

THE CORPORATION OF THE TOWNSHIP OF SOUTH STORMONT

BY-LAW NO. 2022-072

- BEING a by-law to repeal By-law No. 2015-067 and to adopt revised Site Plan and Subdivision Design Guidelines.
-
- WHEREAS the *Municipal Act, 2001*, c. 25 S. 5 (1) provides that the powers of a municipal corporation are to be exercised by its council;
- AND WHEREAS the *Municipal Act, 2001*, c. 25 S. 5 (3) provides that the powers of every council are to be exercised by by-law;
- AND WHEREAS the *Municipal Act, 2001*, c. 25, s. 224 (b) states that it is the role of Council to develop and evaluate the policies and programs under this or any other act;
- AND WHEREAS the *Municipal Act, 2001*, S.O. 2001, c. 25, 2. 447.8 authorizes a municipality to adopt by reference, in whole or in part, with such changes as the council considers appropriate, any code, standard, procedure or regulation as it stands at a specific date, as it stands at the time of adoption or as amended from time to time provided the document is available for public inspection;
- AND WHEREAS the *Planning Act, R.S.O. 1990 P. 13*, as amended, provides that in considering a draft plan of subdivision an approval authority shall have regard to the interrelationship between the design of the proposed plan of subdivision and site plan control matters relating to any development on land, if the land is located with a site plan control area designated under subsection 41(2) of the Planning Act;
- AND WHEREAS the matters herein set out are in conformity with the Official Plan of the United Counties of Stormont, Dundas and Glengarry;
- AND WHEREAS Council did, on the 22nd day of June, 2015, adopt By-law No. 2015-067 to establish guidelines for the design of site plans and subdivisions within the Township of South Stormont.
- NOW THEREFORE Council of the Township of South Stormont hereby enacts as follows:
1. That By-law No. 2015-067, being a by-law to establish guidelines for the design of site plans and subdivisions within the Township of South Stormont, is hereby repealed.

2. That the Site Plan and Subdivision Design Guidelines attached hereto as "Schedule A" and forming part of this by-law be adopted effective the date of passing.

READ and passed in open Council, signed and sealed this 21st day of September, 2022.



Mayor



Clerk



Site Plan & Subdivision Design Guidelines



Schedule "A" to By-law No. 2022-072

September 21st 2022

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O.P.S.D. 301.010
O.P.S.D. 301.020
O.P.S.D. 304.010
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O.P.S.D. 310.020
O.P.S.D. 310.030
O.P.S.D. 350.010
O.P.S.D. 351.010
O.P.S.D. 400.010
O.P.S.D. 400.070
O.P.S.D. 401.010
O.P.S.D. 401.030
O.P.S.D. 403.010
O.P.S.D. 404.020
O.P.S.D. 404.021
O.P.S.D. 404.022
O.P.S.D. 405.010
O.P.S.D. 500.01 (April 1991)
O.P.S.D. 500.010
O.P.S.D. 500.020
O.P.S.D. 500.030
O.P.S.D. 600.040
O.P.S.D. 600.060
O.P.S.D. 604.010
O.P.S.D. 608.010
O.P.S.D. 701.010
O.P.S.D. 701.011
O.P.S.D. 701.012
O.P.S.D. 701.013
O.P.S.D. 701.014
O.P.S.D. 701.015
O.P.S.D. 701.021
O.P.S.D. 701.030
O.P.S.D. 701.031
O.P.S.D. 701.040
O.P.S.D. 701.041
O.P.S.D. 701.050
O.P.S.D. 701.051
O.P.S.D. 701.060
O.P.S.D. 701.061
O.P.S.D. 701.070

O.P.S.D. 701.071
O.P.S.D. 701.080
O.P.S.D. 701.081
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O.P.S.D. 703.012
O.P.S.D. 703.013
O.P.S.D. 703.014
O.P.S.D. 703.015
O.P.S.D. 704.010
O.P.S.D. 705.010
O.P.S.D. 705.020
O.P.S.D. 705.030
O.P.S.D. 705.040
O.P.S.D. 708.010
O.P.S.D. 708.030
O.P.S.D. 803.030
O.P.S.D. 803.031
O.P.S.D. 804.030
O.P.S.D. 804.040
O.P.S.D. 804.050
O.P.S.D. 807.010
O.P.S.D. 807.030
O.P.S.D. 810.010
O.P.S.D. 972.102
O.P.S.D. 972.130
O.P.S.D. 972.132
O.P.S.D. 987.101
O.P.S.D. 987.110
O.P.S.D. 990.110
O.P.S.D. 1003.010
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O.P.S.D. 1006.010
O.P.S.D. 1104.010
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1. GENERAL DESIGN PRINCIPLES

The following design guidelines are issued to Developers and Engineers to provide minimum design requirements of new developments within the Township. The intent is for these guidelines to provide clear directions to Developers and Engineers, which then allows for an efficient design and review process.

Generally, no variance is allowed for minimum guidelines. Variance for some Township-specific standards may however be possible at the discretion of the Township and/or Council.

In any and all cases, it is strongly encouraged that the Township be pre-consulted as soon as possible in the process and that the Township be consulted during design or construction, should these design guidelines need to be clarified.

Final acceptance by Township will also be subject to all applicable approvals from various authorities and/or review agencies.

1.1 Definitions & Abbreviations

For the purpose of these design principles, the following definitions and interpretations shall govern:

CA: shall mean Conservation Authority.

Council: shall mean Council of the Corporation of the Township of South Stormont,

County: shall mean United Counties of Stormont, Dundas & Glengarry.

Developer: shall mean the person or company undertaking the proposed work.

DFO: shall mean Department of Fisheries and Oceans Canada,

Engineer: shall mean a professional, qualified as a civil engineer in the province of Ontario, having current accreditation to practice in the profession and valid professional liability (i.e. errors and omissions insurance),

MNR: shall mean Ontario Ministry of Natural Resources,

MOE: shall mean Ontario Ministry of the Environment and Climate Change,

MTO: shall mean Ontario Ministry of Transportation,

O.P.S.D.: shall mean Ontario Provincial Standard Drawings,
Available online at <http://www.raqsb.mto.gov.on.ca/techpubs/ops.nsf/OPSHomepage>

O.P.S.S.: shall mean Ontario Provincial Standard Specifications,
Available online at <http://www.raqsb.mto.gov.on.ca/techpubs/ops.nsf/OPSHomepage>

Township: shall mean the Corporation of the Township of South Stormont and includes its successors and assigns and its officers, employees, agents and contractors,

1.2 Off-Site Improvements & Infrastructure Extensions

All off-site improvements and extensions of existing infrastructure required to support the proposed development will be the responsibility of the Developer. The Developer shall pay the full cost of the required off-site improvements and/or infrastructure extensions.

In some cases, oversizing of infrastructure may be required to accommodate future development, in which case cost-sharing may be possible. It is strongly recommended that the Township be pre-consulted to determine if any off-site improvements and/or infrastructure extensions will be required to support the proposed development.

1.3 Parkland

As per the requirements of Section 42 and 51.1 of the Planning Act, and as per the Official Plan, a minimum of 5% of park space is required for a residential subdivision, while a minimum of 2% of park space is required for commercial and/or industrial uses. At the Township's discretion, cash-in-lieu of parkland may be acceptable.

Parcels located partly within the flood plain and/or partly used for stormwater management may be accepted as parkland provided they are well located, and provided that the portion of the parcel located outside of the flood plain and/or not used for stormwater management meets the above-noted minimum requirement for parkland area.

Areas designated as parkland shall be graded and finished with a minimum of 100 mm of topsoil and hydroseed.

1.4 Landscaping Standards

All development that is subject to site plan control, as outlined in By-Law No. 2009-11, and all proposed plans of subdivision shall be required to comply with the landscaping requirements of this section, unless explicitly exempted by the Township in its sole discretion.

The Township strongly encourages the retention and incorporation of existing tree cover, plant material grading, ponds and other site features into landscaping plans. In certain cases, the minimum required plant materials may be supplemented by existing tree cover and plant materials on a site, at the discretion of the Township.

All planting materials shall adhere to the list of native landscaping species outlined in **Appendix H - List of Native Species**, unless otherwise approved in writing by the Township in its sole discretion.

Special exemptions to **Appendix H** may be made for sustainability measures particularly with regards to alternative groundcover choices.

Landscaping plans shall be prepared by a landscape architect or other qualified person(s) as determined by the Township in its sole discretion.

A landscaping plan shall include the following:

- Boundaries and dimensions of the site, as well as any easements.
- Location and dimensions of all buildings, parking areas, driveways and entrances, as well as all existing/proposed underground and overhead services (i.e. power lines).
- Location of all existing plant materials to be retained.
- Location of all new plant materials.
- Dimensions of any planting beds/landscaped areas.
- Materials list including all name(s), quantities and size(s) (caliper) of all plant materials.
- a cost estimate respecting the proposed landscaping works and plant materials.

To provide a year-round display of colour and interest, a tree mix of 50% coniferous and 50% deciduous is encouraged.

Sustainable and Adaptable

All landscaping plans shall illustrate a commitment to ecological sustainability and the acknowledgement of a changing climate.

The Township is committed to addressing the impacts of climate change through encouraging adaptive and responsive landscape design. Landscaping plans are strongly encouraged to reflect both a commitment to reducing greenhouse gas emissions as well as the mitigation of the impacts of a changing climate into the future. All landscaping plans shall consider the following:

The use of drought tolerant species.

Utilizing permeable surface materials to help mitigate flooding and “heat island” effects.

- Incorporating “rain gardens” where possible and appropriate.
- The use of shade trees in public areas such as parking lots.
- Methods to reduce the need for watering and the use of chemical fertilizers and pesticides.
- Innovative choices for ground cover to reduce the need for mowing and/or ongoing maintenance. Species to consider where appropriate may include: White Clover, low-growing Thymes, Prostrate Juniper, Sweet Woodruff, Stonecrops, Creeping Jenny, Dead Nettle, Buffalo Grass and Bearberry Cotoneaster among others.
- The use of species attractive to pollinators such as honeybees.

To facilitate overall resistance to disease and future climate conditions, landscaping plans shall incorporate trees of varying species with differing lifespans and characteristics within the context of species in the surrounding area.

Wherever possible, coniferous species shall be placed to help block winter winds and deciduous species located to provide summer shade.

Minimum Numbers and Standards

Commercial/Industrial Development/Non-Residential	
1 tree / 10 metres of road frontage	1 tree / 15 metres remaining site perimeter
1 shrub / 7.5 metres of site perimeter	
Multi-Unit Residential	
1 tree / 10 metres of frontage + 0.5 trees / dwelling unit (min 1)	
1 shrub / 7.5 metres of site perimeter	
Subdivision	
1 tree / residential lot	
30 trees / ha of park and open space	
Tree buffers may be required abutting existing development	
Parking	
1 tree / 4 parking spaces (minimum 1 tree)	
3 shrubs / 4 parking spaces (minimum 3 shrubs)	
Parking – Landscaped Island	
1 deciduous tree / 8.25 m ² of landscaped island	
2 shrubs / 8.25 m ² of landscaped island	

Minimum Sizing Requirements

- 50mm caliper for deciduous trees
- 1.82m height for coniferous trees
- 0.3m height & 0.45m spread for shrubs

Layout / Design Guidelines

Under no circumstances shall any plant materials be located within a road right-of-way unless explicit written permission is received from the Township.

Plantings are encouraged to be clustered in planting beds consisting of a mix of trees and shrubs rather than linear row planting. Mulching will be required for all planting beds and must extend a minimum of 0.5 metres from the central base/root ball diameter of any trees and/or shrubs within the planting bed.

Plant materials with a mature height over 0.5 metres shall not be located within a site triangle for a roadway.

Trees shall generally be located no closer than 1.5 metres to any entrance and/or property line, and 3 metres to a building.

Trees are encouraged to be spaced a minimum of 2 metres apart.

For parking areas containing more than four (4) spaces, a landscaping strip no less than 3 metres in width shall be provided adjacent to all streets and abutting lot lines.

Where parking for more than ten (10) vehicles is proposed, a minimum of one (1) landscaped island measuring a minimum of 1.5 metres in width and 5.5 metres in length will be required for every ten (10) spaces so as to provide visual relief and organize larger areas of parking into smaller cells. No more than 10 continuous parking spaces shall be located in a row of parking without separation by a landscaped island.

Planting will not be permitted within existing/future swales or ditches.

Plantings are encouraged to be located where they will not obscure windows and/or any lighting proposed or existing on a site or building.

1.5 Phasing

Phasing of the proposed development shall be determined by the Developer in order to provide a reasonable time for completion of construction and sale of properties.

If possible, it is desirable that dead-end streets be completed in a single phase, in order to avoid temporary dead-ends and the mixing of construction traffic with residential traffic.

1.6 Easements and Reserves

Any temporary dead-end or open side of a road allowance within the draft plan shall be terminated in a 0.3 m reserve to be conveyed to the Township free of all charges and encumbrances.

Additionally, easements shall be provided to the Township as required for the access and maintenance of infrastructure as further detailed in the relevant Sections.

1.7 Urban vs. Rural Cross-Section

An urban road cross-section as per standard detail SS.1 will be required in subdivisions where lot frontage is equal to or less than 20 m for a single detached dwelling, and/or where a proposed development connects to an existing development featuring an urban cross-section. Deviation from this standard will require Council approval.

A rural road cross-section as per standard detail SS.2 may be utilized in areas where lot frontage for a single detached dwelling exceeds 20 m.

1.8 Draft Plan of Subdivision Approval

An application for draft plan of subdivision approval must be made to the County and shall meet their requirements for submission and the requirements of the Planning Act. It is strongly encouraged that the Township be pre-consulted prior to this submission.

1.9 Subdivision Plan Approval

Once the Developer has received draft plan approval and draft plan conditions, the Developer may then, at its expense, proceed to the detailed design of the subdivision, which includes construction drawings, reports and related approvals required to address conditions of the draft plan approval.

Various studies may also be required at the discretion of Township, County and/or other approving authorities to satisfy conditions of the draft plan approval. These studies shall also be completed at the Developer's expense.

As part of this process, the Township will review the drawings, studies and reports and provide comments. At the Township's discretion, this review may include a professional peer review by a third party. The cost for this peer review will be the responsibility of the Developer.

1.10 Financial Security

The Owner shall file with the Township of South Stormont an Irrevocable Letter of Credit from a Chartered Bank with drawing rights for not less than one (1) year from date of issue and in the amount of not less than one hundred (100%) percent of the "Total X" or the "Total Y", whichever is greater, of Schedule "D" attached, this being the total of the Consultant's approved estimate of quantities and prices, by item, for the construction of all underground or above ground facilities plus the estimated cost of site inspection associated with these works and the project administration by the Consultant, which approved estimate shall be dated not more than three (3) months prior to the date of the Letter of Credit, plus the underground installation costs of utility companies.

From time to time during the construction of underground facilities, the Consultant shall prepare a Progress Certificate indicating the total amount of work completed as of the date of the Progress Certificate. Upon certification of the Progress Certificate by the Engineer, the Township may reduce the balance of the Letter of Credit by the "Total Balance Due" (this being the difference between the "Total Work Performed to Date" and the "Total Paid to Date") less ten (10%) percent of the "Total Work Performed to Date". At no time will the Letter of Credit be reduced to below the value of the "Total X" or "Total Y" (which ever is less) of Schedule "D" until such time as the overall remaining costs to complete the works falls below this value.

Upon satisfactory completion of the works and the issuing of the letter of preliminary acceptance of the facilities, the holdback will be reduced in accordance with Section 9.10.

The Financial Security may be reduced during construction as per the requirements of Section 9.6 and will be adjusted to inflation based on the Consumer Price Index (CPI) established by Statistics Canada.

1.11 Subdivider's Agreement

The Township will then enter into a Subdivider's Agreement with the Developer pursuant to the draft plan approval conditions.

The Township's standard Subdivider's Agreement may be found on the Township's website. Note that the Subdivider's Agreement may be modified at the Township's discretion as required to reflect the proposed development. The Engineer shall be responsible to provide the information required to complete the various Sections and Schedules.

1.12 Construction & Final Acceptance

The Developer or Contractor may proceed to construct the works as set out and as per the requirements of Section 9, once the Subdivider's Agreement is in place.

Final Acceptance of the work may be requested once the requirements listed in Section 9.11 are met, at which point the Financial Security will be fully released.

2. DRAWING REQUIREMENTS

All drawings must be in metric units, and must incorporate a legend, scale and a north arrow. The preferred drawing size is Arch D (24x36") or A1 (594 x 841 mm).

Drawings must be georeferenced (NAD83) with geodetic elevations and must be provided to the Township in hard copy and electronically (in CAD and PDF file formats).

2.1 Cover Sheet

The cover sheet shall include the name of the development, the Developer, the Engineer(s) and the legal description of the property. A list of drawings and a key plan showing existing and proposed street names must also be included.

2.2 General Site Plan, Site Phasing Plan & Erosion Control Plan

An overall site plan at a scale of not less than 1:1,000 is required, showing the entire development as well as existing and proposed aboveground and underground infrastructure. Phasing requirements (if applicable), such as temporary turning basins and temporary capping of underground infrastructure, shall also be shown on this drawing or on a separate drawing for clarity.

In rural cross-sections, a table (or similar) listing required driveway culvert sizes shall be shown on this drawing, or on a separate drawing for clarity.

Lastly, easements, land to be dedicated and erosion control measures shall be shown and labeled on this plan or on a separate drawing for clarity, and must also be shown on the grading plan.

2.3 Plans & Profiles

Plans and profiles are required for all roadways and for all rear-yard catchbasins, as well as for all sewer outlets.

These drawings shall be at a scale of 1:250 or 1:500 (horizontal) and 1:50 (vertical) and shall show the existing and proposed grade along the road centerline. All existing and proposed underground infrastructure shall be shown in both plan and profile.

All east-west streets shall be drawn so that the north arrows points to the top of the page, while north-south streets shall be drawn so that the north arrows points to the right of the page.

Plan and profile drawings shall include stationing, centerline grade of the roadway or surface (proposed and existing) and resulting slopes, top of watermain (where applicable), sanitary or storm sewer inverts (where applicable) and resulting slopes, and/or ditch elevations for both the right and left ditch (where applicable) and resulting slopes.

2.4 Grading Plans

Detailed grading plans shall be prepared at a scale of not more than 1:500, and with enlargements as required for clarity, such as at intersections.

At a minimum, existing grades shall be shown. Contours may also be shown. All elevations must be geodetic, and at least three temporary benchmarks shall be clearly indicated. Temporary benchmarks may also be shown on other drawings for ease of construction.

Grading plans shall include finished grades at all lot corners, at lot high points (if applicable), at centerline of swales, at top and bottom of terracing, and at buildings. Resulting slopes (in %) shall be shown on the grading plans.

Finished grades must also be shown along the centerline of the roadway and ditches (if applicable) at a maximum spacing of 25 m, as well as along curb radii. At a minimum, proposed grades shall be shown at both extremities of a curb radius and at any high or low point(s).

Lastly, all easements and land to be dedicated must be shown and labeled on the grading plan.

2.5 Storm & Sanitary Drainage Area Plans

Overall site plans showing boundaries of storm and sanitary catchment areas shall be provided, complete with area labels matching design spreadsheets. Area labels shall include the corresponding area in hectares, and the runoff coefficient (storm) or population (sanitary).

2.6 Details & O.P.S.D.'s

At a minimum, drawings shall include all relevant details, including stormwater management facility details, as well as all relevant O.P.S.D.'s.

2.7 Street Lighting

The drawings shall detail the type, size, and location of the streetlights, as well as the required electrical equipment including the service panel, grounding system, wiring and conduit routing. The drawings must include all relevant specifications and details, and show the coordination between street lighting equipment and utility structure locations. The drawings must also include a photometric plan with calculation details. The drawings must be signed, dated, and stamped by a qualified Professional Engineer, licensed in the province of Ontario.

2.8 Composite Utility Plan

A composite utility drawing is required as part of the design package that utilizes the base drawing of the subdivision (i.e. including underground services, lot lines, roads, ditches,

etc) and also includes the location of all utility poles, transformer, pedestals, conduits, and buried utilities.

2.9 Registered Plan / Reference Plan

The Developer must retain an Ontario land surveyor to prepare a registered plan showing the exact surveyed boundaries and dimensions of lots on which houses or buildings are to be built, the location, width and names of streets, easements, and the sites of any schools or parks. The registered plan is to be prepared after the Township has approved the design drawings and prior to the execution of a Subdivider's Agreement as per Section 1.10.

The Developer must also provide a list of easements, complete with areas and dedications, whether separately or on the registered plan.

The Developer is to provide revised approved plans once the plan of subdivision is registered to ensure consistency with lot numbering, this will be required if there are changes in lot numbering.

2.10 "As-Built" Drawings

As construction progresses, the "Issued for Construction" drawings shall be updated to reflect the work. Generally, all "as-built" drawings shall be updated to reflect changes made during construction (such as through Site Instructions, Change Orders, etc.) and other information deemed important.

As a minimum, "as-built" drawings shall include the elevation of the roadway at every 25 meters, invert elevations of storm and sanitary sewers at all structures (where applicable), obvert elevations of watermains at every 25 meters (where applicable) and invert elevations at culverts and at along ditches, at every 25 meters (where applicable).

"As-built" grading plans shall be prepared based on rough lot grading (to be completed per the requirements of Section 6.6), and all proposed grades must be verified. The "as-built" grading plan shall clearly denote that the grades verified consist of "rough lot grades" as opposed to "final lot grades". Furthermore, the temporary benchmarks shall be transferred to permanent structures during construction (i.e. fire hydrant top of nut) and shown on the "as-built" grading plans.

The temporary benchmarks shall be transferred to a minimum of three permanent structures, and must also be included at the high and low point(s) of the development.

"As-built" drawings shall be provided to the Township in hard copy (2 copies) and digitally (supplied in both CAD and PDF) upon completion of each individual phases.

3. WATER DISTRIBUTION SYSTEM

An adequately designed water distribution system is essential in providing new and existing developments with safe, high-quality domestic water and adequate fire protection.

As discussed below, detailed hydraulic design of the proposed water distribution system shall be undertaken by the Engineer, and a Servicing Report will be required to support the design.

Note that the Engineer shall complete a Ministry of the Environment's "Form 1 – Record of Watermains Authorized as a Future Alteration" and submit to the Township as per O. Reg. 170/03, upon entering into a Subdivider's Agreement.

3.1 Applicable Standards

New water distribution systems shall be designed as discussed in this section and generally as per the following standards (or latest revisions):

- Ministry of the Environment – Design Guidelines for Drinking-Water Systems (2008)
- Ministry of the Environment – Procedures to Govern the Separation of Sewers and Watermains (Procedure F-6-1)
- Ontario Provincial Standards Drawings & Specifications (latest revision)
- American Water Works Association

3.2 Location of Watermain in Right-of-Way

Watermains shall be installed 8.5 m from the south or west property line in an urban cross-section as per standard detail SS.1, and in the center of the road in a rural cross-section as per standard detail SS.2. Trenching shall be as per SS.3 or as per the requirements of the Occupational Health and Safety Act.

3.3 Easements & Land Dedication

Watermains which cannot be installed in the right-of-way will require minimum 3.0 m wide easements for access and maintenance purposes. Easements located between two new lots shall be centered on the lot line (i.e. one 1.5 m wide easement on each lot), whereas easements located between a new lot and existing property shall be located entirely on the new lot.

3.4 Hydraulic Design

Detailed hydraulic design of the watermain shall be undertaken by the Engineer to ensure compliance with the MOE Design Guidelines for Drinking-Water Systems (2008).

Available flows and pressures shall also be verified by means of hydrant flow testing when no recent data is available. Hydrant flow testing shall be coordinated with the Township.

Domestic water demand calculations shall be based on an average daily domestic demand of 450 L/person/day, and an average of three (3) persons per dwelling.

Minimum hourly, maximum daily and peak hourly demands shall then be obtained by applying the corresponding peaking factor as per Table 3-1 below.

Table 3-1: Peaking Factors for Drinking-Water Systems

Development Population	Minimum Hourly Factor	Maximum Day Factor	Peak Hour Factor
30	0.1	9.5	14.3
150	0.1	4.9	7.4
300	0.2	3.6	5.4
450	0.3	3.0	4.5
500 or more	0.4	2.9	4.3

Adapted from MOE Design Guidelines for Drinking-Water Systems (2008), Table 3-3

As a minimum, required fire flows shall be determined based on the MOE Design Guidelines for Drinking-Water Systems (2008).

A water model shall then be developed using software such as WaterCAD, EPANET or similar, and shall incorporate the supply curve as measured in the field, the calculated domestic & fire flows, and the Hazen-Williams C-factors listed in Table 3-2 below.

Simplified (spreadsheet) calculations may be acceptable for smaller developments featuring a single connection to an existing watermain or at the discretion of the Township. Note that simplified calculations will not be acceptable where two or more connections to the existing watermain are proposed.

Table 3-2: Minimum & Maximum Operating Pressures

Diameter – Nominal	C-Factor
150 mm	100
200 mm to 250 mm	110
300 mm to 600 mm	120
Over 600 mm	130

Source: MOE Design Guidelines for Drinking-Water Systems (2008), Table 10-1

Various scenarios shall then be evaluated to ensure that the minimum and maximum pressures listed in Table 3-3 below are met.

For any water distribution system, the minimum diameter of watermains shall be 150 mm.

Table 3-3: Minimum & Maximum Operating Pressures

Scenario	Minimum Pressure (kPa / psi)	Maximum Pressure (kPa / psi)
Maximum Day + Fire Flow	140 / 20	n/a
Average Day Demand	350 / 50	480 / 70
Maximum Day Demand	350 / 50	480 / 70
Maximum Hourly Demand	275 / 40	n/a
Minimum Hourly Demand	n/a	700 / 100

Adapted from MOE Design Guidelines for Drinking-Water Systems (2008)

3.5 Minimum Separation to Sewers

As per MOE Procedure F-6-1, watermains shall be laid with at least 2.5 m of clear horizontal separation from any storm or sanitary sewer, forcemain or maintenance hole.

When crossing sewers, it is preferred that watermains cross above sewers with sufficient vertical separation to allow for proper bedding and structural support of both utilities. Where the watermain cannot cross above the sewer, a minimum clear vertical separation of 0.5 m will be required between the invert of the sewer and crown of the watermain.

3.6 Dead Ends

Every attempt should be made to loop watermains in order to avoid dead ends. A fire hydrant will be required at a permanent dead end should it be unavoidable.

A fire hydrant or a 50 mm blow off as per O.P.S.D. 1104.030 will be required at temporary dead ends caused by phased construction.

3.7 Depth & Frost Protection

Watermains and water services shall be installed below the Engineer's calculated frost depth, but to achieve cover of not less than 2.25 m.

Where this is not feasible, rigid high-density insulation to O.P.S.S. 1605 shall be installed as per SS.4 along watermains and water services at all locations with insufficient frost cover.

Rigid high-density insulation shall have a minimum compressive strength of 275 kPa (40 psi), and shall be installed in thicknesses and widths as required to achieve sufficient frost protection, as calculated by the Engineer.

3.8 Watermain Pipe & Fittings Materials

Watermain pipe shall be PVC DR18, Class 235 to AWWA C900/C909 and certified to CSA B137.3, UL listed, NSF-61 Certified and FM approved.

Fittings shall be cast-iron to AWWA C110 or AWWA C153 and shall be cement lined in accordance with AWWA C104.

3.9 Service Connections

A minimum 19 mm diameter service is required for each dwelling, complete with a curb stop located at property line and a main stop located near the watermain, as per O.P.S.D. 1104.010 or 1104.020. Acceptable pipe materials include Type K copper, crosslinked polyethylene (PEX) pipe with CSA B137.5 certification, or HDPE pipe in CTS sizes with CSA B137.1 certification. All non-copper products must be installed with a tracer wire and have NSF/ANSI 61 certification.

Service saddles shall be double bolt stainless steel saddle such as model FS202 by The Ford Meter Box Company.

Trenching for single detached dwellings shall be as per SS.5, while trenching for semi-detached dwellings shall be as per SS.6.

In rural areas, water services may be installed outside of the 20.0 m right-of-way as shown in SS.7, at the Developer's discretion. Laterals installed outside of the 20.0 m right-of-way by any party will not be owned or maintained by the Township.

Water service sizing calculations may also be required to confirm service pipe size in rural areas, where service length exceeds the typical urban lengths.

3.10 Gate Valves

A minimum of two (2) valves shall be installed at tee intersections, and a minimum of three (3) valves shall be installed at cross intersections. Valves shall also be installed on straight sections of watermains at a maximum spacing of 400 m.

All valves smaller than 450 mm in diameter shall be resilient-seated gate valves as per AWWA C509 and shall open counter-clockwise. Valves shall be supplied by Mueller, Canada Valve, McAvity or Clow.

Valve boxes shall be a 130 mm diameter slide valve box complete with cast iron cap as supplied by Bibby-Ste-Croix or approved alternate.

3.11 Hydrants

Fire hydrants shall be installed at a maximum spacing of 150 m in new residential developments, and shall be equipped with 2x 65mm outlet nozzles and one 100 mm pumper outlet nozzle with Storz fitting. Hydrants shall open counter-clockwise.

Acceptable fire hydrant model is the Canada Valve Century EM (manufactured by Mueller Canada) painted yellow.

Fire hydrants shall be installed with a valve as per O.P.S.D. 1105.010. Hydrant drain holes shall be plugged.

In rural cross-sections, a culvert and granular access shall be provided at each fire hydrant as per OPSD 217.050.

3.12 Mechanical Restrainers

Mechanical restrainers will be required at all horizontal or vertical bends, fitting and caps. Approved mechanical restrainers consist of Uni-Flange Series 1350 (Ford Meter Box Company), MEGALUG (EBAA Iron), PVC Stargrip Series 4000 (Star Pipe Products) or GripRing (Romac Industries).

Concrete thrust blocks will not be allowed.

3.13 Tracer Wire

A tracer wire is to be installed along all new watermains. Tracer wire is to be continuous (unspliced) and shall be secured to the pipe using fiberglass tape or plastic tie wraps and fastened to a bolt on valves in valve boxes.

Tracer wire shall be 10 gauge, 7 strand copper, 600 V (minimum).

3.14 Cathodic Protection

Cathodic protection consisting of zinc anodes shall be provided as per O.P.S.D. 1109.011, O.P.S.S. 442 and Table 3-4 below.

Table 3-4: Cathodic Protection for New PVC Pipe Systems

Location	Anode Type	Maximum Spacing and Quantity
Less than 50 mm Copper Service	Z-12-24	20.0 m
50 mm Copper Service	Z-12-24	16.0 m
100 – 300 mm Metallic Fittings and Valves	Z-12-24	1 per fitting and valve
400 mm Metallic Fittings and Valves	Z-24-48	1 per fitting and valve
Hydrant Bases	Z-24-48	1 per hydrant
Tracer Wire	Z-12-24	1 per 1,000 m of tracer wire

Source: O.P.S.S. 442 (November 2008)

3.15 Connection to Existing Infrastructure

When connecting to an existing watermain of equal or greater diameter than proposed, it is preferred that a wet tap connection be done. The work shall be completed and paid for by the Developer but shall be coordinated with the Township.

An alternative approved means of connecting to existing watermains shall be using a bolted coupler to AWWA C219, such as Hymax 2000 by Total Piping Solutions Inc.

4. SANITARY SEWERS, STORM SEWERS & CULVERTS

Adequately designed sanitary sewers, storm sewers and culverts are essential in servicing new and existing developments with the collection of sewage and drainage of stormwater runoff & snowmelt, and ensuring that no flooding occurs.

As discussed below, detailed hydraulic design of the proposed sanitary sewers, storm sewers and culverts shall be undertaken by the Engineer, and a Servicing Report will be required to support the design.

4.1 Applicable Standards

New sanitary sewer systems, storm sewer systems and culverts shall be designed as discussed in this section and generally as per the following standards (or latest revisions):

- Ministry of Environment – Design Guidelines for Sewage Works (2008)
- Ministry of Transportation – MTO Gravity Pipe Design Guidelines (2007)
- Ministry of Transportation – Drainage Management Manual (1995-1997)
- Ontario Provincial Standards Drawings & Specifications (latest revision)

4.2 Location of Storm & Sanitary Sewer in Right-of-Way

The sanitary sewer shall be installed 4.5 m from the south or west right-of-way property line in an urban cross-section as per standard detail SS.1, and 5.8 m from the south or west right-of-way property line in a rural cross-section as per standard detail SS.2.

Similarly, the storm sewer shall be installed 7.9 m from the north or east right-of-way property line in an urban cross-section.

Trenching shall be as per SS.3 for both the storm and sanitary sewer.

4.3 Easements & Land Dedication

Storm and sanitary sewers which cannot be installed in the right-of-way will require minimum 3.0 m wide easements for access and maintenance purposes.

Similarly, 3.0 m x 3.0 m easements will be required at a proposed rear-yard catchbasin or ditch inlet directly adjacent to a right-of-way.

Easements located between two new lots shall be centered on the lot line (i.e. one 1.5 m wide easement on each lot), whereas easements located between a new lot and existing property shall be located entirely on the new lot.

4.4 Head Losses in Structures

In order to compensate for hydraulic losses, minimum drop between inverts will be required at structures as per Table 4-1 below. Additionally, the minimum drop between inverts shall be increased as required for pipes to be obvert to obvert at changes in diameter.

Table 4-1: Minimum Drop Between Inverts at Structures

Direction Change (degrees)	Minimum Drop Between Inverts (mm)
0 to 44	30
45 to 89	60
Greater than 90	150

Adapted from MOE Design Guidelines for Sewage Works (2008)

4.5 Depth & Frost Protection

The preferred cover for storm and sanitary sewer mains is 2.80 m for a typical urban lot, or as otherwise demonstrated by the Engineer to allow for gravity drainage of basements.

A general note or comment shall be added to the Grading Plan and service location sheets, specifying lot numbers where gravity drainage of basements may not be possible, should the preferred cover on the storm and/or sanitary sewer not be achievable for all or some lots, or should the Engineer cannot demonstrate that basement drainage is achievable.

All sanitary & storm sewer mains and laterals shall be located below the Engineer's calculated frost depth.

Where this is not feasible, rigid high-density insulation to O.P.S.S. 1605 shall be installed as per SS.4 along sewer mains and laterals at all locations with insufficient frost cover.

Rigid high-density insulation shall have a minimum compressive strength of 275 kPa (40 psi), and shall be installed in thicknesses and widths as required to achieve sufficient frost protection, as calculated by the Engineer.

A minimum cover of 0.30 m and granular frost treatment as per O.P.S.D. 803.030 or 803.031 will be required on all cross-culverts. The extents of frost treatment shall be calculated by the Engineer and clearly denoted on the drawings.

4.6 Sewer & Culvert Pipe Materials

Table 4-2 below describes approved pipe materials for various diameters of sanitary sewers, storm sewers and cross-culverts. Please note that the Township may accept alternative materials at its discretion.

Table 4-2: Approved Sewer Pipe & Culvert Materials

Sewer Material	Material	Note
Sanitary, any dia.	PVC DR 35 to CSA B182.2	
Storm, <= 450 mm dia.	PVC DR 35 to CSA B182.2	

Storm, > 450 mm dia.	PVC DR 35 to CSA B182.2	
Storm, > 450 mm dia.	PVC to CSA B182.4	320 kPa (Ultra Rib, etc.)
Storm, > 450 mm dia.	HDPE to CSA B182.8	320 kPa (Armtec Boss 2000, Soleno Solflo Max etc.)
Storm, > 450 mm dia	Reinforced Concrete to CSA A257.2, minimum Class 65-D or greater, depending on height of fill	See O.P.S.D. 807.010 & O.P.S.D. 807.030
Culverts, any dia.	CSP 68 x 13 x 2.0 mm, Aluminized Type II to CSA G401-07	

4.7 Storm & Sanitary Laterals

Storm and sanitary laterals servicing a single dwelling shall consist of minimum 100 mm diameter PVC SDR 28 pipe, green for storm and white for sanitary, installed at a minimum slope of 2.0% and a maximum slope of 8.0%.

Connection to the storm or sanitary main shall be made using pre-manufactured tees when connecting to a new sewer main, or strap-on saddles when connecting to an existing sewer main, and as per O.P.S.D. 1006.010 or 1006.020.

Foundation drains shall be connected to the storm sewer by gravity where possible, and sump pumps will be required should the storm sewer main be too shallow. Under no circumstance shall sump pumps or foundation drains be connected to the sanitary sewer.

In addition, rainwater leaders shall discharge to the ground surface and not directly to a storm sewer.

Trenching for single detached dwellings shall be as per SS.5, while trenching for semi-detached dwellings shall be as per SS.6. In rural areas, sanitary laterals may be installed outside of the 20.0 m right-of-way as shown in SS.7, at the Developer's discretion.

Laterals installed outside of the 20.0 m right-of-way by any party will not be owned or maintained by the Township.

4.8 Maintenance Holes

Maintenance holes for storm and sanitary will be required at the end of each line, at all changes in grade, pipe size or alignment, and at a maximum spacing of 120 m. Spacing may be increased to 150 m for sewers with a diameter of 450 mm or greater.

Storm and sanitary manholes shall be constructed with tapered tops where possible and shall be sized to accommodate the sewer's size and alignment.

All maintenance holes shall be constructed of precast concrete with gaskets cast integral with the structure where possible, and as per the O.P.S.D.'s listed in Table 4-3 below.

Table 4-3: Acceptable Maintenance Hole Components & Notes

Component	Applicable O.P.S.D.'s	Modifications / Notes
1,200 mm ø MH	701.010, 701.030, 701.031	Precast slab base & cast-in-place base not allowed
1,500 mm ø MH	701.011, 701.040, 701.041	Precast slab base & cast-in-place base not allowed
1,800 mm ø MH	701.012, 701.050, 701.051	Precast slab base & cast-in-place base not allowed
2,400 mm ø MH	701.013, 701.060, 701.061	Precast slab base & cast-in-place base not allowed
3,000 mm ø MH	701.014, 701.070, 701.071	Precast slab base & cast-in-place base not allowed
3,600 mm ø MH	701.015, 701.080, 701.081	Precast slab base & cast-in-place base not allowed
Flat Caps	703.011, 703.012, 703.013, 703.014, 703.015	May only be used where structure is too shallow for tapered top
Manhole Frame & Grate	401.010, 401.030	Open cover for storm, closed for sanitary. Watertight for sanitary located within storm ponding area
Catchbasin Manhole Frame & Grate	400.070	
Adjustment Units	704.010, 704.011	Maximum of 250 mm
Safety Platform	404.020, 404.021, 404.022	Required when structure depth exceeds 5.0 m
Steps	405.010	Maximum distance of 450mm between top of grate and first step
Benching	701.021	Required for sanitary maintenance holes only
Drop Structure @ New MH	1003.010	Required when drop between inverts exceeds 600 mm
Drop Structure @ Existing MH	1003.030	Required when drop between inverts exceeds 600 mm

4.9 Catchbasins & Ditch Inlets

Roadway and rear-yard catchbasins shall be constructed of precast concrete and as per O.P.S.D. 705.010, with a 600 mm deep sump. Catchbasins shall have gaskets cast integral with the structure and two knockouts to allow for 150 mm diameter perforated pipe connections. Frames and grates for roadway and rear-yard catchbasins shall be as per O.P.S.D. 400.010.

Twin inlet catchbasins as per O.P.S.D. 705.020 may also be used where runoff exceeds the grate capacity of a single catchbasin.

The minimum lead size for catchbasins will be 200 mm for single inlet catchbasins and 250 mm for twin inlet catchbasins. Catchbasins shall be installed at all low points, and at the maximum spacing shown in Table 4-4 below.

