensities may be calculated using the following formula for the Intensity-Duration-Frequency relationship and corresponding constants:

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

	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.

2.1.2 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 Township's Engineer. The Rational Formula is:

$$Q = 2.78 C i A$$

in which Q is the storm water runoff in liters per second (l/s), C is the runoff coefficient, i is the average rainfall intensity in mm per hour, and A is the drainage area tributary to the point under design in hectares.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.1 Storm Sewers** cont'd)**2.1.2 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 ($c < 0.35$)	20 minutes or less
Well-developed districts	15 minutes or less
Densely developed districts ($c > 0.75$)	10 minutes or less

The use of inlet times other than those indicated above, shall be subject to the approval of the Township's Engineer.

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

Runoff Coefficients	
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.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.1 Storm Sewers cont'd)****2.1.3 Rainfall Frequency and Intensity**

Storm sewers are to be designed on the Rainfall-Intensity Duration curves prepared for the Township. 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 Township.

2.1.4 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.

2.1.5 Location

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

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.1 Storm Sewers (cont'd)****2.1.6 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 Township's Engineer.

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

2.1.7 Cover

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

2.1.8 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:

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

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 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

2.1 Storm Sewers (cont'd)

2.1.8 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

2.1.9 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.

2.1.10 Pressure Sewers

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

2.1.11 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 Township.

2.1.12 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 Township.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

2.2 Stormwater Management

2.2.1 General

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 Township's Engineer.

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 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.

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

A summary of preferred 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
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.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)

2.2 Stormwater Management (cont'd)

2.2.1 General (cont'd)

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
Small Developments or Expansions	Quantity control may be achieved through lot level grading with an oil and grit separator providing quality control

2.2.2 Quantity and Quality of Storm Water

a) Land Use

The Township'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.

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.

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 Township's Engineer. All design parameters and output are to be provided to the Township's Engineer by hard copy and on a thumbdrive in a format acceptable to the Township'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.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.2 Stormwater Management (cont'd)****2.2.2 Quantity and Quality of Storm Water (cont'd)**

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

	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

c) **General Stormwater Management Design References**

Stormwater Management Practices Planning and Design Manual (MOE, 2003) Ministry of the Environment, 2003

Low Impact Development Stormwater Management Planning and Design Guide Sustainable Technologies Evaluation Program, Living Website

Low Impact Development Stormwater Planning and Design Guide Credit Valley Conservation and Toronto Region Conservation, 2011

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 the Township).

2.2.3 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.

2.2.4 Low Impact Development Systemsa) **General**

If the proponent intends to implement Low Impact Development Systems (LIDS) a list of LID types, locations and extent shall be provided to the Township for approval at the pre-design submission stage. While Low Impact Development Systems are promoted, they cannot be the sole source of quantity control.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.2 Stormwater Management** (cont'd)**2.2.4 Low Impact Development Systems** (cont'd)

In addition to implementing Low Impact Development Systems, 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.
- iv.) All catchbasins shall have an emergency relief flow outlet to the storm sewer or emergency relief flow pipe system.
- v.) All galleries and leads within private property shall have adequately sized easements designated for future maintenance.
- vi.) 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.
- vii.) Each rear yard infiltration catchbasin shall service a maximum of 8 lots.
- viii.) All infiltration catchbasins shall be protected with a permanent sediment measure such as FleXstorm inlet sediment trap or approved equal.
- 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.) Not more than 15% of the total lots may have LIDs installed on private properties.
- xi.) 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.
- xii.) If Low Impact Development Systems are proposed the proponent shall provide the Township with a non-refundable deposit for future maintenance (value to be determined on a site-by-site basis).

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.2 Stormwater Management** (cont'd)**2.2.4 Low Impact Development Systems** (cont'd)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.

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.) 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 home owners.
- iii.) 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.
- iv.) A detailed schedule and log included within the Stormwater Management Report to assist the owner in maintaining water quality control measures.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.2 Stormwater Management (cont'd)****2.2.4 Low Impact Development Systems (cont'd)**

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

2.3 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 Township's Engineer.
- b) Thorough soils investigations and interpretations shall be a prerequisite to the detailed design of the open channel.
- 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) The use of open channels shall not be permitted in residential or urbanized areas. Open channels may be permitted, if approved by the Township, in industrial or rural areas.
- e) Design of open channels and culverts shall be completed using the attached Rainfall Intensity Duration Curve, Drawing ZSD – 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 2.2.2 for a, b and c values.

- 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):

$\frac{V \times r}{<0.5}$	$\frac{n}{0.150}$
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

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.3 Open Channels and Culverts (cont'd)**

- 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 Township's Engineer.
- 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.
- 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.

2.4 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.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.4.1 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.

2.5 Pipe Bedding

Pipe bedding for storm sewer pipes shall conform to the standard Bedding Details as per ZSD – 10 and ZSD – 11.

2.6 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 Township's Engineer 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.

2.7 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).
- c) 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.
- d) 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.
- e) 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.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.7 Maintenance Holes (cont'd)**

- f) 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.
- g) 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 Township.
- 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) Maintenance hole spacing shall be as follows:
- | <u>Pipe Size</u> | <u>Maximum Maintenance Hole Spacing</u> |
|------------------|---|
| Up to 450 mm | 120 m |
| 525 mm to 750 mm | 150 m |
| over 750 mm | 180 m |
- 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 Township's Engineer for approval.

2.8 Catch Basins

- a) Catch basins shall conform to OPSD 705.010, 705.020, 705.030 and 705.040.
- b) All catchbasins must be installed to final asphalt elevation.
- c) Temporary drainage at all catchbasins must be provided at time of asphalt binder course installation by means of 50mm (2") ABS or PVC pipe installed from asphalt surface to the catchbasin. Temporary drainage pipes are to be removed and parged within the catchbasin immediately prior to asphalt surface course installation.
- d) 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.
- e) 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 ZSD-18.

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.8 Catch Basins (cont'd)**

- f) 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:

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

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

2.9 Installation

- a) Sewer pipe bedding shall conform to the Township's bedding standards for gravity and pressure pipe and shall be in accordance with ZSD – 10 and ZSD – 11.
- 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.

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

SECTION 2 – STORM SEWERS AND STORMWATER MANAGEMENT (cont'd)**2.9 Installation** (cont'd)

- f) Road surfaces shall be restored to its original condition where existing roads are disturbed, all to the satisfaction of the Township.
- g) 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 Township for its records. This work shall be performed by an independent inspection company under the supervision of the Township and paid for by the Contractor.
- h) 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.

2.10 Private Drain Connections

Refer to Section 5.1.

SECTION 3 - SANITARY SEWERS

NOTE: REFER TO CURRENT "SANITARY SEWER" STANDARDS PREPARED BY OXFORD COUNTY

SECTION 4 – WATERMAINS

NOTE: REFER TO CURRENT “WATERMAIN” STANDARDS PREPARED BY OXFORD COUNTY

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 Township's right-of-way, approval must be given by the Township and County Engineer.

b) Sanitary Private Drain Connections

i) Refer to the current Sanitary Sewer standards prepared by Oxford County.

c) Storm Private Drain Connections

i) Pipe materials shall conform to Section 2.4.

ii) 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 ZSD – 14.

iii) Private drain connections to industrial, commercial or high density residential properties (minimum 70 units per hectare) shall not be less than 150 mm diameter with an inspection manhole placed 1 – 2m within property line within private property.

iv) ZSD – 17 shows the orientation of the private drain connections.

v) 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.

vi) The installation of the private drain connections shall meet the standards set out in Section 2.

d) Water Services

Refer to the current Watermain standards prepared by Oxford County.

e) Utilities

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

ii) Refer to ZSD – 14 for the location of required services and utilities.

SECTION 5 - LOT SERVICING AND LOT GRADING (cont'd)**5.1 Lot Servicing (cont'd)****f) Driveways**

- i) Driveways shall be constructed with 50mm minimum HL3 asphalt surface, 150mm minimum Granular 'A' base and 300mm minimum Granular 'B' sub-base.
- ii) Driveways on new streets shall be designed based upon the following allowable slopes:
 - Between the curb and sidewalk, driveways shall have a minimum slope of 2% and maximum slope of 6%. Steeper slopes are permissible where the boulevard width is less than 1.0m;
 - Between the sidewalk and property line, driveways shall have a minimum slope of 2% and maximum slope of 10%.
- iii) Driveways on existing streets shall be designed based upon the following allowable slopes:
 - Between the curb and sidewalk, driveways shall have a minimum slope of 2% and maximum slope of 6%. Steeper slopes are permissible where the boulevard width is less than 1.0m;
 - From the sidewalk to 0.5m behind, driveways shall have a slope of 2%;
 - From 0.5m behind sidewalk to property line, driveways shall have a slope of 2% graded down to property line or a maximum slope of 10% graded up to property line.
- iv) Radii of multi-family driveways at curb shall be 3.0m at the ingress and 1.8m at the egress.
- v) Driveway width shall not exceed 50% of the total lot width, to a maximum of 9m.
- vi) Driveways are to be designed and installed perpendicular to the roadway.
- vii) No part of the driveway shall encroach upon the property boundaries when extended from the edge of the right-of-way to the roadway.
- viii) 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.

5.2 Lot Grading**a) General**

All subdivisions shall be graded in accordance with these specifications and the details shown on ZSD – 12. Lot grading plans shall be prepared by the developer and approved by the Township 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

SECTION 5 - LOT SERVICING AND LOT GRADING (cont'd)**5.2 Lot Grading (cont'd)****b) Lot Grading Specifications**

- i) Yard surfaces shall have a minimum slope of 2% (in special cases 1% to be approved by the Township's Engineer).
- 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) The desirable sideyard 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.
- v) The minimum major/rear yard swale depth is 300mm, located a minimum 1.5m from rear property line with minimum 4H:IV slope.
- vi) The minimum rear yard swale depth is 150mm, located a minimum 1.5m from rear property line with minimum 4H:IV slope.
- vii) Grades:
 - a) Minor swales - provides drainage for up to four lots
 - the minimum grade shall be 2% (special cases 1% to be approved by the Township).
 - b) Major/rear yard swales - provide drainage for more than four lots
 - the minimum grade shall be 1%.
- viii) The maximum flow allowable in a side yard swale shall be that from four back yards.
- ix) 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.
- x) Where possible, it is preferred to have lots drain to the front of the property, rather than to a rear yard catch basin.
- xi) Ground elevations at buildings shall be 300mm above any adjacent downstream overland flow routes.
- xii) The maximum ponding permitted at rear yard catchbasins is 450mm.

SECTION 6 – CONSTRUCTION CONTRACT DOCUMENTS

6.1 General

All contract drawings are to be on the Township's Standard drawing size which is 559mm x 914mm. The Township'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) Existing conditions are to be drawn with a lighter pen than the proposed construction.
- b) North shall be shown on all drawings to the top or to the right.
- c) All elevations shall be to Geodetic Survey of Canada Datum.
- d) 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.
- e) A legend shall be used to indicate services as shown in ZSD – 13.
- 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
- ii) 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:
 - scale 1:250
 - showing all existing and proposed lot numbers
 - show all street names
 - show all lot frontages and depths
 - show all sidewalks to be constructed by the subdivider
 - indicate all lots that are semi-detached (SD) or back split (BS)
- iii) Elevations that are to be shown on the Grading Plan include:
 - all elevations are to be Geodetic
 - final ground elevations at lot corners and house corners
 - final center line of road elevation every 25 m
 - 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;
 - 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.
- iv) Drainage Information
 - 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.
 - show all proposed rear lot catch basins, leads and easements.
 - show the location and direction of swales by means of wavy arrows.
 - show the location and direction of overland flow routes by means of bold arrows.

See Drawing ZSD – 13 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) General Plan - Street Lighting

A general plan to a scale of 1:1000 showing the proposed street lighting layout.

h) 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 Township's Engineer, 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

i) 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.

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.

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.

j) Typical Road Cross-Section

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

Upon completion of the work and prior to the assumption of services by the Township, final "as-constructed" are to be submitted to the Township's Engineer for the above and below ground services (plan and profile) and details of special structures as required by the Township's Engineer. 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 Township's Engineer.

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

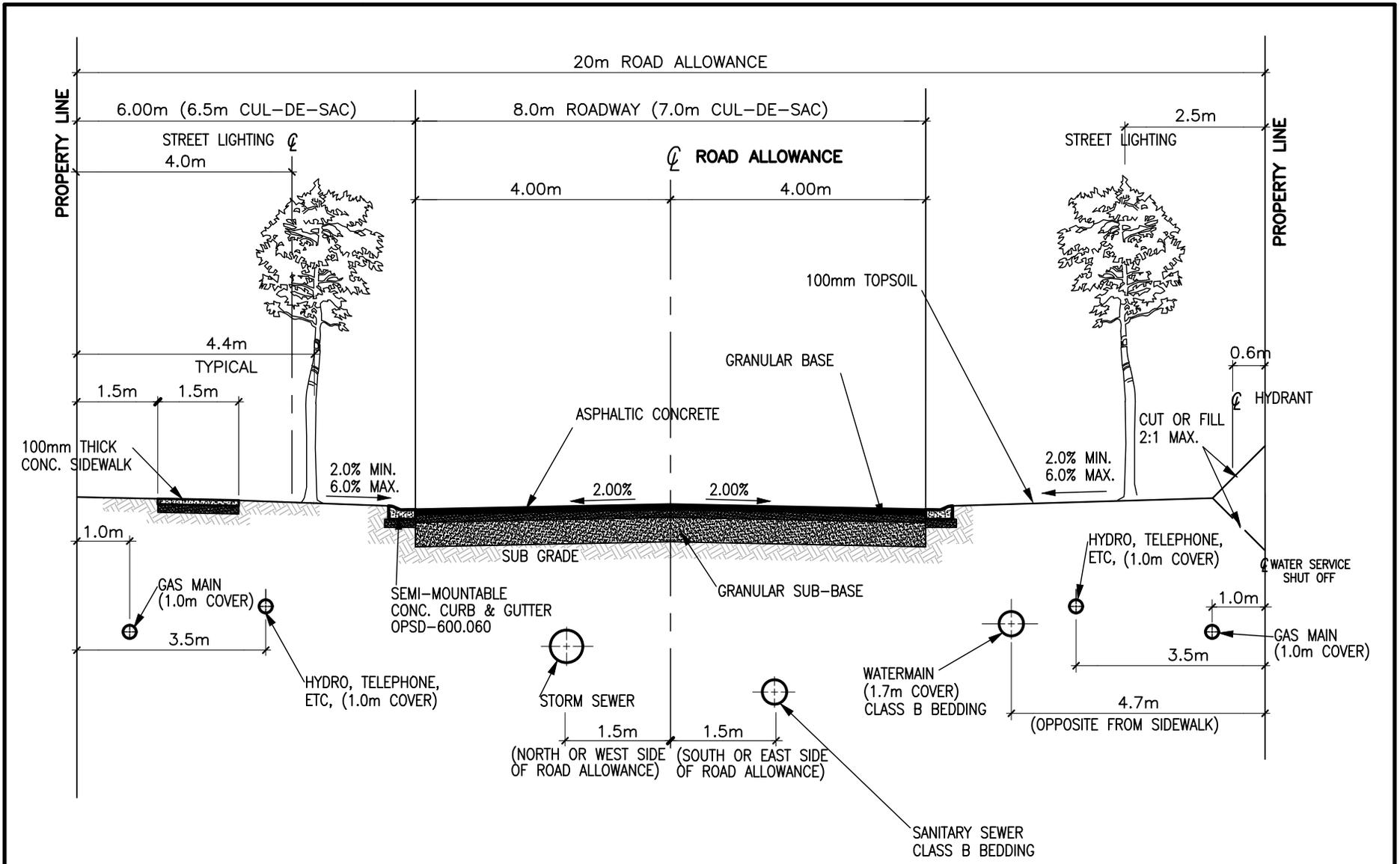
7.2 Drawing Requirements

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 chainage of private drain connections measured from the nearest downstream manhole (0.2m accuracy);
- e. The location and elevation shown on the profile of all services encountered while undertaking the work (0.2m location accuracy, 0.02m elevation accuracy);
- f. The location on plan of all services (0.2m accuracy);
- g. Center line road profile (25m minimum intervals);
- h. The full details for all services i.e. sizes, grades, materials, elevations, etc.;
- i. The digital as-constructed drawing should be geo-referenced shape files and include all items such as water, sanitary sewer, storm sewer and roadwork;
- j. A note on each plan and profile drawing stating that “All elevations related to Geodetic Benchmark No. : _____ Elevation _____.”