Table 4-4: Maximum Roadway Catchbasin Spacing

Longitudinal Slope of Road (%)	Maximum Spacing (m)
0.5 to 3.0	110
3.1 to 4.5	90
Greater 4.5	75

Source: MOE Design Guidelines for Sewage Works (2008)

Ditch inlets as per O.P.S.D. 705.030 or 705.040 complete with frame and grate as per O.P.S.D. 403.010 may be installed in grassed areas where greater flows are expected and/or where terracing is required. Ditch inlets shall have 600 mm deep sumps and two 3.0 m long perforated pipes as per O.P.S.S. 1840, covered with a geotextile sock as per O.P.S.S. 1860.

Catchbasins located outside of a roadway and ditch inlets shall include two 150 mm diameter – 3.0 m long perforated pipe stubs as per O.P.S.S. 1840, covered with a geotextile sock as per O.P.S.S. 1860.

Catchbasin and ditch inlets shall connect to the main storm sewer to a maintenance hole where possible, or as per O.P.S.D. 708.010 (rigid storm sewer) or 708.030 (flexible storm sewer).

4.10 Sanitary Flow Calculation

Domestic sanitary flow calculations shall be based on an average daily domestic flow of 450 L/person/day, and an average of three (3) persons per dwelling. Peak domestic daily flow shall then be obtained by applying a peaking factor calculated as per the Harmon formula below, where P is the population in thousands:

$$PPPPPPPPPPPP FPPPPPPPPPP = 1 + \frac{14}{4 + PP^{0.5}}$$

For residential developments, minimum peaking factor shall be 2.0, while maximum peaking factor shall be 4.0. Additionally, sanitary flow calculations shall include a minimum infiltration and inflow allowance of 0.19 L/s/hectare for new developments, or 0.28 L/s/hectare for existing developments.

4.11 Storm Flow Calculation

Storm runoff may be calculated using the Rational method:

$$Q = 2.78 C P A$$

Where: Q is the peak storm runoff (L/s),

C is the weighed runoff coefficient for the catchment area (see Table 4-5 & 4-6)

i is the storm intensity (mm/hr) for a duration equal to the time of concentration

A is the area of the catchment area (hectare)

The Engineer may elect to calculate weighed runoff coefficients (based on surface type) or use average runoff coefficients (based on development type). Some justification should however be given when selecting an average runoff coefficient.

Table 4-5: Runoff Coefficients – By Surface Type

Surface / Development Type	Coefficient
Asphalt & Concrete Areas	0.90 to 1.00
Roof Areas	0.95 to 1.00
Gravel Areas	0.50 to 0.60
Precast Paving (Interlock)	0.75 to 0.85
Grassed & Undeveloped Areas	0.15 to 0.25

Table 4-6: Runoff Coefficients – By Development Type

Surface / Development Type	Coefficient
Single Family Dwellings, Urban	0.40 to 0.45
Single Family Dwellings, Rural	0.35 to 0.40
Semi-Detached Dwellings	0.45 to 0.60
Row housing, Townhomes	0.50 to 0.70
Apartments	0.60 to 0.75
Commercial	0.75 to 0.85
Industrial	0.65 to 0.75

Adapted from MTO Drainage Management Manual (1995-1997) & MOE Design Guidelines for Sewage Works (2008)

Higher runoff coefficients should be used where slopes are greater, while lower runoff coefficients may be used where slopes are flatter.

Pre-development time of concentration should be calculated as per either the Bransby Williams formula for watersheds with a runoff coefficient greater than 0.40, or the Airport formula for watersheds where the runoff coefficient is less than 0.40, as per the MTO Drainage Management Manual (1995–1997).

Bransby Williams formula (where runoff coefficient > 0.40):

$$T_{cc} = \frac{0.057L}{(C^{0.2}(0.1))}$$

Where: t_c is the time of concentration (min),
 L is the length of the watershed (m)
 s is the average slope of the watershed (%)
 A is the area of the watershed (ha)

Airport formula (where runoff coefficient < 0.40):

$$FF_{\alpha} = \frac{3.26(1.1 - CC)LL^{0.5}}{(ss^{0.33})}$$

Where: t_c is the time of concentration (min),
 C is the runoff coefficient
 s is the average slope of the watershed (%)
 L is the length of the watershed (m)

A minimum time of concentration of 20 minutes shall be used in calculating post-development storm runoff in a rural setting, whereas a minimum time of concentration of 15 minutes shall be used in an urban setting. A longer time of concentration may be used for developments with large lots, and shall be calculated as per the Bransby Williams formula or Airport formula as per above.

The corresponding storm intensities or depths shall be as per Table 4-7 below, and are derived from Environment Canada (EC) Station 6101874 – Cornwall (1991– 2006).

Additional information and continually updated IDF curves may be found on EC’s server: ftp://ftp.tor.ec.gc.ca/Pub/Engineering_Climate_Dataset/IDF

Table 4-7: Design Storm Intensities & Depths

Design Storm, Return Period	Intensity (mm/hr), where t_c is in hours	Depth (mm), 12 h duration
5 years	$i = 25.7(t_c)^{-0.668}$	57.0
100 years	$i = 40.7(t_c)^{-0.639}$	101.8

Source: Environment Canada IDF Data – Station 6101874 – Cornwall (2012)

4.12 Minor / Major System

The minor system (storm sewers, swales and/or ditches) is to be sized to accommodate the 5 year design storm event calculated using the Rational method.

A major system consisting of overland flow or similar shall also be established. The major system shall have capacity to accommodate the 100 year design storm event calculated using the Rational method, while maintaining a 0.30 m freeboard between the 100 year water elevation and finished grade at buildings. For cross-culverts and driveway culverts, a minimum of 0.15 m of freeboard between the 100 year water elevation and centerline of road is required.

Major system calculations shall take into consideration the actual flow capacity of curb & gutters, catchbasins, ditch inlets, and the like, as per the MTO Drainage Management Manual (1995-1997). Rating curves may be found in Appendix D.

The minor system shall be oversized should the above freeboard not be achievable.

4.13 Sewer Pipe & Channel Sizing

No storm or sanitary sewer shall be less than 200 mm in diameter. Cross-culverts shall be a minimum of 600 mm in diameter, and driveway/access culverts shall be a minimum of 400 mm in diameter.

All cross-culverts, storm sewers and sanitary sewers shall be sized as per the MOE Design Guidelines for Sewage Works to accommodate the design flow and to achieve a flow velocity of 0.6 m/s (minimum) to 3.0 m/s (maximum), and per the Manning formula:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

- Where: Q is the peak flow (L/s),
 A is the area of the pipe (m²)
 s is the sewer slope (m/m)
 R is the hydraulic radius (m)
 n is the Manning roughness coefficient (unitless, see Table 4-8)

Likewise, the capacity of the major storm system shall be evaluated using the Manning formula and corresponding Manning roughness coefficients found in Table 4-8 below.

Table 4-8: Minimum Manning Roughness Coefficients

Channel Material	Coefficient
PVC, Concrete & HDPE	0.013
Corrugated Steel Pipe	0.024
Grass	0.035
Concrete Gutter	0.015
Asphalt	0.016

Adapted from MTO Drainage Management Manual (1995-1997)

4.14 Culvert Sizing

Cross-culverts and driveway culverts shall be sized as per the “Culvert Hydraulics” section of the MTO Drainage Management Manual (1995-1997), which may also be found in Appendix E.

The type of control and culvert sizing calculations shall be based on expected tailwater elevation resulting from the existing or proposed downstream conditions.

Design software such as Hydraflow Express, CulvertMaster, HY 8, etc. may also be used in performing calculations.

4.15 Connection to Existing Infrastructure

It is preferred that new storm and sanitary sewers be connected to existing sewer infrastructure by core drilling an existing structure and making a watertight connection. A Link-Seal shall be used to make a watertight connection for sanitary sewers as per SS.8, while non-shrink grout may be used for storm sewer connections.

Where it is not feasible or practical to connect to an existing storm or sanitary structure, a connection to existing infrastructure may be done by removing a piece of existing sewer and installing a new maintenance hole with 1.0 m long sewer stubs and flexible couplers on either side.

Connections to existing infrastructure using a maintenance hole with cast-in-place base (horseshoe maintenance hole) will not be permitted.

In all cases, flows in existing storm and/or sanitary sewers must be maintained through either temporary rerouting of the sewer or mechanically pumping around the restricted area.

4.16 Headwalls

At the discretion of the Township, storm sewers and road cross-culverts discharging to an existing open ditch or drain may require a headwall as per O.P.S.D. 804.030 (pipe diameter less than 900 mm) or O.P.S.D. 804.040 (pipe diameter greater than 900 mm), complete with a grating as per O.P.S.D. 804.050. For storm sewer outlets, the outlet pipe would need to be concrete should the Township not require headwalls.

Additionally, rip-rap with geotextile shall be installed at storm sewer outlets as per O.P.S.D. 810.010 (Type B) in order to protect against erosion.

Headwalls will not be allowed on driveway culverts.

5. STORMWATER MANAGEMENT

Urbanization sees the conversion of previously pervious areas (farm land, grass, woodland, etc.) into impervious areas (asphalt, concrete, roofs, etc.). Some negative effects of urbanization include an increase in the quantity of stormwater runoff, a decrease in the infiltration rate and a decrease in the quality of stormwater runoff, which can have direct and important consequences upstream and/or downstream of a proposed development.

In order to mitigate the effects of urbanization, stormwater management and a detailed Stormwater Management Report are required for all new developments. The Stormwater Management Report may be incorporated into the Servicing Report at the discretion of the Engineer.

5.1 Applicable Standards

New stormwater management facilities shall be designed as discussed in this section and as per the following standards (or latest revisions):

- Ministry of Environment – Stormwater Management Planning and Design Manual (2003)
- Ministry of Natural Resources – River & Stream Systems: Flooding Hazard Limit (2003)
- Ministry of Transportation – Drainage Management Manual (1995-1997)
- Ministry of Environment – Guideline B-6 – Guidelines for Evaluating Construction Activities Impacting on Water Resources (1995)
- Ontario Provincial Standards Drawings & Specifications (latest revision)
- City of Ottawa Sewer Design Guidelines (2012)

5.2 Stormwater Quantity

For any given outlet of a proposed development, the post-development peak runoff must not exceed the corresponding pre-development peak runoff for storm events with return periods of 5 and 100 years. The site as it exists prior to development may generally be considered as the pre-development condition, from which allowable peak flows may be calculated.

In some instances, the Township may dictate the allowable discharge rate from the site based on known capacities of existing infrastructure.

Storage of stormwater will usually be required to achieve the above, which may be achieved by means of a dry pond, wet pond or wetlands. Stormwater facilities must also be located above the highest design flood level, and may not be located on private property.

Enhanced grassed swales along roadways are not acceptable for use as a stormwater management facility.

5.2.1 MODIFIED RATIONAL METHOD

The Modified Rational Method may be used to calculate 5 and 100 year storage requirements of developments smaller than 15.0 hectares, where the storage rate is the difference between the peak flow rate and the allowed release rate, calculated using a 5 minutes time step. The required storage volume corresponds to the time step with the greatest storage volume.

A sample Modified Rational Method calculation may be found in Appendix F.

5.2.2 COMPUTER MODELING

For developments larger than 15.0 hectares and/or drainage systems that are more complex, a computer model shall be created using approved software such as SWMM, PCSWMM, MIDUSS, OTTSWMM, OTTHYMO, etc.

The AES 30% Southern Ontario – 12 hour storm distribution as per Table 5-1 below shall be used in sizing stormwater storage facilities.

Table 5-1: AES 30% Southern Ontario – 12 Hour Storm Distribution

	Hours											
	1	2	3	4	5	6	7	8	9	10	11	12
Rainfall Distribution (%)	15	25	22	14	12	8	3	1	0	0	0	0
Cumulative (%)	15	40	62	76	88	96	99	100	100	100	100	100

Source: Ministry of Natural Resources – River & Stream Systems: Flooding Hazard Limit (2002)

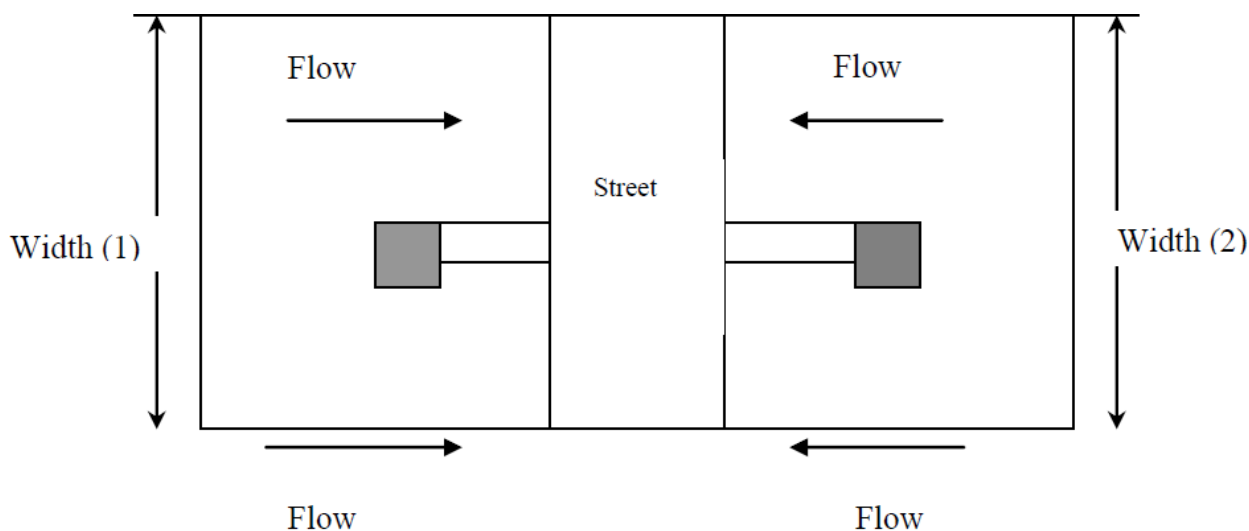
The total depth of rainfall shall be as per Table 4-7: Design Storm Intensities & Depths.

Hydrologic soil classification and curve numbers for the pre and post-development condition shall be determined based on the information provided in per Appendix G.

As per the City of Ottawa Sewer Design Guidelines, depression storage shall be 1.57 mm for impervious areas, and 4.67 mm for pervious areas.

Furthermore, and again as explained in the City of Ottawa Sewer Design Guidelines, the width parameter shall be equal to twice the length of the street segment (if the catchment area is on both sides of the street) or equal to the length of the street segment (if the catchment area is only on one side of the street). Refer to Figure 5.1 below for more information.

Figure 5-1: Schematic of Width Parameter for Typical Subdivision



$$\text{Total Width} = \text{Width (1)} + \text{Width (2)}$$

Source: City of Ottawa Sewer Design Guidelines (2012)

5.3 Stormwater Quality

As a minimum, 70% of total suspended solids (TSS) removal will be required for new developments, equivalent to normal protection as defined in the MOE Stormwater Management Planning and Design Manual (2003), or greater as established by the local Conservation Authority.

Qualitative treatment may be achieved by means of a wet pond, wetlands or infiltration basin designed to meet the criteria established of the MOE Stormwater Management Planning and Design Manual (2003).

Other acceptable means of providing qualitative treatment is with a Stormceptor[®] unit by Imbrium, CDS[®] unit by Contech sized to accommodate the proposed development, or alternative product to the approval of the Township. A dry pond may also be used in conjunction with supplementary treatment.

Enhanced grassed swales along roadways are not acceptable for use as a stormwater management facility.

5.4 Stormwater Quality during Construction

Temporary erosion and sediment control measures will be required and shall meet the general requirements of Ministry of Environment Guideline B-6 – Guidelines for Evaluating Construction Activities Impacting on Water Resources (January 1995).

Generally, erosion and sediment control measures shall consist of light-duty or heavy-duty silt fencing as per O.P.S.D. 219.110 or 219.130, and straw bale flow check dams as per O.P.S.D. 219.180. Other measures may also be acceptable.

Temporary erosion and sediment control measures shall be maintained throughout construction, and monitored on a weekly basis and after significant rainfall events throughout construction. Repairs shall be undertaken as necessary to maintain functionality.

Temporary erosion and sediment control measures shall be removed only once seeding or sodding is completed and grass has reached a height of 150 mm or been mowed twice.

5.5 Access & Fencing

A minimum 4.0 m wide granular access road and easement (where required) must be provided for access and future maintenance of the stormwater management facility. The granular access road shall be constructed of a minimum of 300 mm of Granular "B" Type II and 150 mm of granular "A" as per O.P.S.S. 1010, compacted to 100% Standard Proctor Density.

Chainlink fencing with top rail as per O.P.S.D. 972.130 will be required where the side slopes of the stormwater management facility are steeper than 5H:1V for 3 m on either side of the permanent pool, or 3H:1V elsewhere, or at the Township's discretion.

Fence posts shall be installed as per O.P.S.D. 972.132, and a lockable single swing gate as per O.P.S.D. 972.102 shall be installed as required to access the stormwater management facility for maintenance purposes.

6. LOT GRADING

The Engineer must submit detailed lot grading plans for Township approval. The general intent of lot grading is to generally ensure that existing drainage patterns are not impeded and to generally ensure that runoff drains away from all existing and new buildings.

6.1 Minimum & Maximum Slopes

A minimum slope of 1.0% will be required for all grassed and asphalted areas, while a slope of 2.0% is preferred. The maximum slope for grassed and asphalted areas shall be 5.0% for back yards and 7.0% for front yards.

Terracing at 4H:1V (or flatter) will be required where grass slopes exceed the maximum allowed. Terracing at 3H:1V is acceptable where 4H:1V is not feasible.

Slope anchoring, structures or retaining walls will be required, to the approval of the Township, where resulting slopes are steeper than 3H:1V.

6.2 Retaining Walls

Retaining walls may be installed in locations where 4H:1V or 3H:1V terracing is not feasible. All retaining walls shall be installed on private property, will not be permitted within an easement and shall not interfere with lot grading or maintenance.

All retaining walls exceeding 1.0 m in height must be designed and stamped by a qualified Structural Engineer in the province of Ontario and may be constructed of armor stone, cast-in-place concrete or a manufactured precast concrete product intended for retaining wall construction.

Likewise to the above, all retaining walls exceeding 1.5 m in height must be designed and stamped by a qualified Structural Engineer in the province of Ontario, but may not be constructed of armor stone.

The height of the retaining wall will be measured from the lowest finished ground elevation to the highest finished ground elevation. Stepping of walls to avoid height restrictions will not be allowed.

Additionally, guards are to be provided to the requirements of the Ontario Building Code (latest edition).

6.3 Typical Lot Grading

As a minimum, finished grade at the house should be 150 mm above the lot proposed high point or as approved at the Township's discretion.

The preferred grading configuration is split drainage as per SS.9. Back to front drainage as per SS.10 is acceptable in cases where split drainage is not possible.

The Engineer may also consider walkout basements as per SS.11 where the grade allows. Lots designated as “walkout” shall be clearly identified on the grading plan, and required terracing (3H:1V or flatter) shall be clearly identified on the grading plan.

The Engineer shall also consider the need for structural backfill where the lot fill quantities exceed the depth of proposed footings, and shall provide the Township with a drawing indicating structural fill areas. Furthermore, a geotechnical engineer shall test and certify all lots requiring structural fill, and a general note or comment shall be added to the grading plan to this effect.

6.4 Swales & Subdrains

Swales will be required along the perimeter of the development, in rear yards where proposed lots are back to back and as otherwise required to ensure positive drainage of the development.

The minimum longitudinal swale slope shall be 0.5% if a perforated subdrain and clear stone surrounded with non-woven geotextile is installed as per SS.12. The perforated subdrain shall be covered with a geotextile sock and shall outlet to an open ditch through a 3.0 m long CSP culvert complete with rodent grate as per SS.13 or to a catchbasin or ditch inlet.

Swales may be installed without a perforated subdrain as per SS.12 if a longitudinal slope of 2.0% (or more) is provided along its entire length.

When located between two new properties, swales shall be located centered on the lot line. Perimeter swales bordering existing property shall be located entirely on new property, unless written permission is obtained from the owner of the existing property.

6.5 Easements & Land Dedication

3.0 m wide easements will be required along swales draining more than two (2) lots. Swales draining more than two (2) lots shall also be sized to accommodate the design storm as per Section 4.

6.6 Rough Lot Grading

Rough lot grading is the responsibility of the Developer, and must be completed and approved by the Township prior to the issuance of building permits. At the Township’s discretion, partial rough lot grading approval may be provided (i.e. for a number of specific lots).

Prior to acceptance by the Township, the rough lot grades must be 100 mm to 300 mm below the final lot grade and the swales or other drainage channels must be installed. Lots shall be shaped or contoured as necessary to provide positive drainage.

6.7 Final Lot Grading

Final lot grading is the responsibility of the property owner. As a condition of issuing the building permit, the property owner must remit the required lot grading deposit, pursuant to the Township's current fees and lot grading policy.

Prior to acceptance by the Township, the final lot grade at property boundaries and swales must be within 50 mm of the proposed lot grade, and general drainage patterns must match those of the approved grading plan.

Upon completion of final lot grading, the property owner must then retain and pay for the services of a Lot Grading Professional (LGP) to verify lot grading compliance, as outlined in the Township's lot grading policy.

When the Township receives an acceptable "as-built" lot grading plan certified by a LGP, the lot grading deposit reimbursement will be authorized by the CBO or designate, unless it has previously been forfeited.

If deviations from the approved lot grading plan are required, the property owner shall provide a professional engineer's opinion confirming that surface water run-off will be discharged to a positive drainage system and that the subject property and surrounding properties will not be negatively impacted.

Refer to the Township's lot grading policy for additional information.

7. ROADWAY DESIGN

Proposed roadway systems shall generally be designed to allow for the safe and efficient movement of goods and people within the Township, while providing an acceptable level of service.

At the discretion of the Township, a Traffic Impact Assessment study may be required to support the proposed development.

7.1 Applicable Standards

New roadways shall be designed as discussed in this section and generally as per the following standards (or latest revisions):

- Transportation Association of Canada – Geometric Design Guide for Canadian Roads (1999)
- Ministry of Transportation – Roadside Safety Manual (1993)
- Ministry of Transportation – Book 5 – Regulatory Traffic Signs (2000)
- Ministry of Transportation – Book 6 – Warning Signs (2000)
- Ministry of Transportation – Book 11 – Pavement, Hazard & Delineation Markings (2000)
- Ontario Good Roads Association – Geometric Guidelines for Municipal Roads (1999)
- Ontario Provincial Standards Drawings & Specifications (latest revision)

7.2 Layout

The Township should be consulted as early as possible in order to review the proposed road layout.

Every attempt should be made to avoid cul-de-sacs. Asphalted turning basins as per O.P.S.D. 500.010 (Type A), 500.020 (Type A or B) or 500.030 (Type A or B) will be required where a cul-de-sac is unavoidable.

Similarly, “hammerhead” temporary turning basins as per O.P.S.D. 500.01 (April 1991) will be required at temporary dead ends due to phased construction. Temporary turning basins do not need to be asphalted.

A minimum of 7.6 m of right-of-way daylighting (sight triangle) shall be provided at intersections.

7.3 Road & Right-of-Way Widths and Slopes

Typical road width shall be 6.5 m (3.25 m lane width) for a rural cross-section and 8.0 m (4.0 m lane width) for an urban cross-section, at a 2.0% crown. For rural cross-sections, 1.0 m wide granular shoulders at a 6.0% slope will be required, complete with a 0.5 m granular rounding.

For either a rural or urban cross-section, the road shall be centered within the 20.0 m right-of-way. Refer to standard detail SS.1 and SS.2 for more information.

In rural cross-sections, ditch fore and back slopes shall be 3H:1V or flatter, and ditches shall be sufficiently deep to drain the road sub-base.

7.4 Design Speed

Wherever possible, all new local roads and cul-de-sacs shall be designed to a minimum design speed of 50 km/h and to the requirements of the Transportation Association of Canada (TAC) – Geometric Guidelines for Municipal Roads (1999).

A minimum design speed of 40 km/h may be used at the discretion of the Township should the design not be able to meet requirements of the above desired design speed.

7.5 Horizontal Alignment

As per TAC guidelines for low speed urban design (Figure 2.1.2.4), the minimum horizontal centerline radius for a local road or cul-de-sac shall be 105 m for a 50 km/h design speed and 60 m for a 40 km/h design speed, for a normal crown ($e = -0.02$).

At the discretion of the Township, a reverse crown ($e = 0.02$) could be introduced in order to allow for a minimum centerline radius of 86 m for a 50 km/h design speed and 47 m for a 40 km/h design speed.

Horizontal alignment of proposed roadways and minimum radii should be taken into consideration during development of the draft plan. Smaller radii may be allowed for low-volume roads at the Township's discretion.

7.6 Vertical Alignment

As per TAC guidelines, the maximum gradient shall be 8.0% for a local road or cul-de-sac in an urban cross-section, or 7.0% for a local road or cul-de-sac in a rural cross-section. The minimum gradient shall be 0.5%, for either rural or urban cross-sections.

Vertical curves, to a minimum length of 50 m, will be required where the algebraic difference in grades exceeds 2% (e.g. where a -1.0% gradient meets a +1.5% gradient).

For a crest vertical curve, the minimum rate of vertical curvature (K) shall be 7 for both the 50 km/h and 40 km/h design speeds.

For a sag vertical curve, the minimum K shall be 12 for both the 50 km/h and 40 km/h design speeds.

It is preferred that higher K factors be used whenever possible.

At intersections, the crown of the major street shall be maintained throughout the intersection. The vertical alignment of the intersecting street shall be adjusted as detailed

in O.P.S.D. 300.010 or 300.020, in order provide a smoother transition between the crown of the major street and the gradient of the intersecting street.

Either ditch elevations (in rural cross-sections) or curb elevations (in urban cross-sections) shall be modified at vertical curves in order to maintain a minimum longitudinal slope of 0.5%.

7.7 Intersections

In rural cross-sections, semi-mountable curb and gutters as per O.P.S.D. 600.060 shall be installed at all corner radii as per O.P.S.D. 304.010, Plan C. Concrete curb outlets as per O.P.S.D. 604.010 shall be provided at all low points complete with a rip-rap pad as per O.P.S.D. 810.010 Type B (with geotextile).

Curbs shall be terminated as per O.P.S.D. 608.010.

Similarly, a mountable curb and gutter and curb outlets shall be installed along the interior radius of a horizontal curve with a centerline radius equal to 60 m or less.

In either rural or urban cross-sections, curbs shall be graded such that a minimum slope of 0.5% is achieved along the radii and such that no flat areas are created. Proposed curb grades shall be clearly shown on the grading plan.

Curb radii shall have a minimum radius of 9.0 m within a proposed development, and shall have a minimum radius of 11.0 m at the intersection of a County Road or roadway of equivalent classification.

7.8 Sidewalks, Walkways & Pathways

Sidewalks (on one side of the roadway) will be required for all new roads, except for cul-de-sacs shorter than 175 m. This requirement may be removed at the discretion of the Township. In some locations, a paved shoulder may be an acceptable alternative.

Furthermore, walkways and/or pathways on dedicated land may be required to provide pedestrian access to public facilities such as schools, parks, etc. It is strongly recommended that the Township be pre-consulted to determine the requirement for sidewalks, paved shoulders, walkways and/or pathways. Where required, asphalt pathways shall be as per standard detail SS.14.

Sidewalks shall be constructed to a width of 1.5 m as per O.P.S.D. 310.010M or O.P.S.D. 310.020M and to a thickness of 125 mm, complete with 152x152 MW18.7 x MW18.7 welded wire mesh at driveways (if driveway locations are known) or to a thickness of 150 mm if driveway locations are unknown. At commercial and industrial driveways, the thickness shall be increased to 200 mm.

Granular base for sidewalks shall consist of a minimum of 200 mm of Granular "A", extending a minimum of 0.3 m beyond the edge of sidewalk.

Sidewalk ramps are to be provided at unsignalized intersections as per OPSD 310.033 and at signalized intersections as per OPSD 310.030 (separate crosswalks) or as per OPSD 310.031 (intersecting crosswalks), complete with tactile walking surface indicator plates as per OPSD 310.039.

Monolithic curb and sidewalk will not be allowed.

7.9 Curbs

Barrier curbs with standard gutter as per O.P.S.D. 600.040 shall be installed in urban cross-sections. Curb depressions will be required at all driveway locations. Curbs may be depressed during their construction if driveway locations are known, or may be installed to full height throughout and cut at a later time by the Developer if the driveway locations are unknown.

In rural cross-sections, semi-mountable curbs and standard gutters as per O.P.S.D. 600.060 shall be installed at all intersections radii and interior radii of a horizontal curve with a centerline radius equal to 60 m or less.

Monolithic curb and sidewalk will not be allowed.

7.10 Driveways & Entrances

Residential driveways in urban cross-sections shall be as per O.P.S.D. 350.010 or 351.010. Likewise, residential driveways in rural cross-sections shall be as per O.P.S.D. 301.010 or 301.020. The maximum driveway slope shall be 8.0%.

7.11 Fencing

In locations where back yards abut a public street, the Developer shall install a wood screening fence along and at a distance of 0.3 m from the lot line, on private property. The wood screening fence shall be as per standard detail SS.15, or equivalent, to the satisfaction of the Township and may not be located within swales or otherwise impede drainage.

A clause is to be added to the agreement of purchase and sale of the lot such that all future maintenance and/or replacement of the fence will be the responsibility of the purchaser of the lot.

In locations where infill or greenfield developments are proposed, if a public street or private road allowance is introduced between abutting existing residential land uses, the Developer is required to ensure buffering elements such as a wood screening fence or vegetative elements are introduced on the existing lot(s) where concerns are raised prior to the registration of the agreement. The Developer shall make the necessary arrangements with the landowners to satisfy their concerns. If a wood screening fence is introduced, it shall be constructed as per standard detail SS.15, or equivalent, to the satisfaction of the Township and may not be located within swales or otherwise impede drainage and shall be designed to accommodate any existing easements.

Fencing is to be installed as part of the subdivision and the fencing for the entire subdivision must be in place prior to the issuance of building permits.

7.12 Asphalt Pavement Design & Materials

Any local road shall be constructed of a minimum compacted thickness of 300 mm of Granular “B” Type II to OPSS 1010, 150 mm of Granular “A” to OPSS 1010, 50 mm of HL-8 hot mix asphalt (base course) and 40 mm of HL-3 hot mix asphalt (surface course) to OPSS 1150.

A geotechnical subsurface investigation will be required and shall be prepared by a qualified Geotechnical Engineering firm.

The surface course shall be placed a minimum of one full year after the installation of the base course, but preferably only once house construction is complete. The base course must be swept by truck prior to the placing of a surface course, and the surface course may not be placed after October 15.

7.13 Perforated Subdrains

In urban cross-sections, 150 mm diameter perforated subdrains shall be provided on both sides of the road (as shown on detail SS.1) in order to drain the granular base and sub-base. Perforated subdrains shall outlet to catchbasins.

Perforated subdrains shall meet the requirements of OPSS 1840 and shall be covered with a geotextile sock as per OPSS 1860.

7.14 Signage & Line Painting

The Developer will be responsible for the supply and installation of all regulatory & warning signage, which shall conform with the Manual on Uniform Traffic Control Devices (MUTCD) and MTO Book 5 – Regulatory Traffic Signs or MTO Book 6 – Warning Signs.

Sign reflectivity shall be Type III – High Intensity Grade for the following signs:

- Checkerboard
- Curve sign with Advisory Speed Tab
- Do Not Enter
- Load Restricted Bridge
- One Way
- School Zone Speed Limit
- Stop, Stop Ahead & Stop Ahead New
- Traffic Signal Ahead New
- Two-Way Traffic Ahead
- Wrong Way
- Yield, Yield Ahead & Yield Ahead New

Reflectivity of other signs not listed above shall be Type I – Engineering Grade as a minimum.

The Developer will also be responsible for the supply and installation of all street name signs, which shall be as per the Township's standard.

Sign support shall consist of Rib Bak breakaway system as per O.P.S.D. 987.101 and 987.110. Non breakaway posts as per O.P.S.D. 990.110 may be used on roadways with barrier curbs and posted speed of 70 km/h or less.

Permanent subdivision signage (i.e. sign with name of subdivision) will not be allowed within the Right-of-Way and will not be maintained by the Township.

7.15 Connection to Existing Roadways

Step connections will be required at all connection to existing asphalt. The existing asphalt shall be grinded to a minimum width of 1.0 m and to a minimum thickness of 40 mm, as shown on standard detail SS.16.

7.16 Road Cuts

Road cuts will be allowed as required to connect to existing underground infrastructure. A road cut permit shall be obtained from the Township, from the County or from the Ministry of Transportation, where applicable.

Reinstatement of the roadway shall match existing granular and asphalt thicknesses, while maintaining the minimum thicknesses mentioned in Section 7.12. Step connections to a minimum width of 1.0 m will also be required as per Section 7.15 where connecting to existing asphalt. Note that the above are minimum requirements that may be increased as prescribed by the County or Ministry of Transportation.

7.17 Ditch Infill Requirements

In rural cross-sections, partial ditch infill or complete ditch infill may be allowed at the Township's discretion and as per the Township's Ditch Infill Policy (Schedule "A" to By-law No. 2014-061). The two types of ditch infill are discussed below.

7.17.1 PARTIAL DITCH INFILL

A partial ditch infill does not need to be designed nor stamped by an Engineer, but does require a permit for its construction.

Partial ditch infills shall consist of a 100 mm or 150 mm diameter perforated HDPE pipe to OPSS 1840, wrapped in a geotextile filter sock to OPSS 1860. 19 mm clear stone wrapped in non-woven geotextile shall be used as pipe surround and cover.

Outlet/inlet pipes consisting of either a corrugated steel pipe (CSP) to OPSS 1801 or 320 kPa HDPE pipe to CSA B182.8 complete with steel rodent trap will also be required at the inlet and outlet of the perforated pipe.

Refer to standard detail SS.17 and to the Township's Ditch Infill Policy for additional details.

7.17.2 COMPLETE DITCH INFILL

A complete ditch infill shall be designed and stamped by an Engineer, and a permit will be required for its construction.

Filled ditches shall consist of 320 kPa HDPE perforated pipe as per CSA B182.8, wrapped in a geotextile filter sock as per OPSS 1860. The pipe shall be sized to convey the ditch flow as per Section 4 and shall be a minimum of 375 mm in diameter. 19 mm clear stone wrapped in non-woven geotextile shall be used as pipe bedding, surround and cover.

A minimum of one catchbasin will be required, and shall be located as required to drain the boulevard. The catchbasin(s) shall be a minimum of 300 mm in diameter and shall be constructed of a pre-manufactured 320 kPa HDPE fitting (cross), complete with a 300 mm deep sump and cast iron grate.

The culvert underneath the driveway shall consist of a CSP 68 x 13 x 2.0 mm pipe, with Aluminized Type II coating to CSA G401-07. Joints between the CSP and HDPE culvert shall be overlapped with geotextile filter sock a minimum of 300 mm.

Refer to standard detail SS.18 and to the Township's Ditch Infill Policy for additional details.

8. UTILITIES

8.1 Street Lighting

Street lighting design is a requirement of the subdivision design package. The design of the street lighting system shall be in accordance with the latest editions of the following documents:

- Transportation Association of Canada’s (TAC) Guide for the Design of Roadway Lighting (the “TAC Manual”)
- Electrical Safety Authority’s (ESA) Guidelines for the Design, Installation, Operation & Maintenance of Street Lighting Assets
- Ontario Provincial Standard Drawings, Volume 4 - Electrical Work
- The Ontario Electrical Safety Code

All street lighting will be owned by the Township and must utilize one of the Township’s standardized LED luminaires manufactured by Phillips/Lumec, outlined in Table 8-1 below.

Table 8-1 – Acceptable Luminaires for Street Lighting

Mounting Style	Name	Mounting Bracket
Arm Mounted	RoadView Small (RVS)	2.4m X 1.2m aluminum tapered elliptical bracket
	L40U Pendant (L40U-STM)	S25AU6 (6’ reach) bracket – ordered as an option with the luminaire
Post-Top	UrbanScope (MPTC)	n/a
	L40U Post-Top (L40U)	n/a

Control of the streetlights shall be done using individual photocell devices mounted on each luminaire. Photocell devices shall be of the “long life” type.

Poles shall be of the concrete direct buried type and shall be specified with interior corrosion protection and exterior silane sealer options to provide the greatest service life to the Township.

Choice of poles and luminaires will be dependent on whether the subdivision is new or a continuation of a previous phase. For phase continuations, pole specifications (height, colour, etc.) and luminaire type shall be chosen to match the previous phase.

The streetlight locations shall be as per standard detail SS.1 or SS.2.. Streetlights should be located on property lines where possible, and if not, should be coordinated with the proposed driveway locations.

Streetlights should be equidistantly spaced at an appropriate distance to meet the guidelines in the TAC Manual. Spacing will depend on the pole height and the luminaire wattage & light distribution type. However, spacing between streetlights shall not exceed 75m.

Power for the streetlights shall be supplied from an unmetered electrical service in accordance with the local electrical utility. The engineer shall coordinate these requirements with the electrical utility company and design the street lighting electrical system accordingly. The locations of all street lighting equipment shall be coordinated with all utility equipment within the subdivision.

8.2 Canada Post

The Engineer shall coordinate with Canada Post, and the Developer shall provide a concrete pad in locations where a supermailbox is required, complete with matching concrete access walkway as per standard detail SS.19 or to the satisfaction of Canada Post.

8.3 Natural Gas, Hydro, Cable, Communications

The Engineer shall again coordinate with the utility companies in order to service the development with natural gas (where available), underground hydro, cable and communications infrastructure.

Underground utilities shall be installed in a joint utility trench as per standard detail SS.20, or to the satisfaction of the various utility companies. Road crossings shall be as per standard detail SS.21 or to the satisfaction of the various utility companies.

A composite utility drawing is required as part of the design package that utilizes the base drawing of the subdivision (i.e. including underground services, lot lines, roads, ditches, etc) and also includes the location of all utility poles, transformer, pedestals, conduits, and buried utilities.

8.4 Easements

Utility easements shall be provided to the satisfaction of the various utility companies.

In rural cross-sections, underground utilities shall be installed in 3.0 m wide utility easements, to be located on each side and outside of the proposed right-of-way, as shown on standard detail SS.2.

In urban cross-sections, underground utilities may be installed on each side and inside the proposed right-of-way, as shown on standard detail SS.1.

9. CONSTRUCTION

9.1 Public Relations

The Developer and/or Engineer will need to be available to address concerns or questions of the general public and/or adjacent property owners. The Township should be involved whenever required.

The Developer will be responsible for the sweeping of roadways dirtied by construction activities.

9.2 Health & Safety

It is of vital importance that construction proceeds in the safest manner possible and at all times as per the Ontario Health and Safety Act (O. Reg. 213/91 as amended by O. Reg. 88/13 or latest) and other Provincial regulations.

Where applicable, a Notice of Project shall be filled by the Contractor and submitted to the Ministry of Labour prior to the start of construction.

9.3 Traffic Control

Where work is required within existing right-of-ways, traffic control shall be provided by the Contractor as per the requirements of the Ontario Health and Safety Act (O. Reg. 213/91 as amended by O. Reg. 88/13 or latest) and Ministry of Transportation Book 7 – Temporary Conditions.

The Contractor must maintain access for emergency vehicles to each adjacent property at all times, and must maintain two-way through traffic at all times using at least one open 3.5 m wide lane.

In rare cases, temporary road closures may be allowed. All temporary road closures must be approved by the Township, and the Contractor or Developer will be responsible to notify emergency services, bus companies, etc.

All construction equipment must be moved a minimum of 4 metres from the edge of pavement at the end of each day's work, and the Contractor must patrol the entire site to ensure that all signage is in place and that there are no traffic hazards.

9.4 Inspection During Construction

The Developer shall retain the services of a qualified Engineer to provide inspection services during construction of municipal infrastructure, to supervise the construction and to ensure a quality product.

A site inspector must be present at all times during any underground construction. Periodic inspections will be required during the construction of surface works.