LIST OF STANDARD DRAWINGS**Zorra****Standard Drawing****Description**

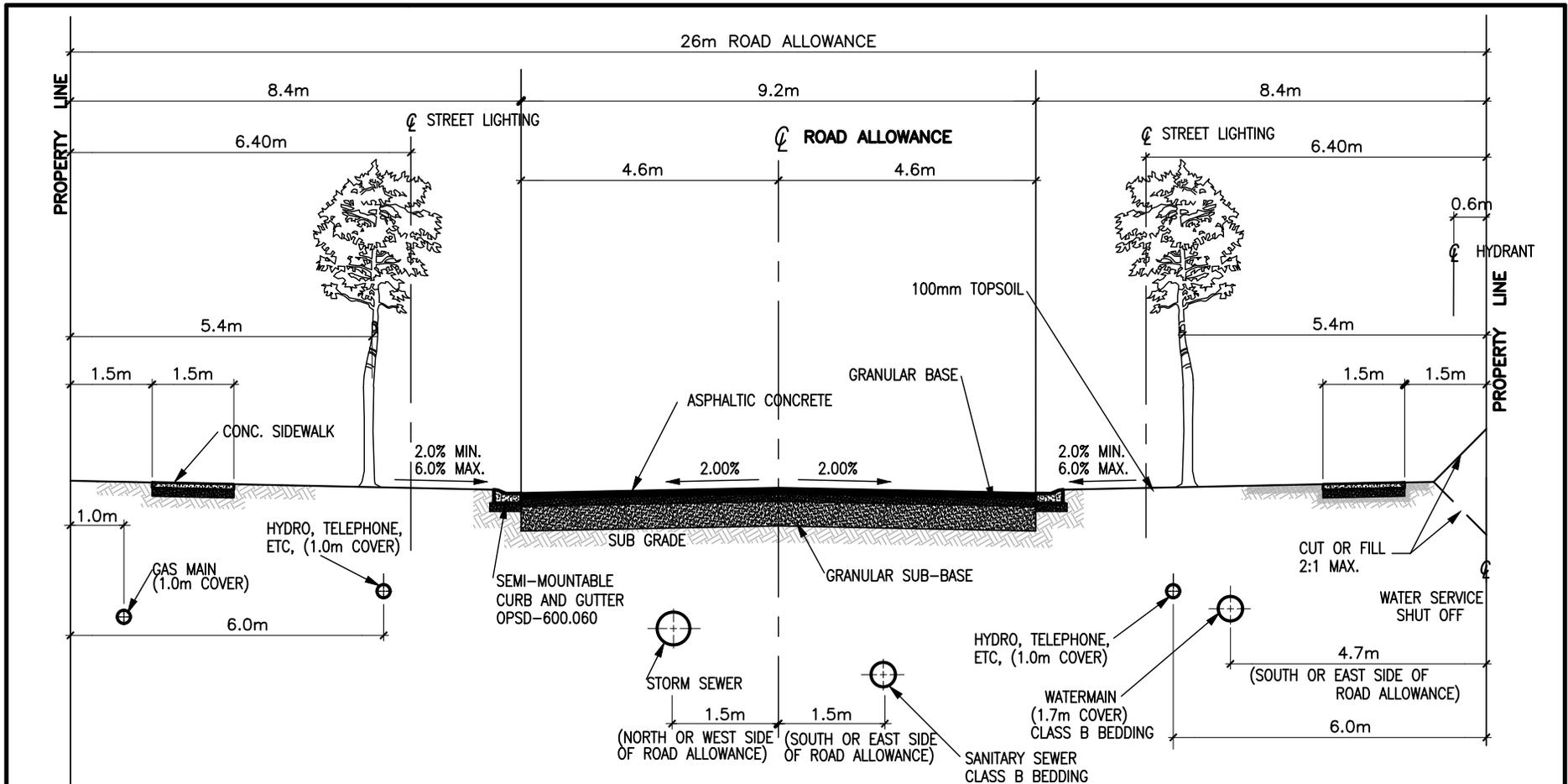
ZSD – 1	Utility Locations for Residential Roads – 20.0m Road Allowance
ZSD – 2	Utility Locations for Residential Roads – 26.0m Road Allowance
ZSD – 3	Utility Locations for Industrial Roads – 26.0m Road Allowance
ZSD – 4	Residential Cul-De-Sac
ZSD – 5	Industrial Cul-De-Sac
ZSD – 6	Standard Cross-Section – Local and Minor-Local Roadway Residential
ZSD – 7	Standard Cross-Section – Collector/Arterial Roadway Residential
ZSD – 8	Standard Cross-Section – Industrial Roadway
ZSD – 9	Walkway Details
ZSD – 10	Pipe Bedding Details Class B and Class C
ZSD – 11	Pipe Bedding Details Class A-1 and Class A-2
ZSD – 12	Lot Drainage Plan
ZSD – 13	Plan and Profile Legend
ZSD – 14	Lot Servicing
ZSD – 15	Rainfall Intensity Duration Curves
ZSD – 16	SWM Rainfall Intensity Chart
ZSD – 17	Private Drain Connections at Street Line
ZSD – 18	600 x 840 Pre-Cast Concrete Curb Inlet Catchbasin
ZSD – 19	Maintenance Hole Benching and Pipe Opening Alternatives
ZSD – 20	Cast-in-Place Maintenance Hole Drop Structure Tee
ZSD – 21	Cast-in-Place Maintenance Hole Drop Structure Wye
ZSD – 22	Sewer Service Connections for Main Pipe Sewer
ZSD – 23	Standard R.O.W. Residential Asphalt Ditches
ZSD – 24	Concrete Barrier Curb with Standard Gutter
ZSD – 25	Concrete Semi-Mountable Curb with Standard Gutter
ZSD – 26	Standard for Street Curve
ZSD – 27	Concrete Sidewalk
ZSD – 28	Concrete Sidewalk Adjacent to Curb and Gutter
ZSD – 29	Concrete Sidewalk Ramps Tactile Walking Surface



NOTES:

1. HYDRO & STREET LIGHTING WIRING TO BE UNDERGROUND. BELL, HYDRO, & T.V. CABLE MAY BE STACKED IN A COMMON TRENCH.
2. BELL & T.V. CABLE PEDESTALS ARE TO BE LOCATED AT 0.3m(1') OFF PROPERTY LINE.
3. WHERE POSSIBLE, LOCATE STREET LIGHTS, HYDRANTS, PEDESTALS, ETC. OPPOSITE PERPENDICULAR LOT LINES.

TOWNSHIP OF ZORRA	
UTILITY LOCATIONS	
FOR	
RESIDENTIAL ROADS	
20.0m ROAD ALLOWANCE	
OCTOBER, 2021	ZSD - 1

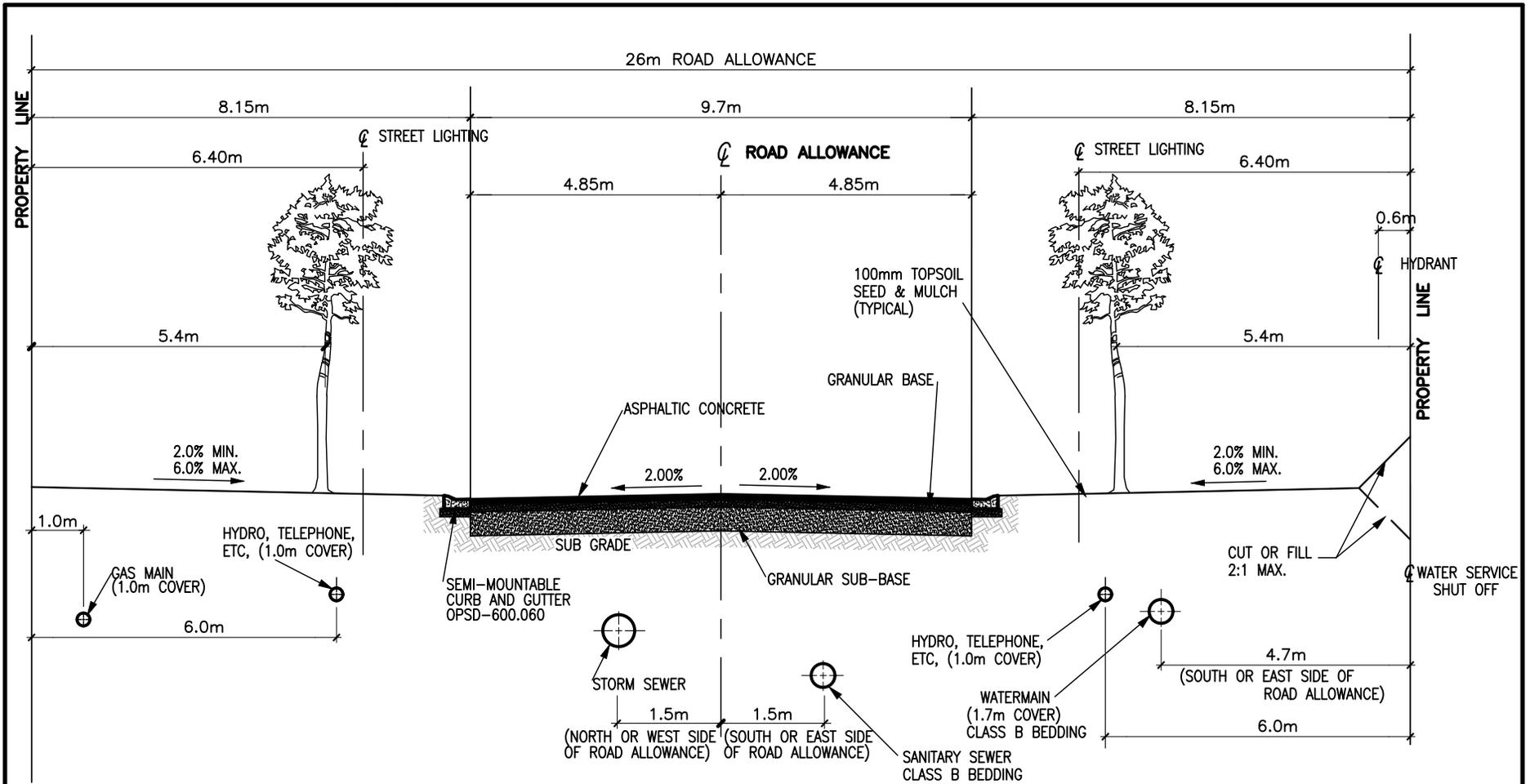


STANDARD RIGHT-OF-WAY CROSS-SECTION
FOR COLLECTOR STREETS WITH
CONCRETE CURB AND GUTTER AND ASPHALTIC CONCRETE

NOTES:

1. HYDRO & STREET LIGHTING WIRING TO BE UNDERGROUND. BELL, HYDRO, & T.V. CABLE MAY BE STACKED IN A COMMON TRENCH.
2. BELL & T.V. CABLE PEDESTALS ARE TO BE LOCATED AT 0.3m(1') OFF PROPERTY LINE.
3. WHERE POSSIBLE, LOCATE STREET LIGHTS, HYDRANTS, PEDESTALS, ETC. OPPOSITE PERPENDICULAR LOT LINES.

TOWNSHIP OF ZORRA	
UTILITY LOCATIONS	
FOR	
RESIDENTIAL ROADS	
26.0m ROAD ALLOWANCE	
OCTOBER, 2021	ZSD - 2

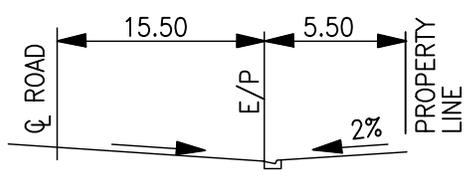
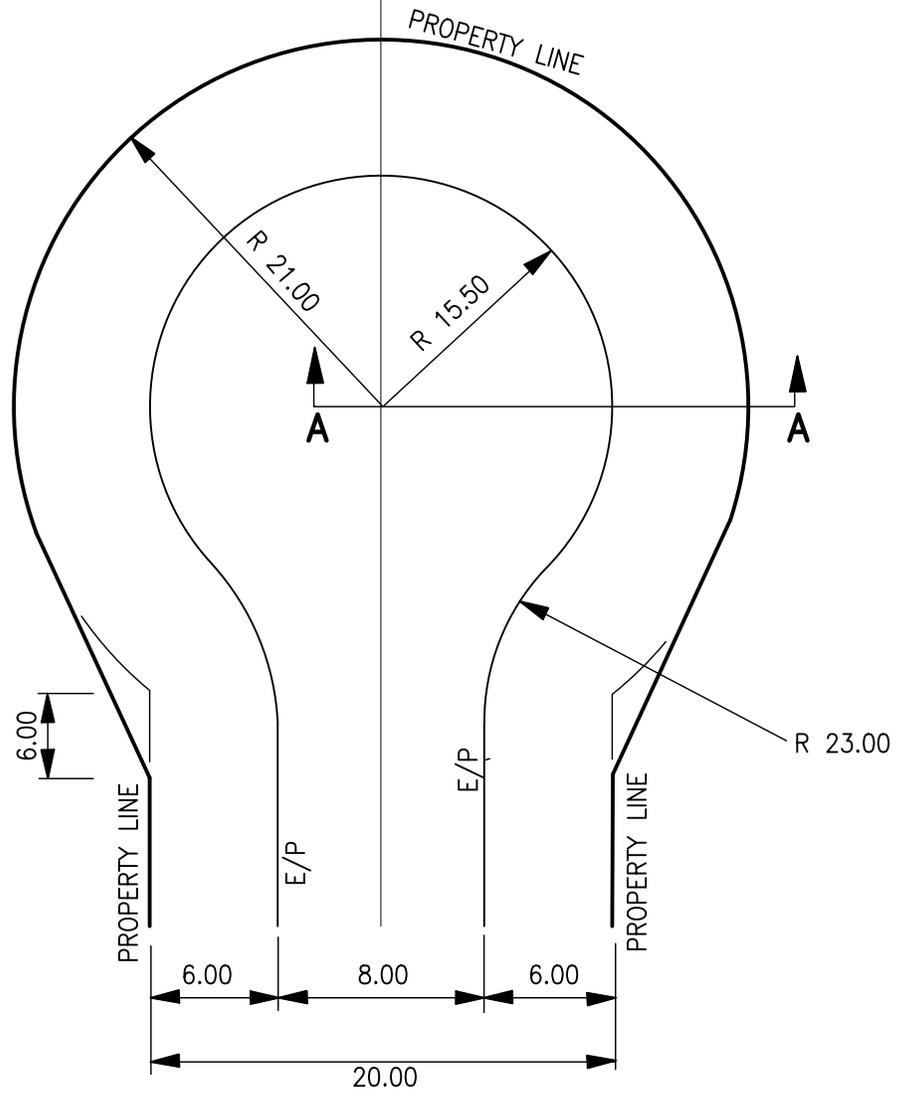


STANDARD RIGHT-OF-WAY CROSS-SECTION
FOR COLLECTOR STREETS WITH
CONCRETE CURB AND GUTTER AND ASPHALTIC CONCRETE

NOTES:

1. HYDRO & STREET LIGHTING WIRING TO BE UNDERGROUND. BELL, HYDRO, & T.V. CABLE MAY BE STACKED IN A COMMON TRENCH.
2. BELL & T.V. CABLE PEDESTALS ARE TO BE LOCATED AT 0.3m(1') OFF PROPERTY LINE.
3. WHERE POSSIBLE, LOCATE STREET LIGHTS, HYDRANTS, PEDESTALS, ETC. OPPOSITE PERPENDICULAR LOT LINES.

TOWNSHIP OF ZORRA	
UTILITY LOCATIONS	
FOR	
INDUSTRIAL ROADS	
26.0m ROAD ALLOWANCE	
OCTOBER, 2021	ZSD - 3

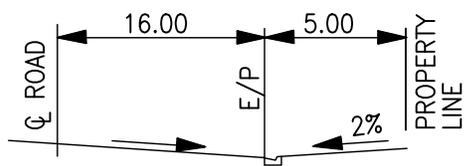
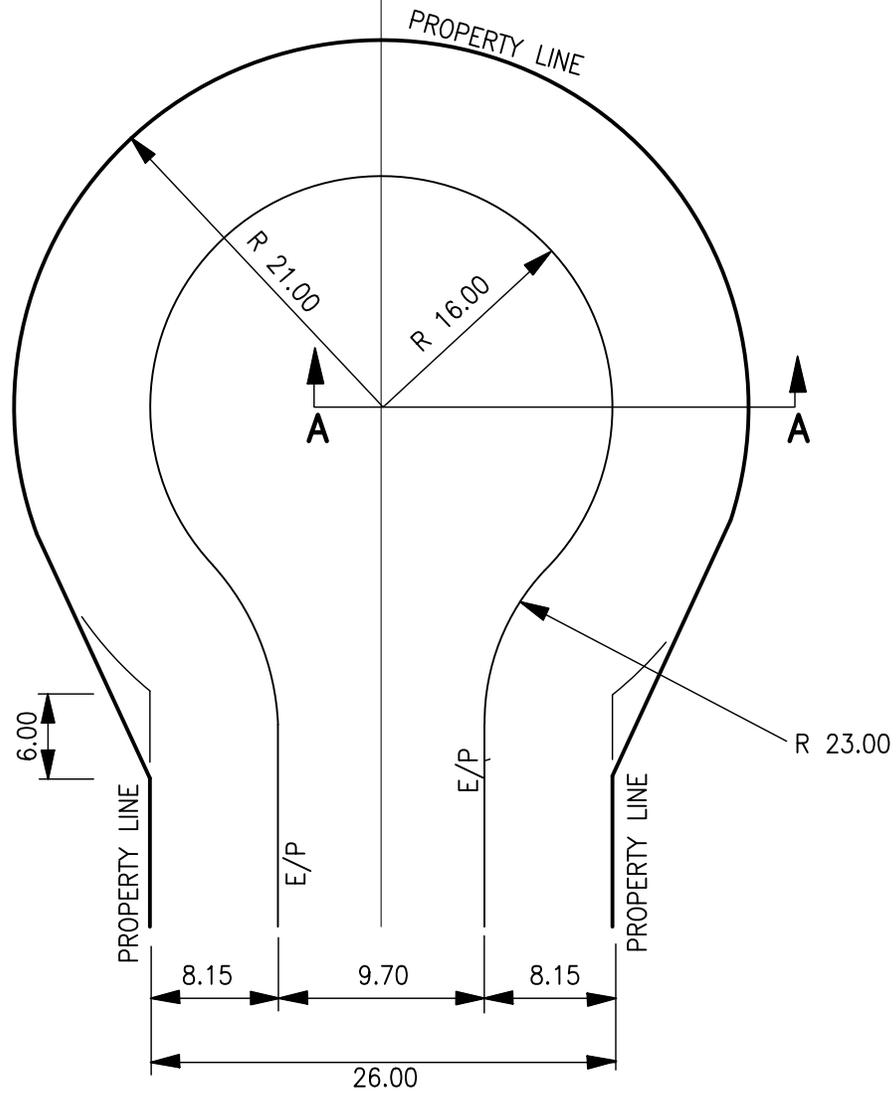


SECTION A-A

NOTES:

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

TOWNSHIP OF ZORRA	
RESIDENTIAL CUL-DE-SAC	
OCTOBER, 2021	ZSD - 4

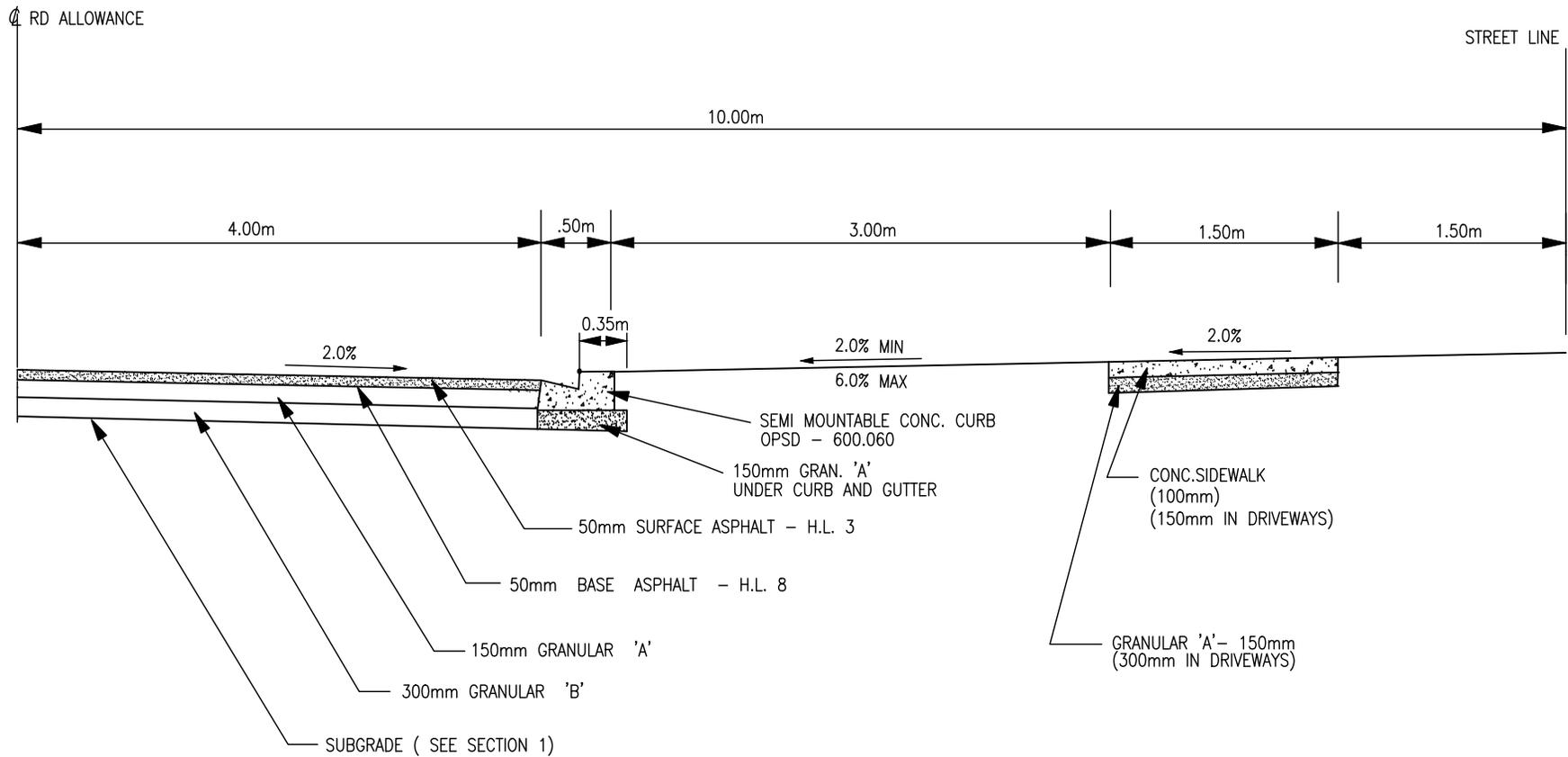


SECTION A-A

NOTES:

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

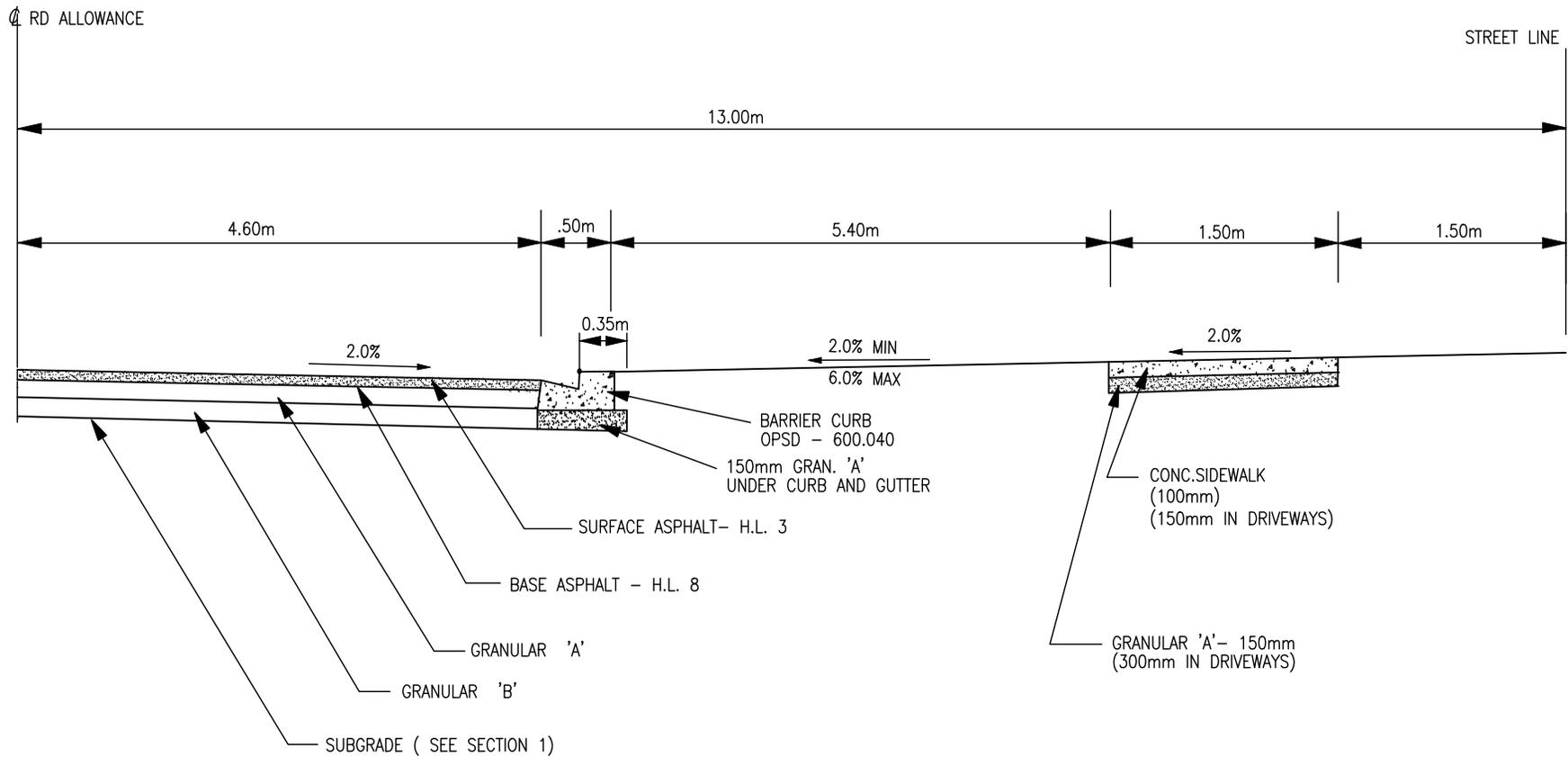
TOWNSHIP OF ZORRA	
INDUSTRIAL CUL-DE-SAC	
OCTOBER, 2021	ZSD - 5



NOTES:

- 1 - SEE SERVICING STANDARDS - SECTION 1.
- 2 - CROWN OF ROAD TO BE 2%.
- 3 - 2% OF CROSSFALL TO BE USED IN SIDEWALK CONSTRUCTION.
- 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.

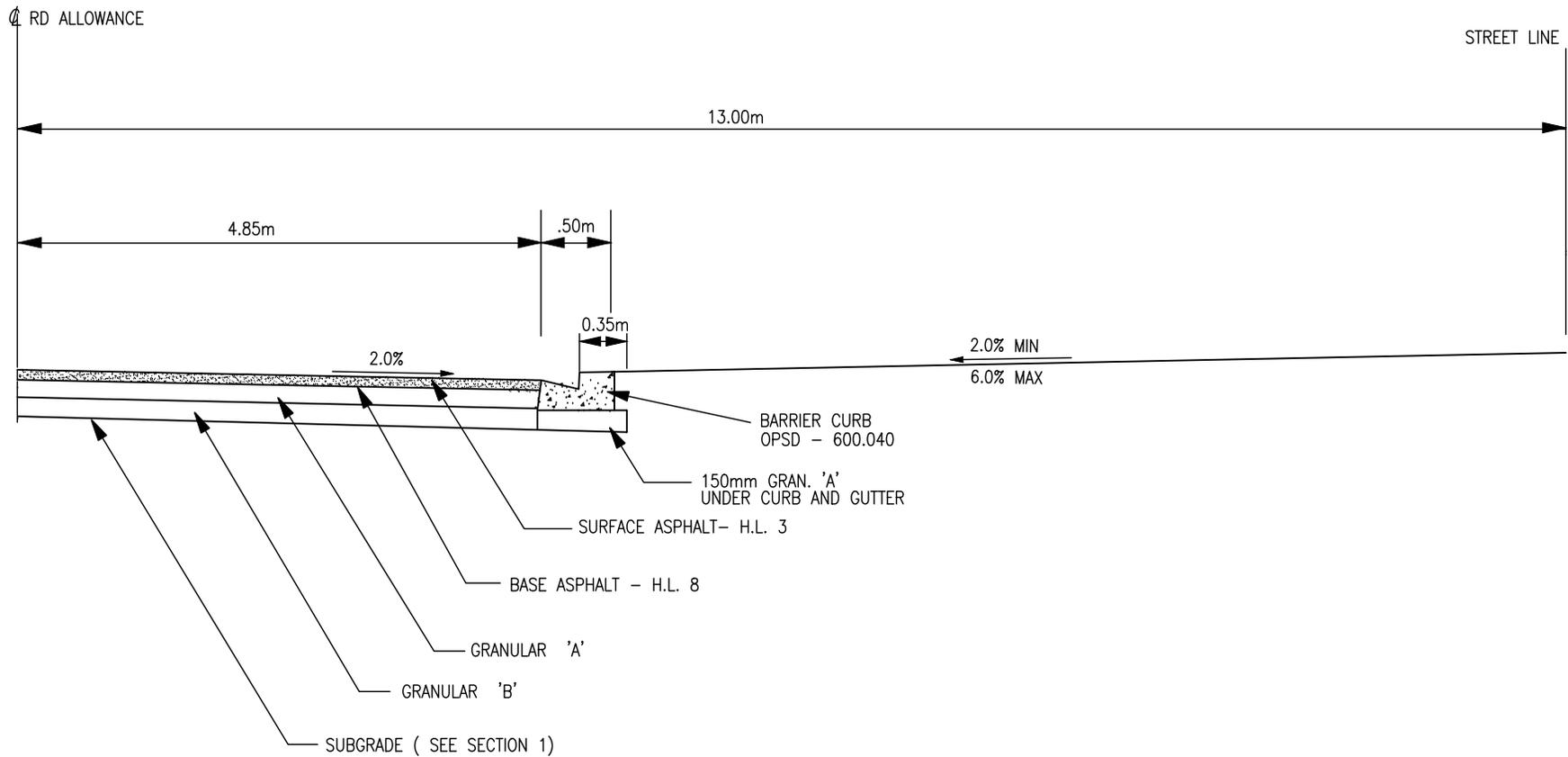
TOWNSHIP OF ZORRA	
LOCAL AND MINOR-LOCAL ROADWAY RESIDENTIAL	
20.0m ROAD ALLOWANCE	
OCTOBER, 2021	ZSD - 6



NOTES:

- 1 - SEE SERVICING STANDARDS - SECTION 1.
- 2 - CROWN OF ROAD TO BE 2%.
- 3 - 2% OF CROSSFALL TO BE USED IN SIDEWALK CONSTRUCTION.
- 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.

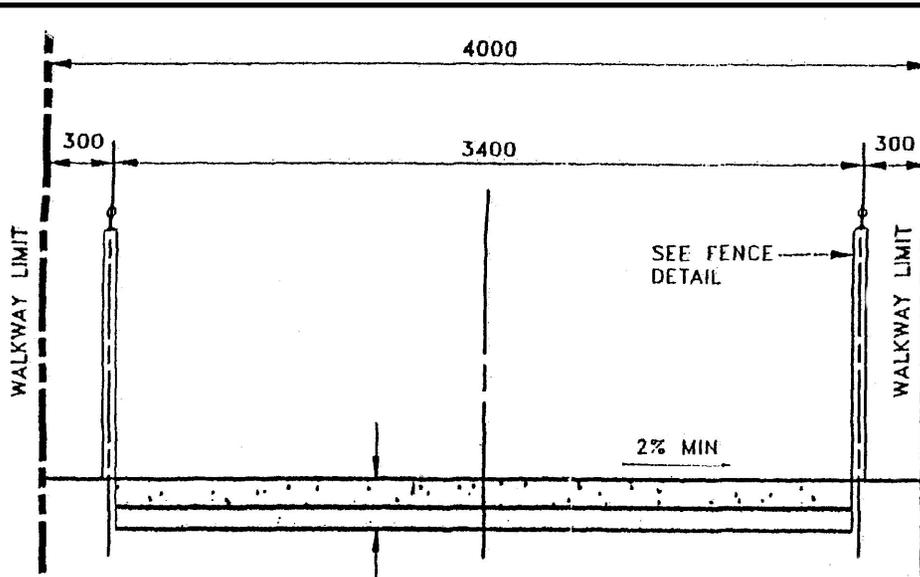
TOWNSHIP OF ZORRA	
COLLECTOR / ARTERIAL ROADWAY RESIDENTIAL	
26.0m ROAD ALLOWANCE	
OCTOBER, 2021	ZSD - 7



NOTES:

- 1 - SEE SERVICING STANDARDS - SECTION 1.
- 2 - CROWN OF ROAD TO BE 2%.
- 3 - 2% OF CROSSFALL TO BE USED IN SIDEWALK CONSTRUCTION.
- 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.