9.5 Testing & Materials Testing

The Developer shall retain the services of a qualified Engineer to conduct or supervise testing during construction, as listed in Table 9-1 below.

Table 9-1: Testing During Construction

Testing	Applicable Standard	Frequency / Notes
Forcemain, hydrostatic pressure test	OPSS 412	Allowable leakage shall be 0.041 L / mm of pipe diameter / km of pipe / hour
Watermain, hydrostatic pressure test	OPSS 441	Allowable leakage shall be 0.041 L / mm of pipe diameter / km of pipe / hour
Watermain, disinfection & flushing	AWWA C651	
Watermain, bacteriological testing	AWWA C651	Testing for E.Coli, total coliform and heterotrophic plate count
Storm sewers, CCTV inspection	OPSS 409	All storm sewers shall be videoed.
Sanitary sewers, CCTV inspection	OPSS 409	All sanitary sewers shall be videoed.
Asphalt temperature	120°C (minimum) – 160°C (maximum)	Every load

Similarly, the developer shall retain the services of a qualified Geotechnical Engineering firm and recognized laboratory to conduct materials testing during construction, as listed in Table 9-2 below.

Table 9-2: Materials Testing During Construction

Testing	Test	Frequency / Notes
Granular	Gradation	Min. 1 for each material, more if source is changed
Granular	Proctor	Min. 1 for each material, more if source is changed
Trench bedding	Compaction	Random, 2-3 times a week
Trench surround	Compaction	Random, 2-3 times a week
Trench backfill	Compaction	Random, 2-3 times a week
Road subgrade	Visual	Visual check prior to placing sub-base
Road subbase	Compaction	Every 20-25 m, prior to placing granular base
Road base	Compaction	Every 20-25 m, prior to placing asphalt
Asphalt	Full Marshall	Min. 1 for each 500 tonnes, for each type of asphalt
Asphalt	Compaction	Every 20-25 m
Concrete	Air	Every load

Concrete	Slump	Every load
Concrete	Cylinders	Every day (small pours) or every 4 loads (large pours)

9.6 Reduction of Financial Security

The financial security submitted as part of the Subdivider's Agreement and calculated as per Section 1.9 may be reduced at a maximum frequency of once per month as construction progresses, provided that the completed work has been reviewed and approved by the Engineer.

A request for a reduction of the financial security shall be prepared by the Engineer and shall be accompanied by an estimate of the value of work remaining to be completed. Furthermore, the request for reduction shall be sent directly to the Township by the Engineer.

In addition, the Developer will be responsible for the payment of administration fees as per the Township's current fees and charges By-law, as well as any and all direct costs incurred by the Township to release financial security.

9.7 Meetings

A pre-construction meeting shall be held prior to the start of construction. At a minimum, representatives of the Developer, the Engineer, the Contractor and the Township shall attend.

A site meeting will be required prior to connecting to existing watermain. At a minimum, representatives of the Engineer, the Contractor and the Township shall attend.

Construction meetings are to be held at regular intervals, as deemed required by the Engineer. The Township shall be invited to attend these meetings and shall receive copies of the meeting minutes.

9.8 Issuance of Building Permits

Building permits may only be issued once the following requirements are met:

- the underground infrastructure has been installed and tested to meet current legislative requirements,
- roadway granular base has been installed to within 75mm of design grade,
- rough lot grading has been completed to the requirements of Section 6.6,
- service location sheets (as per detail SS.22 or SS.23) have been provided to the Township,
- registered easements and dedications have been provided to the Township,
- any required fencing has been installed as per standard detail SS.15.

The Engineer is responsible to recommend acceptance of the work noted above, and shall prepare a list of deficiencies to be addressed prior to Final Acceptance of the work.

9.9 Substantial Completion

The work will be deemed substantially completed once all the following requirements are met:

- the work is ready for use or is being used for its intended purpose,
- the base course of asphalt has been installed,
- a deficiency walkthrough has been completed by the Township and Engineer,
- the value of outstanding deficiencies is less than 3% of the first \$500,000 + 2% of the next \$500,000 + 1% of the balance of the Engineer’s estimate for the work.

The Engineer is responsible to recommend acceptance of the work noted above, and shall prepare a list of deficiencies to be addressed prior to Final Acceptance of the work.

9.10 Warranty Period

A one year warranty period for all constructed works will begin once Substantial Completion Acceptance is achieved.

Financial Security in the form of cash, certified cheque or irrevocable Letter of Credit from a major banking institution will be required for the duration of the warranty period and will be calculated as per Table 9-3 below.

Table 9-3: Value of Financial Security During Warranty Period

Value of Engineer’s estimate	Value of Financial Security During Warranty Period
Less than \$500,000	5% of original Financial Security
\$500,000 to \$1,000,000	\$25,000 on the first \$500,000 + 4% on the next \$500,000
More than \$1,000,000	\$45,000 on the first \$1,000,000 + 3% on balance

9.11 Final Acceptance

The Engineer may request Final Acceptance of the work once all of the following requirements are met, at which point the Financial Security will be fully released:

- all deficiencies have been addressed,
- all remaining work has been completed,
- close-out documentation has been provided to the Township,
- the warranty period has expired and any issues have been rectified,
- a final walkthrough has been completed by the Township and Engineer,
- all other conditions of the Subdivider’s Agreement have been met.

Close-out documentation shall consist of a binder including:

- “as-built” drawings in hard copy (2 copies) and digitally (CAD & PDF) on DVD, as per section 2.102.9,
- service location sheets (if applicable) in hard copy and in PDF (on DVD),
- watermain test results (if applicable),

- storm and sanitary sewer CCTV inspection reports & DVD's (if applicable),
- geotechnical testing reports,
- approvals (such as from MOE, MTO, etc.),
- utility drawings (natural gas, hydro, cable, communication),
- other information the Engineer deems important.

10. SITE PLAN CONTROL

10.1 Applicable Standards

- Planning Act, R.S.O. 1990, c. P.13
- Township of South Stormont Site Plan Control By-law (latest revision)
- Township of South Stormont Zoning By-law (latest revision)
- Township of South Stormont Regulate Parking By-law (latest revision)
- Township of South Stormont Fence By-law (latest revision)
- Ontario Building Code 2012 (or latest revision)
- Ontario Provincial Standards Drawings (latest revision)
- Ministry of Transportation – Book 5 – Regulatory Traffic Signs (latest revision)

10.2 Applicability

The requirements of Site Plan Control apply to the land uses listed in the current Site Plan Control By-law, as amended.

The Township will enter into a Site Plan Agreement with the Developer once it is satisfied with the design drawings, studies and reports and once all requirements have been met. The Township's standard Site Plan Agreement may be found on the Township's website.

Note that the Site Plan Agreement may be modified as required to reflect the proposed development and that the Engineer shall be responsible to provide the information required to complete the various Sections and Schedules.

10.3 Submission Requirements

Submissions for Site Plan Control shall be as per the "Application for Site Plan Approval" available on the Township's website.

Refer to the fee schedule available on the Township's website for information on the applicable fees.

10.4 Parking Requirements

As per the Township's Zoning By-law and where four (4) or more parking spaces are required, each parking space, except for barrier free parking spaces, shall have a minimum width of 2.75 m and a minimum length of 5.50 m. Barrier free parking spaces shall have a minimum width of 3.66 m and a minimum length of 5.50 m.

Parking aisles providing ingress and egress directly and from every parking shall be at least 6.7 m wide for two-way traffic, or 4.0 m wide for one-way traffic.

Other parking requirements shall be determined based on the type of development and the Township's Zoning By-law.

For multi-residential and commercial developments located within the Urban Settlement Area Boundary, paving of driveways and parking lots is required with a clear definition of entrance ways.

For industrial developments located within the Urban Settlement Area Boundary, paving of driveways and parking lots located in the front yard is required with a clear definition of entrance ways.

10.5 Site Access

Site access in urban cross-sections shall be similar to O.P.S.D. 350.010 or 351.010, but to a minimum width of 6.7 m for two-way access or 4.0 m for one-way access.

10.6 Barrier Free Parking Requirements

Where required by the Township's Zoning By-law, not less than 2% of the total number of parking spaces shall be provided for barrier free parking, with a minimum of one space.

As per the Township's Parking By-law, "Disabled Parking Permit" signs shall be installed at each barrier free parking space. Barrier free signs shall be 30 x 45 cm Rb-93 as per MTO Book 5 and as per Section 11 of the Ontario Regulation 581/90.

10.7 Landscaping & Fencing Requirements

Landscaping is strongly encouraged by the Township, and every effort shall be made to protect and preserve existing mature trees during design and construction.

The Township strongly encourages the retention and incorporation of existing tree cover, plant material grading, ponds and other site features into landscaping plans. In certain cases, the minimum required plant materials may be supplemented by existing tree cover and plant materials on a site, at the discretion of the Township.

Drawings shall comply with section 1.4 Landscaping Standards and corresponding **Schedule A - List of Native Species**.

As per the Township's Zoning By-law where four (4) or more parking spaces are required, a minimum 3 m wide continuous strip of landscaped open space shall be provided along the lot line, in areas where parking areas abut a Residential Zone and/or where parking areas abut a street.

Wood screening fence as per standard detail SS.15 (or equivalent or alternative design, to the satisfaction of the Township) will be required where commercial and industrial development is adjacent to residential development, or at the Township's discretion. Fences will not be permitted in swales or ditches, or where visibility issues may occur, such as near driveways or intersections, and must not interfere with maintenance.

Wood screening fence as per standard detail SS.15 and/or a mix of a vegetative buffer in conjunction with a berm (or equivalent or alternative design, to the satisfaction of the

Township) will be required where a multi-residential development is adjacent to a low density residential zone, or at the Township's discretion.

10.8 Signage

Signage for all new developments shall be as per the Township's Sign By-law, where applicable.

10.9 Exterior Lighting

As per the Township's Zoning By-law, exterior lighting shall meet all of the following requirements:

- illumination shall be directed downwards, not cause direct or indirect glare on a street that may interfere with traffic or pedestrian safety,
- illumination shall not consist of a colour or be so designed or located that it may be confused with traffic signal,
- illumination shall not cause direct or indirect glare on land or buildings in a residential zone.

10.10 Water Servicing

Average daily domestic water demand shall be calculated from Table 8.2.1.3.B. of the Ontario Building Code, where applicable.

The water service shall be sized to accommodate the peak flow, which should generally be calculated by distributing the average daily demand (as calculated above) over a reasonable time frame for the proposed development (i.e. 8 hours for an office building), and applying a peaking factor per Section 4.10.

Where applicable, the water service shall also be sized to accommodate required firefighting flows, which shall be calculated as per the guidelines of the Fire Underwriters Survey – Water Supply for Public Fire Protection (1999).

10.11 Storm and Sanitary Sewer Servicing

Similarly to above, average daily sanitary flows shall be calculated from Table 8.2.1.3.B of the Ontario Building Code, where applicable.

The sanitary service shall be sized to accommodate the peak flow, which should generally be calculated by distributing the average daily sanitary flow (as calculated above) over a reasonable time frame (i.e. 8 hours for an office building), and applying a peaking factor per Section 4.10.

Storm sewers shall be sized similar to Section 4.11, to accommodate the 5 year design storm calculated using the Rational Method. An initial (inlet) post-development time of concentration of 10 minutes shall however be used.

Minimum pipe sizes, slopes and location of clean-outs or maintenance holes shall be as per the requirements of the Ontario Building Code.

10.12 Stormwater Management – Quantity

As described in Section 5, for any given outlet of a proposed development, the post-development peak runoff must not exceed the corresponding pre-development peak runoff for storm events with return periods of 5 and 100 years. The site as it exists prior to development may generally be considered as the pre-development condition, from which allowable peak flows may be calculated, unless otherwise dictated by the Township.

Storage of stormwater will usually be required to achieve the above.

Surface storage may be provided in dry pond, wet pond, wetlands, parking lots, access roads or other hard surfaced areas, to a depth of not more than 300 mm for the 100 year storm, with a maximum drawdown time of 12 hours.

Underground storage may be achieved through a StormTech system, StormChamber system (by Soleno) or equivalent, through a septic tank or through oversized pipes (or a combination thereof).

Refer to Section 5.2 for additional information on sizing storage facilities.

10.13 Stormwater Management – Quality

Additionally, 70% of total suspended solids (TSS) removal will be required for new developments as a minimum, equivalent to normal protection as defined in the MOE Stormwater Management Planning and Design Manual (2003), or greater as established by the local Conservation Authority.

Qualitative treatment may be achieved by means of a wet pond, wetlands or infiltration basin designed to meet the criteria established of the MOE Stormwater Management Planning and Design Manual (2003).

Other acceptable means of providing qualitative treatment is with a Stormceptor[®] unit by Imbrium, CDS[®] unit by Contech sized to accommodate the proposed development, or alternative product to the approval of the Township. A dry pond may also be used in conjunction with supplementary treatment.

10.14 Site Grading

Site grading shall meet the general requirements of Section 6.

10.15 Retaining Walls

Retaining walls shall meet the requirements of Section 6.2.

10.16 Waste Management

A garbage and recycling area must be provided to the satisfaction of the Township and must be clearly identified on the site plan. The garbage and recycling area shall be designed to allow easy access and maneuvering of trucks on site, and must be located as to not create a detriment to abutting landowners.

10.17 Fire Route

Fire routes shall be designed to meet the requirements of the Ontario Building Code.

As per the Township's Parking By-law, authorized signs shall be erected a distance of not more than 22.9 m between signs.

10.18 Deposit

In order to ensure that all proposed works are provided and maintained by the Owner, the Owner shall deposit with the Township an amount representing 20% of the construction cost estimate for the site plan works. The construction cost estimate shall be prepared by the Engineer and sent directly to the Township by the Engineer.

Such deposit shall be made in cash, certified cheque or irrevocable Letter of Credit.

Appendix A

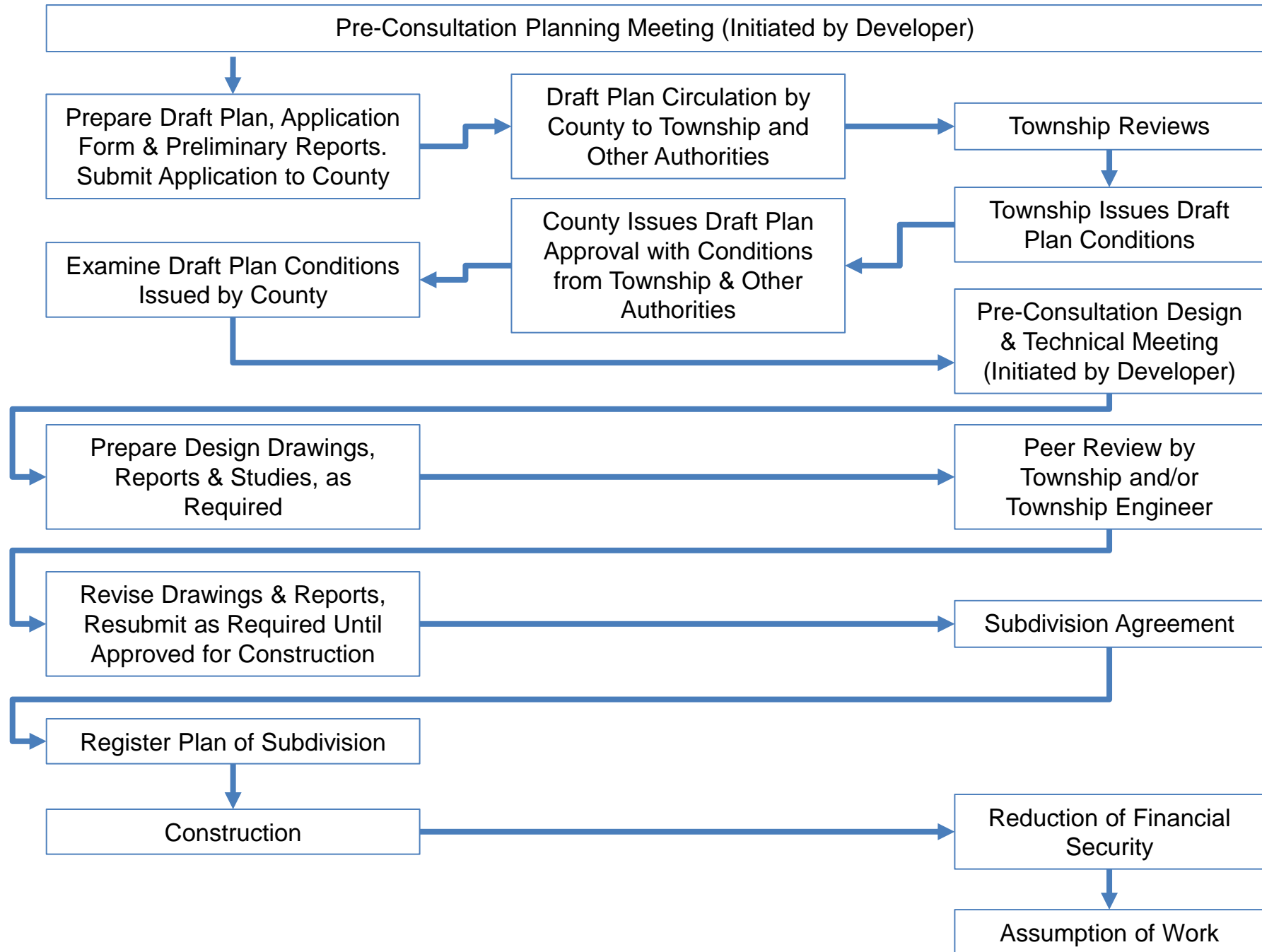
Development Flow Chart

DEVELOPMENT FLOW CHART

DEVELOPER

COUNTY

TOWNSHIP



Appendix B

Standard Details



TOWNSHIP OF
SOUTH
STORMONT

TYPICAL ROADWAY CROSS-SECTION - URBAN

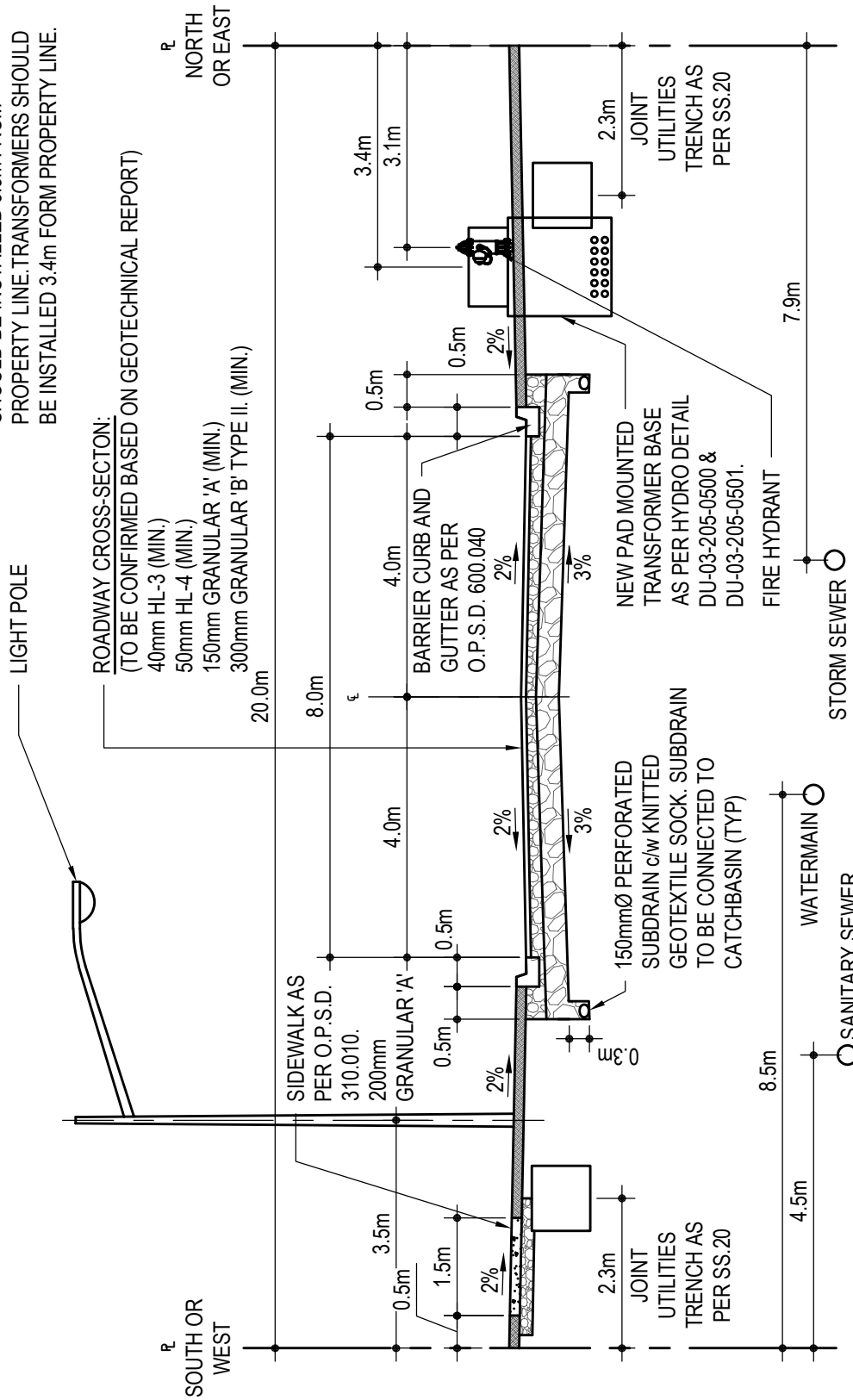
SCALE:
N.T.S.

DATE:
2022/06/

DRAWING NO:

SS.1_REV1

NOTE: FIRE HYDRANT SHOULD BE INSTALLED 3.1m FROM PROPERTY LINE. LIGHT STANDARDS SHOULD BE INSTALLED 3.5m FROM PROPERTY LINE. TRANSFORMERS SHOULD BE INSTALLED 3.4m FROM PROPERTY LINE.





TOWNSHIP OF
SOUTH
STORMONT

TYPICAL ROADWAY CROSS-SECTION - RURAL

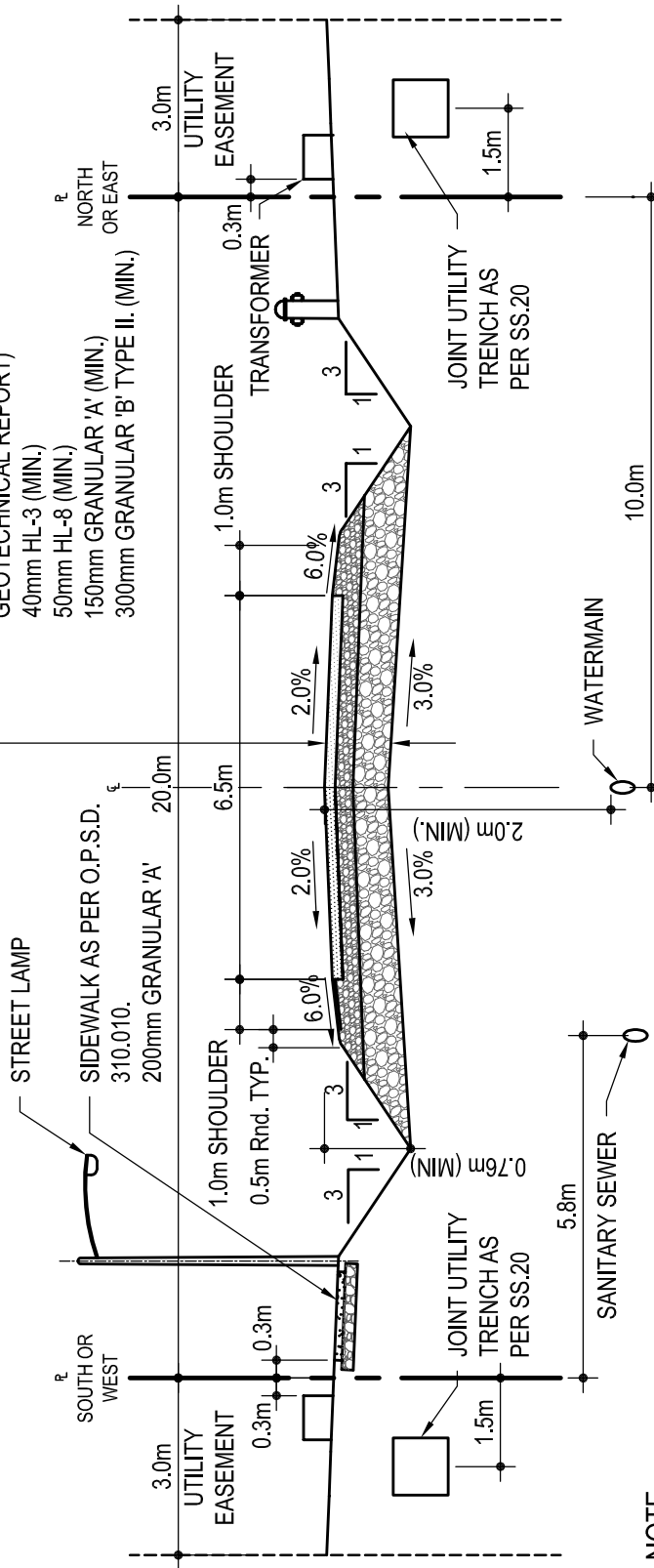
SCALE:
N.T.S.

DATE:
2015/05/28

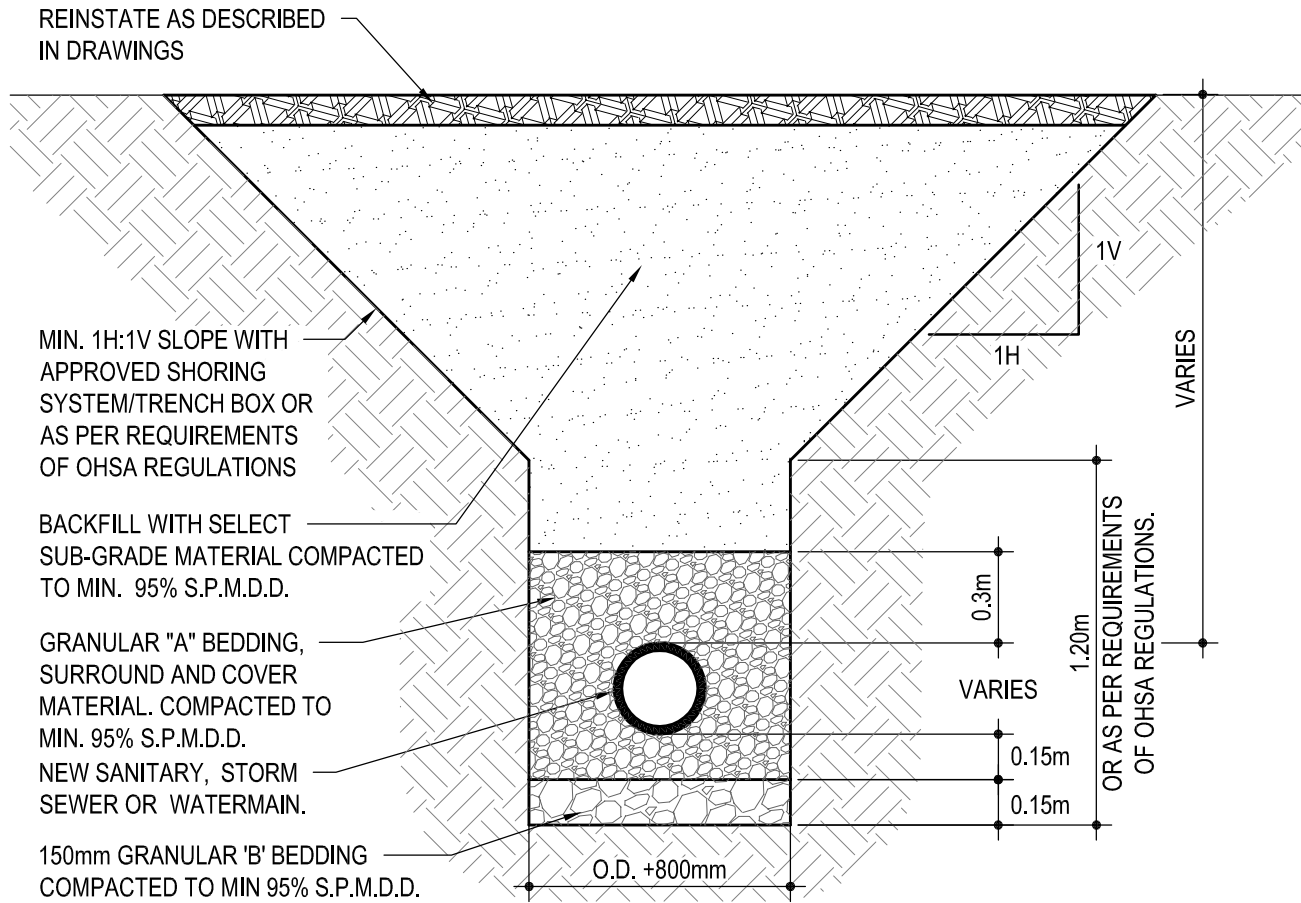
DRAWING NO:

SS.2

ROADWAY CROSS-SECTION:
(TO BE CONFIRMED BASED ON
GEOTECHNICAL REPORT)
40mm HL-3 (MIN.)
50mm HL-8 (MIN.)
150mm GRANULAR 'A' (MIN.)
300mm GRANULAR 'B' TYPE II. (MIN.)



NOTE
JOINT UTILITY TRENCH IS TO BE TAPERED TO SUIT AT LOCATIONS
IN WHICH THERE IS A CHANGE IN ROAD CROSS SECTION.



TOWNSHIP OF
SOUTH
STORMONT

TYPICAL TRENCH DETAIL

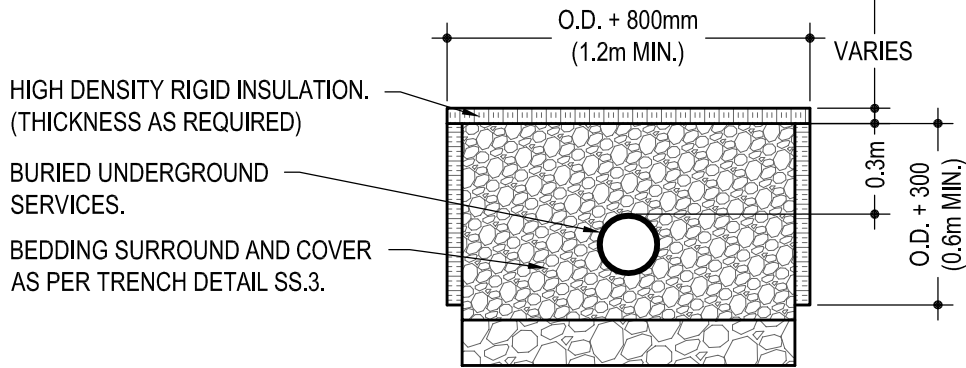
SCALE:
N.T.S.

DATE:
2014/04/08

DRAWING NO:

SS.3

FINISHED GROUND



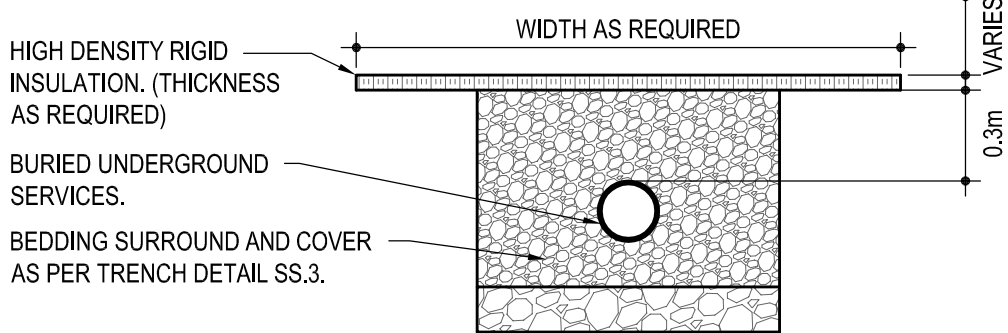
HIGH DENSITY RIGID INSULATION.
(THICKNESS AS REQUIRED)

BURIED UNDERGROUND
SERVICES.

BEDDING SURROUND AND COVER
AS PER TRENCH DETAIL SS.3.

TYPE 'A'

FINISHED GROUND



HIGH DENSITY RIGID
INSULATION. (THICKNESS
AS REQUIRED)

BURIED UNDERGROUND
SERVICES.

BEDDING SURROUND AND COVER
AS PER TRENCH DETAIL SS.3.

TYPE 'B'



TOWNSHIP OF
SOUTH
STORMONT

FROST PROTECTION DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.4

REINSTATE AS DESCRIBED
IN DRAWINGS.

MIN. 1H:1V SLOPE WITH
APPROVED SHORING
SYSTEM/TRENCH BOX OR
AS PER REQUIREMENTS
OF OHSR REGULATIONS

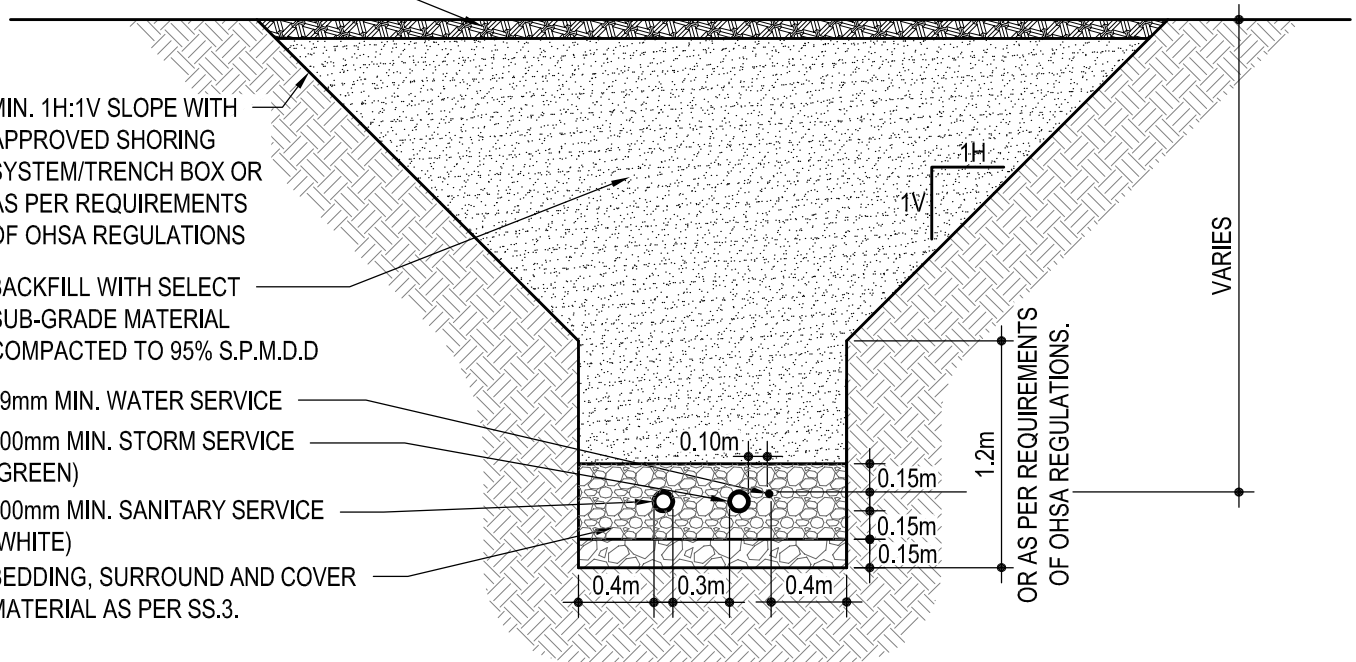
BACKFILL WITH SELECT
SUB-GRADE MATERIAL
COMPACTED TO 95% S.P.M.D.D

19mm MIN. WATER SERVICE

100mm MIN. STORM SERVICE
(GREEN)

100mm MIN. SANITARY SERVICE
(WHITE)

BEDDING, SURROUND AND COVER
MATERIAL AS PER SS.3.



OR AS PER REQUIREMENTS
OF OHSR REGULATIONS.

VARIES



TOWNSHIP OF
SOUTH
STORMONT

TRENCH DETAIL - SINGLE SERVICE CONNECTION

SCALE:
N.T.S.

DATE:
2015/05/28

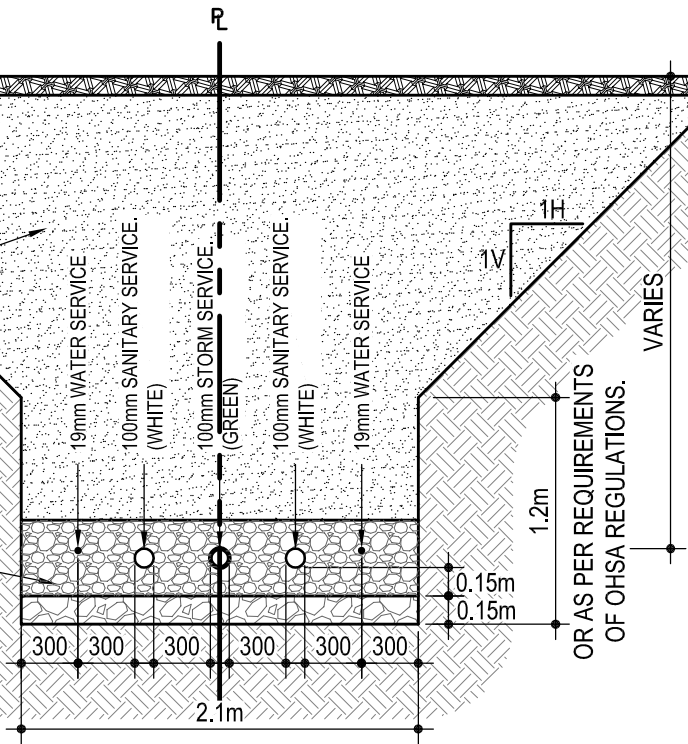
DRAWING NO:

SS.5

REINSTATE AS DESCRIBED
IN DRAWINGS.

MIN. 1H:1V SLOPE WITH
APPROVED SHORING
SYSTEM/TRENCH BOX OR AS
PER REQUIREMENTS OF
OHSA REGULATIONS
BACKFILL WITH SELECT
SUB-GRADE MATERIAL
COMPACTED TO 95% S.P.D

BEDDING, SURROUND AND COVER
MATERIAL AS PER SS.3.



OR AS PER REQUIREMENTS
OF OHSA REGULATIONS.