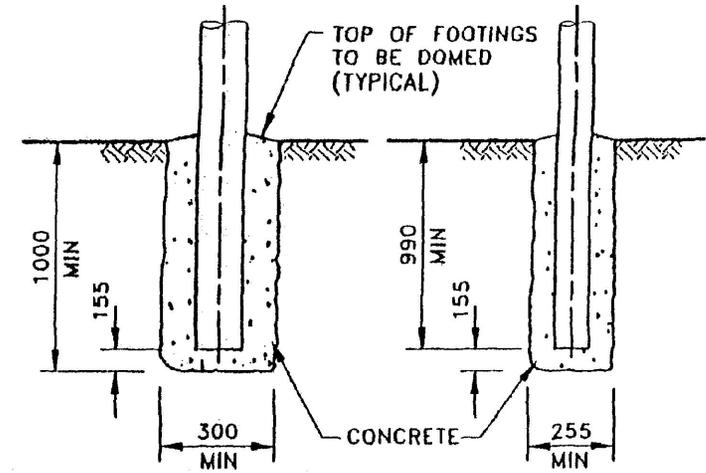
TOWNSHIP OF ZORRA	
INDUSTRIAL ROADWAY 26.0m ROAD ALLOWANCE	
OCTOBER, 2021	ZSD - 8



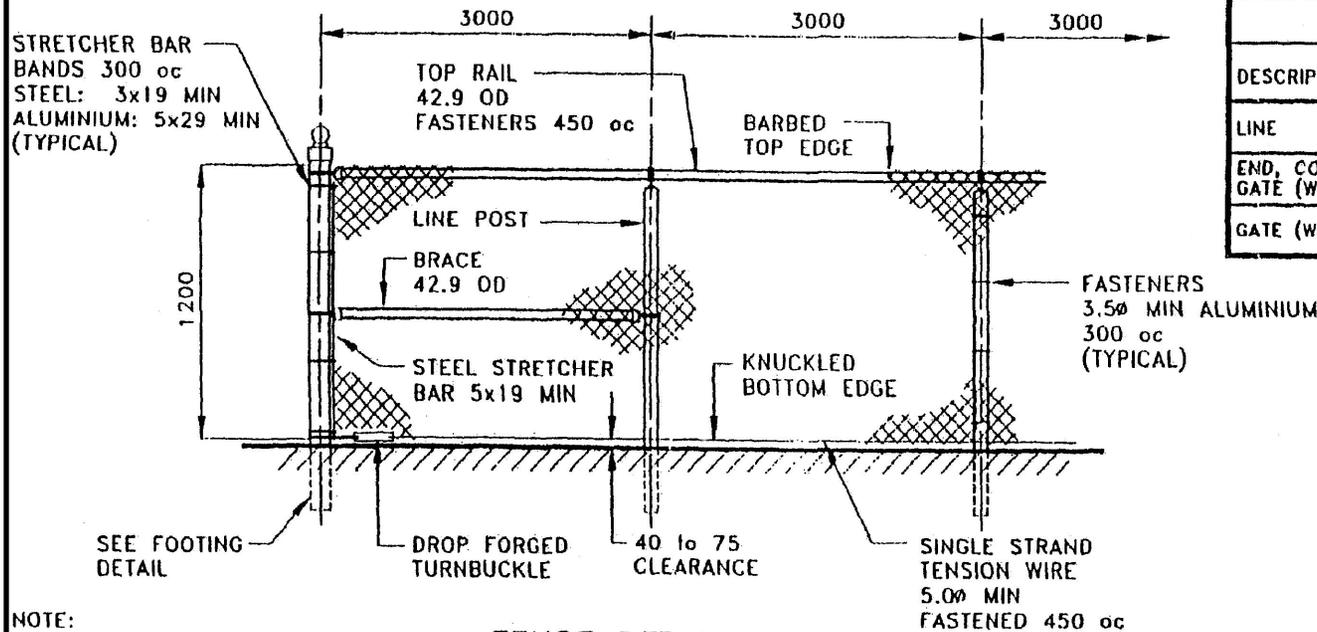
150 CONCRETE - 30MPa
150 COMPACTED GRANULAR 'A'

CROSS SECTION

END, CORNER, STRAINING OR GATE POST LINE POST



FOOTING DETAIL



FENCE DETAIL

NOTE:
ALL DIMENSIONS IN MILLIMETRES
UNLESS SHOWN OTHERWISE

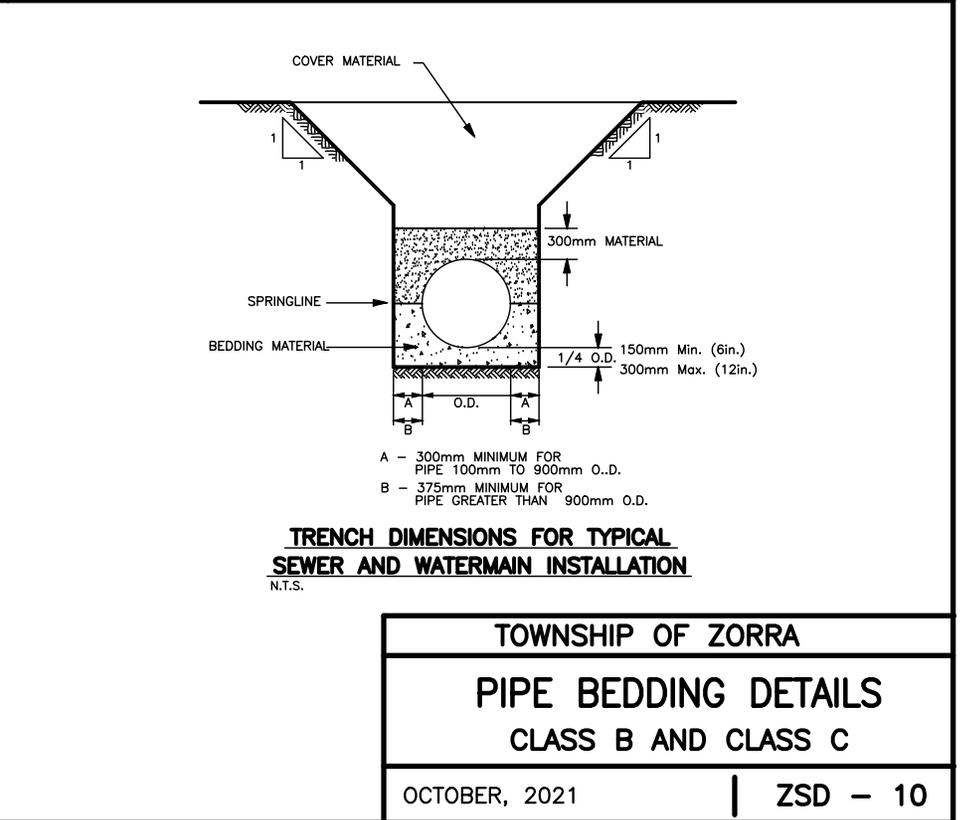
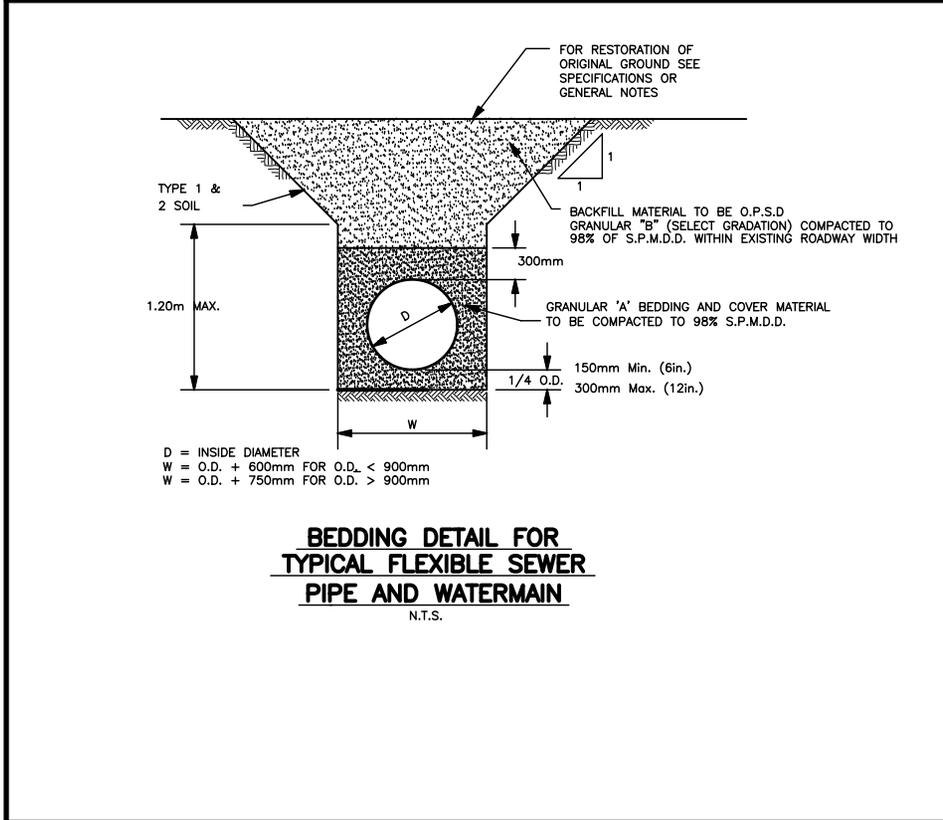
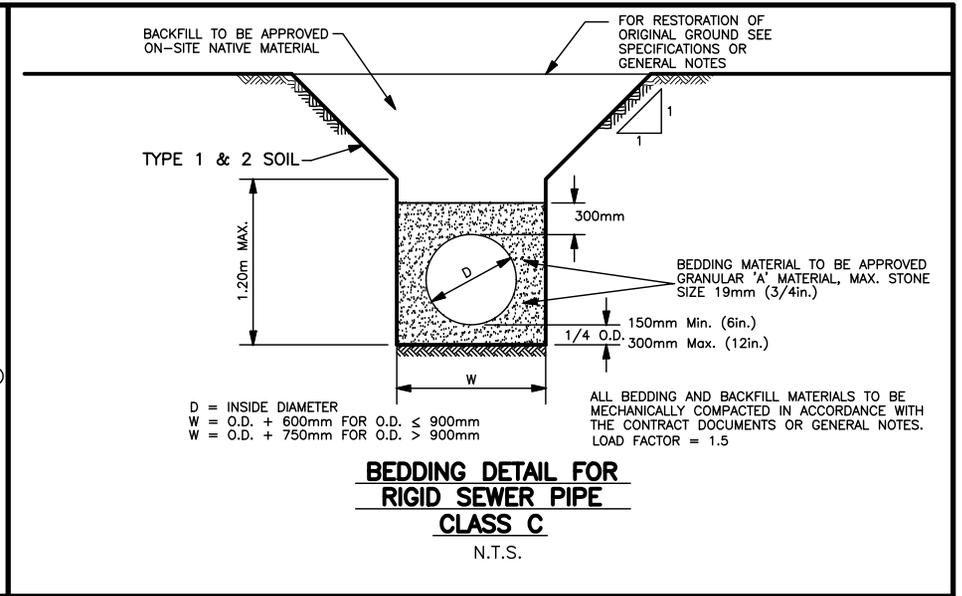
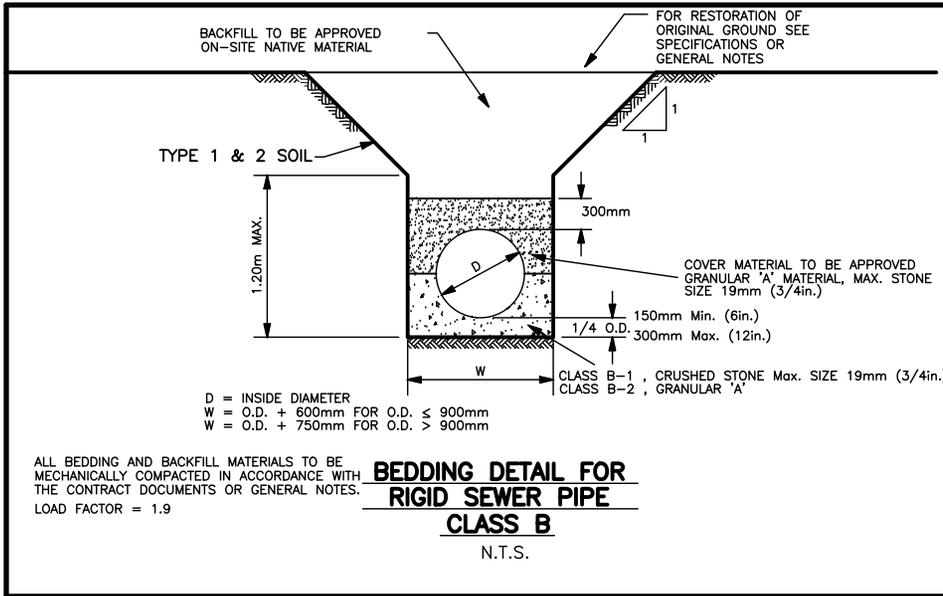
DESCRIPTION	OD	LENGTH	
		STANDARD	RET. WALL
LINE	60.3	2700	2000
END, CORNER, STRAINING AND GATE (WITH 5.5m MAX OPENING)	88.9	2900	2300
GATE (WITH 10.0 MAX OPENING)	114.3	2900	-

TOWNSHIP OF ZORRA

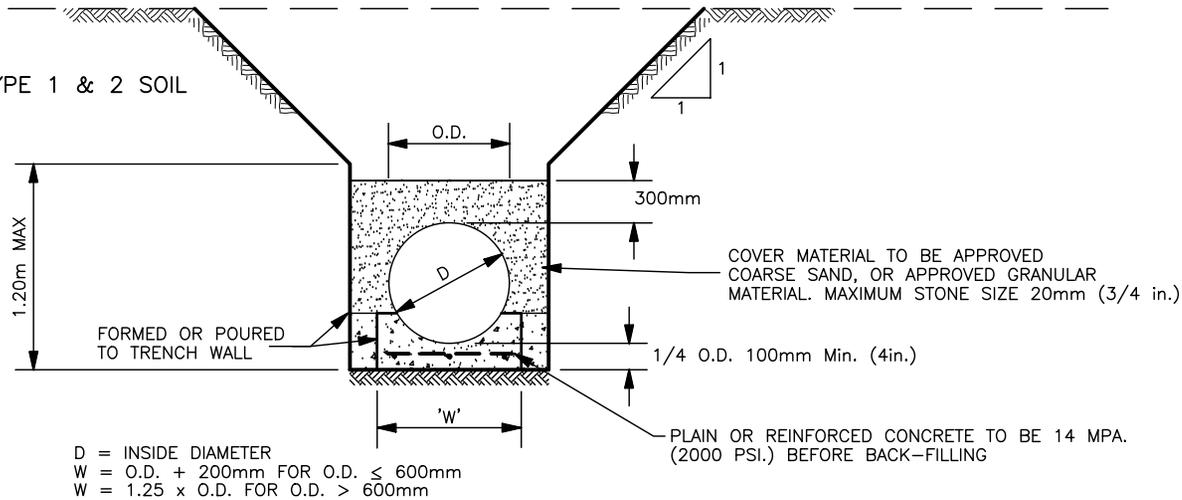
WALKWAY DETAILS

OCTOBER, 2021

ZSD - 9



TYPE 1 & 2 SOIL



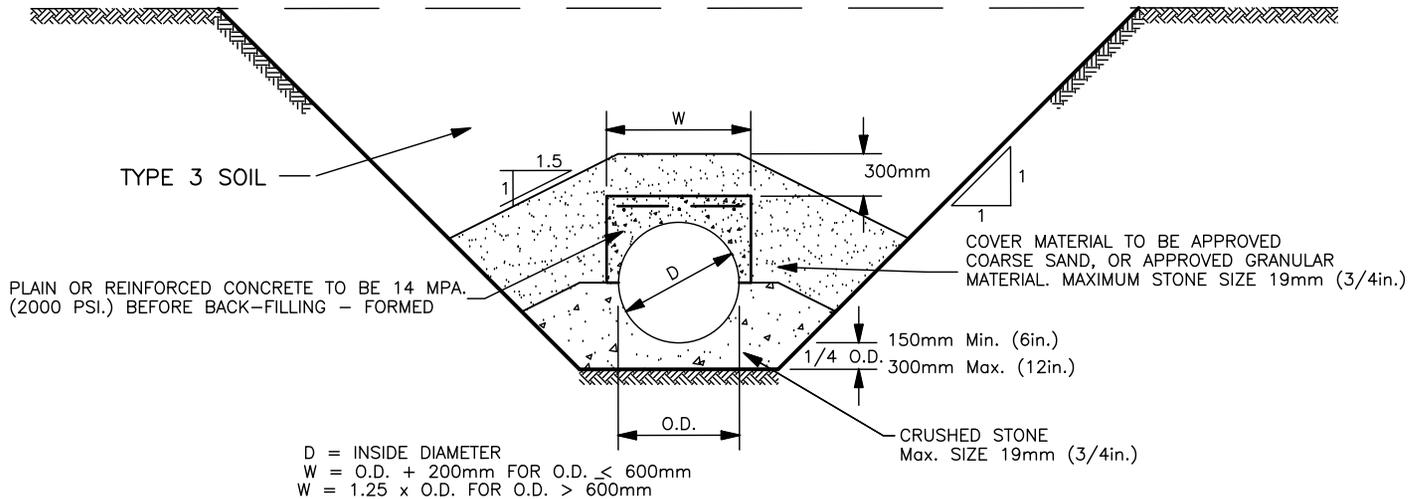
D = INSIDE DIAMETER
 W = O.D. + 200mm FOR O.D. ≤ 600mm
 W = 1.25 x O.D. FOR O.D. > 600mm

**BEDDING DETAIL FOR
 CLASS A - 1**

N.T.S.

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

TYPE 3 SOIL



D = INSIDE DIAMETER
 W = O.D. + 200mm FOR O.D. ≤ 600mm
 W = 1.25 x O.D. FOR O.D. > 600mm

**BEDDING DETAIL FOR
 CLASS A - 2**

N.T.S.

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

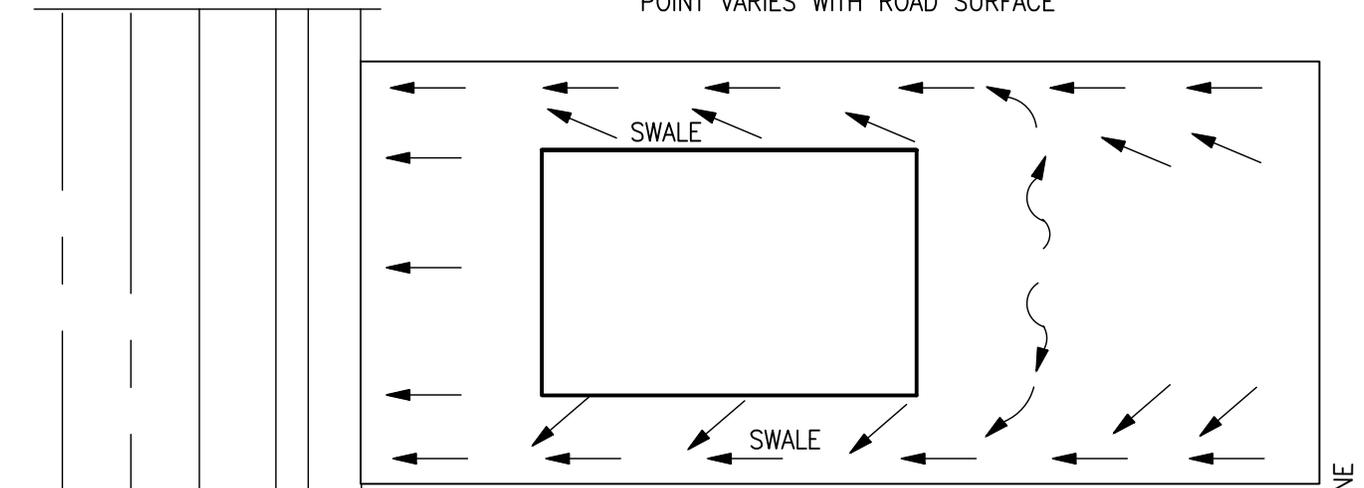
TOWNSHIP OF ZORRA

**PIPE BEDDING DETAILS
 CLASS A-1 AND CLASS A-2**

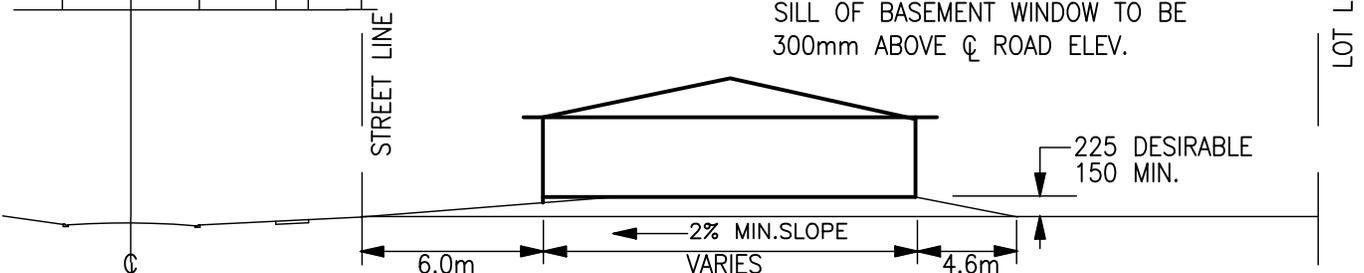
OCTOBER, 2021

ZSD - 11

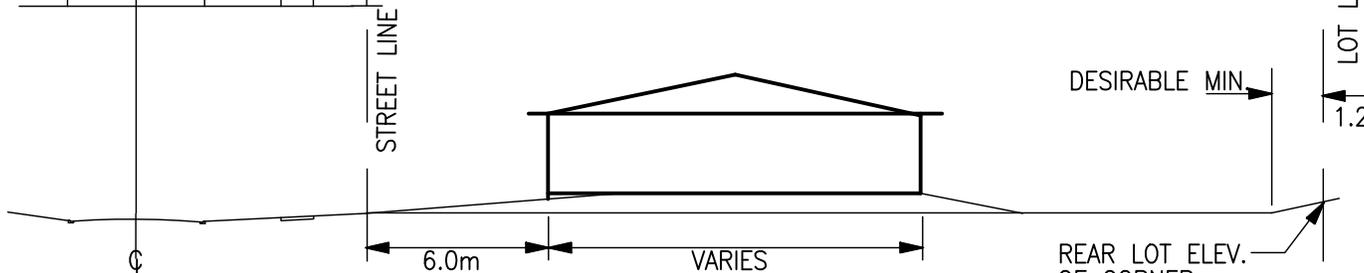
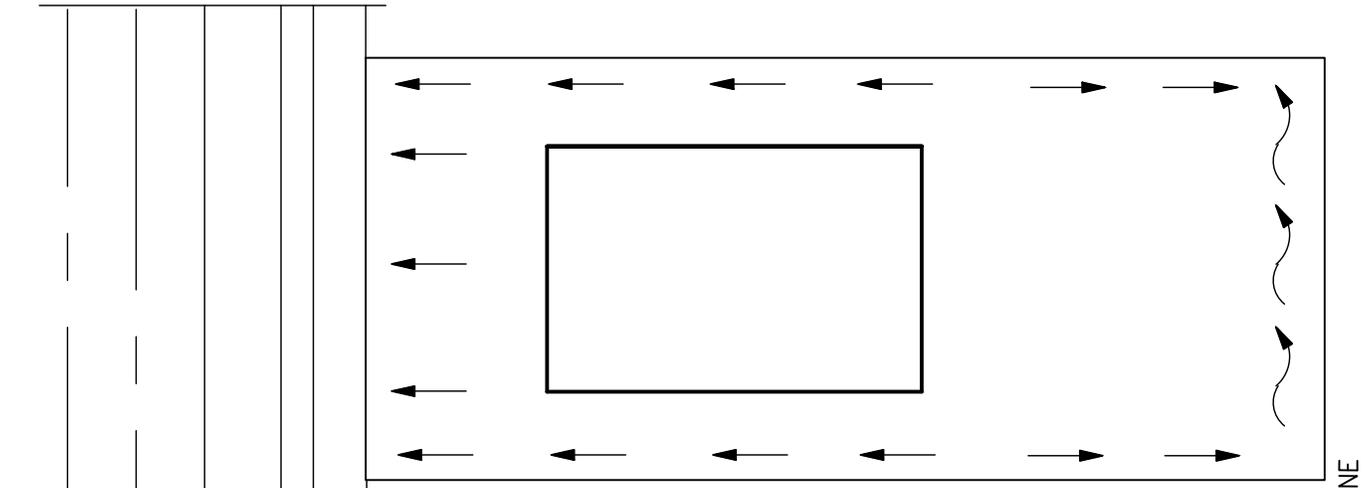
2% MIN. SWALE GRADE. LOCATION OF DIVISION POINT VARIES WITH ROAD SURFACE



SILL OF BASEMENT WINDOW TO BE 300mm ABOVE C ROAD ELEV.



TYPICAL FRONT LOT DRAINAGE



TYPICAL REAR LOT DRAINAGE

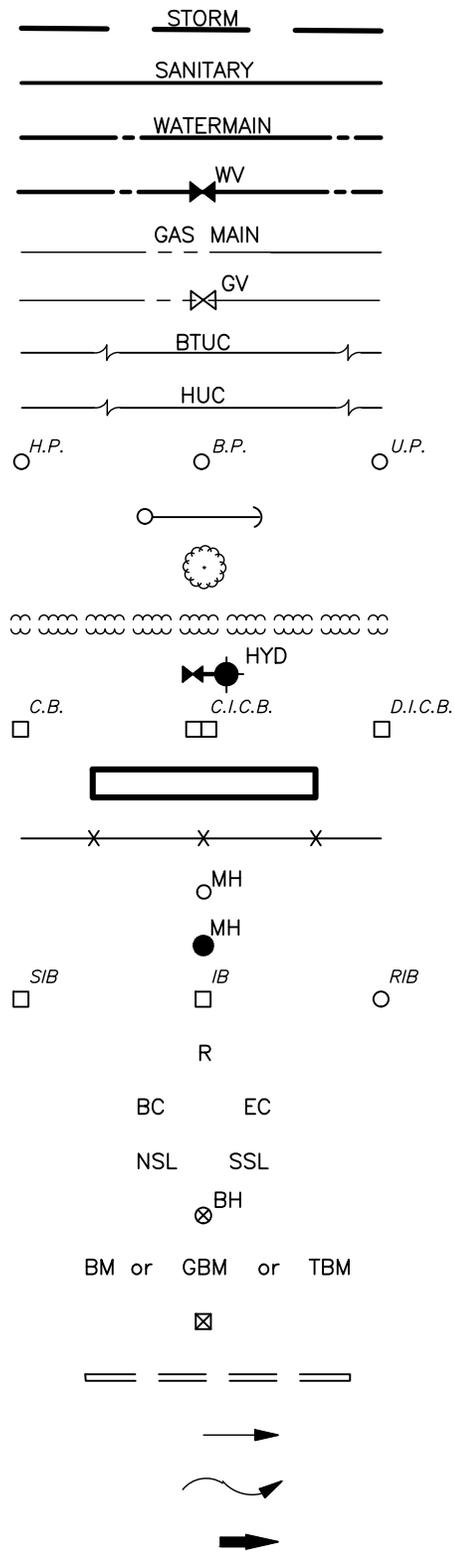
NOTES:

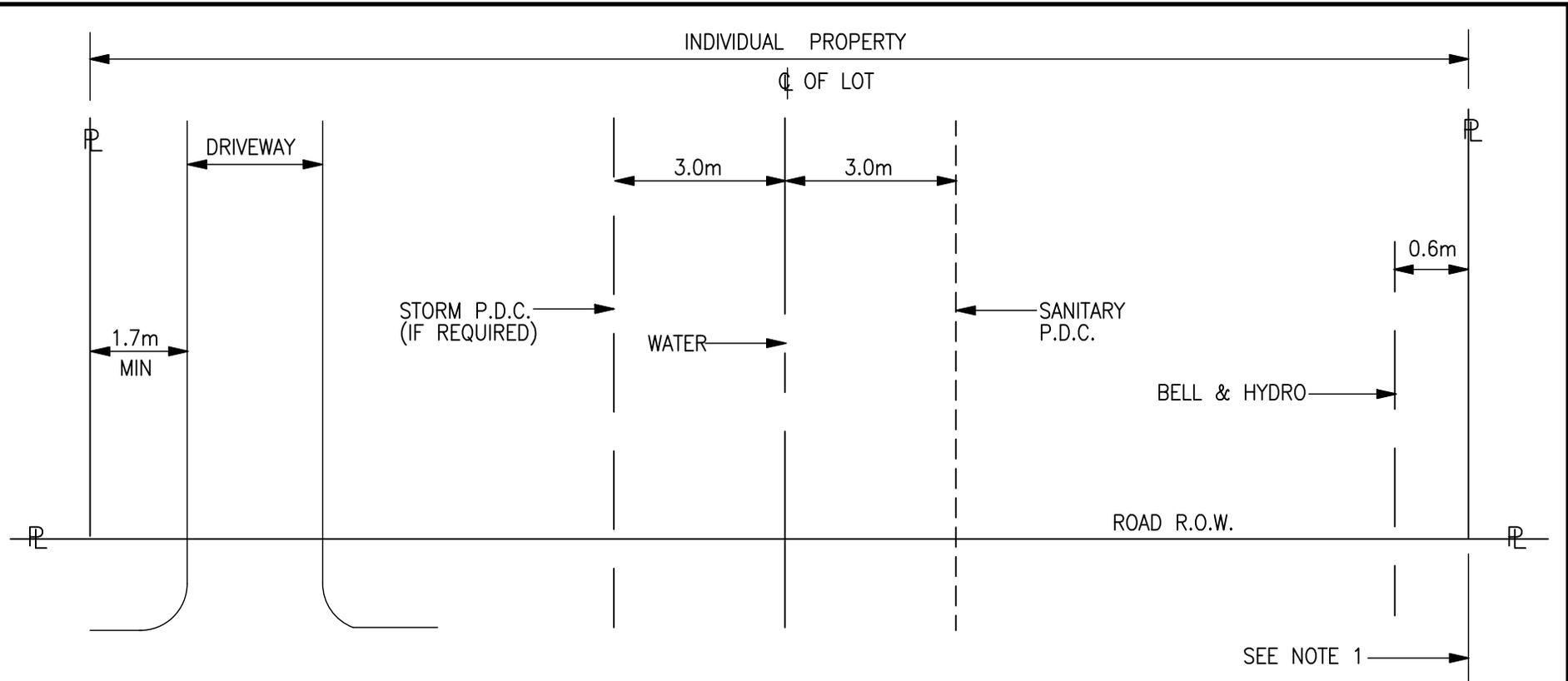
MINIMUM LOT DIMENSIONS, FRONT YARD DEPTHS, AND SIDE YARD WIDTHS TO BE IN ACCORDANCE WITH ZONING BY-LAW.

TOWNSHIP OF ZORRA	
LOT DRAINAGE PLAN	
OCTOBER, 2021	ZSD - 12

LEGEND:

STORM SEWER
 SANITARY(OR COMBINES)SEWER
 WATERMAIN
 WATER VALVE
 GAS MAIN
 GAS VALVE
 BELL CABLE(UNDERGROUND)
 HYDRO CABLE(UNDERGROUND)
 HYDRO,BELL,UTILITY POLES
 GUY ANCHOR
 TREE
 HEDGE,BUSH
 HYDRANT
 CATCH/CURB INLET/DITCH INLET BASIN
 BUILDING
 FENCE
 EXISTING MANHOLE
 PROPOSED MANHOLE
 PROPERTY BARS
 RADIUS
 BEGINNING/END OF CURVE
 NORTH/SOUTH STREET LINE
 BOREHOLE
 BENCH MARK
 HYDRO TOWER
 CULVERT
 DIRECTION OF FLOW/MINOR SWALE
 MAJOR/REAR YARD SWALE
 OVERLAND FLOW ROUTE

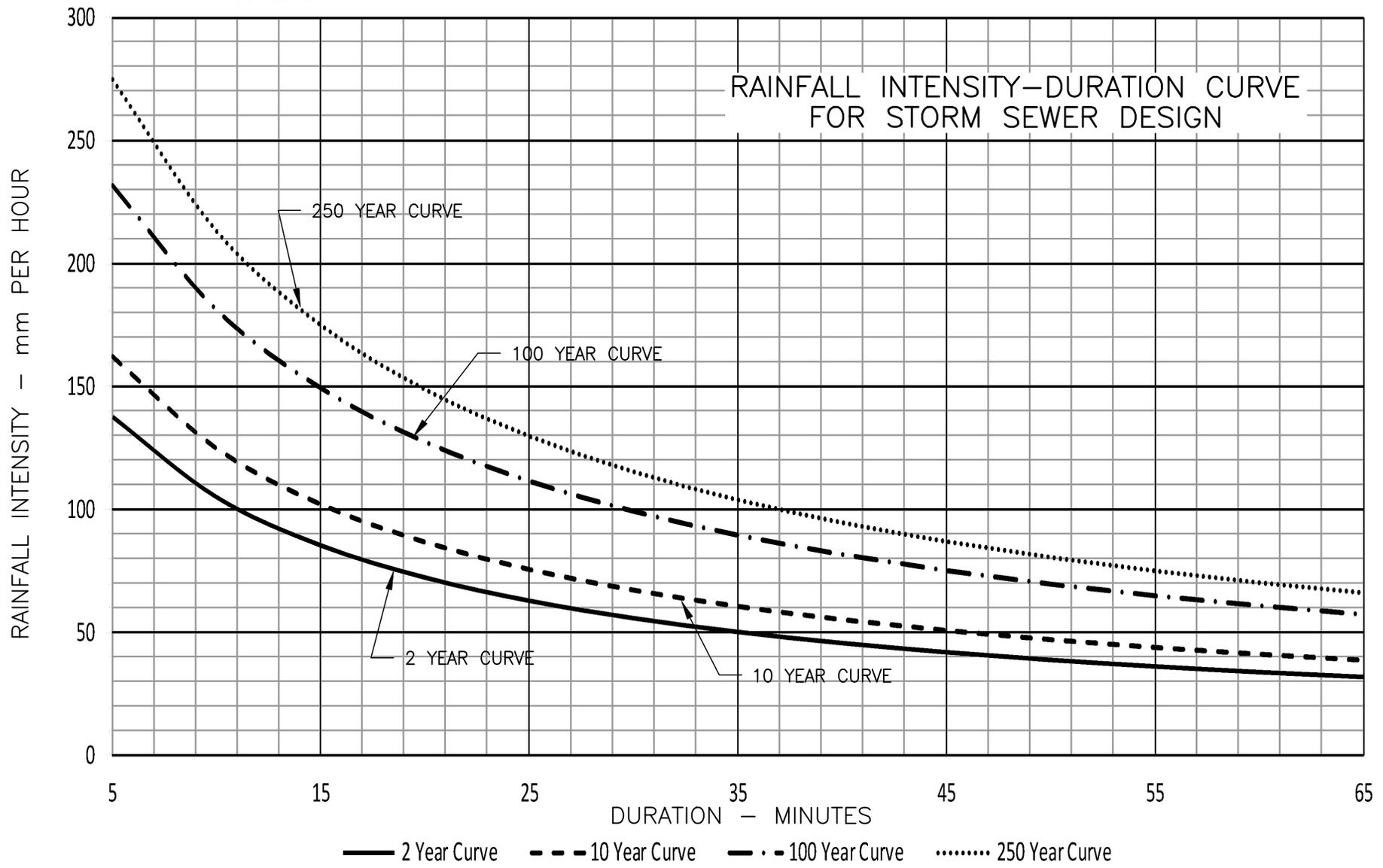




NOTES:

1. ALL HYDRANTS, PADMOUNTS TRANSFORMERS AND STREET LIGHT POLES ARE TO BE INSTALLED ON LOT LINES ONLY AND IN ACCORDANCE WITH ZSD 1.
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-DETACHED 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.