VARIES



TOWNSHIP OF
SOUTH
STORMONT

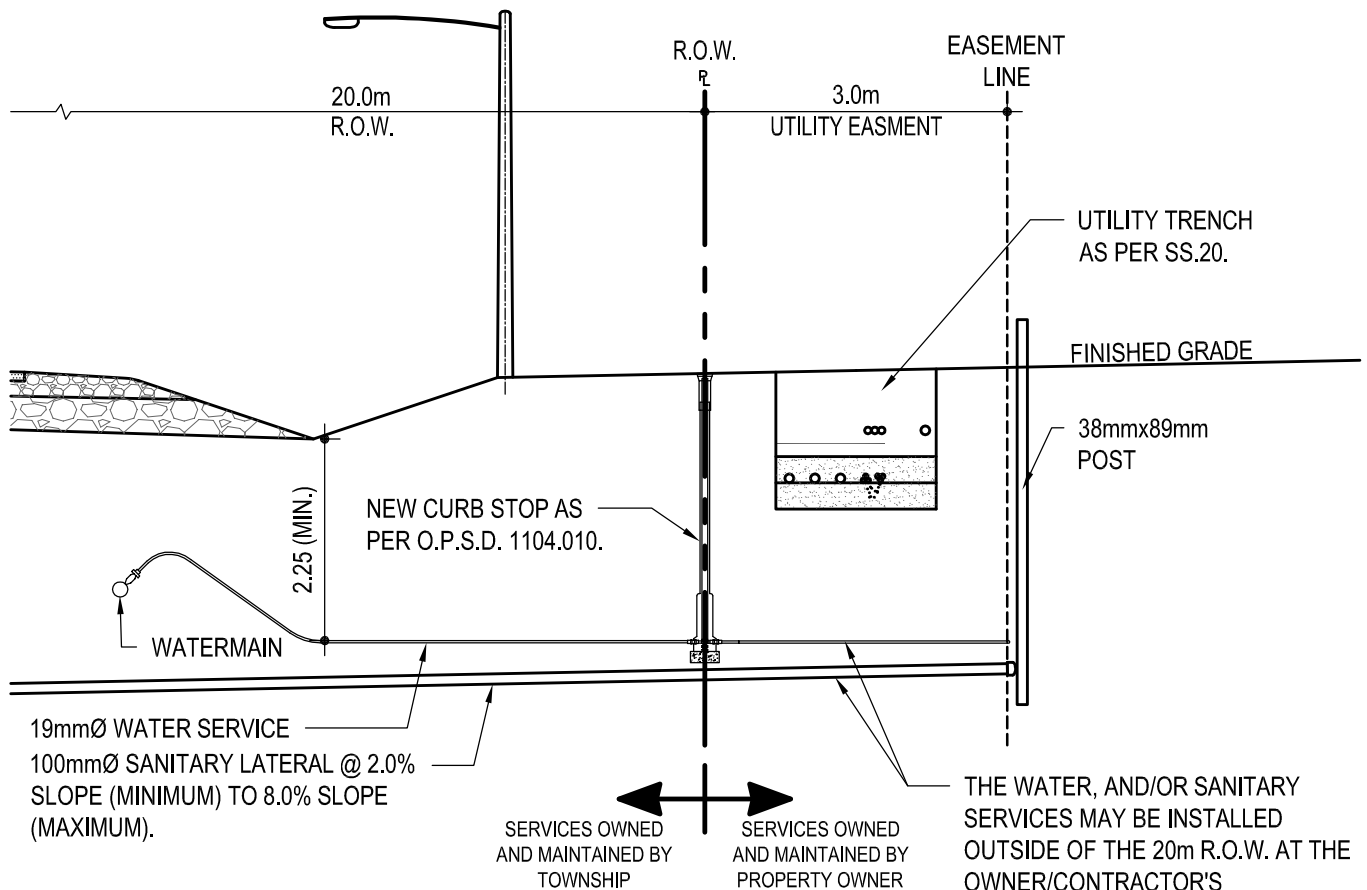
TRENCH DETAIL - DOUBLE SERVICE CONNECTION

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.6



NOTE:
 ALL BURIED SERVICES WITH LESS THAN 2.0m OF COVER SHALL BE INSULATED AS PER SS.4, AS REQUIRED TO ACHIEVE FROST PROTECTION.



TOWNSHIP OF SOUTH STORMONT

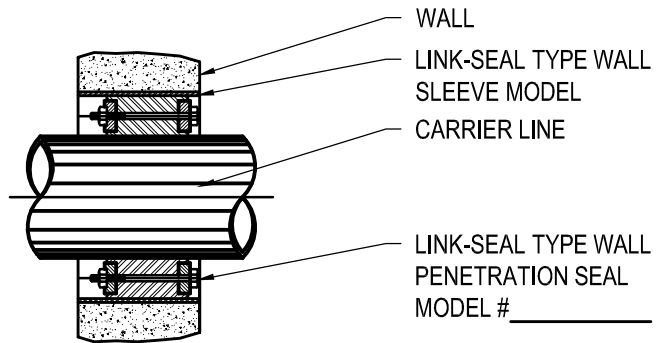
20m R.O.W. RURAL LOT SERVICING DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.7



TOWNSHIP OF
SOUTH
STORMONT

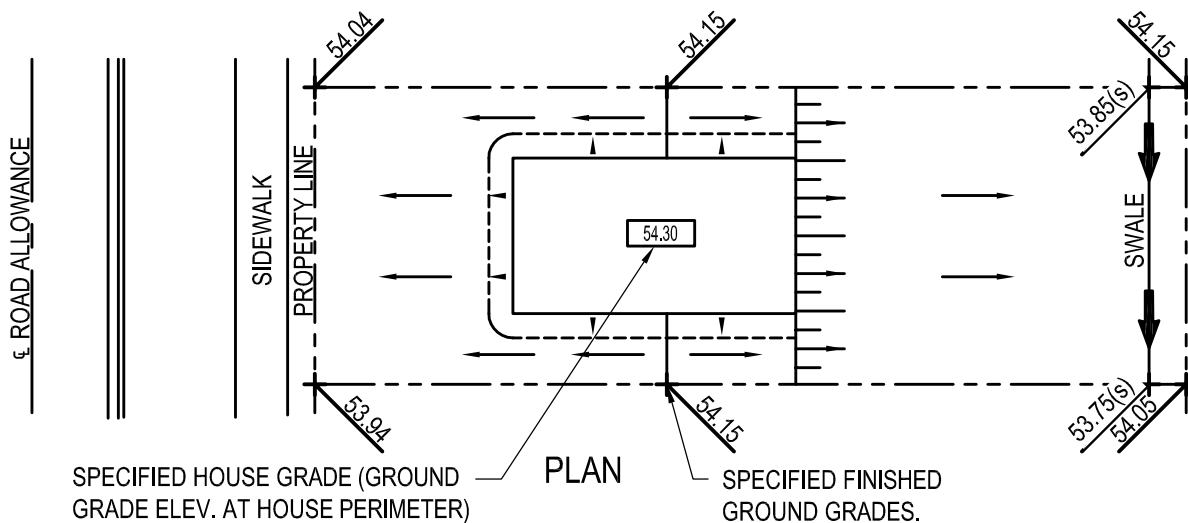
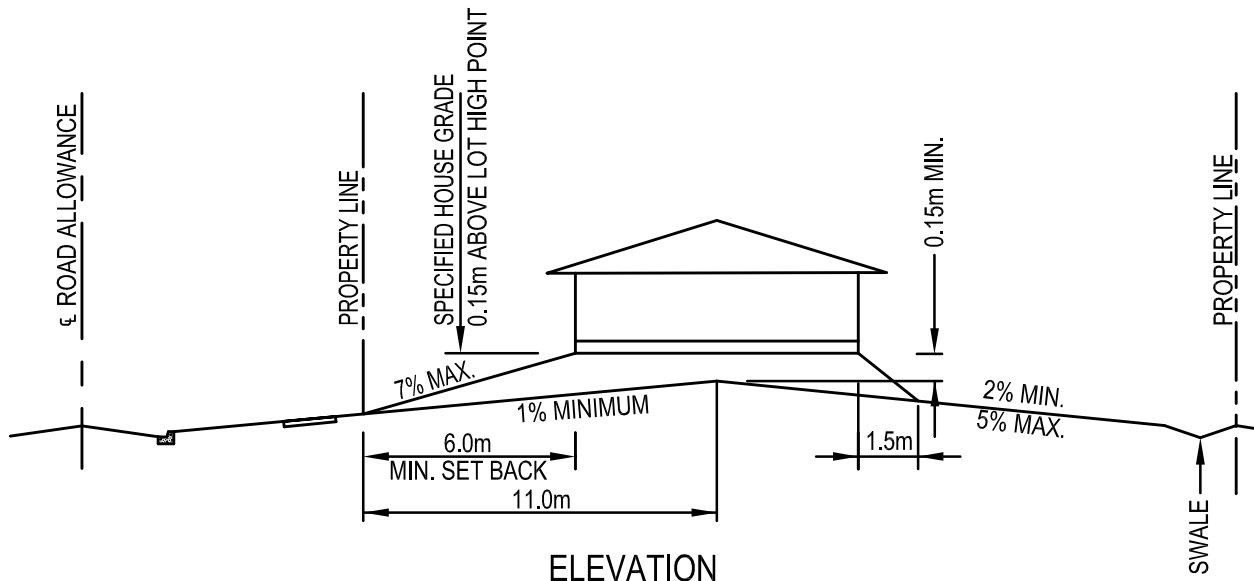
LINK-SEAL DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.8



NOTES

1. FOR ALL LOTS, THE HOUSING DEVELOPER SHALL BASE THEIR DESIGN ON THE 'AS-BUILT' SERVICE LOCATION SHEETS AND MAINTAIN A MINIMUM STORM AND SANITARY SERVICE SLOPE OF 2.0% ON PRIVATE PROPERTY.
2. FOR ALL LOTS, THE HOUSING DEVELOPER SHALL REFER TO EXISTING AND FINISHED GRADE AND DETERMINE IF AND QUANTITY OF STRUCTURAL FILL REQUIRED.



TOWNSHIP OF
SOUTH
STORMONT

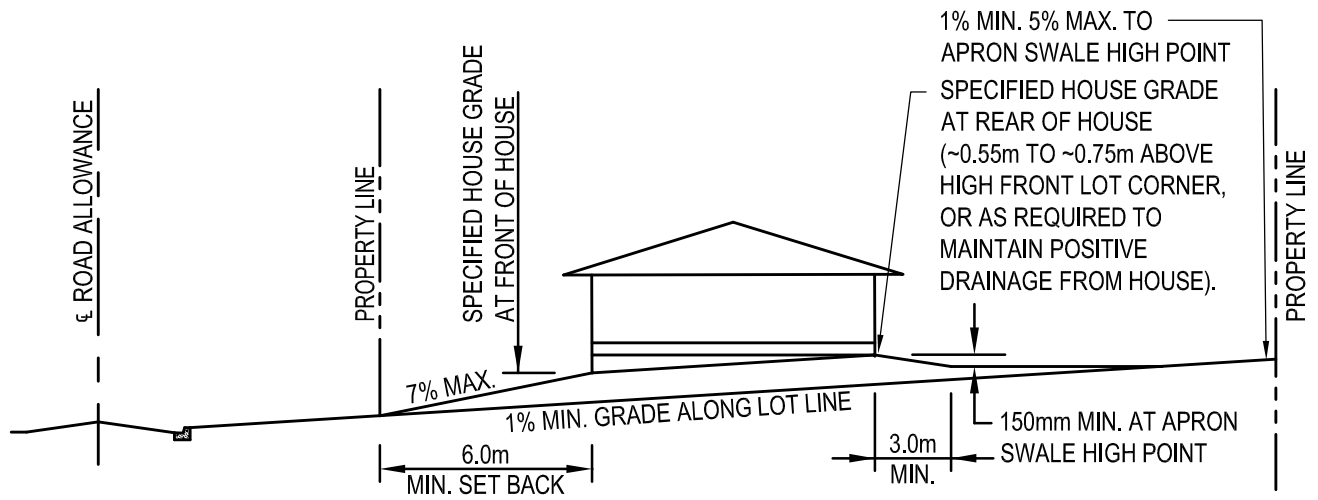
TYPICAL SPLIT LOT GRADING

SCALE:
N.T.S.

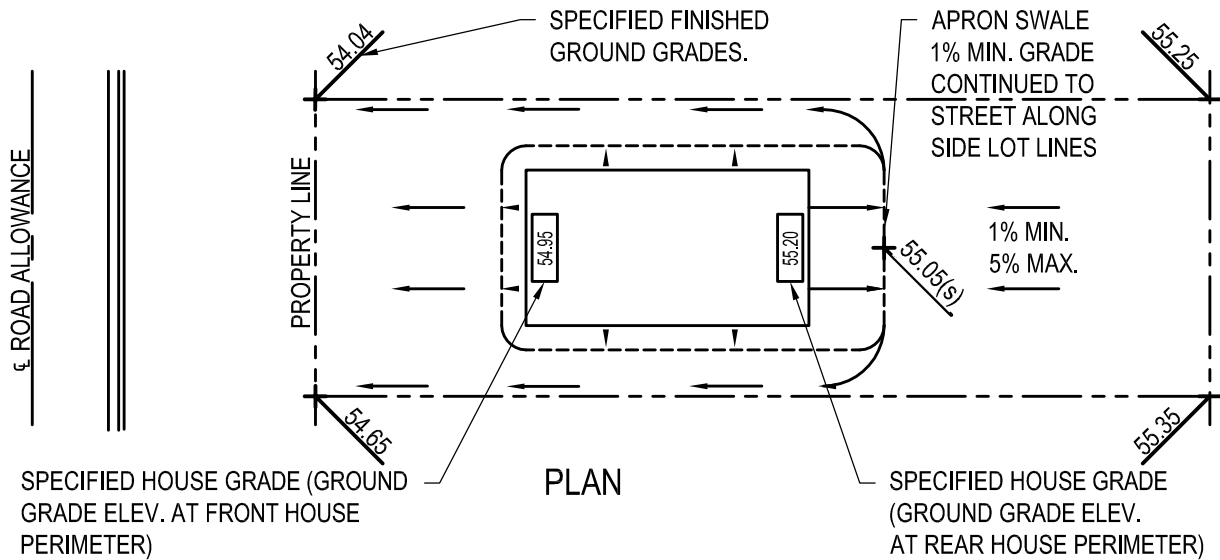
DATE:
2015/05/28

DRAWING NO:

SS.9



ELEVATION



NOTES

1. FOR ALL LOTS, THE HOUSING DEVELOPER SHALL BASE THEIR DESIGN ON THE 'AS-BUILT' SERVICE LOCATION SHEETS AND MAINTAIN A MINIMUM STORM AND SANITARY SERVICE SLOPE OF 2.0% ON PRIVATE PROPERTY.
2. FOR ALL LOTS, THE HOUSING DEVELOPER SHALL REFER TO EXISTING AND FINISHED GRADE AND DETERMINE IF AND QUANTITY OF STRUCTURAL FILL REQUIRED.

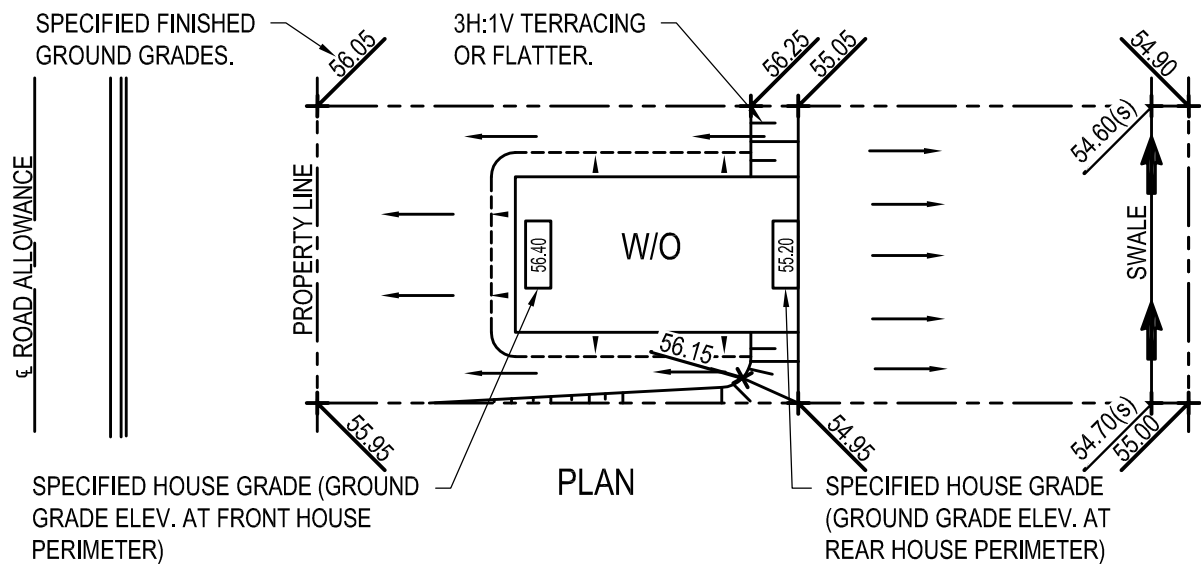
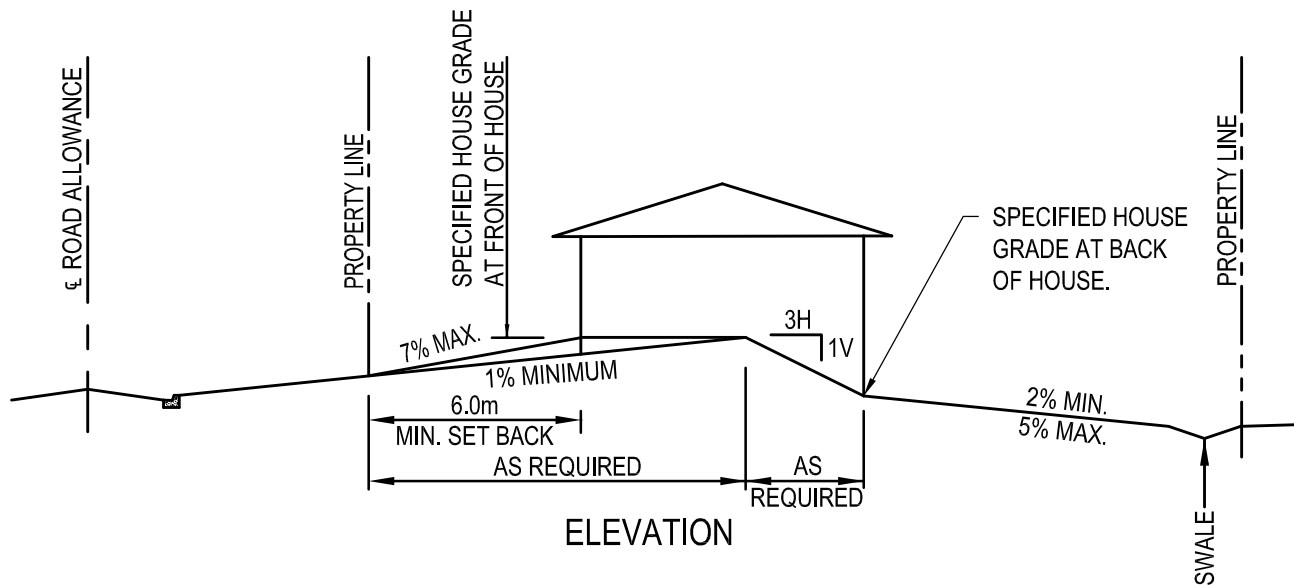


TOWNSHIP OF
SOUTH
STORMONT

TYPICAL BACK TO FRONT LOT
GRADING

SCALE:
N.T.S.
DATE:
2015/05/28
DRAWING NO:

SS.10



NOTES

1. FOR ALL LOTS, THE HOUSING DEVELOPER SHALL BASE THEIR DESIGN ON THE 'AS-BUILT' SERVICE LOCATION SHEETS AND MAINTAIN A MINIMUM STORM AND SANITARY SERVICE SLOPE OF 2.0% ON PRIVATE PROPERTY.
2. FOR ALL LOTS, THE HOUSING DEVELOPER SHALL REFER TO EXISTING AND FINISHED GRADE AND DETERMINE IF AND QUANTITY OF STRUCTURAL FILL REQUIRED.



TOWNSHIP OF
SOUTH
STORMONT

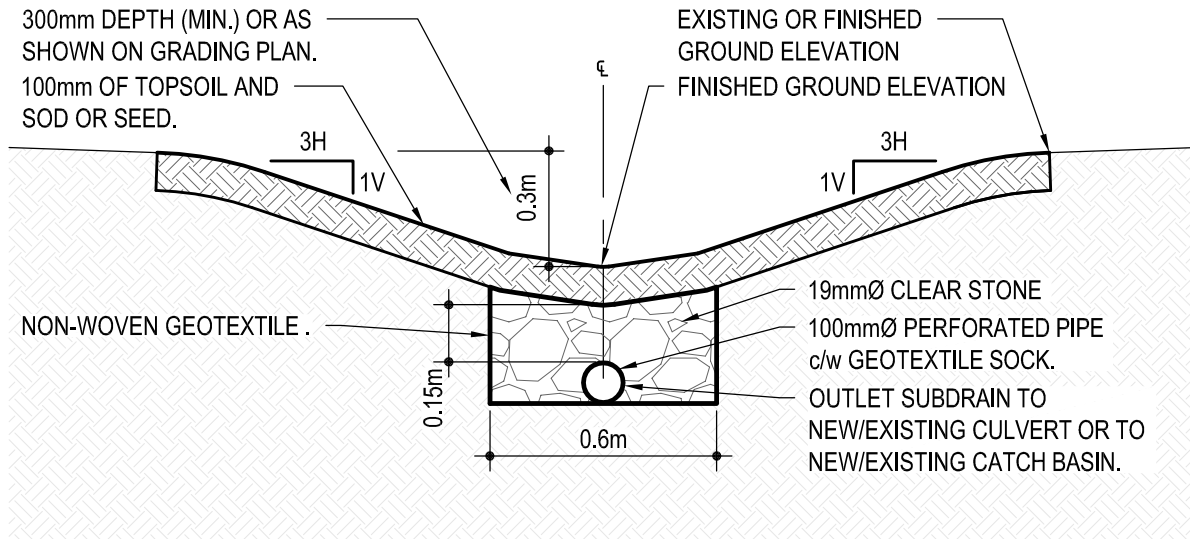
**TYPICAL WALK OUT BASEMENT
LOT GRADING**

SCALE:
N.T.S.

DATE:
2015/05/28

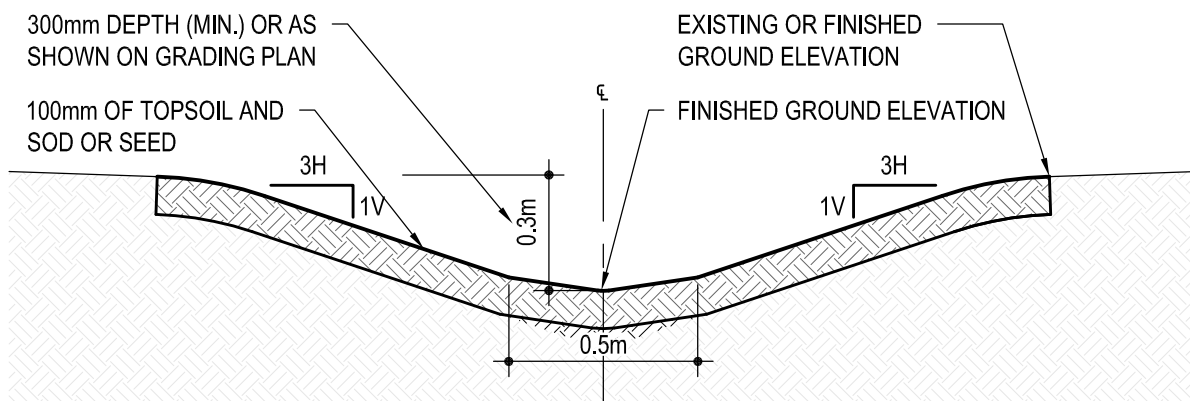
DRAWING NO:

SS.11



TYPICAL SWALE c/w WEEPING TILE DETAIL

SCALE: N.T.S.



TYPICAL SWALE DETAIL

SCALE: N.T.S.



TOWNSHIP OF
SOUTH
STORMONT

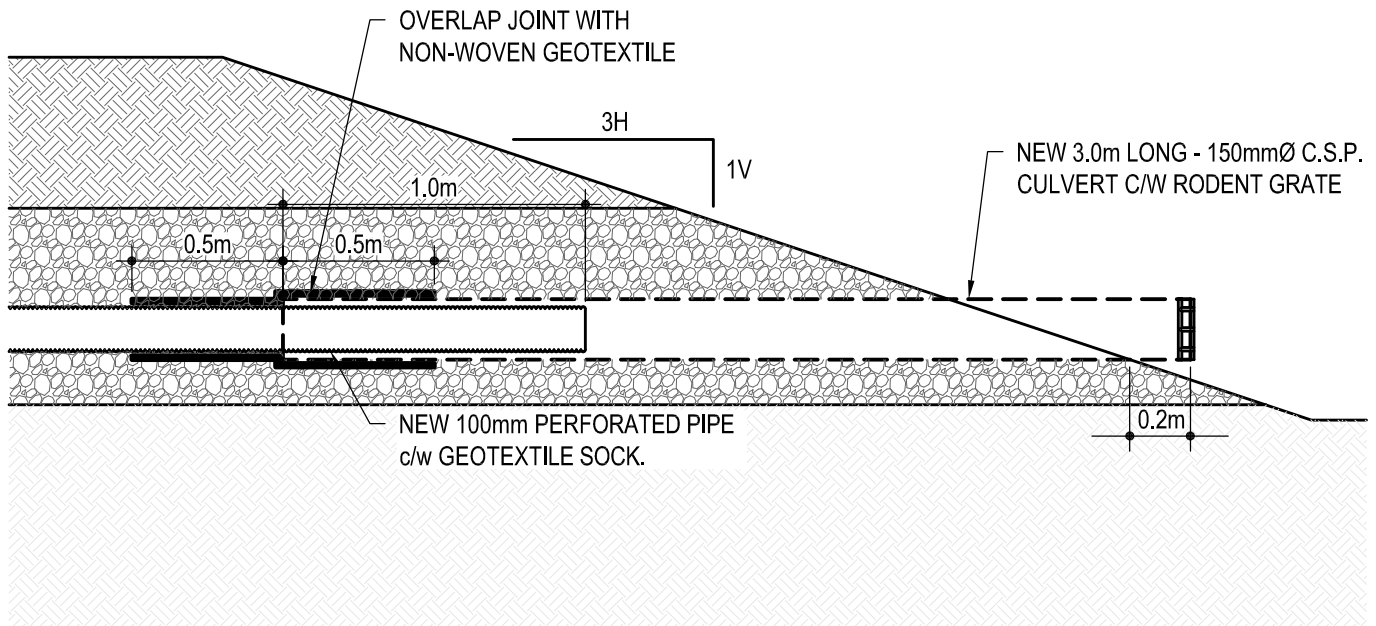
SWALE DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.12



TOWNSHIP OF
SOUTH
STORMONT

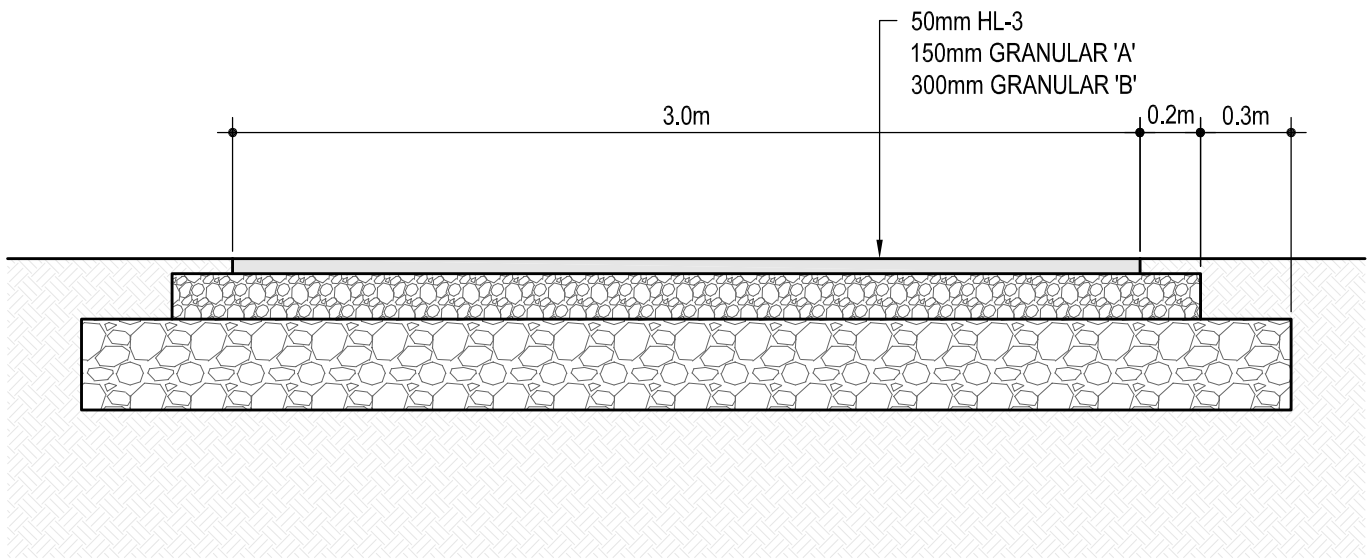
PERFORATED SUBDRAIN OUTLET DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.13



TOWNSHIP OF
SOUTH
STORMONT

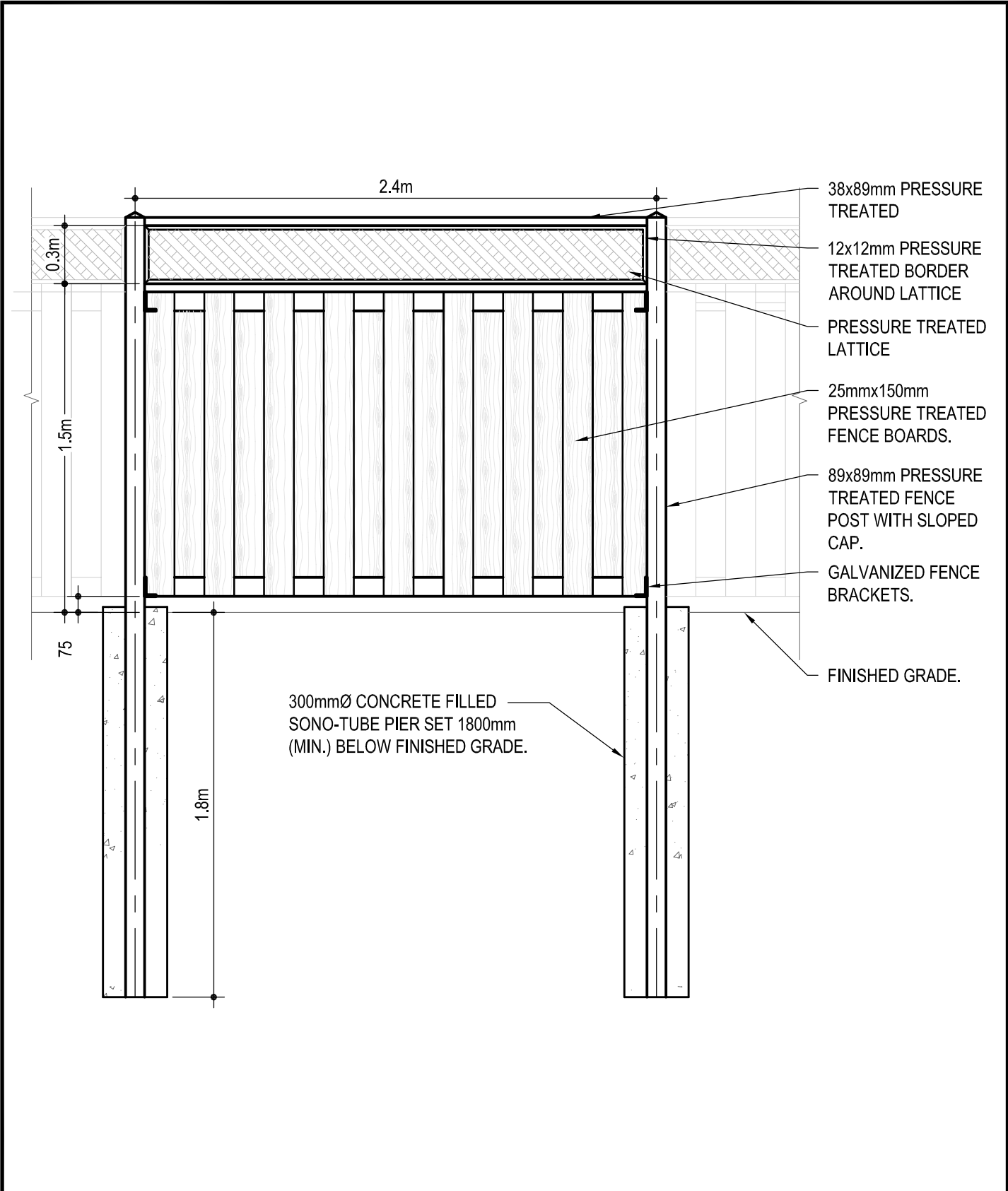
ASPHALT PATHWAY DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.14



- 38x89mm PRESSURE TREATED
- 12x12mm PRESSURE TREATED BORDER AROUND LATTICE
- PRESSURE TREATED LATTICE
- 25mmx150mm PRESSURE TREATED FENCE BOARDS.
- 89x89mm PRESSURE TREATED FENCE POST WITH SLOPED CAP.
- GALVANIZED FENCE BRACKETS.
- FINISHED GRADE.

300mmØ CONCRETE FILLED SONO-TUBE PIER SET 1800mm (MIN.) BELOW FINISHED GRADE.

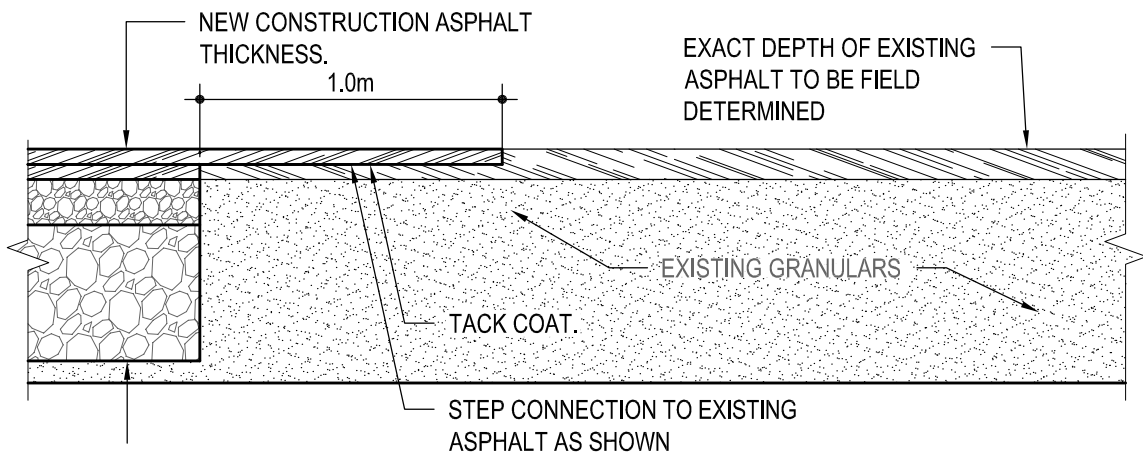


TOWNSHIP OF SOUTH STORMONT

WOOD SCREENING FENCE

SCALE:
N.T.S.
DATE:
2015/05/28
DRAWING NO:

SS.15



TOWNSHIP OF
SOUTH
STORMONT

STEP CONNECTION DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.16

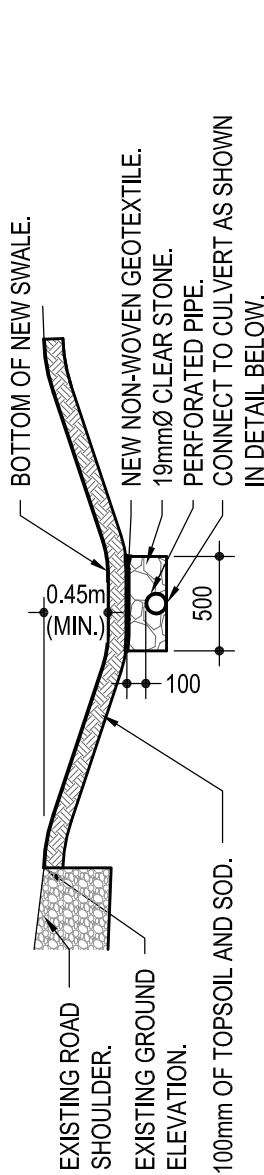
GENERAL NOTES & SPECIFICATION

PRODUCTS

- PERFORATED PIPE TO BE 100mmØ OR 150mmØ PERFORATED POLYETHYLENE PIPE c/w KNITTED GEOTEXTILE SOCK AS PER OPSS 1860 & 1840.
- CLEAR STONE AS PER OPSS 1010.
- OUTLET PIPE - GALVANIZED PIPE 1.6mm THICK AS PER OPSS 1801 OR POLYETHYLENE PIPE - HDPE MINIMUM PIPE STIFFNESS OF 320kPa. A STEEL RODENT TRAP WILL BE INSTALLED AT THE END OF PIPE.
- TOPSOIL AS PER OPSS 802.
- SOD AS PER OPSS 803.
- GEOTEXTILE WRAP AT PIPE CONNECTION TO BE NON-WOVEN CLASS I AS PER OPSS 1860.

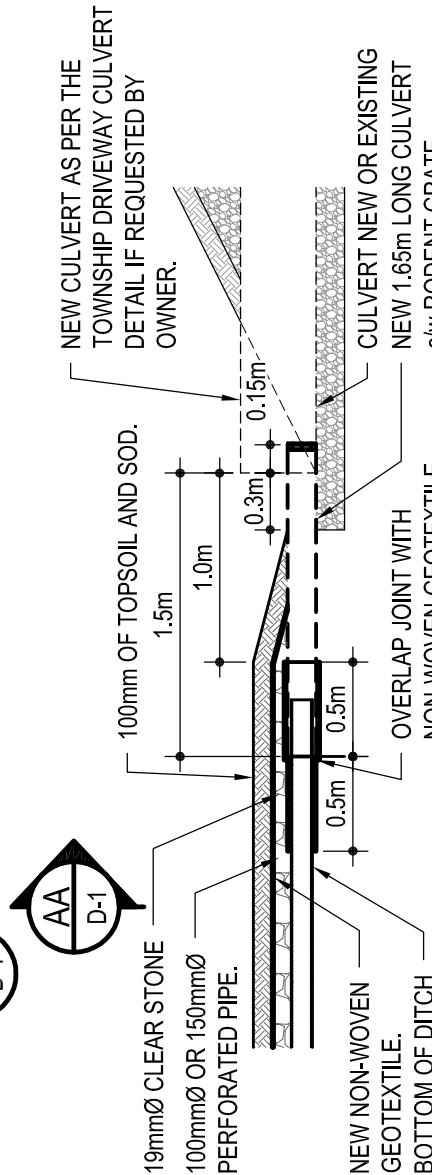
EXECUTION

- THE ELEVATION OF THE BOTTOM OF DITCH AND OR SWALE WILL BE DETERMINED BY THE TOWNSHIP. THE TOWNSHIP WILL DETERMINE THE DIAMETER OF THE PERFORATED PIPE.
- EXCAVATE THE BOTTOM OF DITCH TO REMOVE EXISTING TOPSOIL AND VEGETATION.
- BACKFILL DITCH BOTTOM WITH SELECT SUBGRADE MATERIAL AND COMPACTED TO 95% S.P.D. IF REQUIRED.
- INSTALL PERFORATED PIPE c/w CLEAR STONE, GEOTEXTILE, TOPSOIL AND SOD AS SHOWN IN DETAILS.
- TOPSOIL AND SOD TO BE INSTALLED AT OWNER'S DISCRETION.
- GEOTEXTILE BETWEEN TOPSOIL AND CLEAR STONE ONLY REQUIRED IF HOMEOWNER INSTALLS TOPSOIL AND SOD.
- OUTLET PIPE SHALL TERMINATE A MINIMUM OF 150mm INSIDE THE EXISTING CULVERT.