TOWNSHIP OF ZORRA	
LOT SERVICING	
OCTOBER, 2021	ZSD - 14



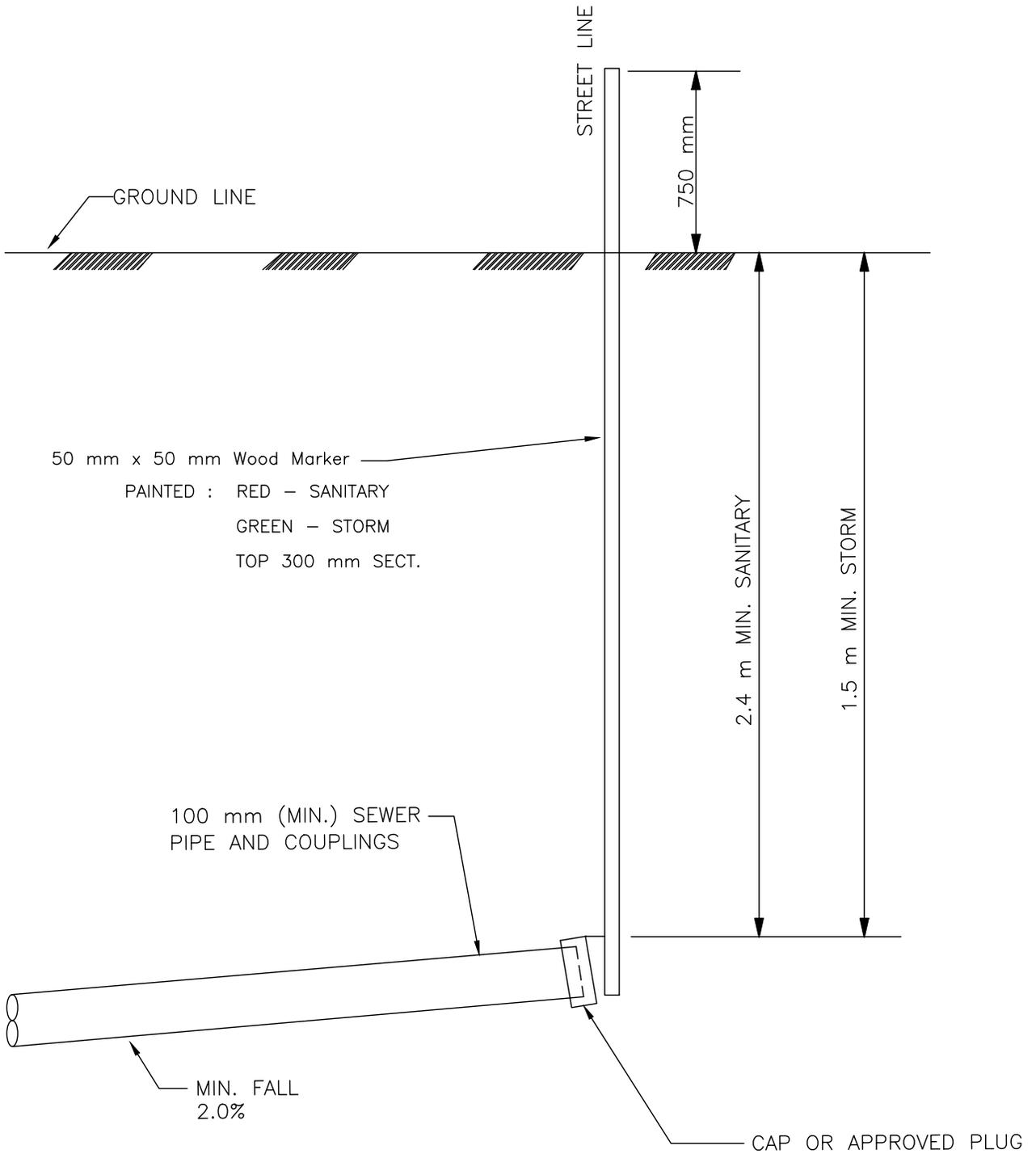
TOWNSHIP OF ZORRA	
RAINFALL INTENSITY DURATION CURVES	
OCTOBER, 2021	ZSD - 15

**CULVERT AND STORMWATER MANAGEMENT DESIGN
RAINFALL INTENSITY CHART
AES DESIGN STORM (LONDON AIRPORT 1943–1986)**

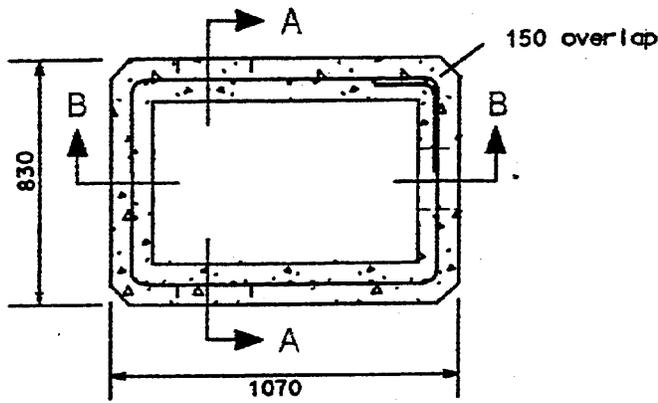
$$I = a / (t + b)^c$$

	2 year	5 year	10 year	25 year	50 year	100 year	250 year
a=	1290.00	1330.31	1574.38	1455.00	1499.06	2619.36	3048.22
b=	8.500	7.938	9.025	5.000	4.188	10.500	10.030
c=	0.860	0.855	0.860	0.820	0.809	0.884	0.888

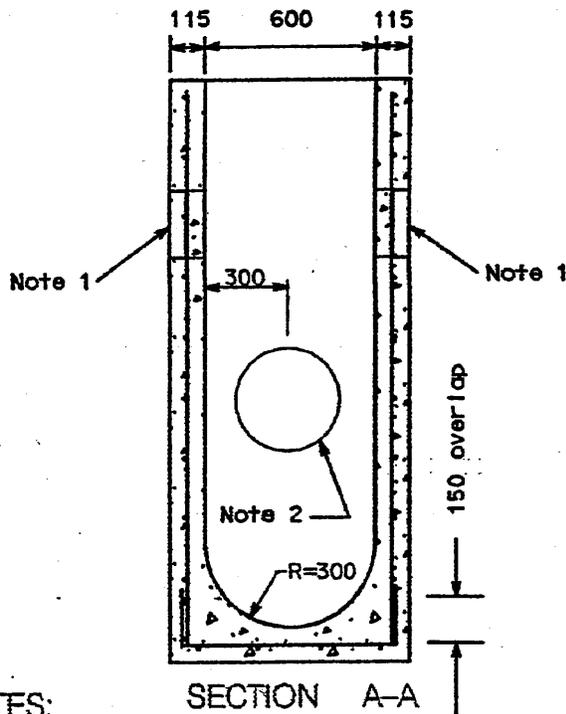
Time (min)	Intensity (mm/hr)						
5	137.56	149.04	162.47	220.22	249.21	232.24	274.73
10	104.91	112.71	124.99	157.93	175.35	181.39	212.89
15	85.40	91.34	102.27	124.74	137.36	149.56	174.67
20	72.35	77.17	86.92	103.88	113.89	127.67	148.59
30	55.86	59.41	67.38	78.83	86.08	99.36	115.11
45	42.09	44.68	50.94	58.84	64.14	75.20	86.77
60	34.03	36.10	41.26	47.45	51.71	60.87	70.05
90	24.90	26.41	30.25	34.76	37.92	44.49	51.04
120	19.81	21.01	24.10	27.76	30.32	35.32	40.44
360	8.01	8.52	9.76	11.53	12.70	14.04	15.98
720	4.46	4.75	5.43	6.57	7.28	7.70	8.74
1440	2.47	2.64	3.01	3.73	4.17	4.20	4.75



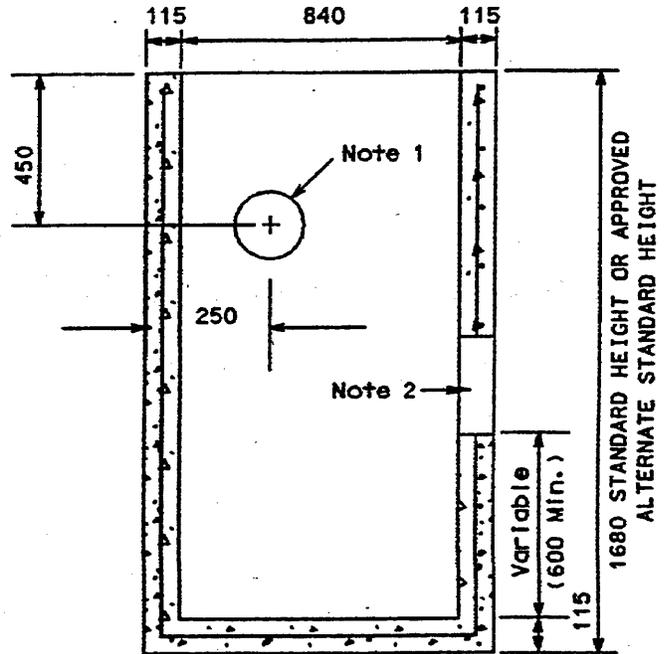
TOWNSHIP OF ZORRA	
PRIVATE DRAIN CONNECTIONS AT STREET LINE	
OCTOBER, 2021	ZSD - 17



PLAN



SECTION A-A



SECTION B-B

NOTES:

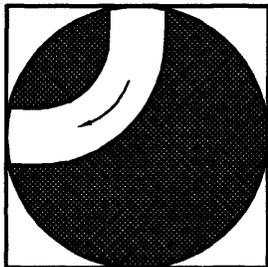
1. 200mm dia. knockout to accommodate subdrain. Knockout to be half wall thickness from the outside.
2. Outlet hole size 400mm dia. location as required.
3. All reinforcing steel bars to be 15. Reinforcing steel shall have 50mm cover
4. Granular backfill to be placed and compacted to a min. thickness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

A. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

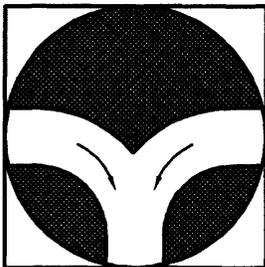
TOWNSHIP OF ZORRA
600x840 PRECAST CONCRETE
CURB INLET CATCHBASIN

OCTOBER, 2021

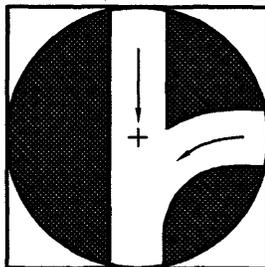
ZSD - 18



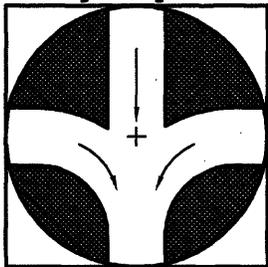
1. Right angle bend



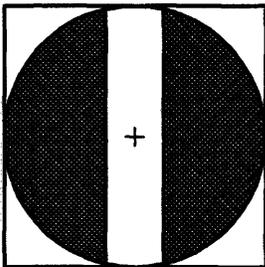
2. Tee connection



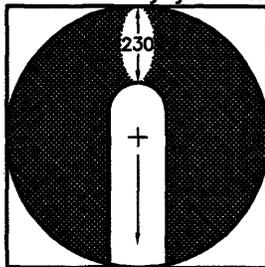
3. Three way junction



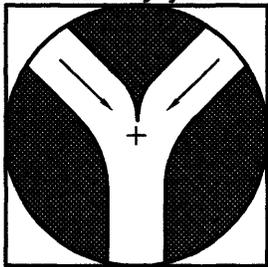
4. Four way junction



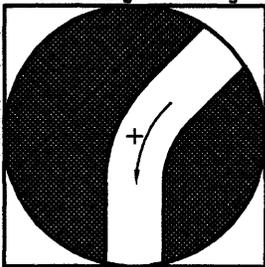
5. Straight through



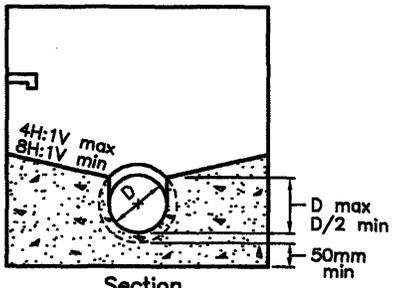
6. Dead end



7. Wye connection



8. 45° bend



Section

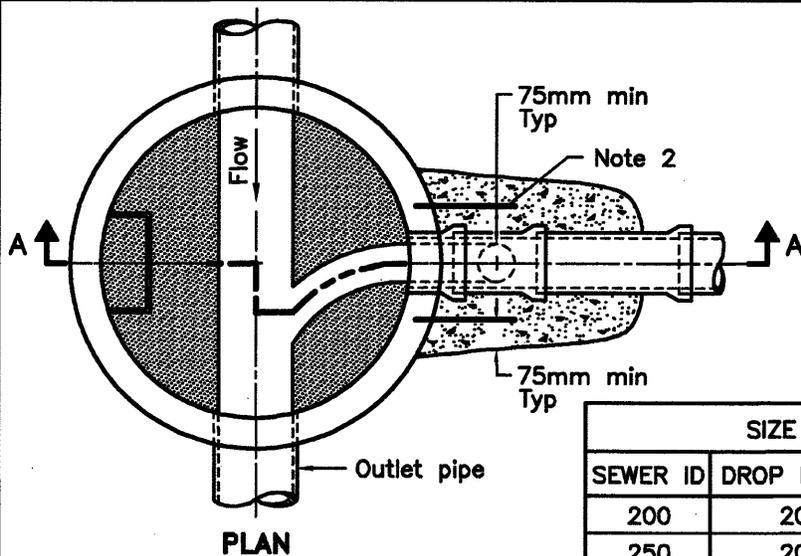
MAXIMUM SIZE HOLE IN THE WALL IN PRECAST RISER SECTIONS					
Maintenance Hole Diameter	No. 1-4	No. 5 and 6	No. 8	No. 7	
				Inlet Hole	Outlet Hole
1200	700	860	780	700	860
1500	860	1220	960	860	1170
1800	1220	1485	1220	1220	1485
2400	1485	2020	1760	1485	2020
3000	1930	2450	2300	1930	2450
3600	2470	3085	2730	2470	3085

NOTES:

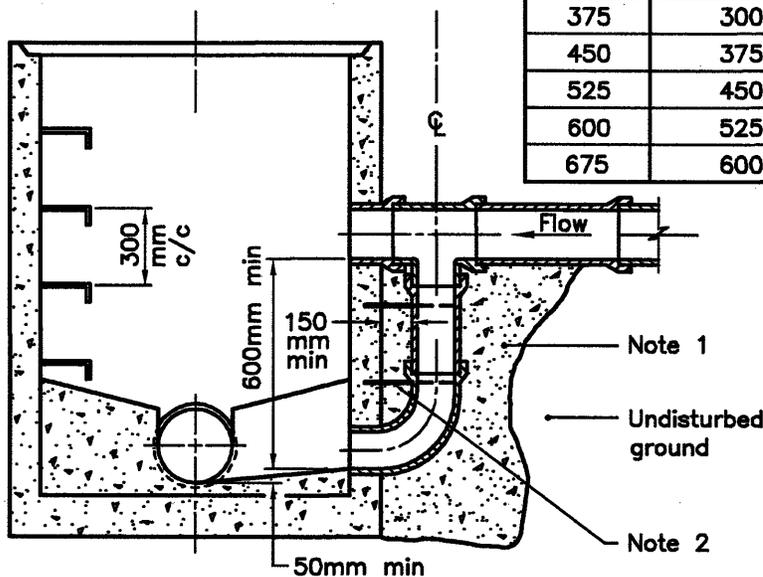
- 1 Slopes shall be maintained from the outlet hole opening for top of benching.
- A Concrete for benching shall be 30MPa.
- B When benching is hand-finished, it shall be given wood float finish, channel shall be given steel trowel finish.
- C Benchng slope and height shall be as specified.
- D When specified, maintenance holes that are 1200mm in diameter with a uniform channel for 200 or 250mm pipe may be prebenched at the manufacturer with standardized benching slope and channel orientation.
- E All dimensions are nominal.
- F All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 4	
MAINTENANCE HOLE BENCHING AND PIPE OPENING ALTERNATIVES	OPSD 701.021		

TOWNSHIP OF ZORRA
MAINTENANCE HOLE BENCHING AND PIPE OPENING ALTERNATIVES
OCTOBER, 2021
ZSD - 19



SIZE OF DROP PIPE		
SEWER ID	DROP PIPE ID	APPLICATION
200	200	Storm and Sanitary
250	200	Storm and Sanitary
300	250	Storm and Sanitary
375	300	Storm and Sanitary
450	375	Storm
525	450	Storm
600	525	Storm
675	600	Storm



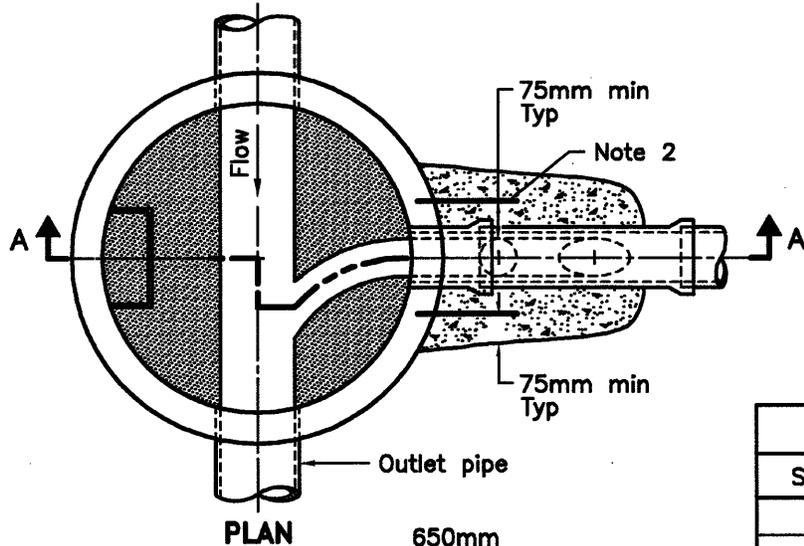
SECTION A-A

NOTES:

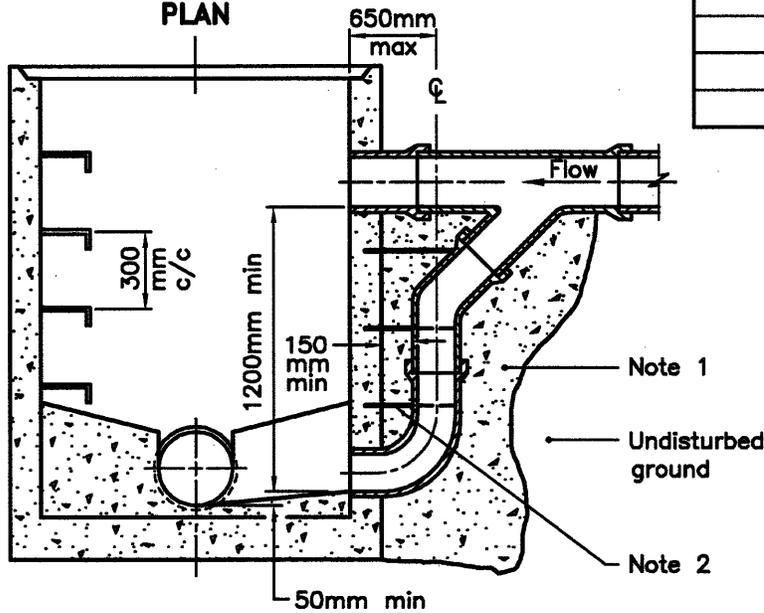
- 1 Concrete shall be placed to undisturbed ground and the outside face of the maintenance hole, but there shall be a minimum of 150mm of 15MPa concrete around the drop pipe.
 - 2 Concrete shall be secured to the maintenance hole with 450mm long, 13mm diameter threaded rods and drilled expansion anchors down either side of the drop pipe at 300mm centres.
- A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2016	Rev 3	
CAST-IN-PLACE MAINTENANCE HOLE DROP STRUCTURE TEE	-----		
OPSD 1003.010			

TOWNSHIP OF ZORRA	
CAST IN PLACE MAINTENANCE HOLE DROP STRUCTURE TEE	
OCTOBER, 2021	ZSD - 20



SIZE OF DROP PIPE	
SEWER ID	DROP PIPE ID
200	200
250	200
300	250
375	300



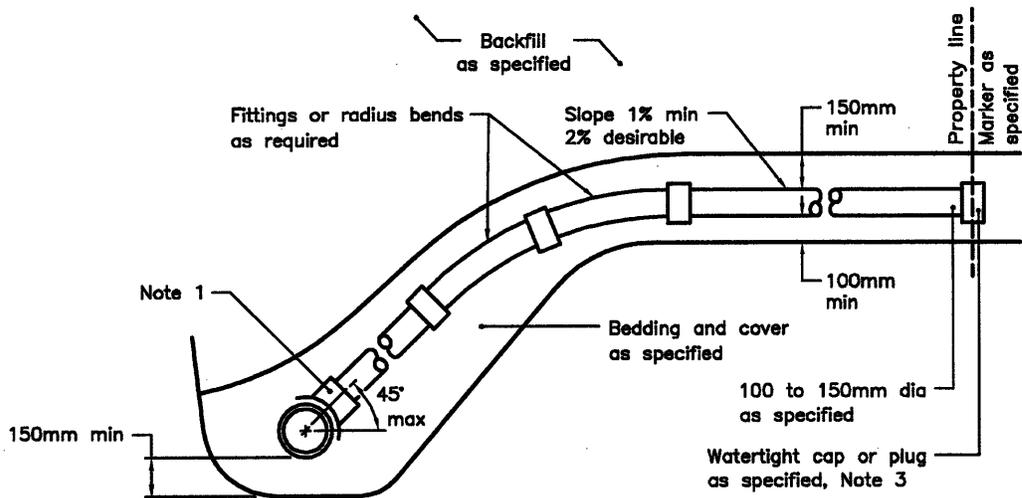
SECTION A-A

NOTES:

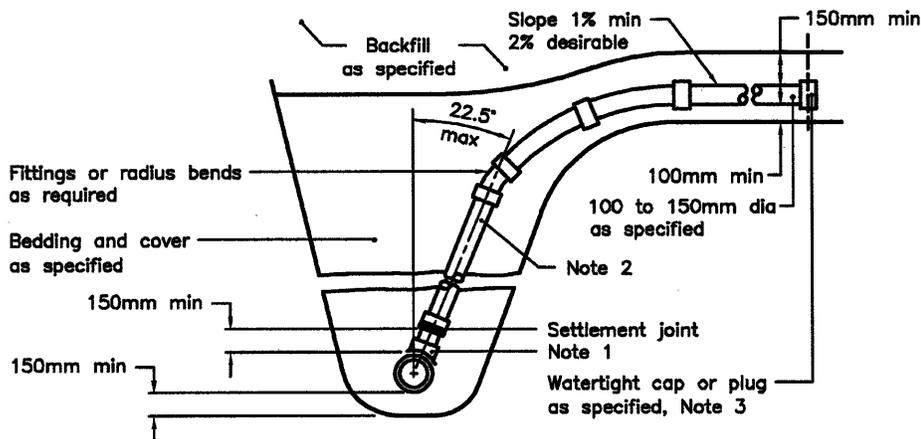
- 1 Concrete shall be placed to undisturbed ground and the outside face of the maintenance hole, but there shall be a minimum of 150mm of 15MPa concrete around the drop pipe.
 - 2 Concrete shall be secured to the maintenance hole with 450mm long, 13mm diameter threaded rods and drilled expansion anchors down either side of the drop pipe at 300mm centres.
- A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2016	Rev 3	
CAST-IN-PLACE MAINTENANCE HOLE DROP STRUCTURE WYE	-----		
OPSD 1003.020			

TOWNSHIP OF ZORRA	
CAST IN PLACE MAINTENANCE HOLE DROP STRUCTURE WYE	
OCTOBER, 2021	ZSD - 21



CONNECTION WITHOUT VERTICAL RISER



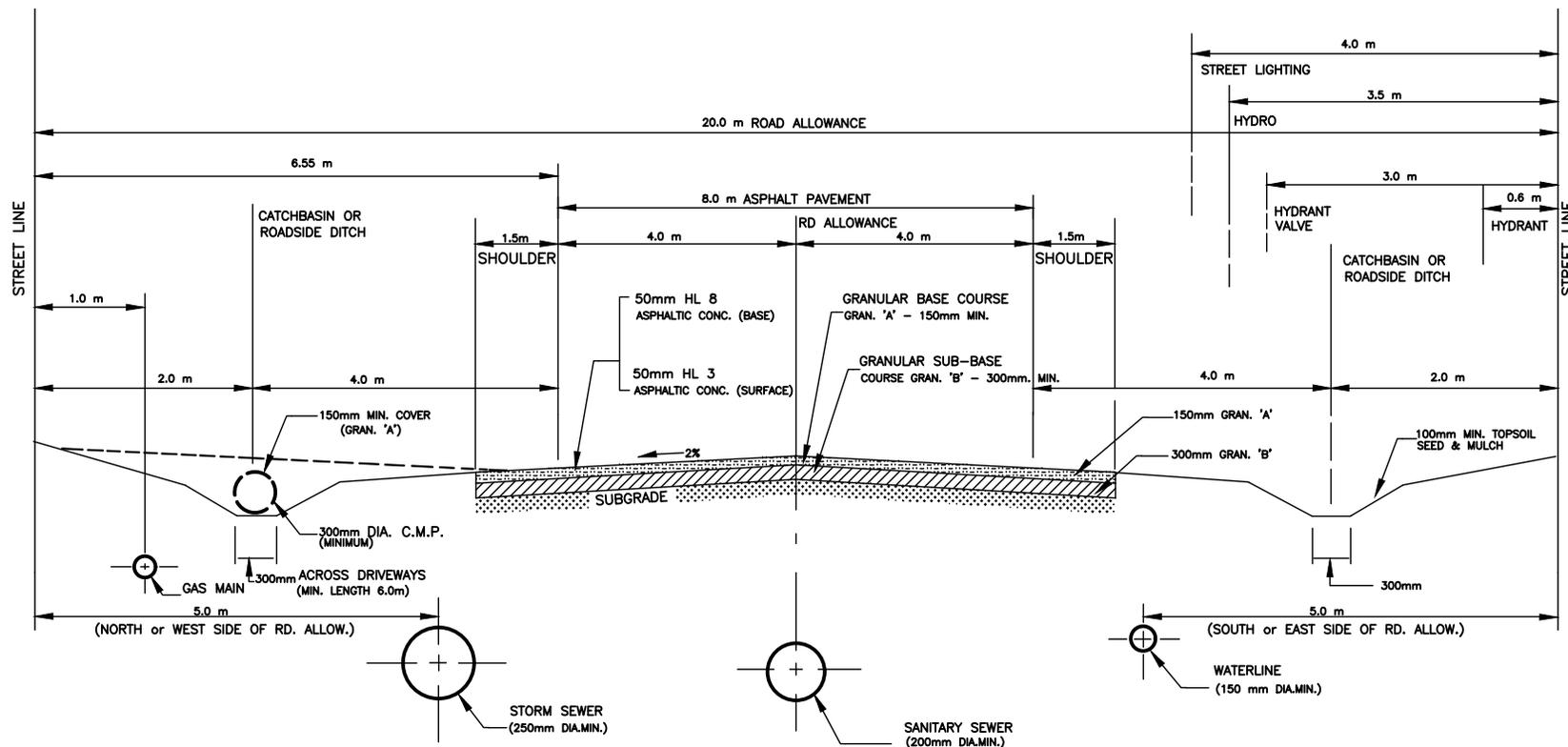
CONNECTION WITH VERTICAL RISER

NOTES:

- 1 Sewer service connections to the main pipe sewer shall be made using factory made tees, strap-on-saddles, or other approved saddles.
- 2 Vertical risers shall be as specified.
- 3 Cap or plug at property line shall be adequately braced.
- A Maintenance holes shall be used at the main sewer to connect service connections greater than or equal to 200mm.
- B For new construction, saddles shall be installed on the main pipe before that pipe is laid.
- C Approved cut-in tool shall be used for field made connections.
- D All dimensions are in millimetres unless otherwise shown.

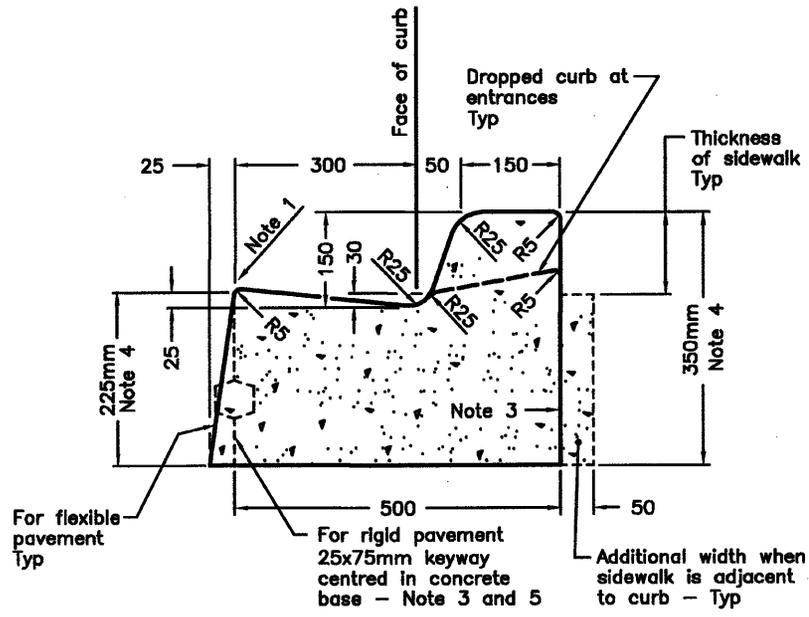
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2016	Rev 3	
SEWER SERVICE CONNECTIONS FOR MAIN PIPE SEWER			
OPSD 1006.010			

TOWNSHIP OF ZORRA	
SEWER SERVICE CONNECTIONS FOR MAIN PIPE SEWER	
OCTOBER, 2021	ZSD - 22

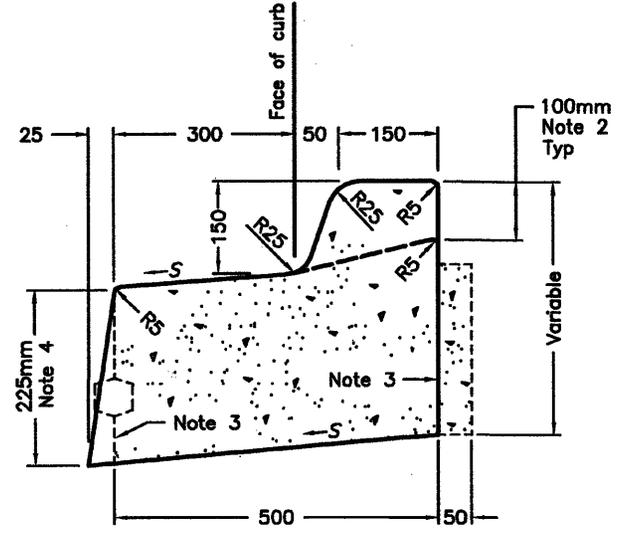


**STANDARD RIGHT-OF-WAY CROSS-SECTION
FOR RESIDENTIAL STREETS WITH
ASPHALTIC CONCRETE PAVEMENT AND ROADSIDE DITCH**

TOWNSHIP OF ZORRA	
STANDARD R.O.W. RESIDENTIAL ASPHALT - DITCHES	
OCTOBER, 2021	ZSD - 23



TANGENT



SUPERELEVATED

LEGEND:

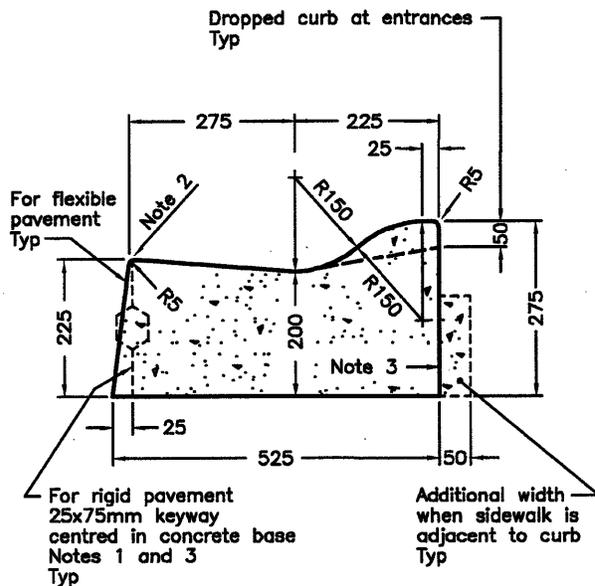
S - Rate of pavement superelevation in percent, %.