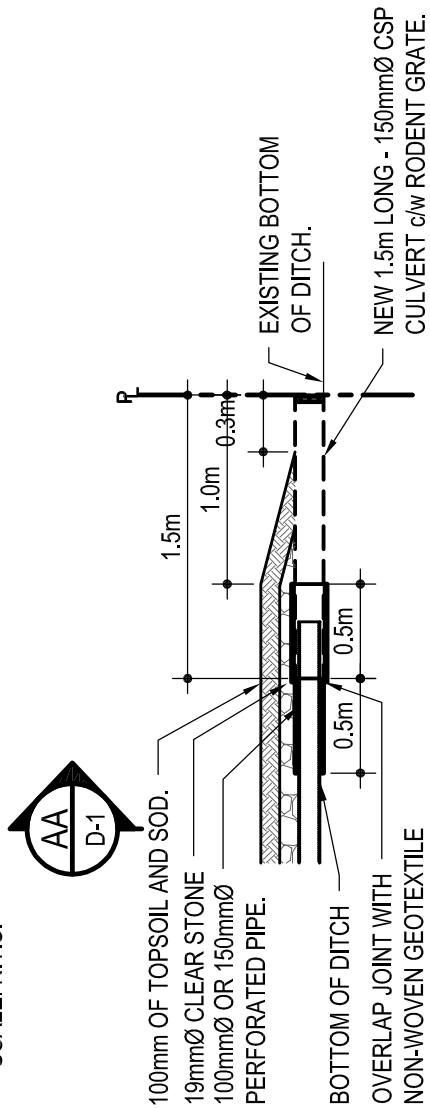
AA TYPICAL CROSS-SECTION AA

SCALE: N.T.S.



INLET/OUTLET AT CULVERT DETAIL

SCALE: N.T.S.



TOPSOIL & SOD INLET/OUTLET DETAIL AT PROPERTY LINE

SCALE: N.T.S.



TOWNSHIP OF SOUTH STORMONT

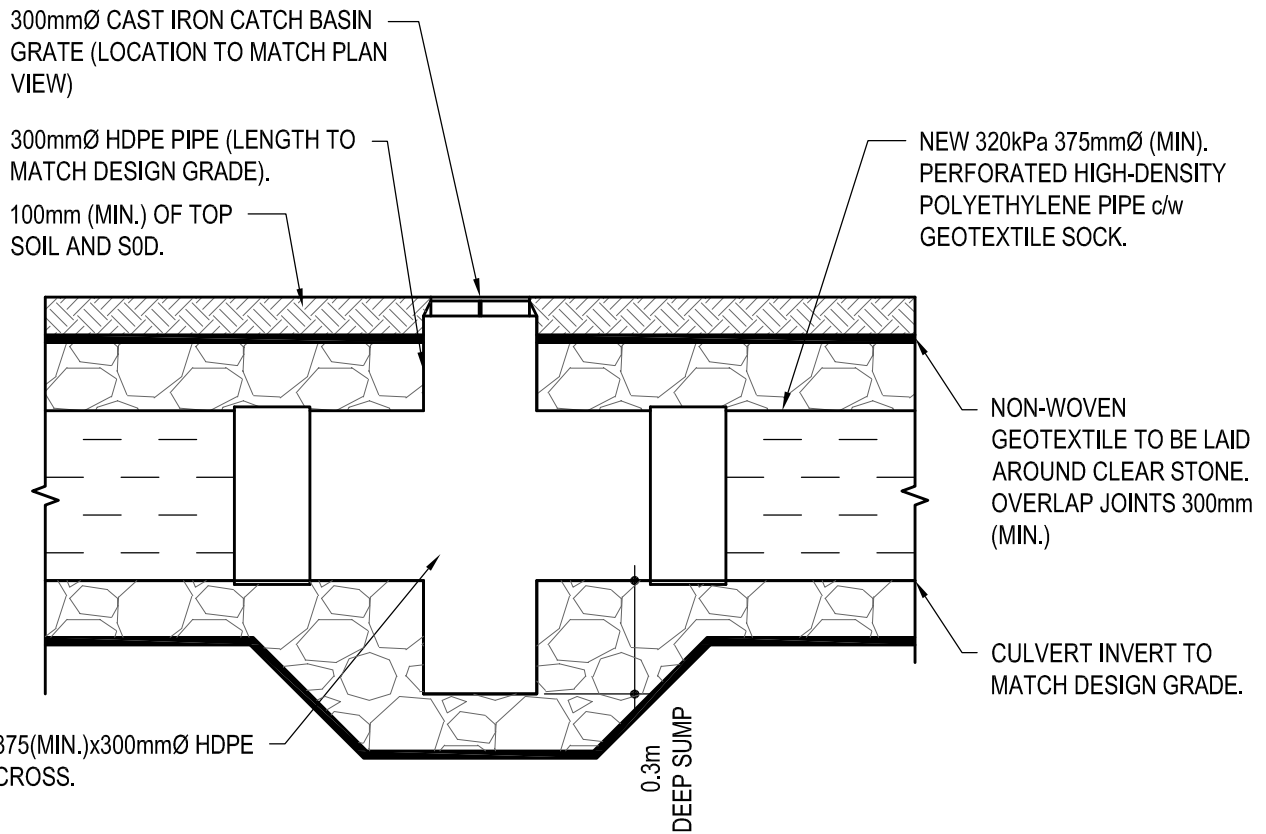
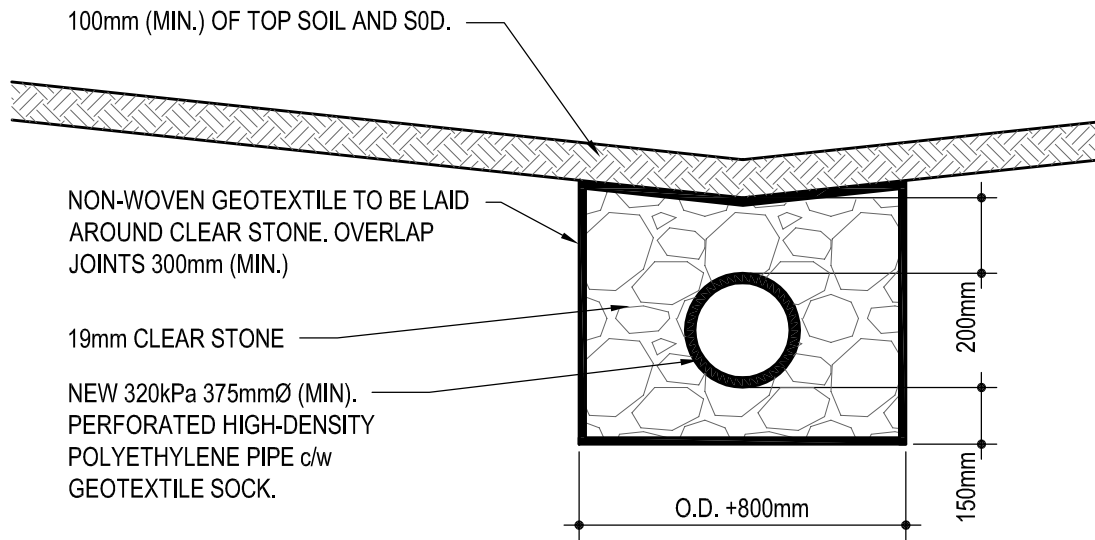
PARTIAL DITCH INFILL DETAILS

SCALE: N.T.S.

DATE: 2015/05/28

DRAWING NO:

SS.17



TOWNSHIP OF
SOUTH
STORMONT

COMPLETE DITCH INFILL DETAIL

SCALE:
N.T.S.
DATE:
2015/05/28
DRAWING NO:

SS.18

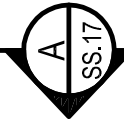
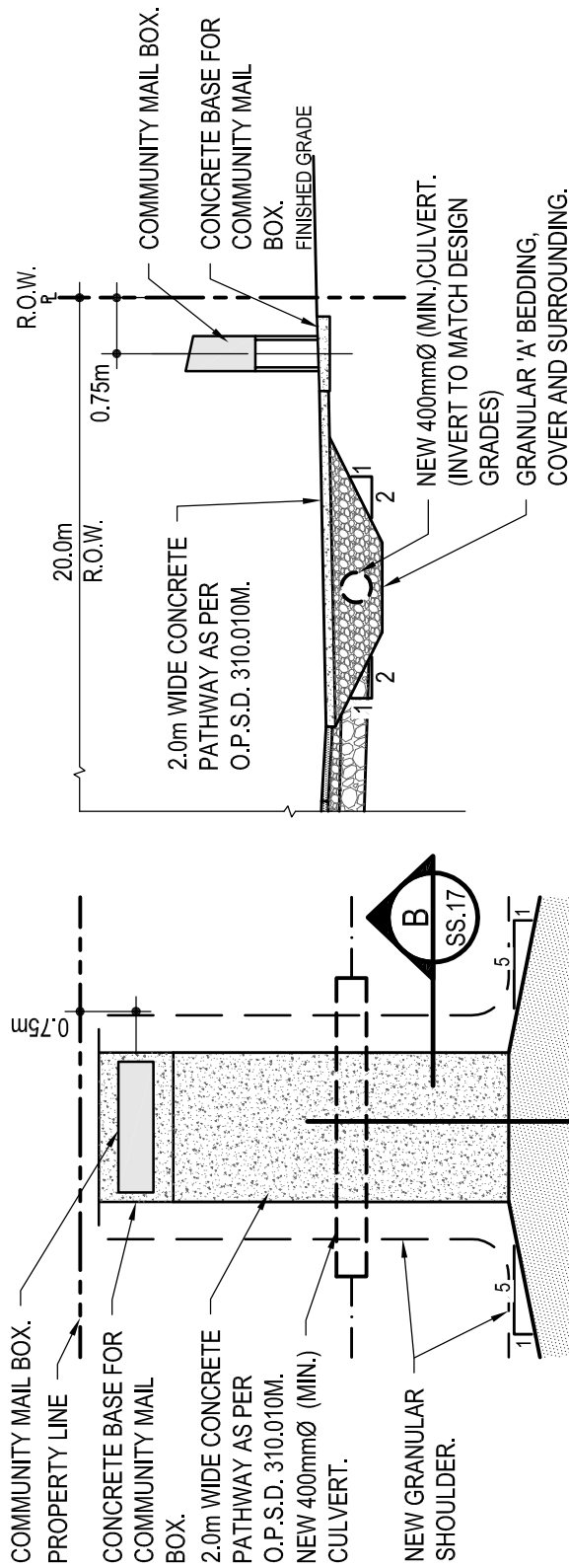


TOWNSHIP OF
SOUTH
STORMONT

COMMUNITY MAILBOX DETAIL

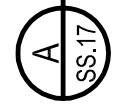
SCALE:
N.T.S.
DATE:
2015/05/28
DRAWING NO:

SS.19



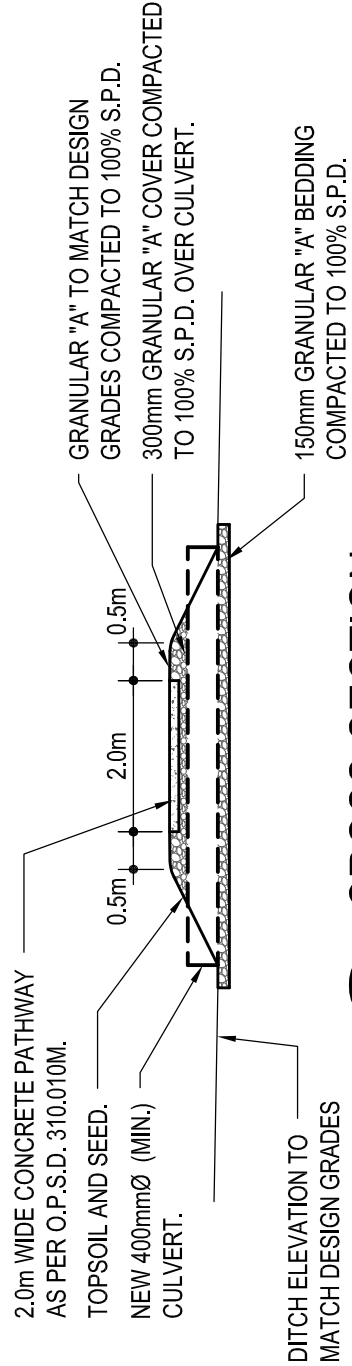
PLAN VIEW

SCALE: N.T.S.



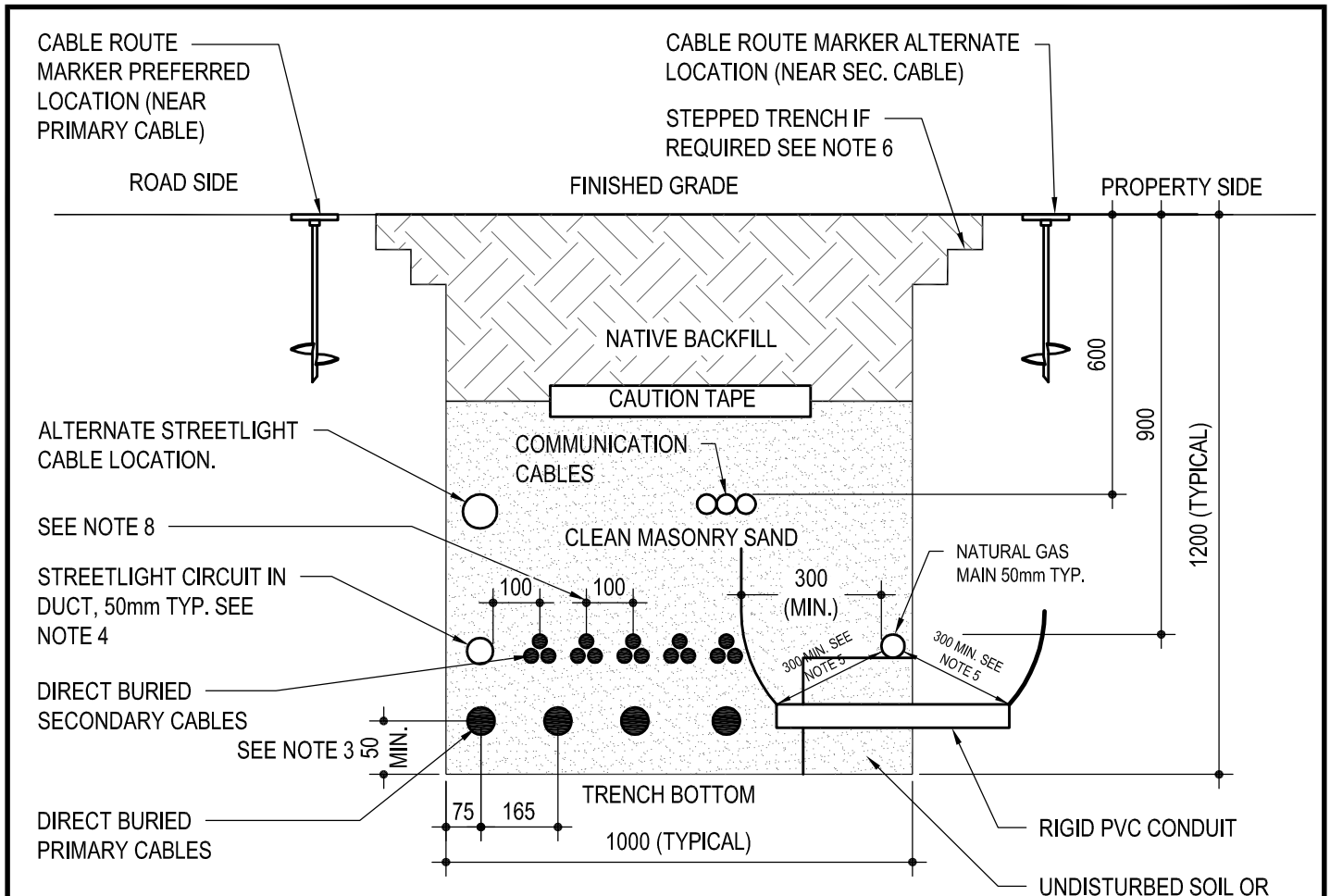
CROSS-SECTION

SCALE: N.T.S.



CROSS-SECTION

SCALE: N.T.S.



NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL SEPARATIONS AND DEPTHS OF BURIAL ARE MINIMUM.
3. IN THE PRESENCE OF SHARP ROCK, DEBRIS OR RUBBLE, INCREASE SAND PADDING TO 100mm.
4. STREETLIGHT WIRE DUCT MAY BE INSTALLED AT A REDUCED BURIAL DEPTH, UP TO A MINIMUM DEPTH OF 600mm. SEPARATIONS TO SUPPLY CABLE BASED ON MAXIMUM STREETLIGHT DUCT DIAMETER OF 50mm.
5. MUST MAINTAIN 300mm MINIMUM FROM ALL EXPOSED SUPPLY CABLES TO GAS MAIN. WHEN CROSSING GAS MAIN AND IF 300mm OF CLEAR VERTICAL SEPARATION IS NOT ACHIEVABLE, SECONDARY CABLES SHALL BE INSTALLED IN SHORT LENGTH OF RIGID PVC CONDUIT.
6. CONSTRUCTION, STEPPING AND/OR SUPPORTING OF THE TRENCH WALL TO CONFORM TO THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT.
7. NON-REQUIRED CIRCUITS OR JOINT USE COMPONENTS MAY BE OMITTED PROVIDED THAT CLEARANCES AND SEPARATIONS ARE MAINTAINED. PRIMARY CABLES (IF PRESENT) MUST BE INSTALLED ON THE BOTTOM ROW OF SUPPLY CABLES. SECONDARY CABLE BUNDLES MAY BE SUBSTITUTED IN PLACE OF PRIMARY CABLE(S) WHEN REQUIRED.
8. INTERMITTENT CONTACT IS ALLOWABLE BETWEEN SECONDAY CABLES WHERE REQUIRED.



TOWNSHIP OF
SOUTH
STORMONT

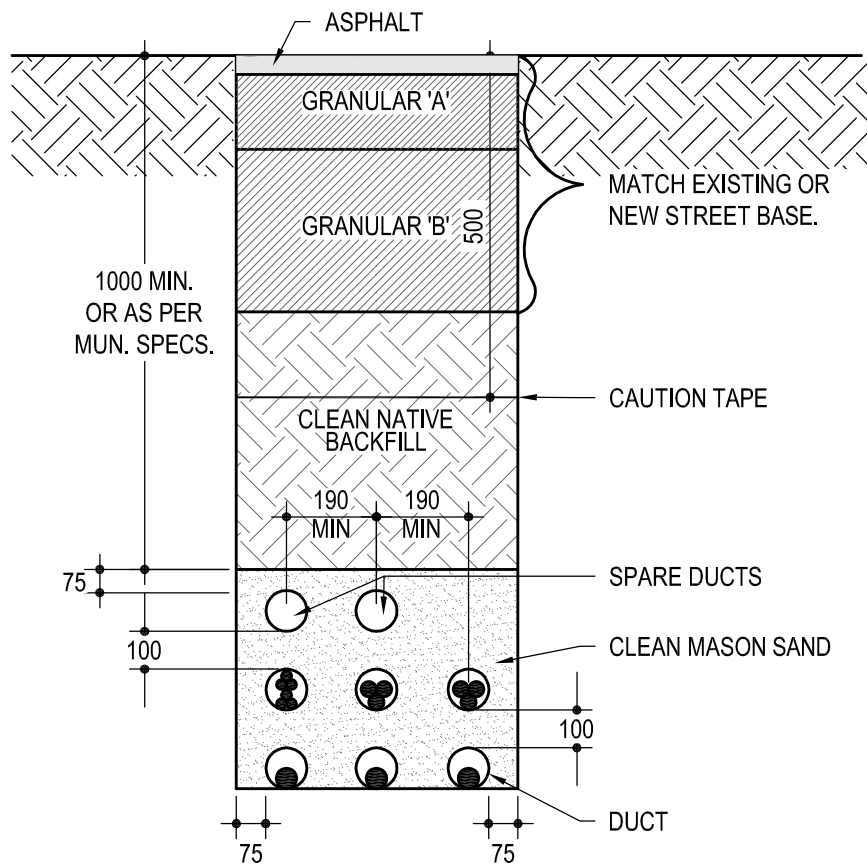
JOINT UTILITY TRENCH DETAIL

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.20



TOWNSHIP OF
SOUTH
STORMONT

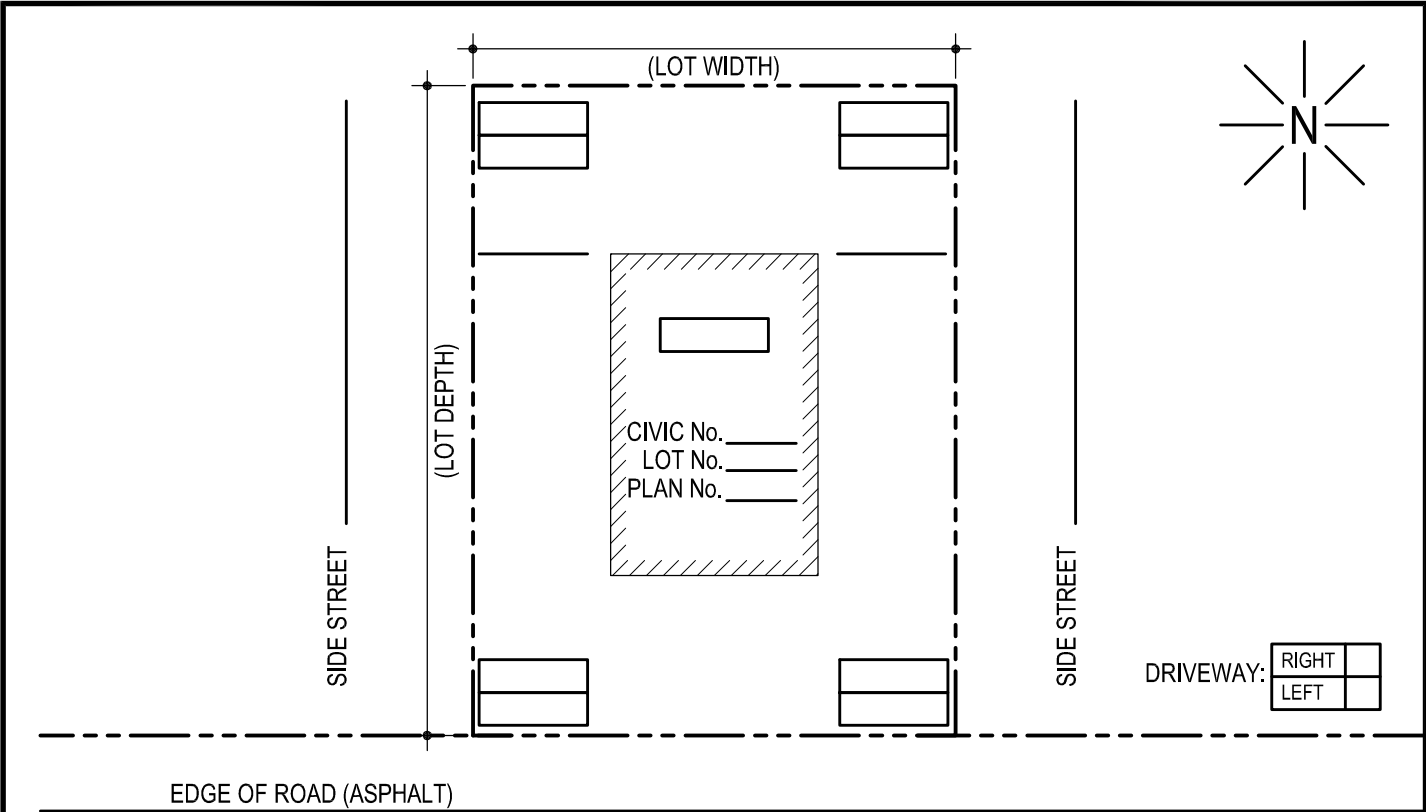
UTILITY TRENCH ROAD CROSSING

SCALE:
N.T.S.

DATE:
2015/05/28

DRAWING NO:

SS.21



_____ STREET NAME

SANITARY
MATERIAL: _____
COLOUR: _____
SIZE: _____
INVERT: _____

WATER
MATERIAL: _____
SIZE: _____
INVERT: _____

STORM
MATERIAL: _____
COLOUR: _____
SIZE: _____
INVERT: _____

REQUIRED CULVERT DIA.: _____
(IF APPLICABLE)

NOTES:

1. SHOW PLAN LOCATION OF SEWERS AND WATERMAINS. SPECIFY TYPE AND SIZE.
USE SYMBOLS INDICATED HERE:
 STORM SEWER _____
 SANITARY SEWER _____
 WATERMAIN _____
 2. TO DISTINGUISH BETWEEN THE SERVICES AT LOT LINE USE THE FOLLOWING COLOR CODE:
 STORM SEWER.....GREEN
 SANITARY SEWER.....RED
 WATERMAIN.....BLUE
 3. SANITARY SERVICE AS-BUILT ELEVATION MAY BE SUITABLE FOR SANITARY DRAINAGE OF BASEMENT. (TO BE CONFIRMED BY THE HOUSE DEVELOPER)
- (CIRCLE ONE): YES / NO



THIS FORM WAS PREPARED BY: _____ DATE: _____

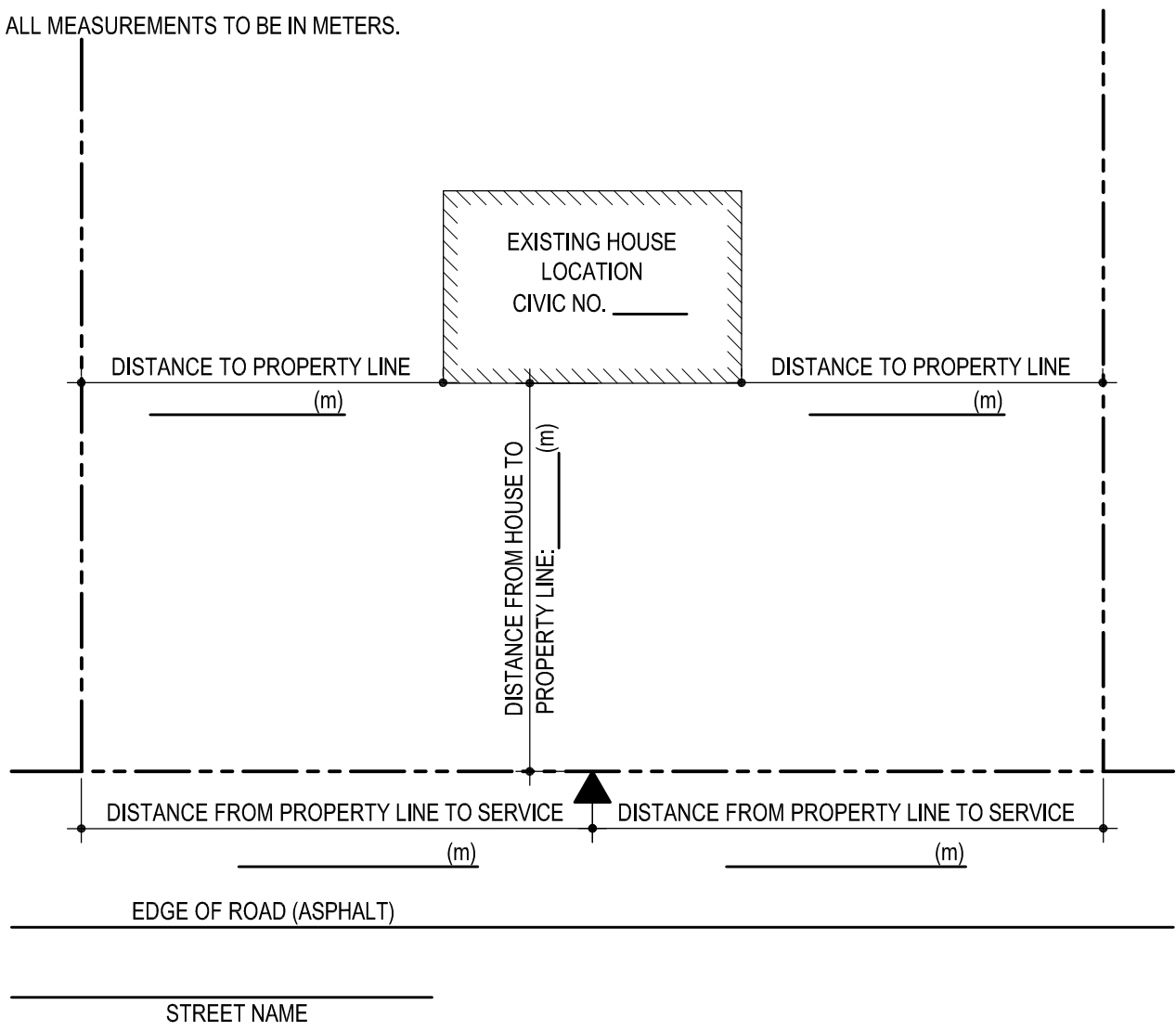
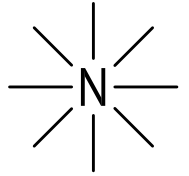


SERVICE LOCATION SHEET - NEW DEVELOPMENT

SCALE:
N.T.S.
DATE:
2014/04/08
DRAWING NO:
SS.22

M:\2014\141-15756-00\MumSS Design Standard.dwg\141-15756-00-FIG-1-23.dwg Jun 01, 2015-12:18pm BY:(ken.white)

- 1) LOCATE NEW WATER SERVICE LOCATION (ON PROPERTY LINE) WITH A
- 2) LOCATE WELL WITH A 
- 3) LOCATE SEPTIC SYSTEM WITH A 
- 4) ALL MEASUREMENTS TO BE IN METERS.



THIS FORM WAS PREPARED BY: _____

DATE: _____



TOWNSHIP OF
SOUTH
STORMONT

SERVICE LOCATION SHEET - SERVICING EXISTING DEVELOPMENT

SCALE:
N.T.S.

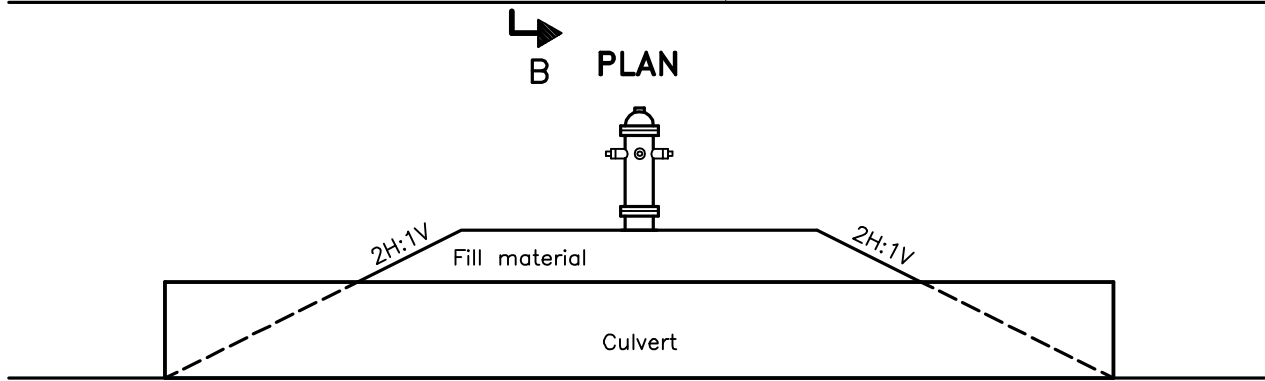
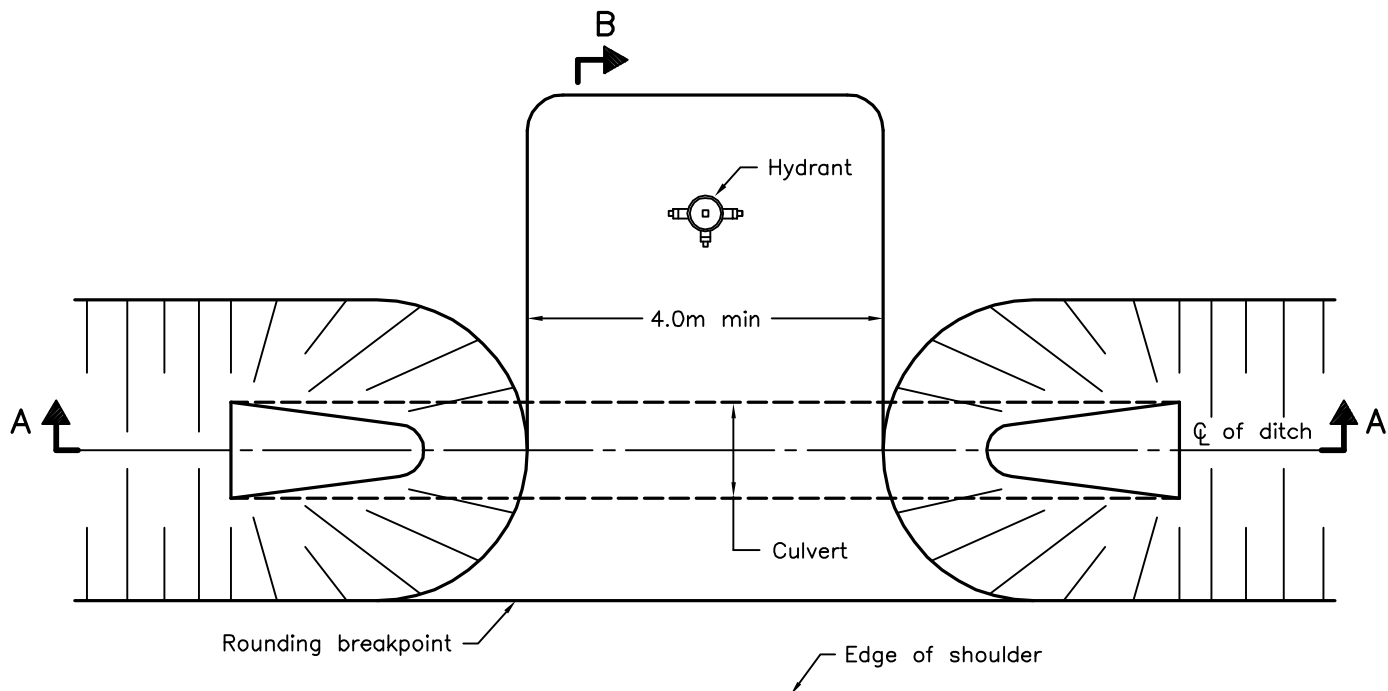
DATE:
2014/04/08

DRAWING NO:

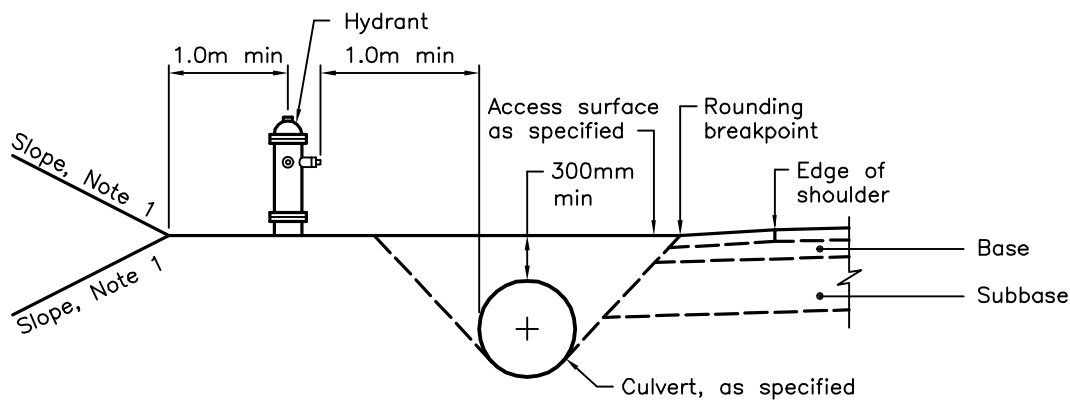
SS.23

Appendix C

Ontario Provincial Standard Drawings (O.P.S.D.'s)



SECTION A-A



SECTION B-B

NOTE:

1 Slope shall be 2H:1V or flatter.

A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2011

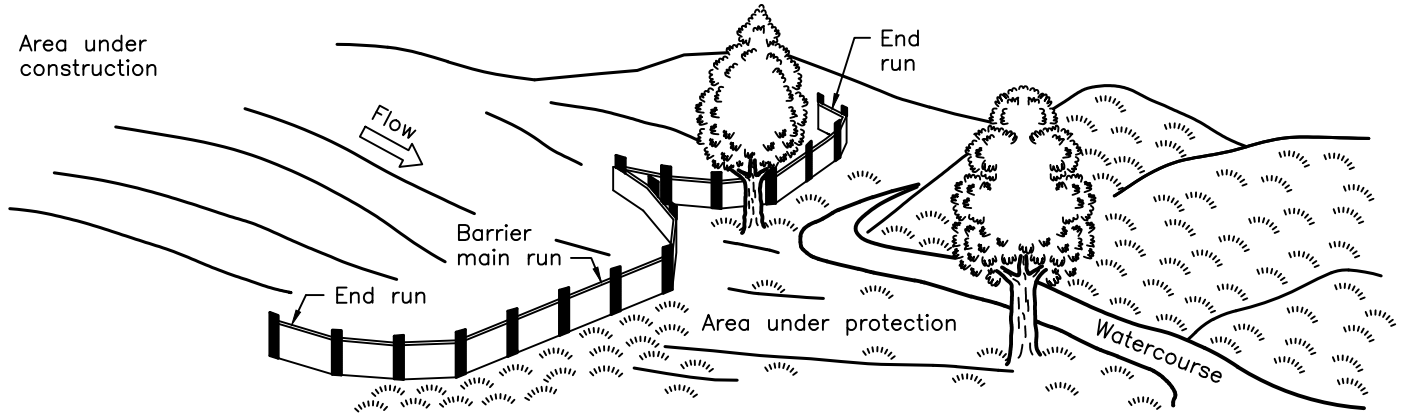
Rev 2

**ACCESS TO HYDRANT
ACROSS DITCH**

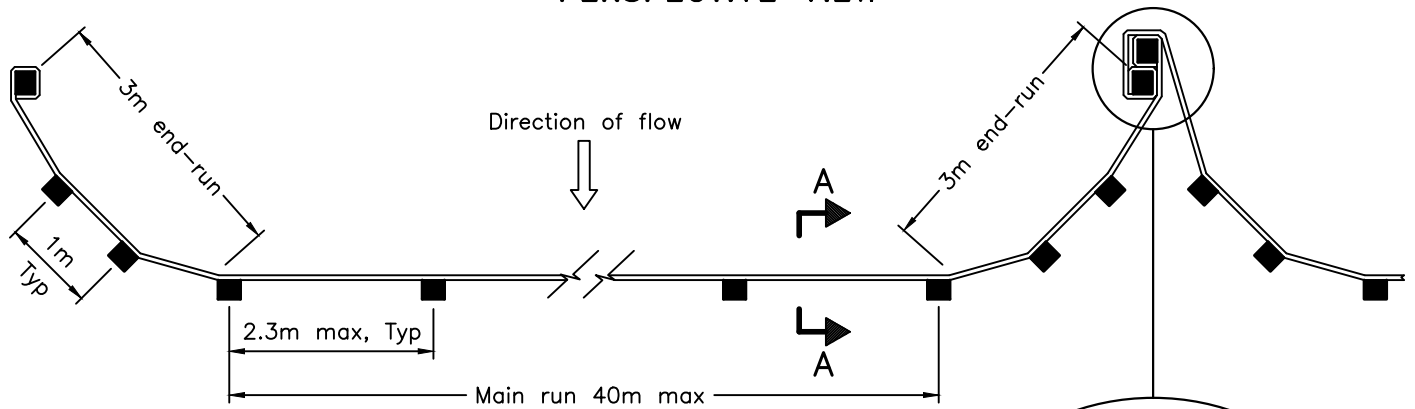


OPSD 217.050

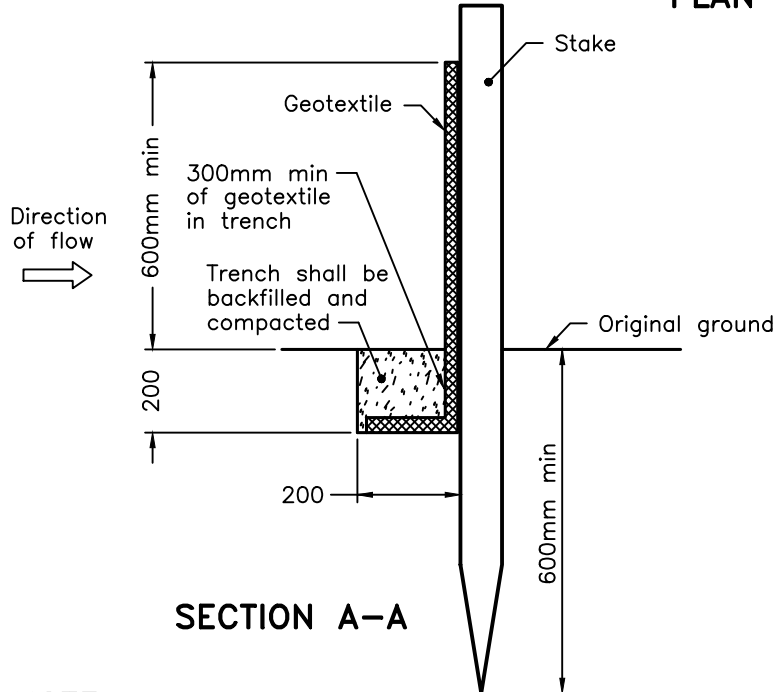
Area under construction



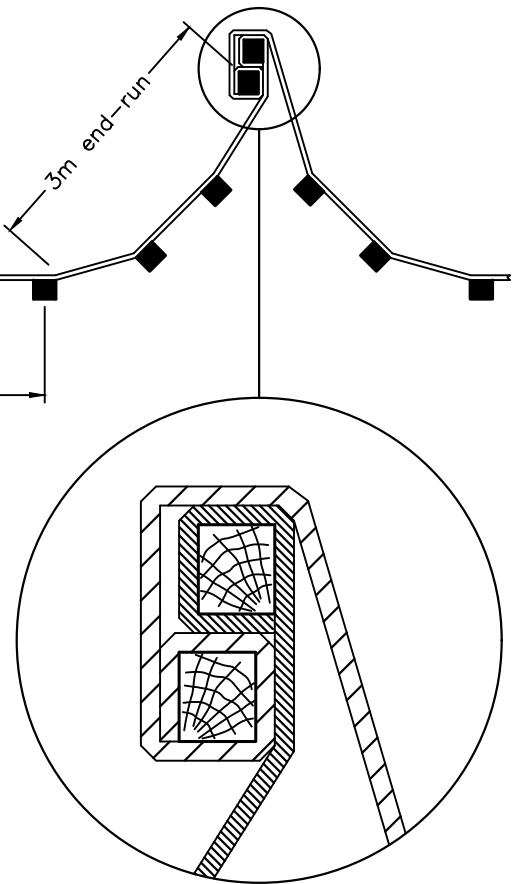
PERSPECTIVE VIEW



PLAN



SECTION A-A



JOINT DETAIL

NOTE:

A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

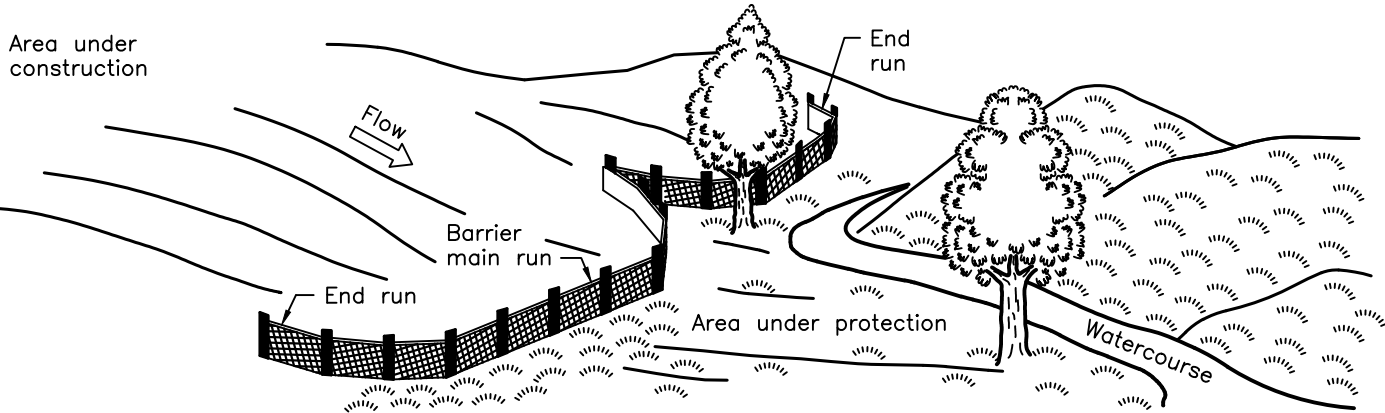
Nov 2021

Rev 3

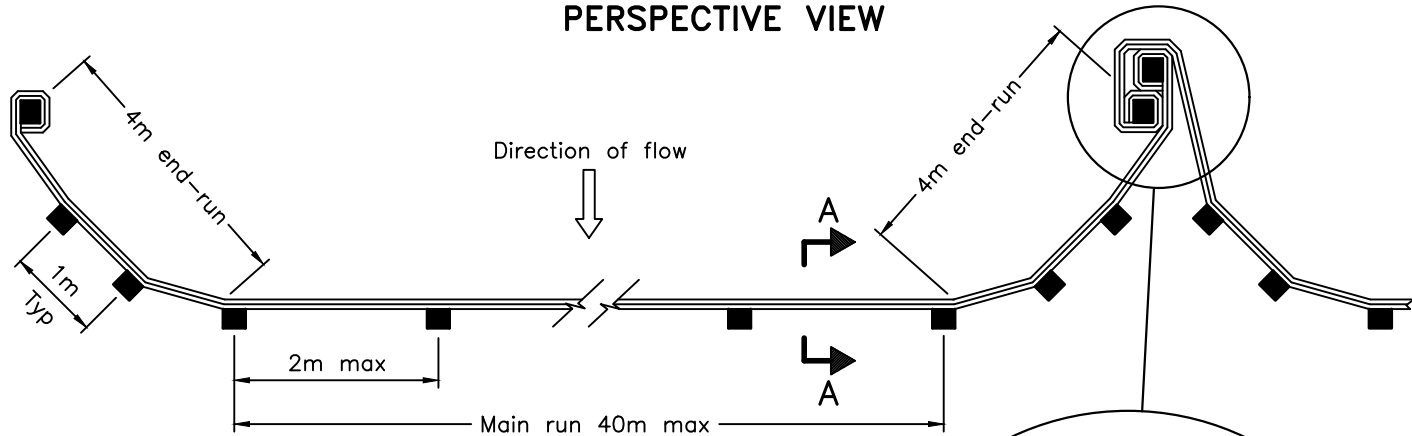
LIGHT-DUTY
SILT FENCE BARRIER



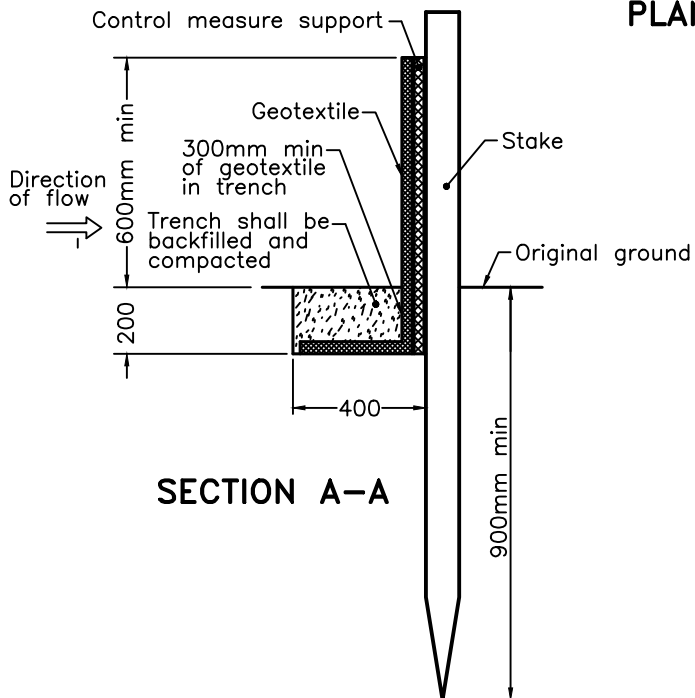
OPSD 219.110



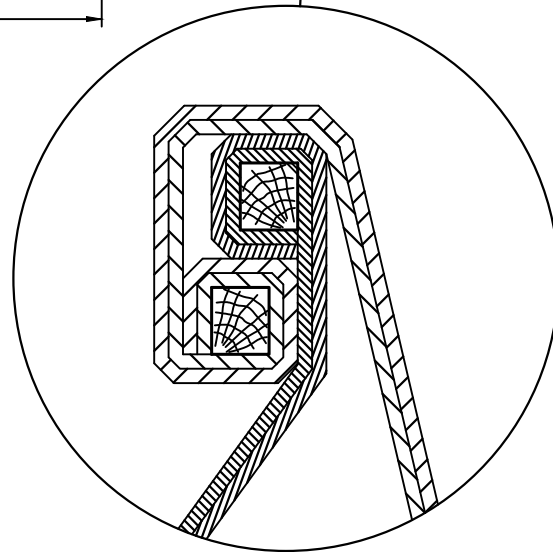
PERSPECTIVE VIEW



PLAN



SECTION A-A



JOINT DETAIL

NOTE:

A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

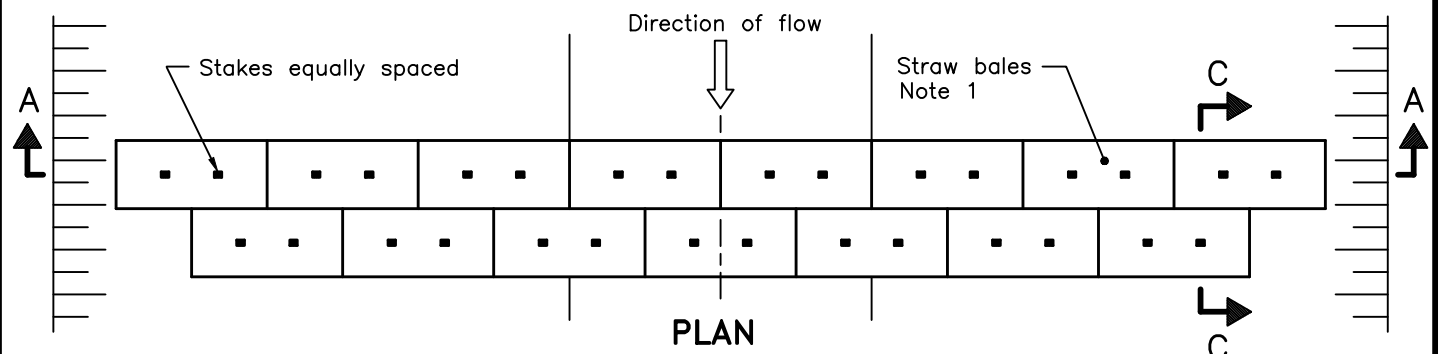
Nov 2021

Rev 3

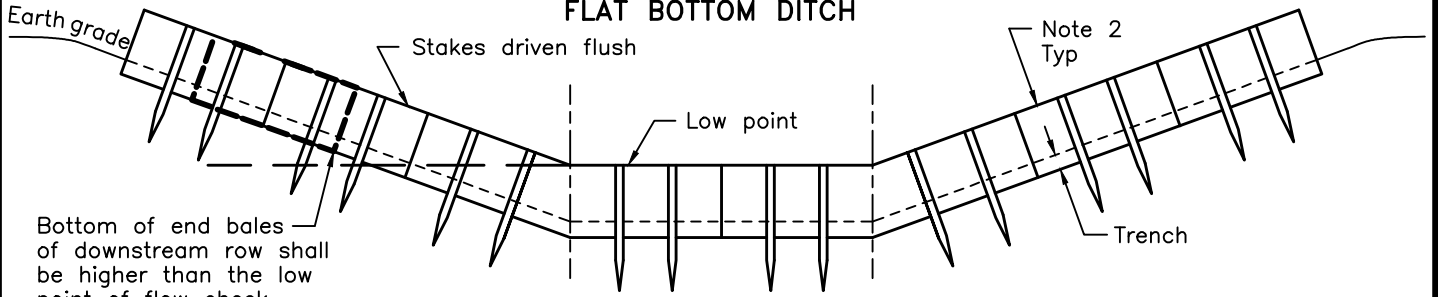
HEAVY-DUTY
SILT FENCE BARRIER



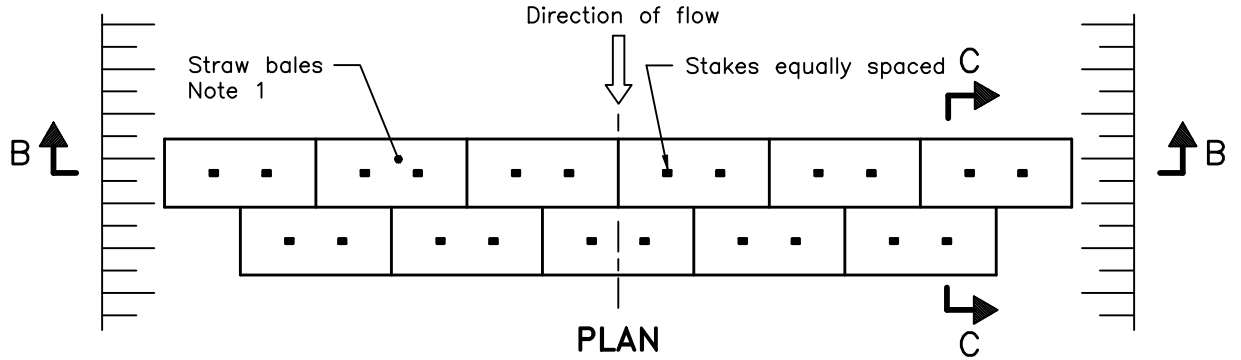
OPSD 219.130



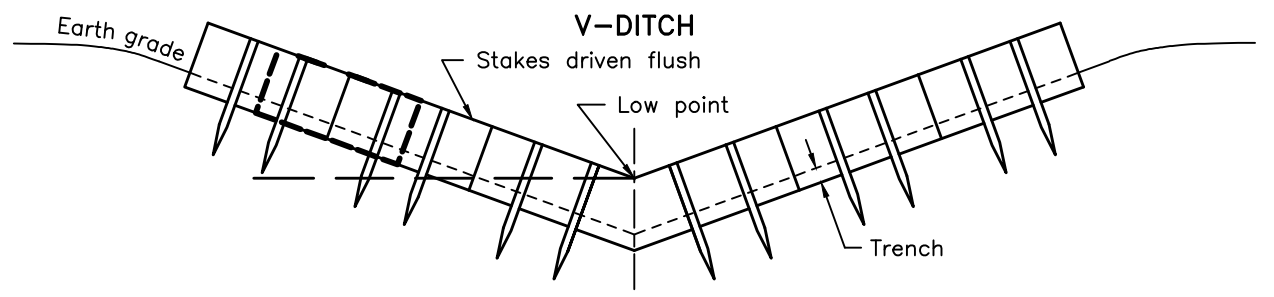
PLAN
FLAT BOTTOM DITCH



SECTION A-A



PLAN

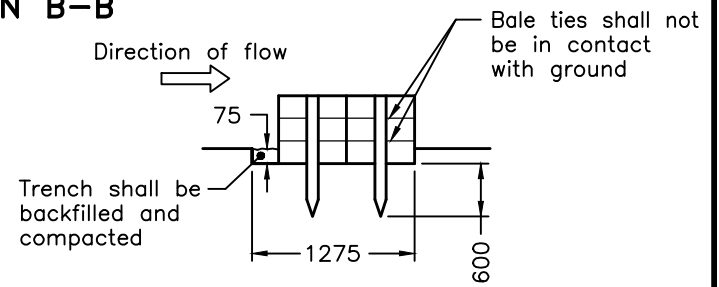


SECTION B-B

NOTES:

- 1 Number of bales varies and shall suit ditch.
- 2 Straw bales shall be butted tightly against adjoining bales and shaped to conform to the sides of the ditch to prevent water flow through barrier.

- A Fill and compact gaps with loose straw.
- B All dimensions are in millimetres unless otherwise shown.



SECTION C-C

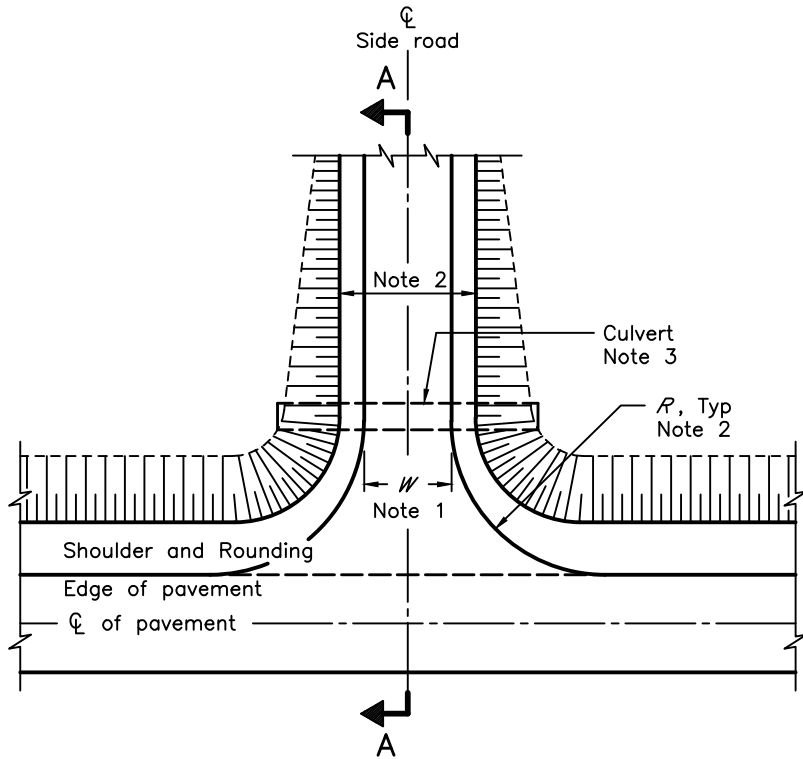
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2021 | Rev | 3

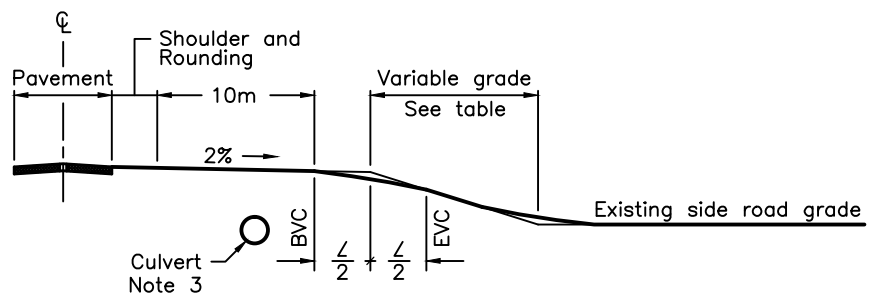
STRAW BALE FLOW CHECK DAM



OPSD 219.180



PLAN



SECTION A-A

GRADE TABLE	
Downgrade %	L m
3	4
4	8
5	12
6	16
7	20
8	24
9	28
Max 10	32

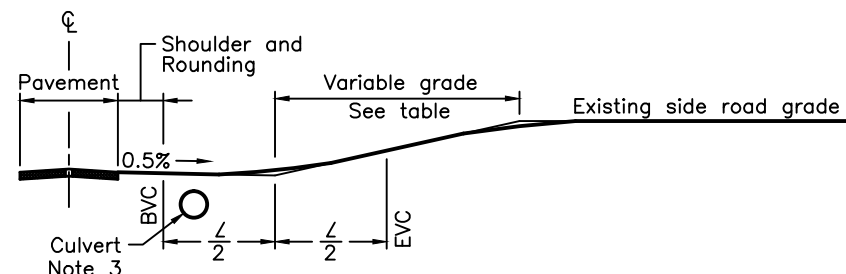
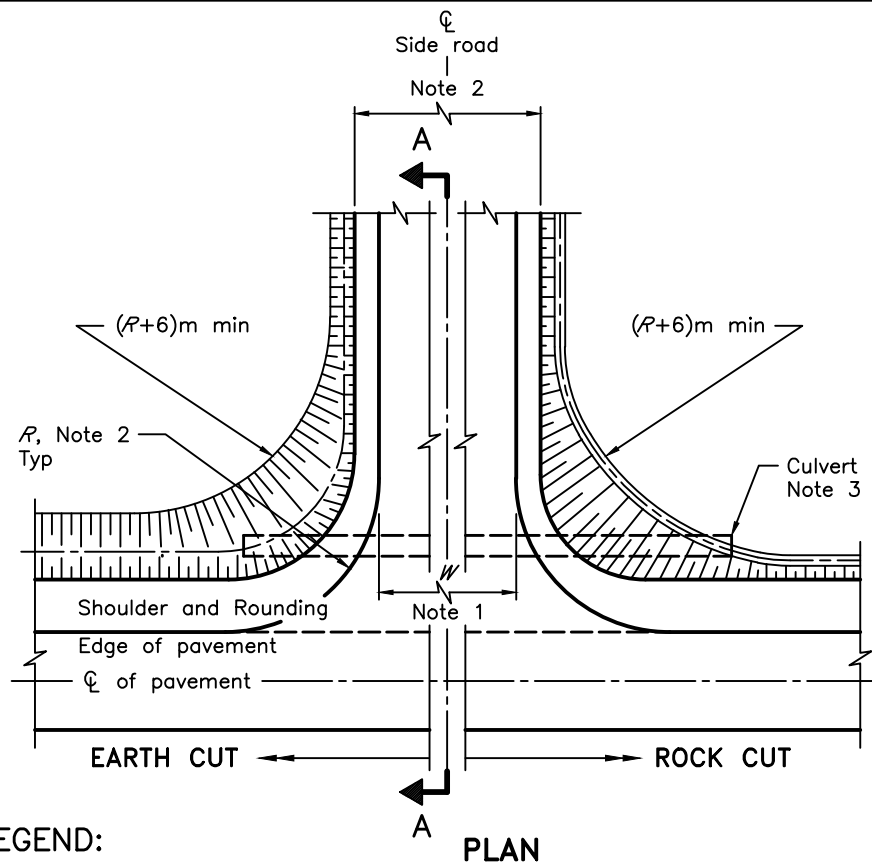
LEGEND:

- L - Length of vertical curve
- R - Side road radius
- W - Pavement width

NOTES:

- 1 When curb and gutter is specified, W shall be 8.5m minimum. Taper to existing pavement width at 1:25 along each pavement edge.
- 2 Side road radii and pavement and shoulder widths shall be as specified.
- 3 Culvert type, dimensions, and location shall be as specified.
- A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3	
SIDE ROAD INTERSECTION			
FILL			OPSD 300.010



SECTION A-A

GRADE TABLE	
Upgrade %	L m
1	6
2	10
3	14
4	18
5	22
6	26
7	30
8	34
9	38
Max 10	42

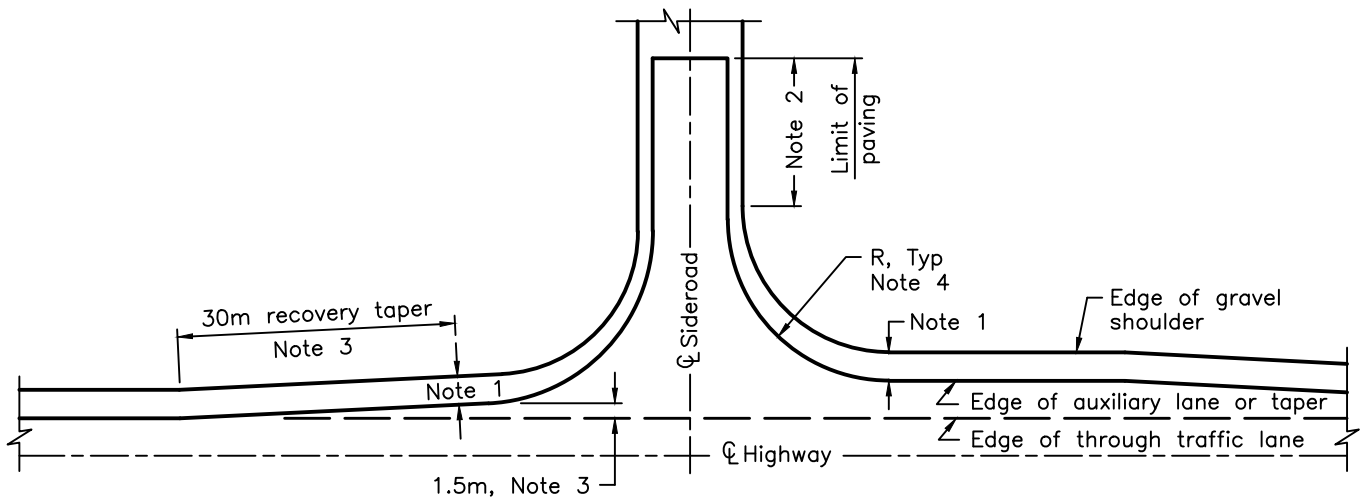
LEGEND:

- L - Length of vertical curve
- R - Side road radii
- W - Pavement width

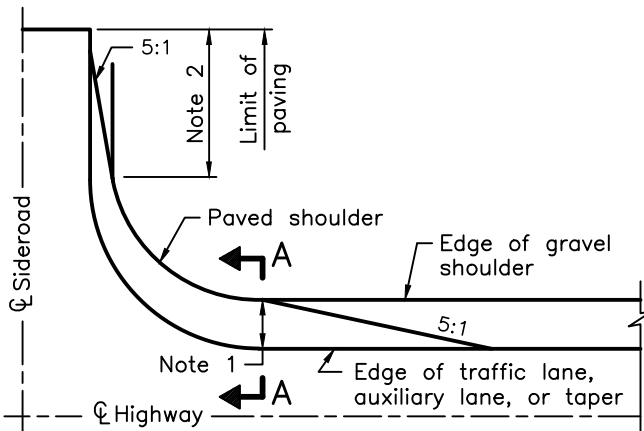
NOTES:

- 1 When curb and gutter is specified, W shall be 8.5m minimum. Taper to existing pavement width at 1:25 along each pavement edge.
- 2 Side road radii and pavement and shoulder widths shall be as specified.
- 3 Culvert type, dimensions, and location shall be as specified.
- A This OPSD shall be read in conjunction with OPSD 200.010 and 201.010.
- B All dimensions are in millimetres unless otherwise shown.

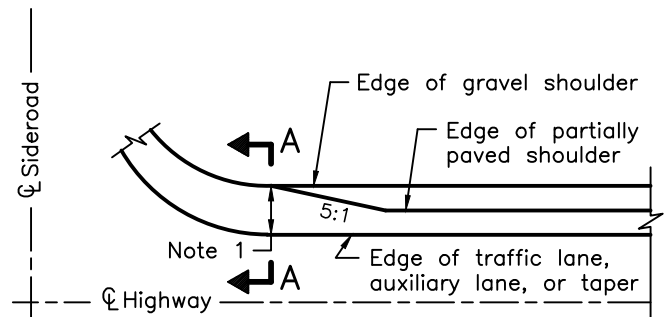
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3	
SIDE ROAD INTERSECTION			
CUT			OPSD 300.020



PLAN A, AUXILIARY LANE OR TAPER - GRAVEL SHOULDER

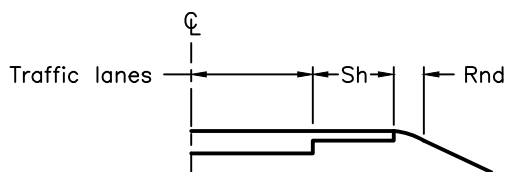


PAVED SHOULDER RADIUS WITH GRAVEL SHOULDER ON HIGHWAY



PAVED SHOULDER RADIUS WITH PARTIALLY PAVED SHOULDER ON HIGHWAY

PLAN B, PAVED SHOULDER OR PARTIALLY PAVED SHOULDER

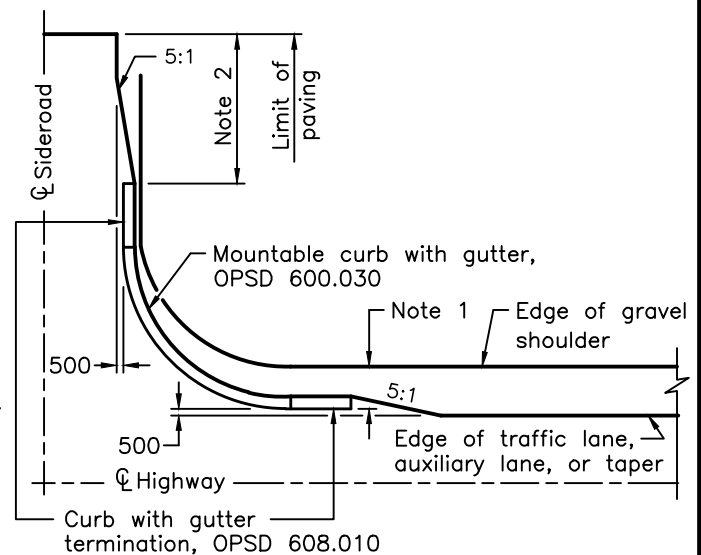


SECTION A-A

NOTES:

- 1 Highway shoulder width tapers to sideroad shoulder width over length of radius.
- 2 For gravel sideroad, distance shall be 15.0m.
- 3 Recovery taper is required when traffic lanes include auxiliary lane or taper.
- 4 Sideroad radii as specified.

A All dimensions are in millimetres unless otherwise shown.



PLAN C, CURB AND GUTTER

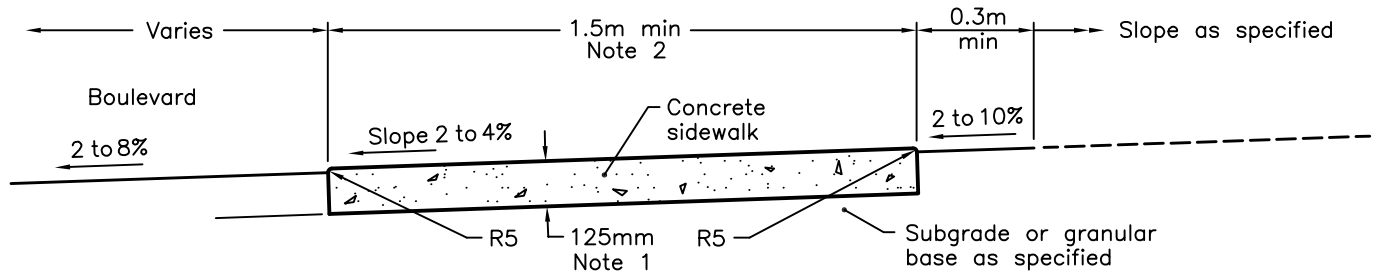
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2018 Rev 2

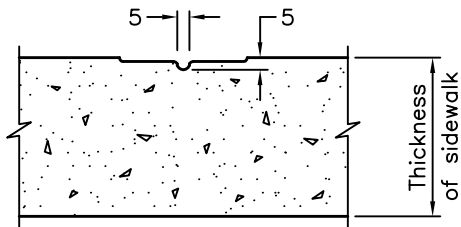
**SHOULDER TREATMENT
SIDEROAD INTERSECTIONS**



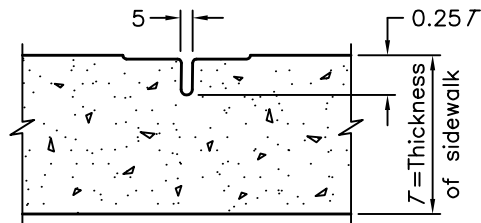
OPSD 304.010



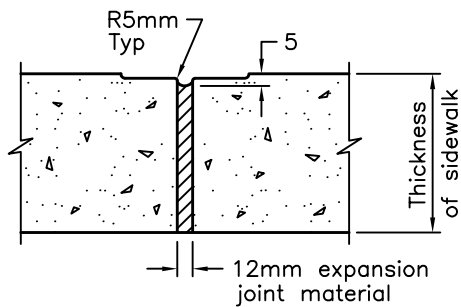
TYPICAL SECTION



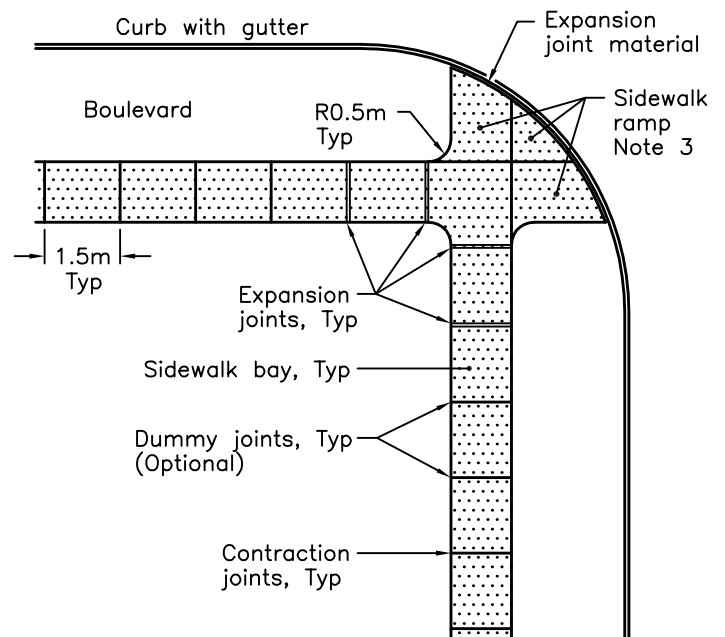
DUMMY JOINT (OPTIONAL)



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

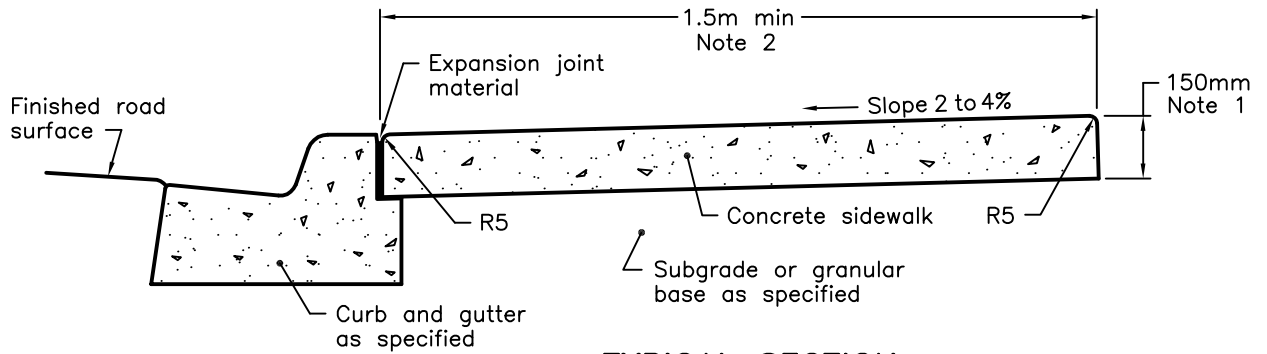
Nov 2019

Rev 3

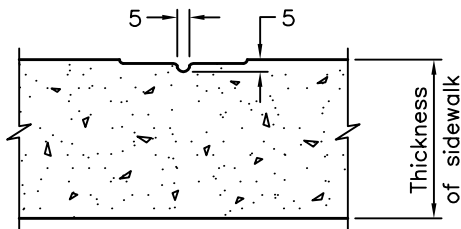
CONCRETE SIDEWALK



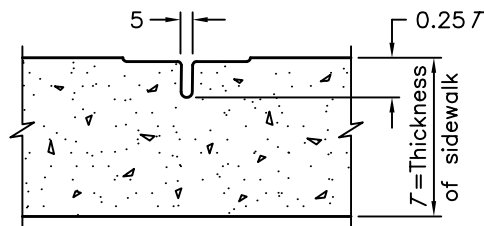
OPSD 310.010



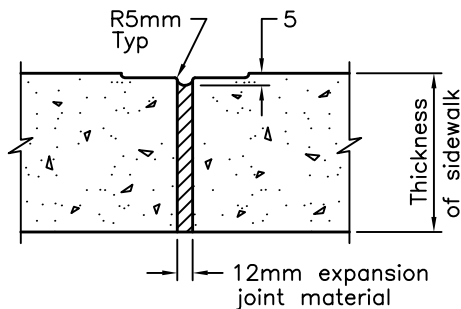
TYPICAL SECTION



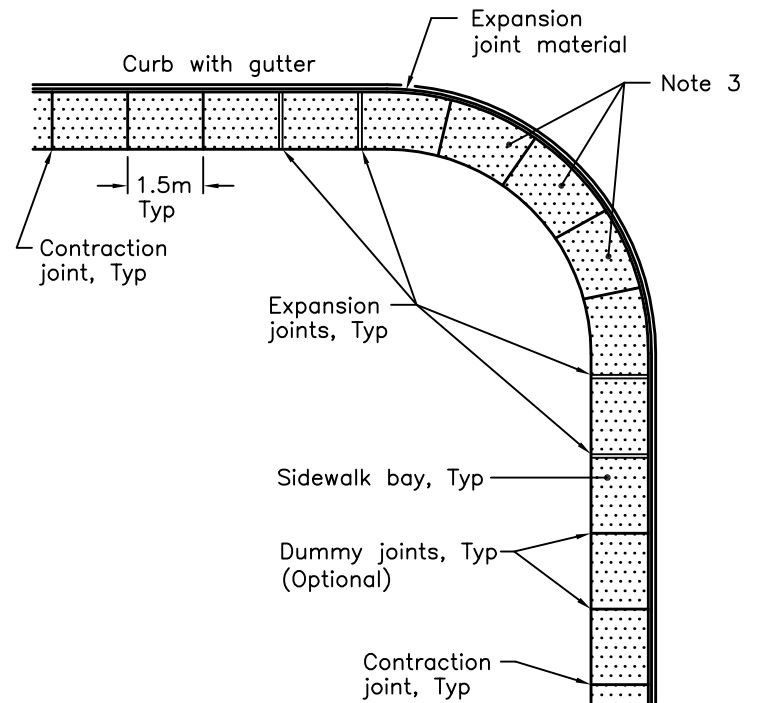
DUMMY JOINT



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

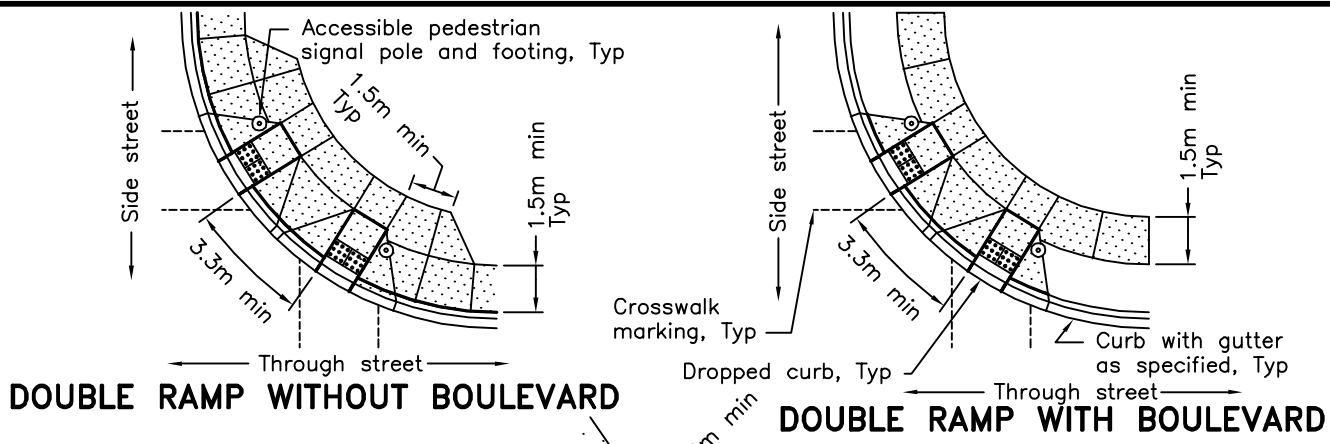
Nov 2019

Rev 3

**CONCRETE SIDEWALK
ADJACENT TO CURB WITH GUTTER**

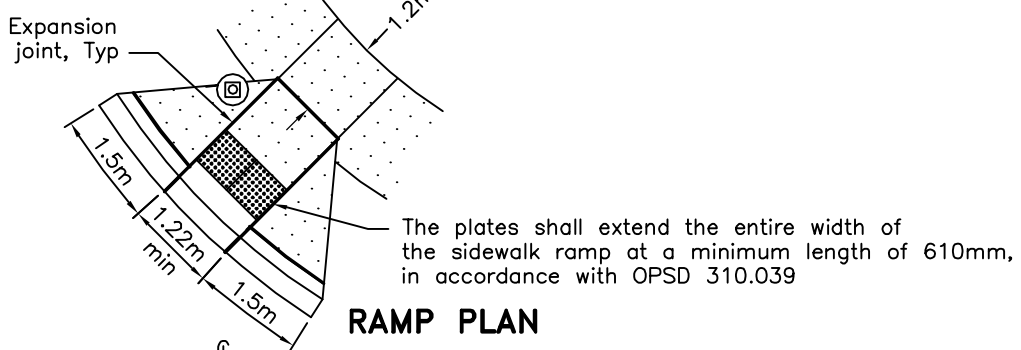
OPSD 310.020



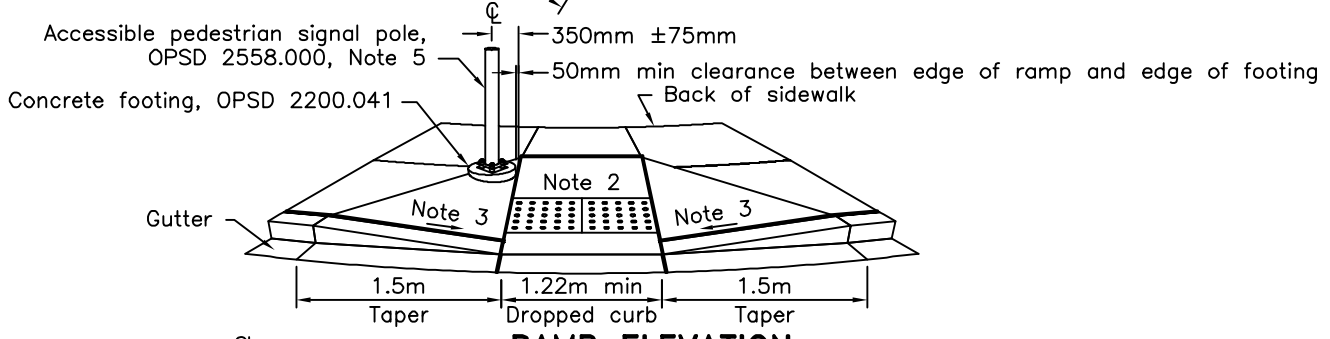


DOUBLE RAMP WITHOUT BOULEVARD

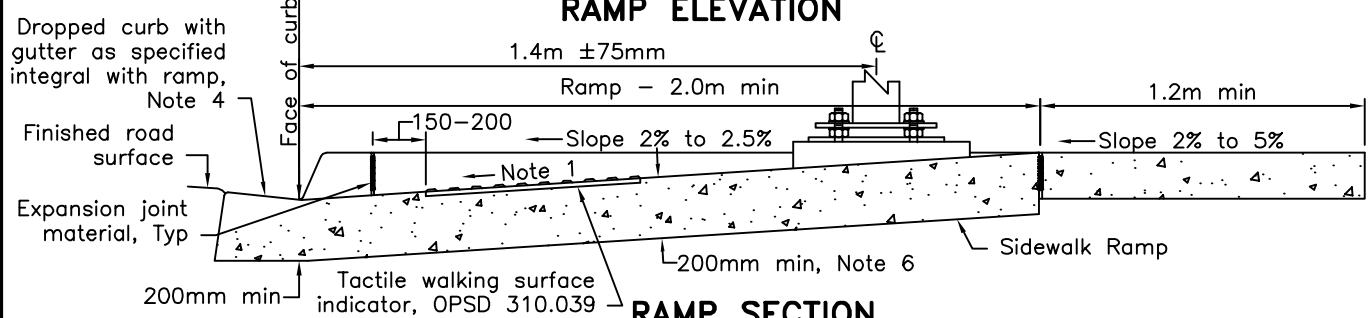
DOUBLE RAMP WITH BOULEVARD



RAMP PLAN



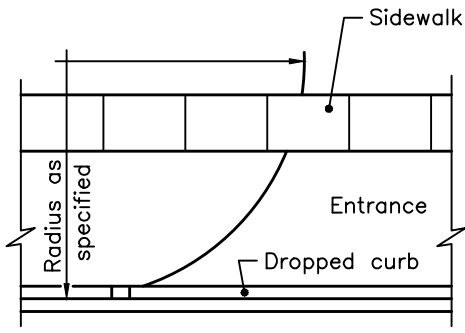
RAMP ELEVATION



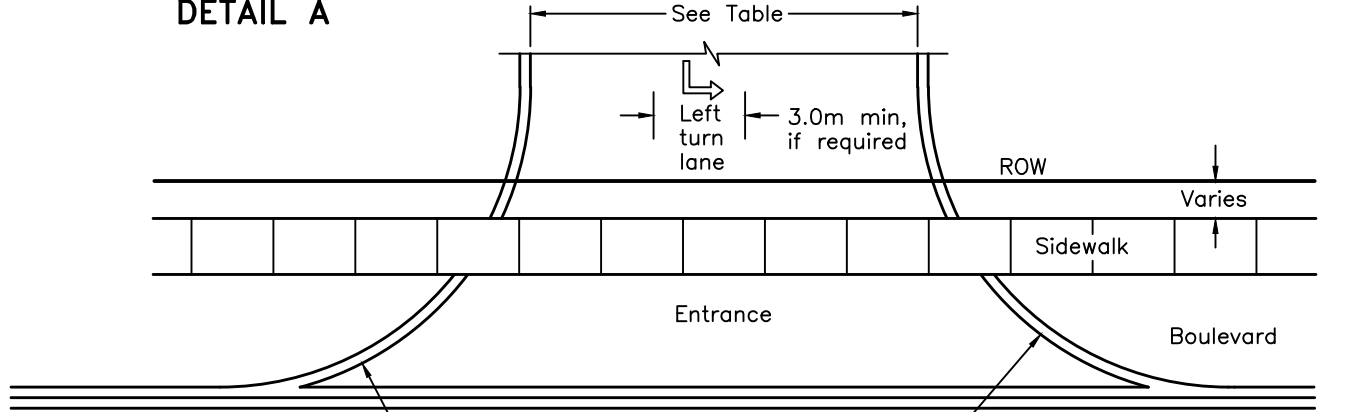
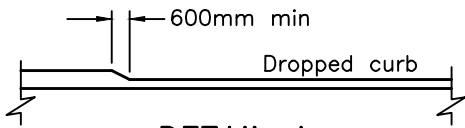
RAMP SECTION

- NOTES:**
- 1 Slope of ramp shall not exceed 8%.
 - 2 Cross slope of ramp shall not exceed 2% in either direction.
 - 3 Cross slope of flared side of ramp shall not exceed 8%.
 - 4 Dropped curb at ramp shall be modified to eliminate 30 mm step at gutter.
 - 5 Accessible pedestrian signal to have tactile arrow that aligns with direction of crosswalk.
 - 6 Minimum thickness of ramp is 200mm. Minimum thickness of sidewalk and flared sides adjacent to ramp is 150mm.
- A Where only one crosswalk is present at an intersection, only one curb ramp is required.
 B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 1	
CONCRETE SIDEWALK RAMPS AT SIGNALIZED INTERSECTIONS	-----		
OPSD 310.030			



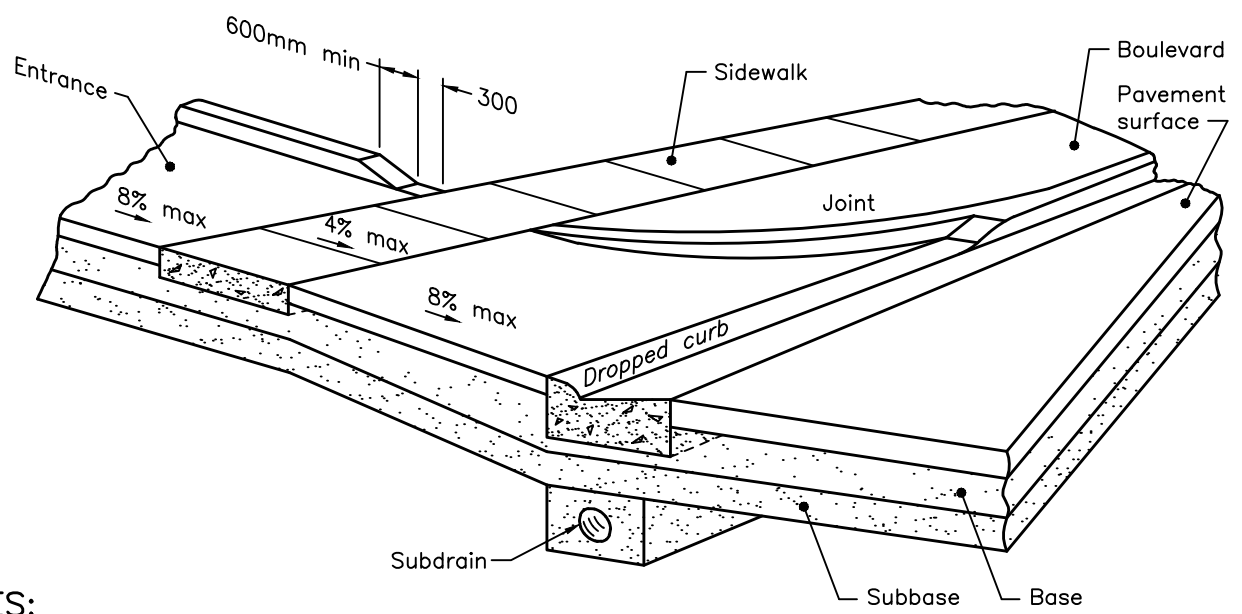
DRIVEWAY DIMENSIONS						
LAND USE	WIDTH m				RADIUS m	
	One-Way		Two-Way		min	max
	min	max	min	max		
Light Industrial, Commercial, and Apartment	4.5	7.5	7.2	12.0	4.5	12.0
Heavy Industrial	5.0	9.0	9.0	15.0	9.0	15.0



Concrete curb or curb with gutter. For entrance without curb or curb with gutter see Detail A

PLAN

See table for driveway radius



NOTES:

A All dimensions are in millimetres unless otherwise shown.

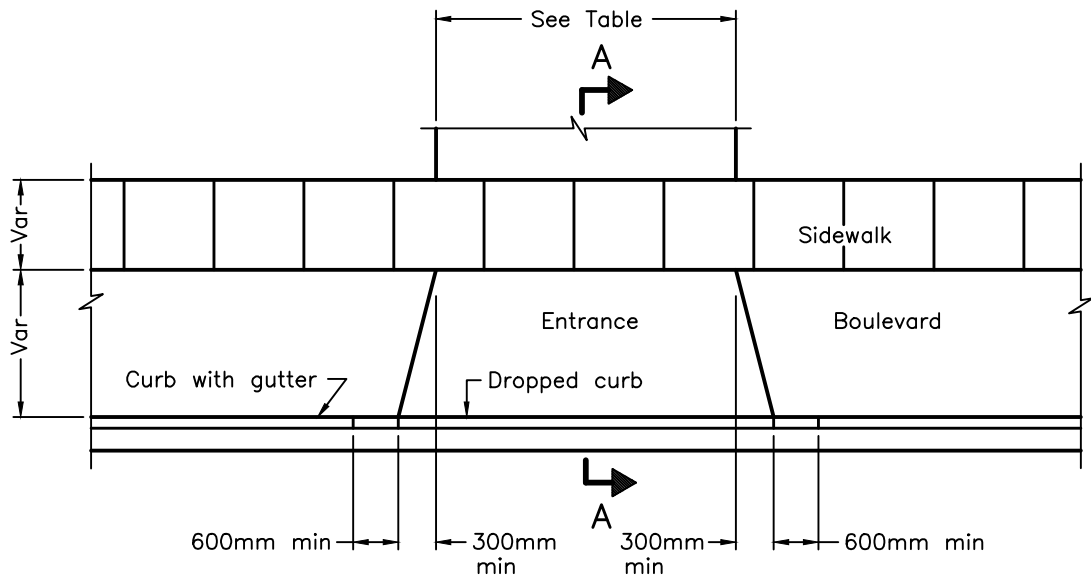
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2018 Rev 2

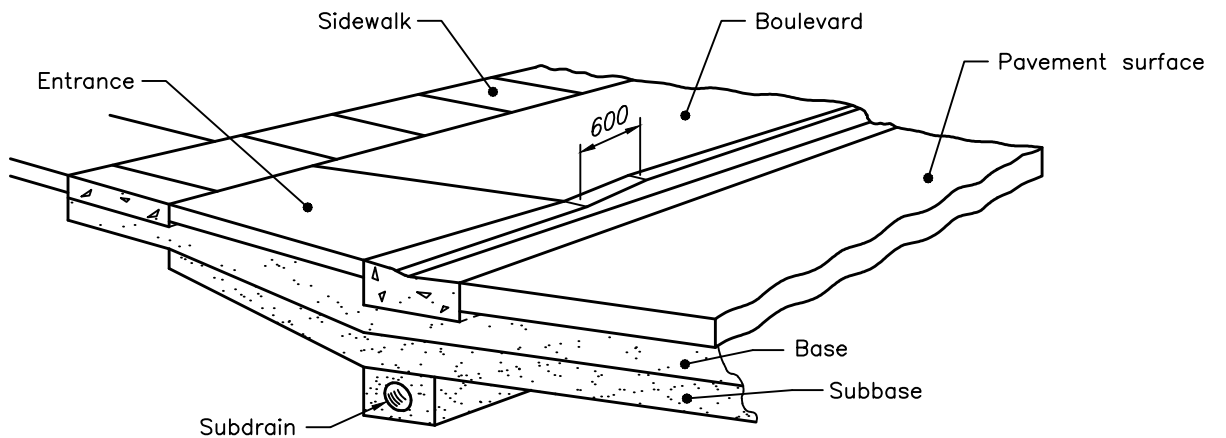
**URBAN
INDUSTRIAL, COMMERCIAL, AND
APARTMENT ENTRANCES**

OPSD 350.010

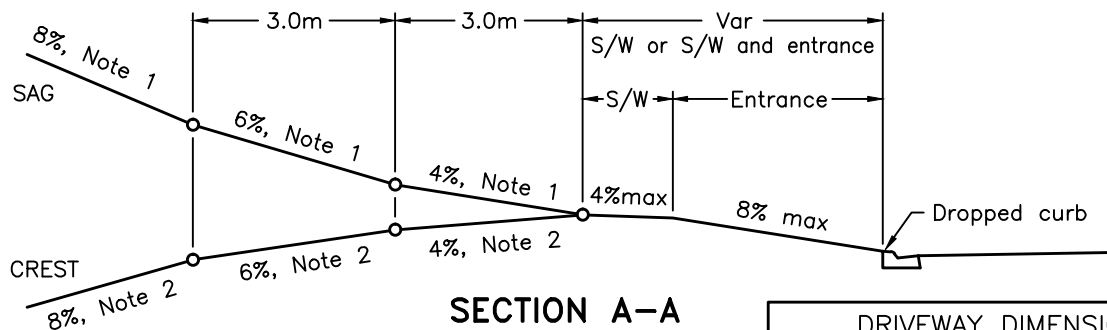




PLAN



ISOMETRIC VIEW



SECTION A-A

DRIVEWAY DIMENSIONS				
LAND USE	WIDTH m			
	Single		Double	
	min	max	min	max
Residential	3.0	4.3	6.0	7.3

NOTES:

- 1 Maximum upgrade shall be 10%.
- 2 Maximum downgrade shall be 8%.

A All dimensions are in millimetres unless otherwise shown.

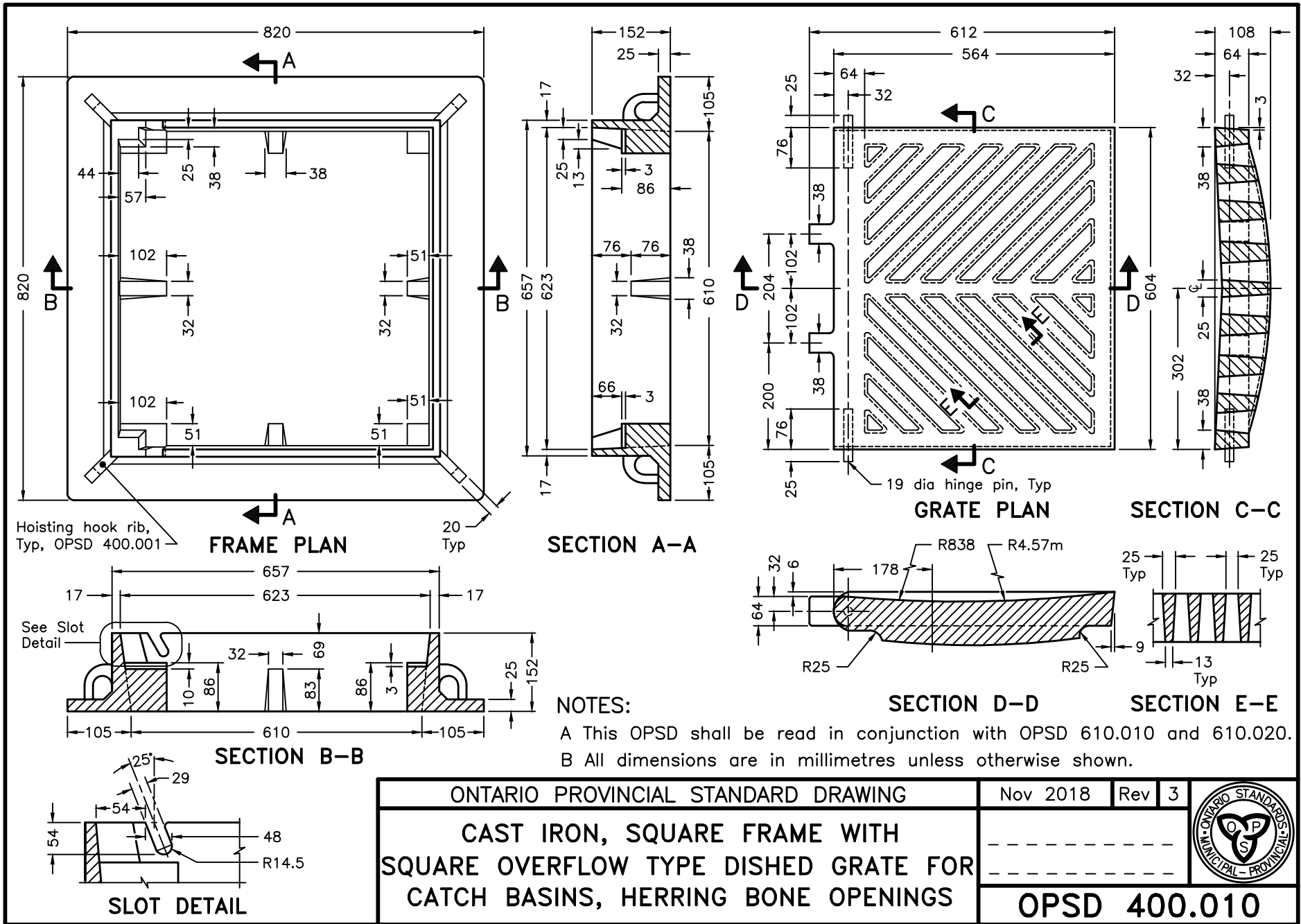
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2018 | Rev | 2

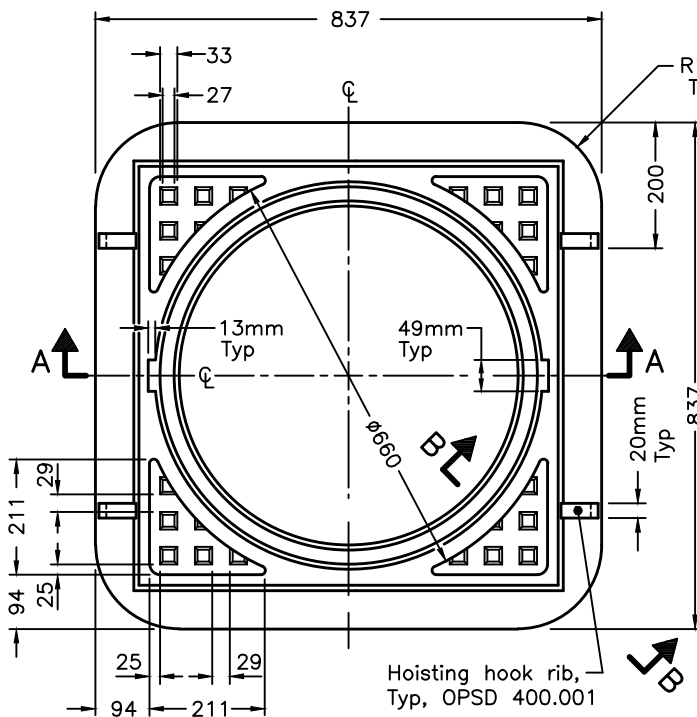
**URBAN RESIDENTIAL
ENTRANCE**

OPSD 351.010

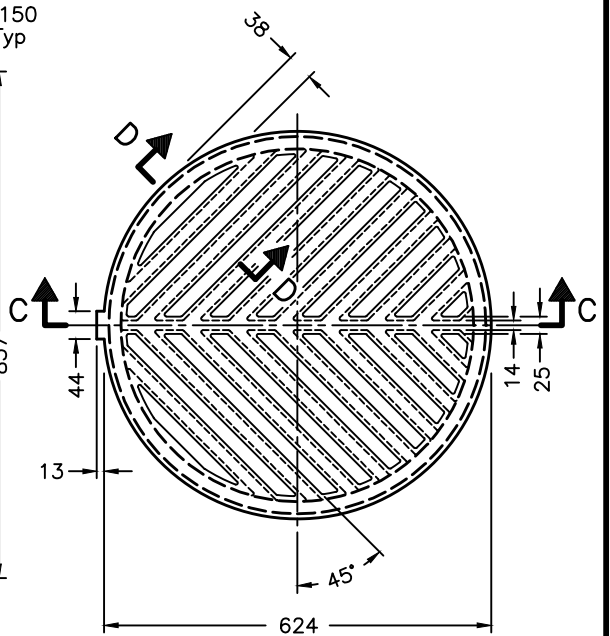




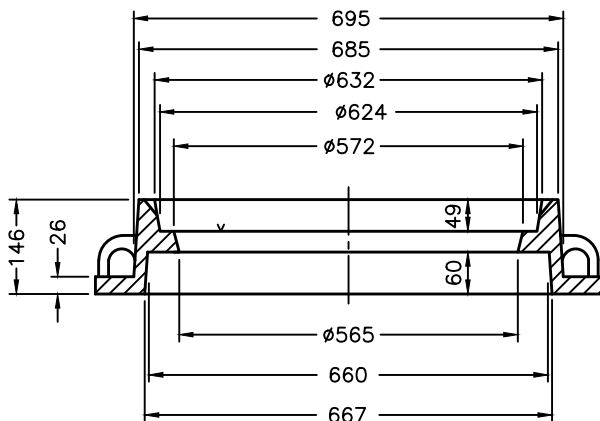
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3	
CAST IRON, SQUARE FRAME WITH SQUARE OVERFLOW TYPE DISHED GRATE FOR CATCH BASINS, HERRING BONE OPENINGS	----- -----		
OPSD 400.010			



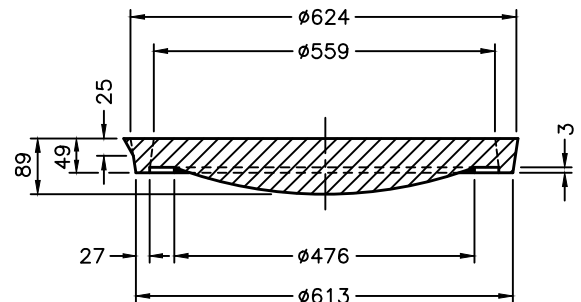
FRAME PLAN



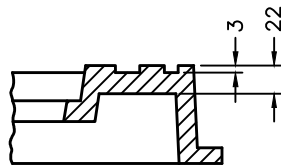
GRATE PLAN



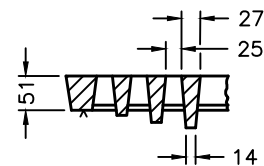
SECTION A-A



SECTION C-C



SECTION B-B

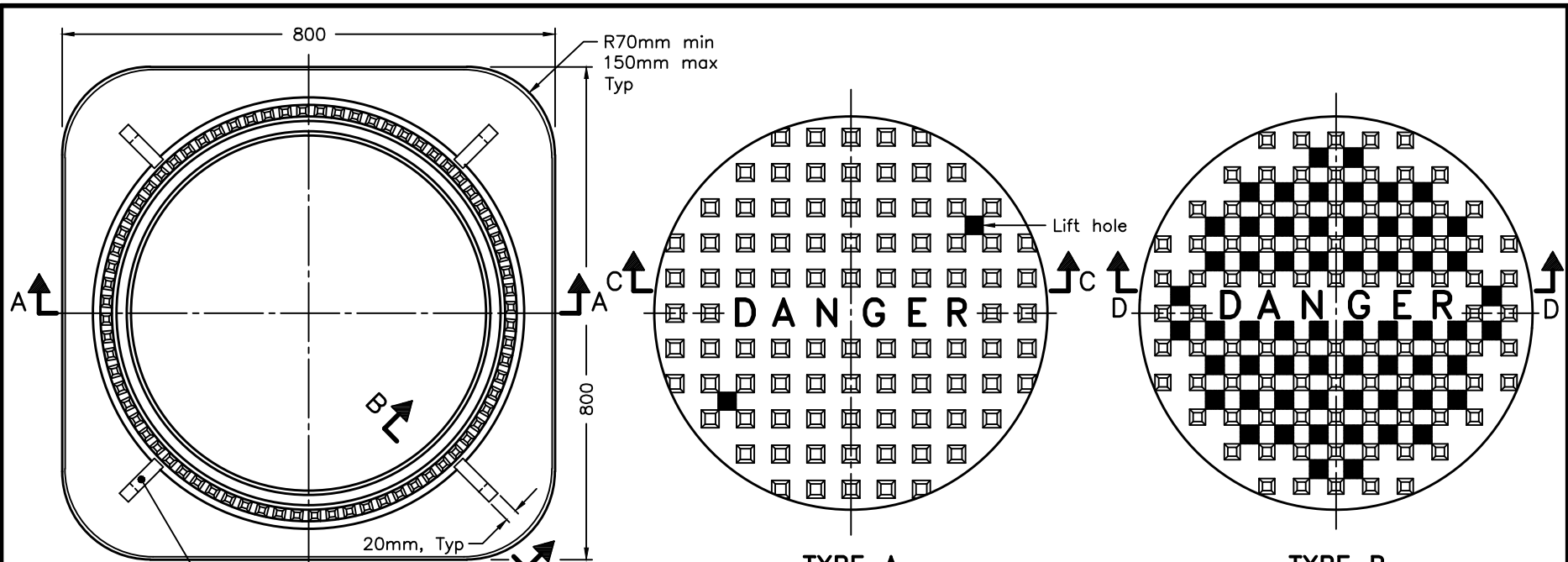


SECTION D-D

NOTES:

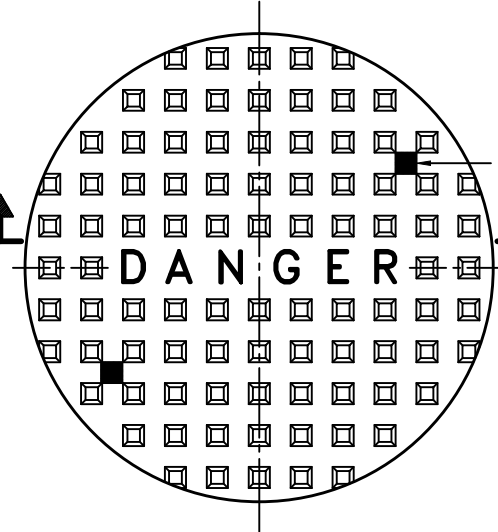
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2018	Rev	6	
CAST IRON, RAISED SQUARE FRAME WITH CIRCULAR FLAT GRATE FOR CATCH BASINS, HERRING BONE OPENINGS					
		OPSD 400.070			

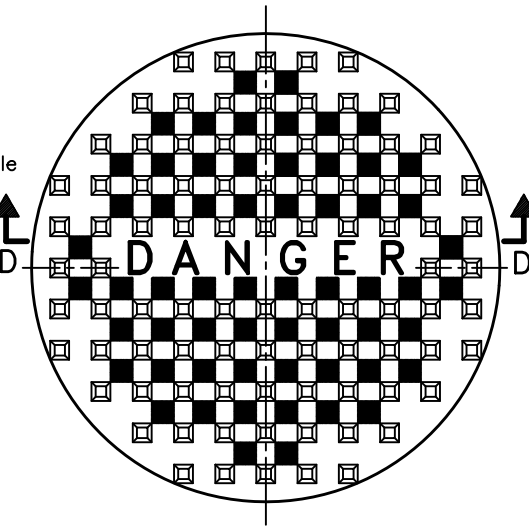


Hoisting hook rib,
Typ, OPSD 400.001

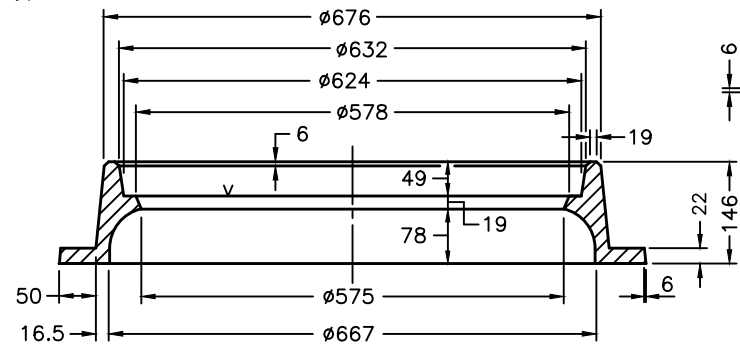
FRAME PLAN



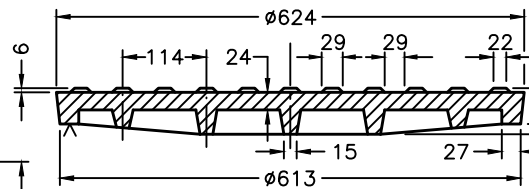
**TYPE A
CLOSED COVER**



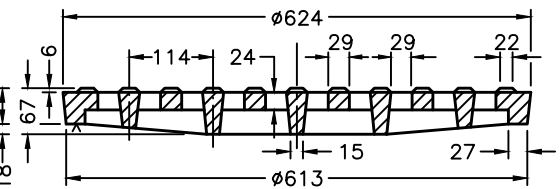
**TYPE B
OPEN COVER**



SECTION A-A

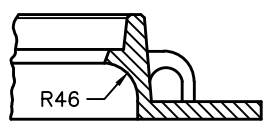


SECTION C-C




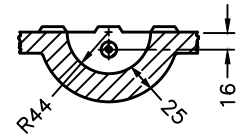
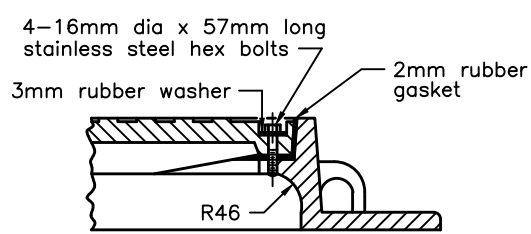
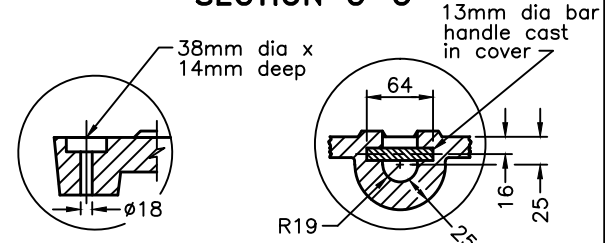
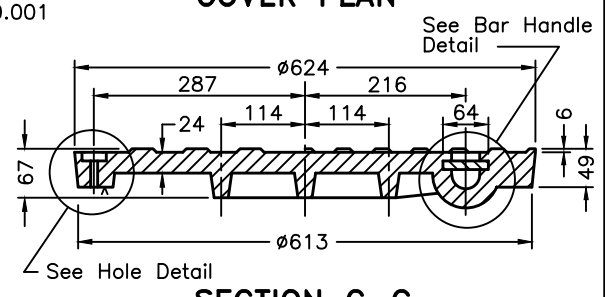
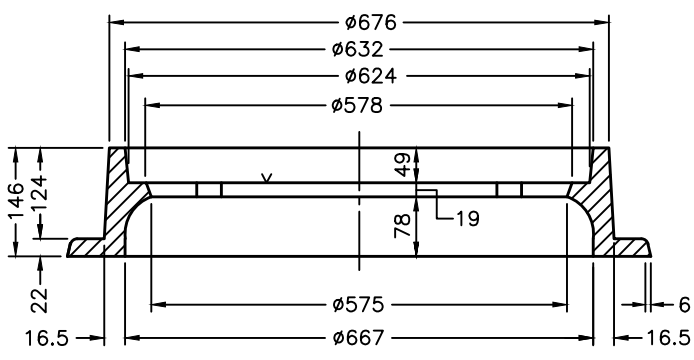
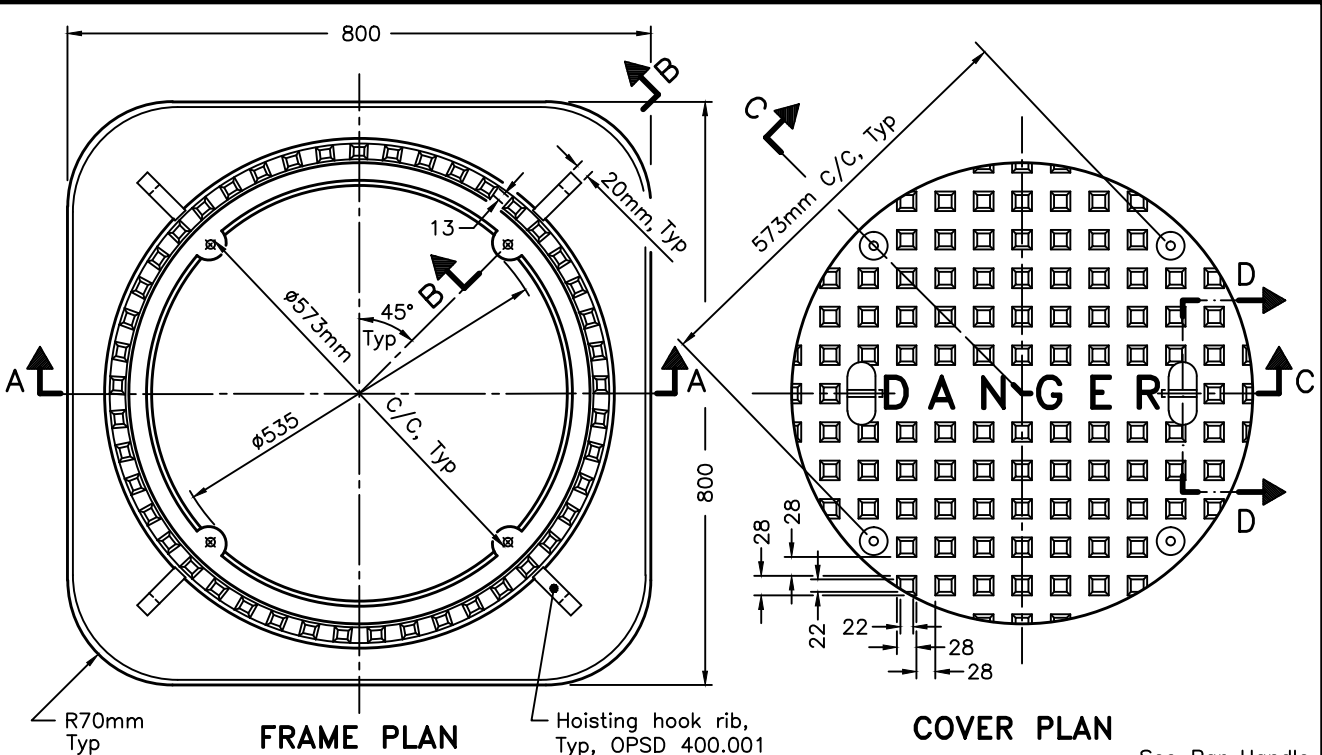
SECTION D-D

NOTES:
 A Covers shall be Type A or Type B, as specified.
 B All dimensions are in millimetres unless otherwise shown.