NOTES:

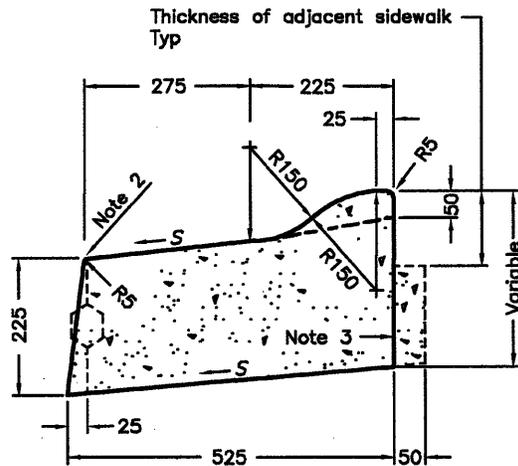
- 1 Flexible and composite pavement shall be placed 5mm above the adjacent edge of gutter.
- 2 When sidewalk is continuously adjacent, the dropped curb at entrances shall be reduced to 75mm.
- 3 For slipforming procedure a 5% batter is acceptable.
- 4 For composite pavement the depth of concrete curb shall be adjusted to depth of concrete pavement.
- 5 When tie bars are specified, refer to OPSD 552.010 and 552.020 for details.

- A Treatment at entrances shall be according to OPSD 351.010.
- B Outlet treatment shall be according to the OPSD 610 Series.
- C The transition from one curb type to another shall be a minimum length of 3.0m, except in conjunction with guide rail where it shall be according to the OPSD 900 Series.
- D All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2012	Rev 2	
<h2 style="margin: 0;">CONCRETE BARRIER CURB WITH STANDARD GUTTER</h2>		<h2 style="margin: 0;">OPSD 600.040</h2>		
TOWNSHIP OF ZORRA				
<h3 style="margin: 0;">CONCRETE BARRIER CURB WITH STANDARD GUTTER</h3>				
OCTOBER, 2021			ZSD - 24	



TANGENT



SUPERELEVATED

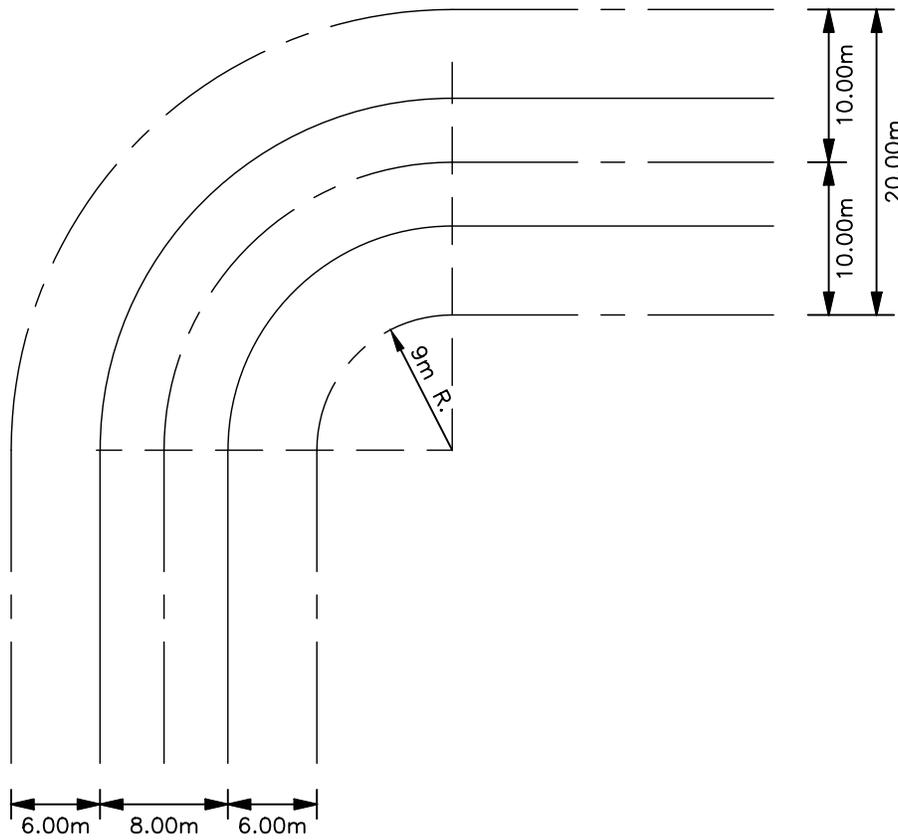
LEGEND:

S - Rate of pavement super-elevation in percent, %.

NOTES:

- 1 When curb and gutter is adjacent to concrete pavement or base, this drawing shall be used in conjunction with OPSD 552.010 and 552.020.
- 2 Flexible and composite pavement shall be placed 5mm above the adjacent edge of gutter.
- 3 For slipforming procedure a 5% batter is acceptable.
- A Treatment at entrances shall be according to OPSD 351.010.
- B Outlet treatment shall be according to the OPSD 610 Series.
- C The transition from one curb type to another shall be a minimum length of 3.0m, except in conjunction with guide rail where it shall be according to the OPSD 900 Series.
- D All dimensions are in millimetres unless otherwise shown.

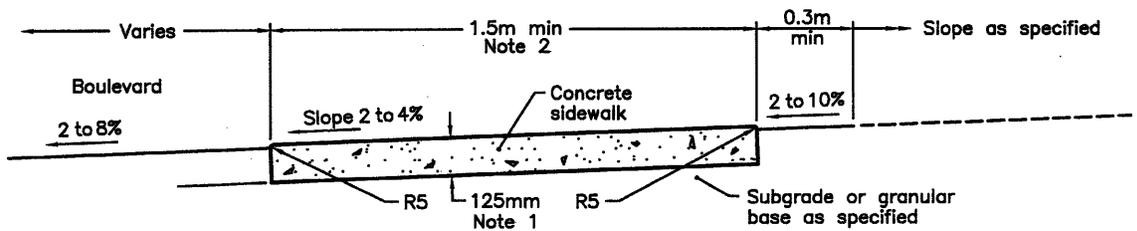
ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2012	Rev	2	
<p style="text-align: center;">CONCRETE SEMI-MOUNTABLE CURB WITH STANDARD GUTTER</p>		<p style="text-align: center;">OPSD 600.060</p>			
		TOWNSHIP OF ZORRA		<p style="text-align: center;">CONCRETE SEMI-MOUNTABLE CURB WITH STANDARD GUTTER</p>	
OCTOBER, 2021				ZSD - 25	



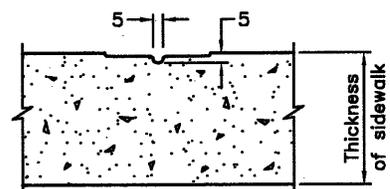
NOTES:

ALL DIMENSIONS SHOWN ARE
MINIMUM REQUIREMENTS.

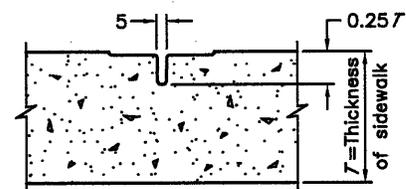
TOWNSHIP OF ZORRA	
STANDARD FOR STREET CURVE	
OCTOBER, 2021	ZSD - 26



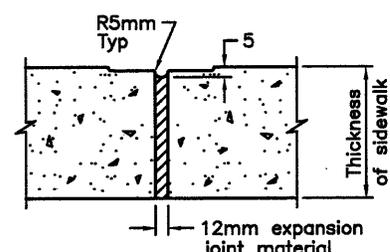
TYPICAL SECTION



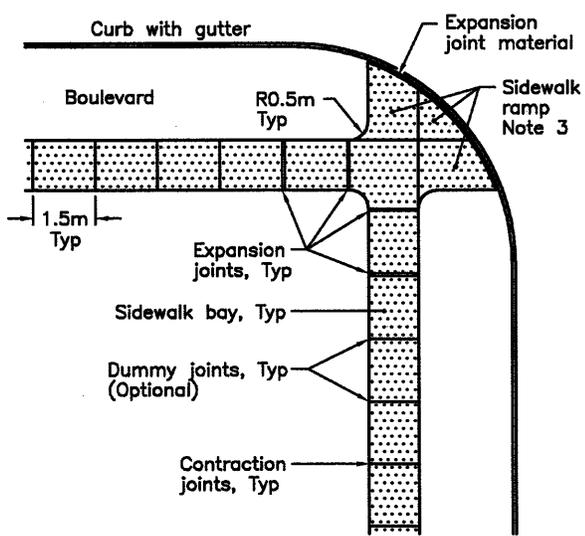
DUMMY JOINT (OPTIONAL)



CONTRACTION JOINT (Note 4)



EXPANSION JOINT



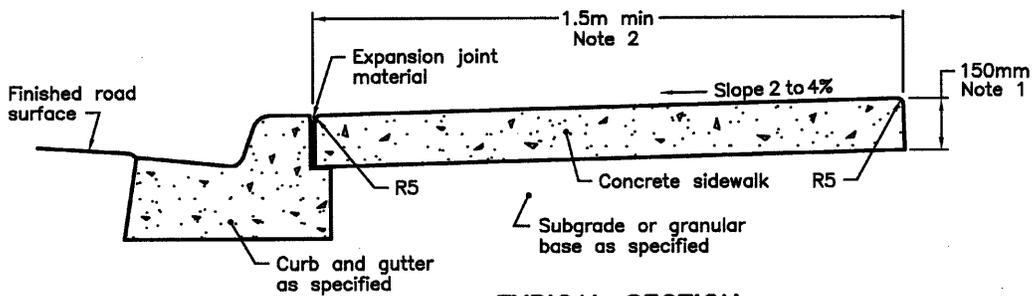
JOINT LAYOUT

NOTES:

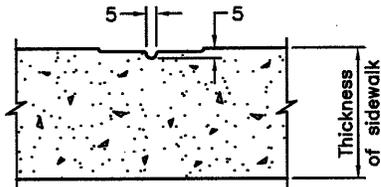
- 1 Sidewalk thickness at residential driveways and adjacent to curb shall be 150mm. At commercial and industrial driveways, the thickness shall be 200mm.
- 2 Sidewalk width shall be wider when specified.
- 3 This OPSD shall be read in conjunction with OPSD 310.030, 310.031, 310.033, and 310.039.
- 4 Contraction Joint may be tooled or sawcut.
- A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev	3	
CONCRETE SIDEWALK	OPSD 310.010			

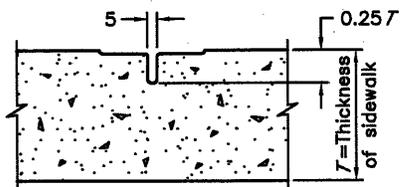
TOWNSHIP OF ZORRA
CONCRETE SIDEWALK
OCTOBER, 2021
ZSD - 27



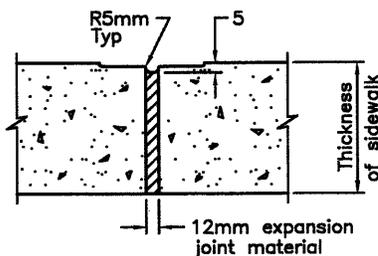
TYPICAL SECTION



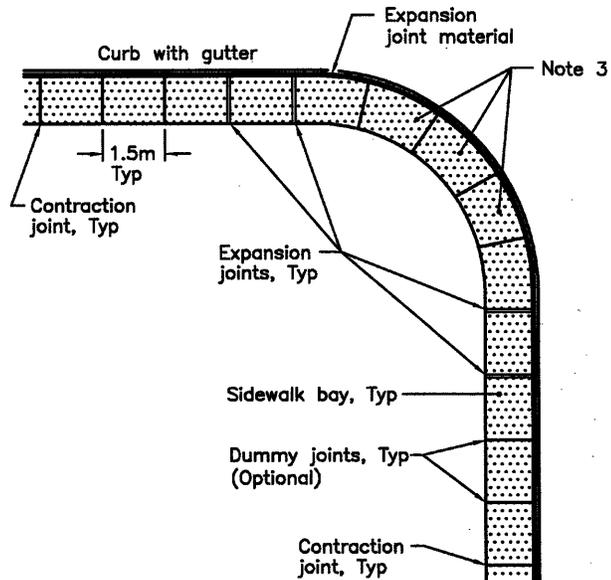
DUMMY JOINT



CONTRACTION JOINT



EXPANSION JOINT



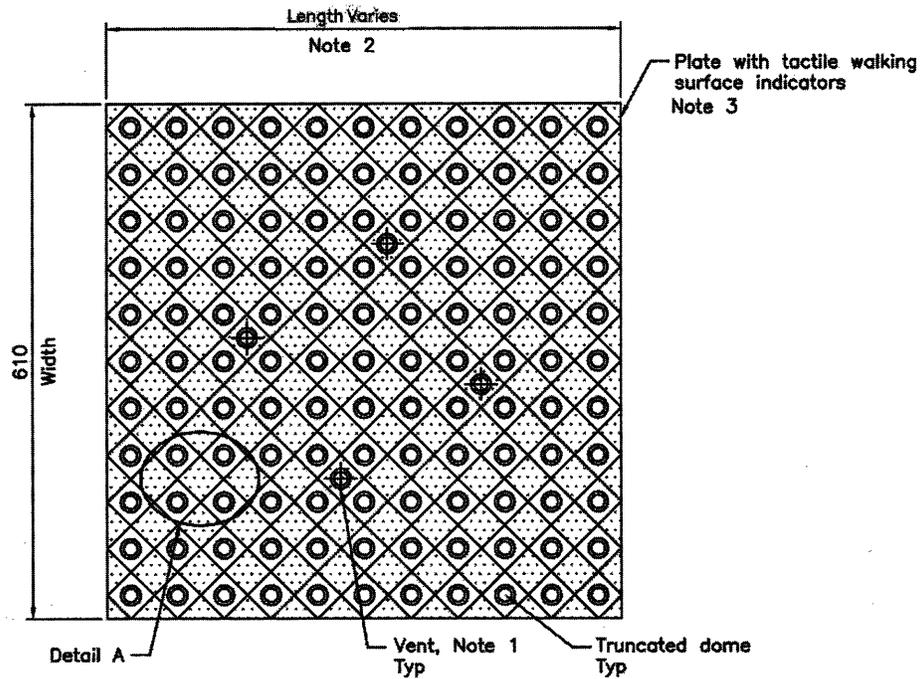
JOINT LAYOUT

NOTES:

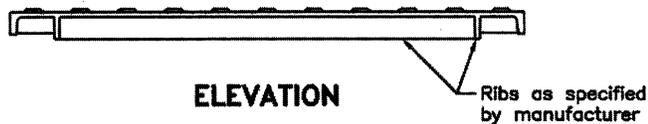
- 1 At commercial and industrial driveways, the thickness shall be 200mm.
 - 2 Sidewalk width shall be wider when specified.
 - 3 This OPSD shall be read in conjunction with OPSD 310.030, 310.031, 310.033, and 310.039.
- A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 3	
CONCRETE SIDEWALK ADJACENT TO CURB WITH GUTTER	OPSD 310.020		

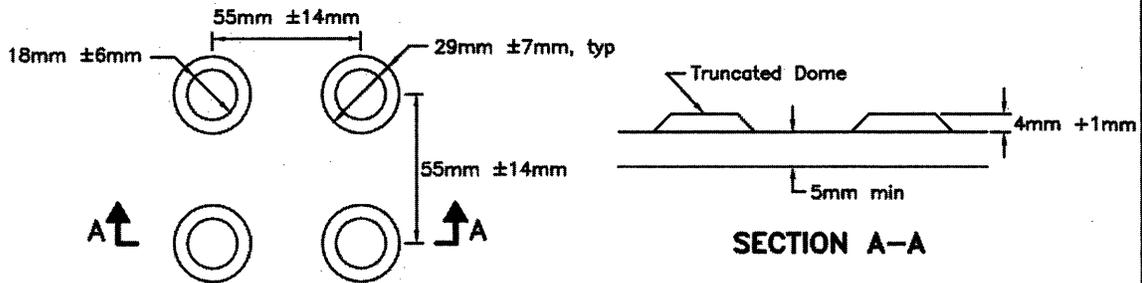
TOWNSHIP OF ZORRA
CONCRETE SIDEWALK ADJACENT TO CURB AND GUTTER
OCTOBER, 2021
ZSD - 28



PLAN



ELEVATION



**DETAIL A
TRUNCATED DOMES PLAN**

NOTES:

- 1 Vents shall be as specified by the manufacturer.
- 2 Length of plate may be increased to suit the curb depression width.
- 3 Material of plate shall be as specified in Contract Documents.
- A Adjacent cast iron plates shall be permanently connected using a locking mechanism and any hardware shall be hot dipped galvanized.
- B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 1	
CONCRETE SIDEWALK RAMPS TACTILE WALKING SURFACE INDICATORS COMPONENT	-----		

OPSD 310.039			

TOWNSHIP OF ZORRA	
CONCRETE SIDEWALK RAMPS TACTILE WALKING SURFACE	
OCTOBER, 2021	ZSD - 29