SECTION B-B

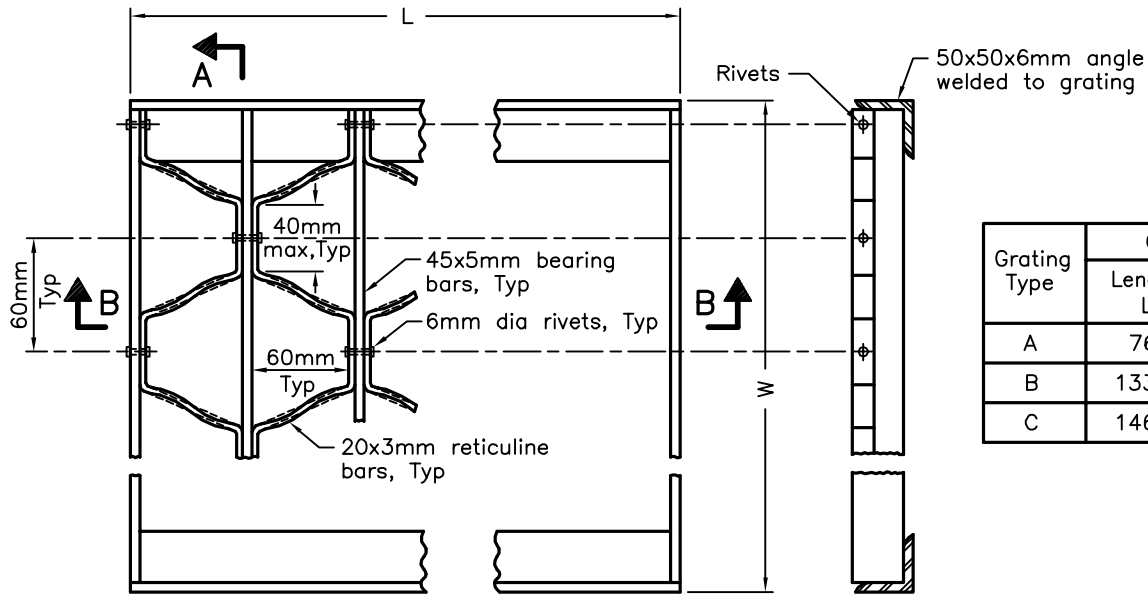
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 4	
CAST IRON, SQUARE FRAME WITH CIRCULAR CLOSED OR OPEN COVER FOR MAINTENANCE HOLES	-----		
OPSD 401.010			



NOTE:
 A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2018	Rev 4	
CAST IRON, SQUARE FRAME WITH CIRCULAR WATERTIGHT COVER FOR MAINTENANCE HOLES		-----		

OPSD 401.030				



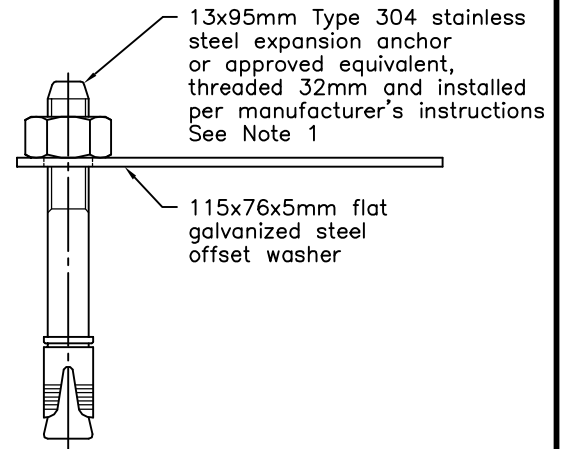
Grating Type	Grating Size	
	Length L	Width W
A	762	768
B	1338	768
C	1465	768

PLAN OF GRATE

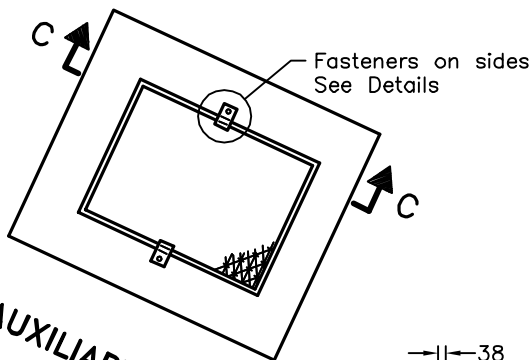
SECTION A-A



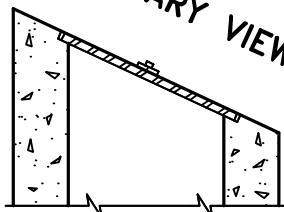
SECTION B-B



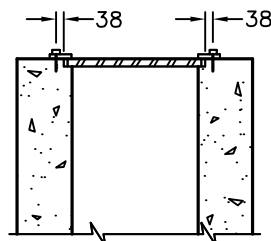
FASTENER DETAIL



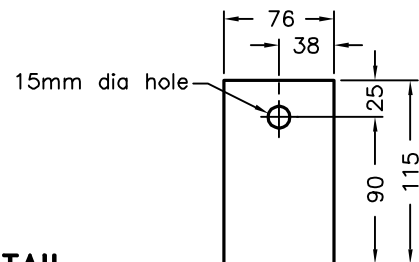
AUXILIARY VIEW



SECTION C-C



FASTENER EMBEDMENT DETAIL



OFFSET WASHER DETAIL

NOTES:

- 1 Equivalent (13x100mm Galvanized J-Bolt) cast-in-place anchor may be used.
- A Fastener shall be inserted to maintain minimum concrete cover requirements.
- B All steel components and rivets shall be galvanized.
- C All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

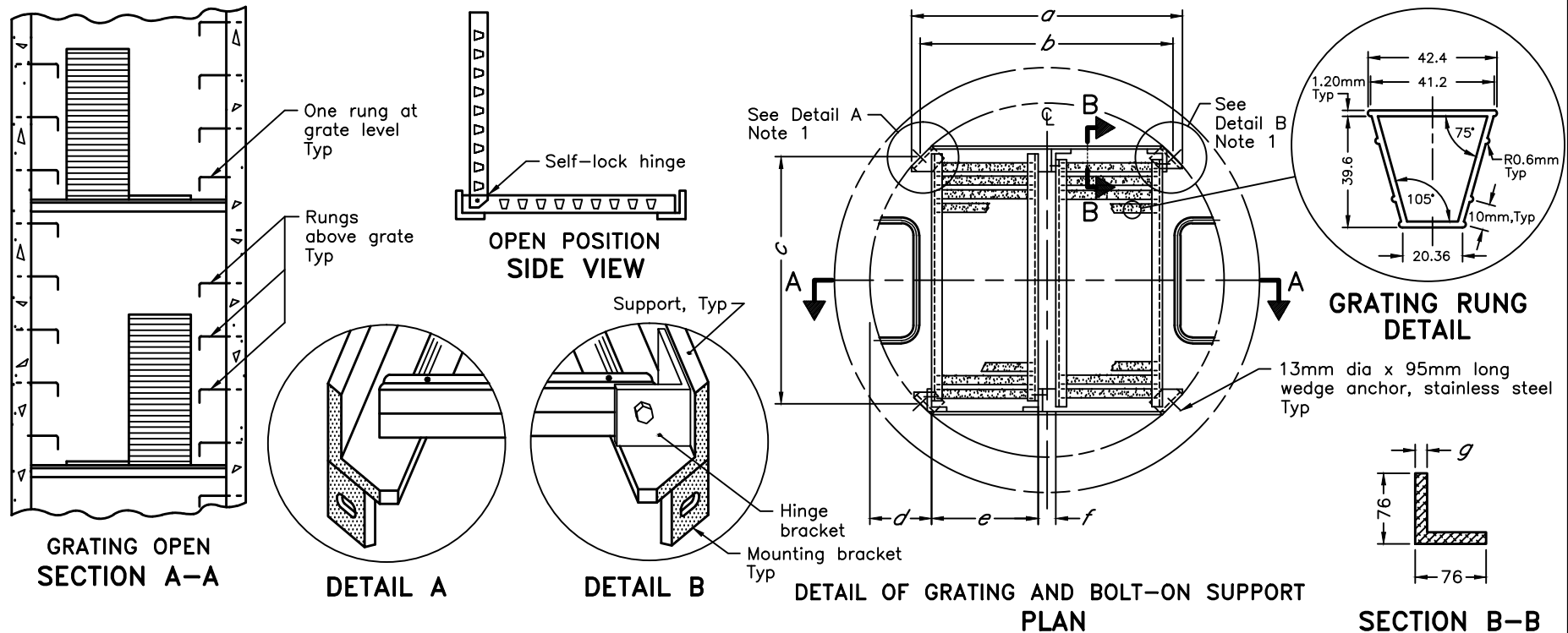
Nov 2017

Rev 3

**GALVANIZED STEEL
HONEYCOMB GRATING
FOR DITCH INLETS**



OPSD 403.010

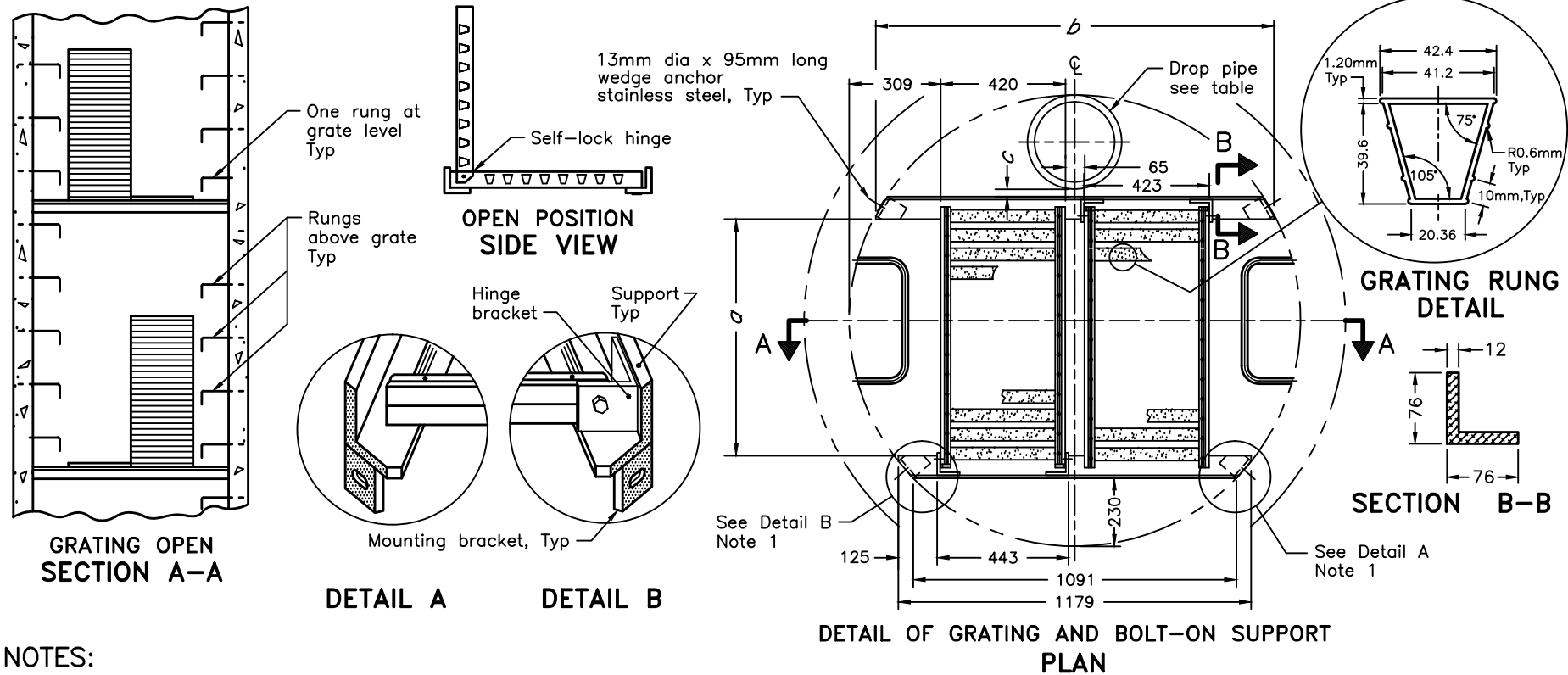


NOTES:

- 1 All hinge brackets and mounting brackets shall be welded all around to support angle.
- A All aluminum in contact with concrete shall be thoroughly coated with asphalt paint.
- B Maintenance hole depth between 5.0m and 10.0m, grate shall be placed at midpoint. Maintenance hole depth between 10.0m and 15.0m, grates shall be placed at third-points.
- C All fasteners shall be 304 stainless steel.
- D All welding shall be according to CSA W47.2 and W59.2.
- E All aluminum components shall be 6000 series structural aluminum.
- F All dimensions are in millimetres unless otherwise shown.

MH Diameter	No of Grates	a	b	c	d	e	f	g
1200	2	900	850	850	225	352	65	10
1500	2	1128	1078	1078	311	419	65	12
1800	3	1344	1293	1293	308	360	65	12
2400	4	1774	1724	1724	401	360	65	12

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 4	
ALUMINUM SAFETY PLATFORM FOR CIRCULAR MAINTENANCE HOLES	-----		
OPSD 404.020			

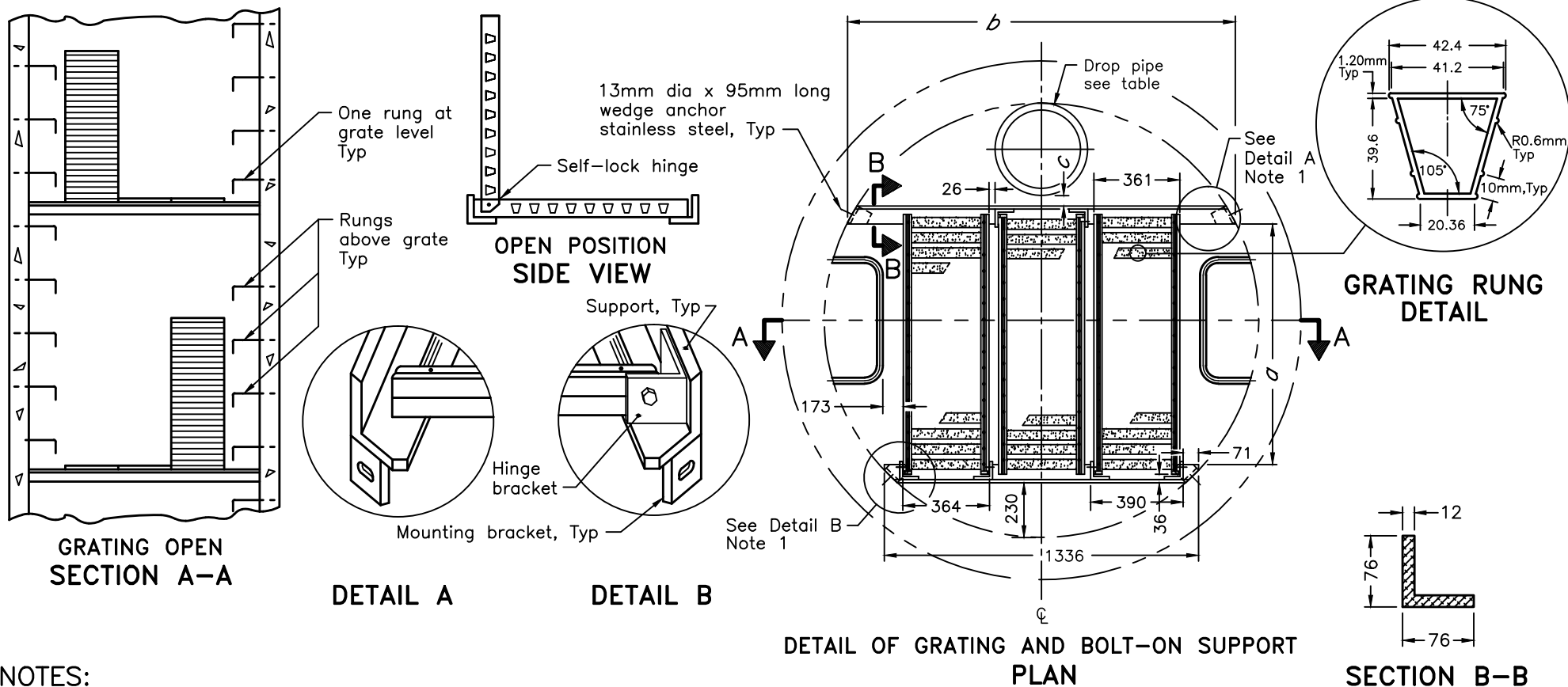


NOTES:

- 1 All hinge brackets and mounting brackets shall be welded all around to support angle.
- A All aluminum in contact with concrete shall be thoroughly coated with asphalt paint.
- B Maintenance hole depth between 5.0m and 10.0m, grate shall be placed at midpoint. Maintenance hole depth between 10.0m and 15.0m, grates shall be placed at third-points.
- C All fasteners shall be 304 stainless steel.
- D All welding shall be according to CSA W47.2 and W59.2.
- E All aluminum components shall be 6000 series structural aluminum.
- F All dimensions are in millimetres unless otherwise shown.

INSIDE DIA DROP PIPE	<i>a</i>	<i>b</i>	<i>c</i>	OUTSIDE DIA DROP PIPE, MAX
150	932	1143	59	160
200	866	1254	62	213
250	799	1335	76	267
300	799	1335	25	318

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3	
ALUMINUM SAFETY PLATFORM FOR 1500mm DIAMETER CIRCULAR MAINTENANCE HOLES WITH DROP PIPE	-----		
OPSD 404.021			

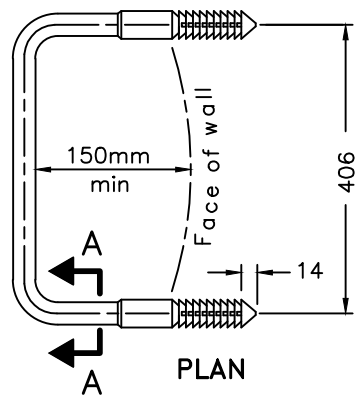


NOTES:

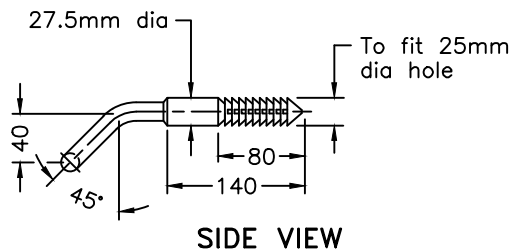
- 1 All hinge brackets and mounting brackets shall be welded all around to support angle.
- A All aluminum in contact with concrete shall be thoroughly coated with asphalt paint.
- B Maintenance hole depth between 5.0m and 10.0m, grate shall be placed at midpoint. Maintenance hole depth between 10.0m and 15.0m, grates shall be placed at third-points.
- C All fasteners shall be 304 stainless steel.
- D All welding shall be according to CSA W47.2 and W59.2.
- E All aluminum components shall be 6000 series structural aluminum.
- F All dimensions are in millimetres unless otherwise shown.

INSIDE DIA DROP PIPE	<i>a</i>	<i>b</i>	<i>c</i>	OUTSIDE DIA DROP PIPE, MAX
150	1218	1316	79	160
200	1218	1316	29	213
250	1150	1433	47	267
300	1082	1524	65	318
375	1014	1610	58	389

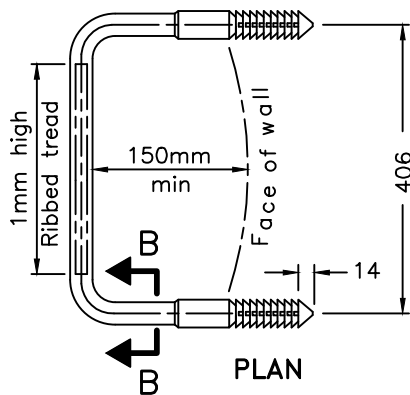
ONTARIO PROVINCIAL STANDARD DRAWING ALUMINUM SAFETY PLATFORM FOR 1800mm DIAMETER CIRCULAR MAINTENANCE HOLES WITH DROP PIPE	Nov 2018 Rev 3	
OPSD 404.022		



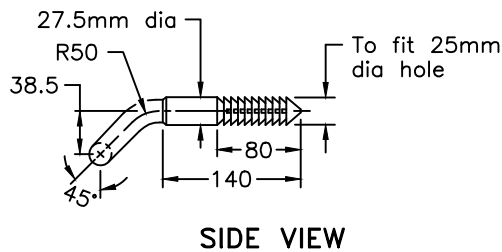
PLAN



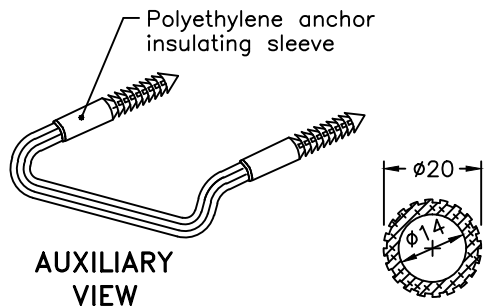
SIDE VIEW



PLAN

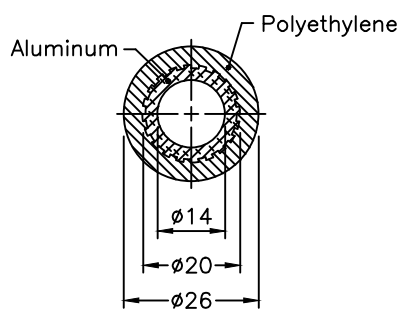


SIDE VIEW

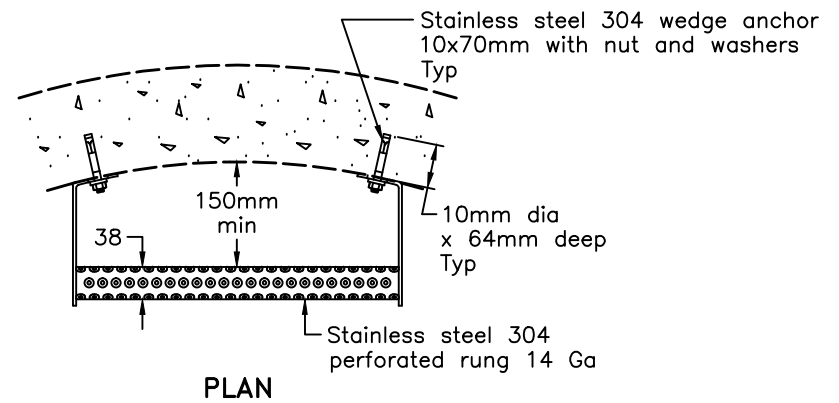


AUXILIARY VIEW

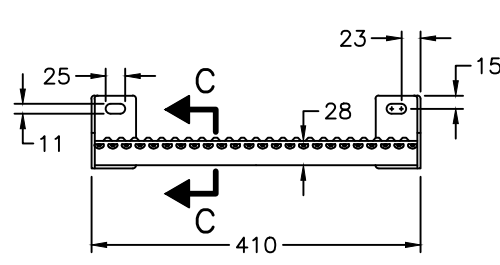
EXTRUDED CIRCULAR SECTION A-A



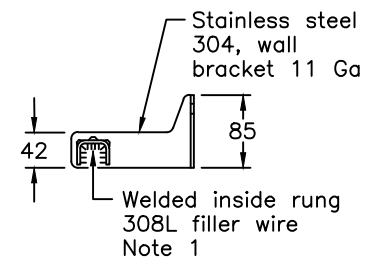
SECTION B-B



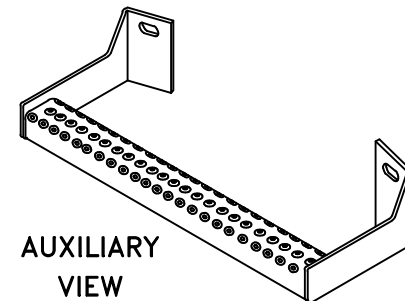
PLAN



FRONT VIEW



SECTION C-C



AUXILIARY VIEW

CIRCULAR ALUMINUM

CIRCULAR ALUMINUM WITH POLYETHYLENE ENCASEMENT

RECTANGULAR STAINLESS STEEL

NOTE:

1 The company undertaking welded fabrication shall be certified according to CSA W47.1. All welding shall be according to CSA W59.

A All aluminum components shall be 6000 series structural aluminum.

B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2018

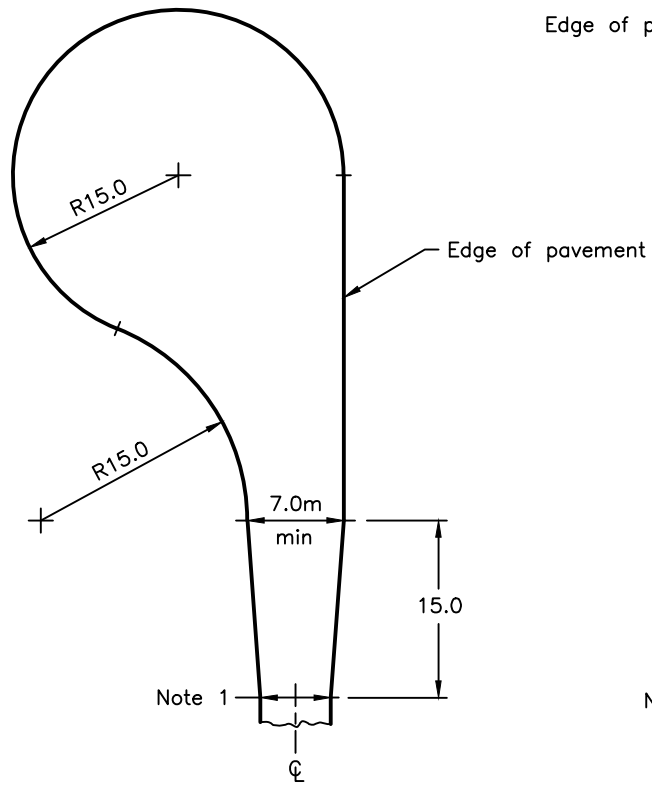
Rev 4

MAINTENANCE HOLE STEPS

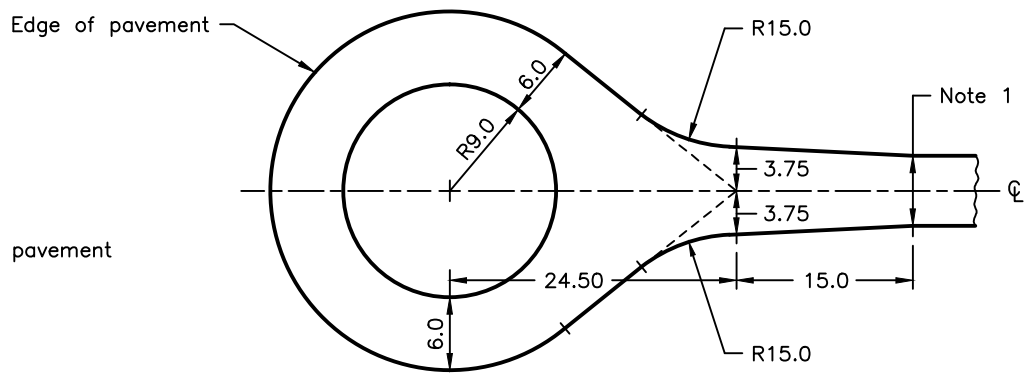
HOLLOW

OPSD 405.010

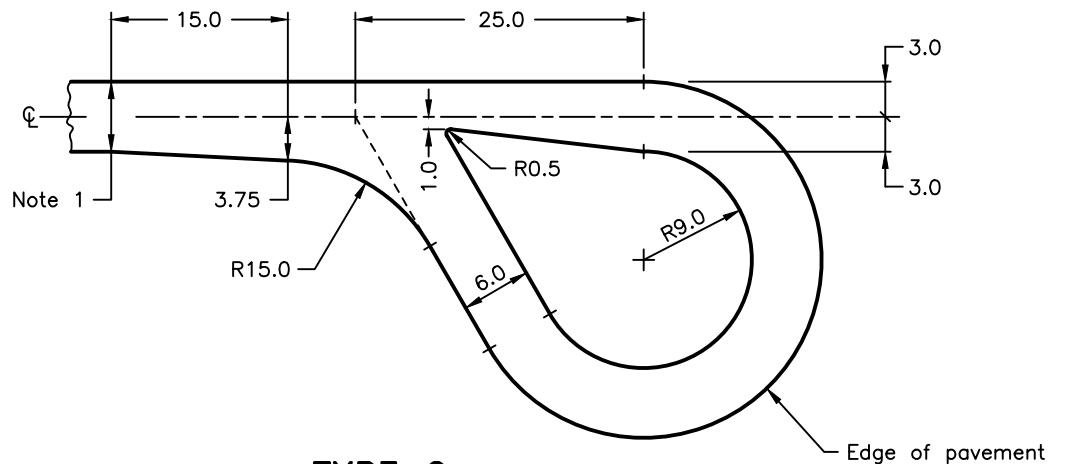




TYPE A



TYPE B



TYPE C

NOTES:

1 Width of pavement, shoulder, and rounding to match terminated roadway.

A Drainage and grading as specified.

B All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

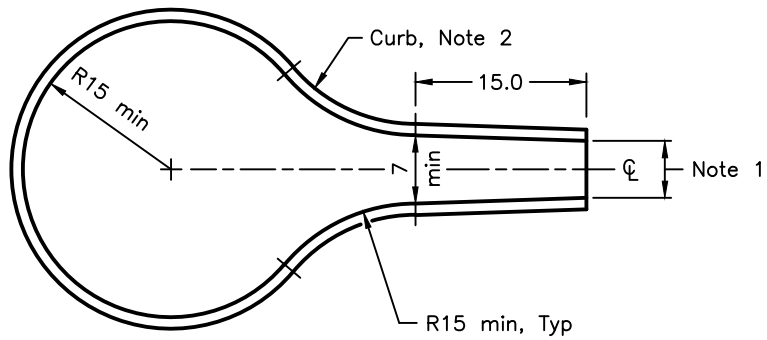
Nov 2018

Rev 1

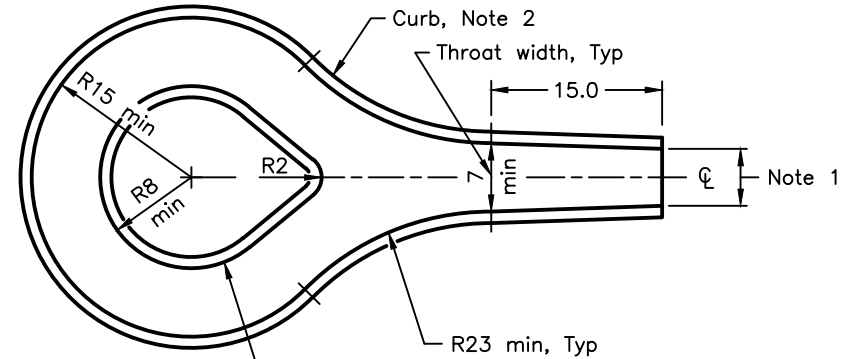
**TURNING BASINS
FOR TERMINATED RURAL ROADWAYS**



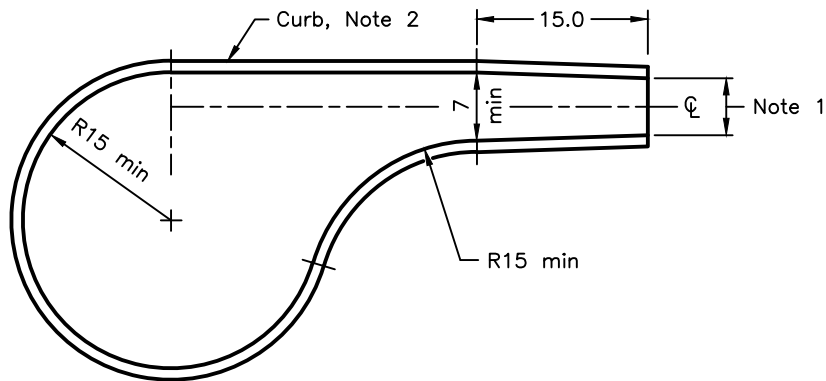
OPSD 500.010



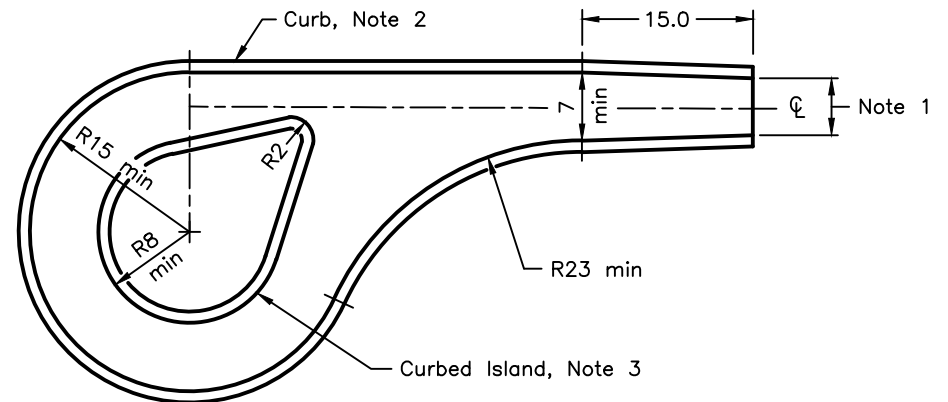
TYPE A



TYPE C



TYPE B



TYPE D

NOTES:

- 1 Width of pavement to match terminated roadway.
- 2 Type of curb to match terminated roadway.
- 3 Island curb shall be according to OPSD 600.090.
- A Drainage and grading as specified.
- B All dimensions are in metres unless otherwise shown.

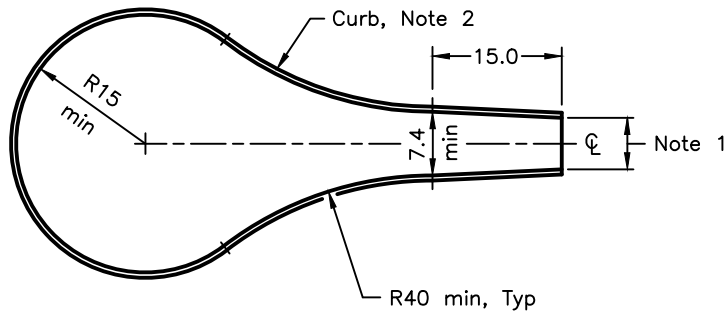
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2018 Rev 1

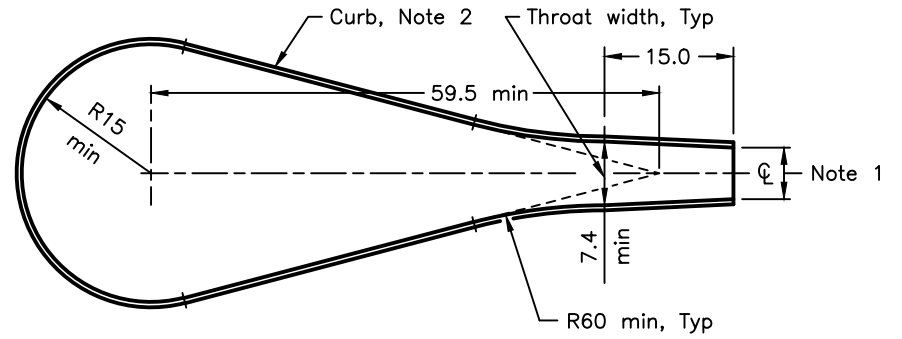
**TURNING BASINS
FOR TERMINATED URBAN ROADWAYS
RESIDENTIAL**



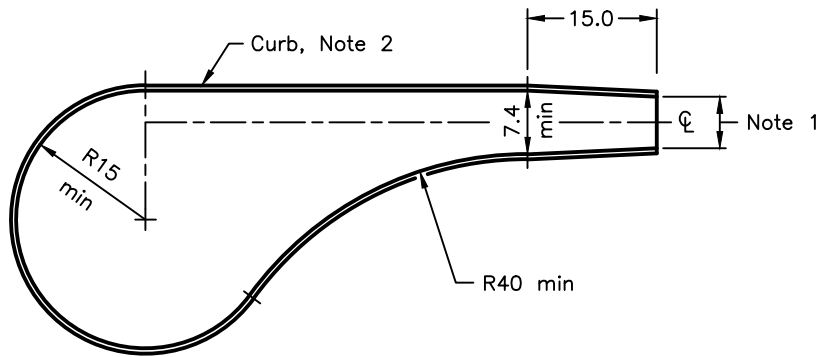
OPSD 500.020



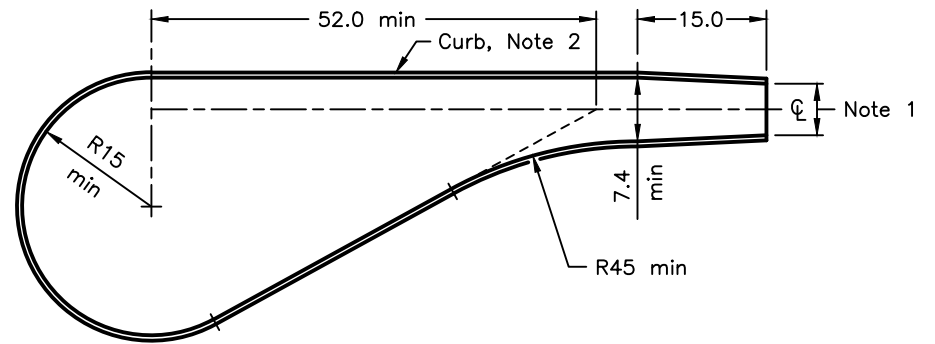
TYPE A



TYPE C




TYPE B



TYPE D

NOTES:

- 1 Width of pavement to match terminated roadway.
- 2 Type of curb to match terminated roadway.
- A Drainage and grading as specified.
- B Minimum radius should be increased to accommodate design vehicles.
- C All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 1	
TURNING BASINS FOR TERMINATED URBAN ROADWAYS INDUSTRIAL AND COMMERCIAL			
OPSD 500.030			

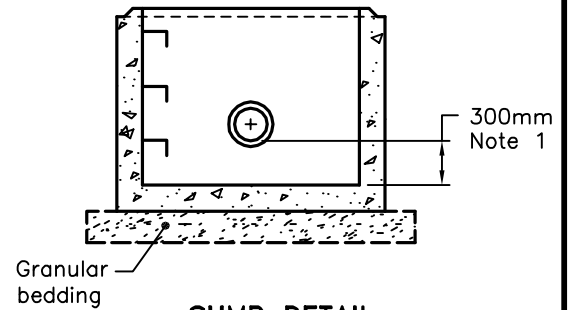
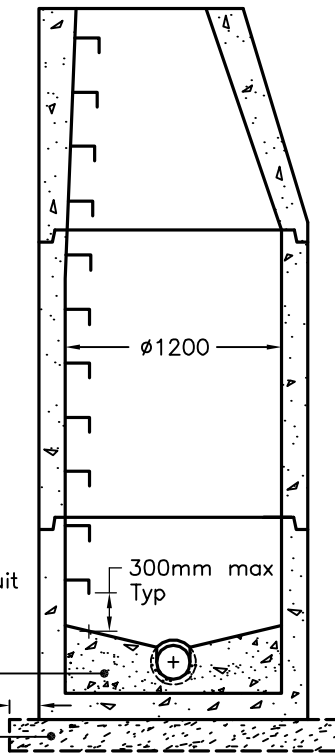
Tapered top
See alternative C

Riser sections
as required

Monolithic base with inlet
and outlet openings to suit
See alternatives A and B

Bench or sump
as specified

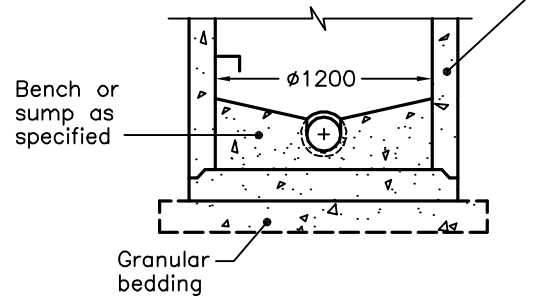
300mm, Typ
Granular bedding



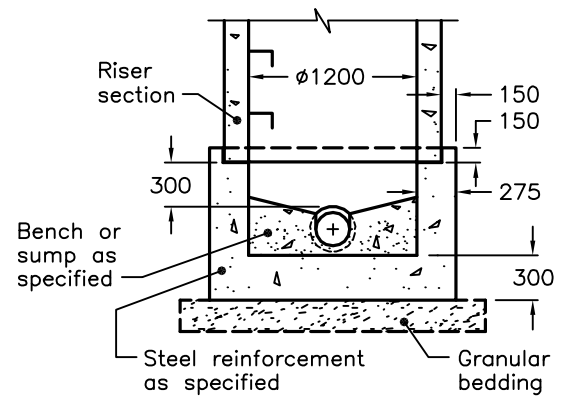
SUMP DETAIL

ALTERNATIVES

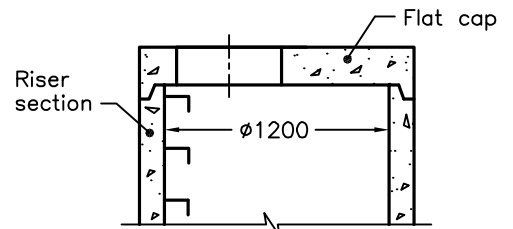
Bottom riser section with
inlet and outlet openings to suit



A PRECAST SLAB BASE



B CAST-IN-PLACE BASE



C PRECAST FLAT CAP

NOTES:

- 1 The sump is measured from the lowest invert.
- A Granular backfill shall be placed to a minimum thickness of 300mm all around the maintenance hole.
- B Precast concrete components shall be according to OPSD 701.030, 701.031, or 701.032.
- C Structure exceeding 5.0m in depth shall include safety platform according to OPSD 404.020.
- D Pipe support according to OPSD 708.020.
- E For benching and pipe opening details, see OPSD 701.021.
- F For adjustment unit and frame installation, see OPSD 704.010.
- G All dimensions are nominal.
- H All dimensions are in millimetres unless otherwise shown.

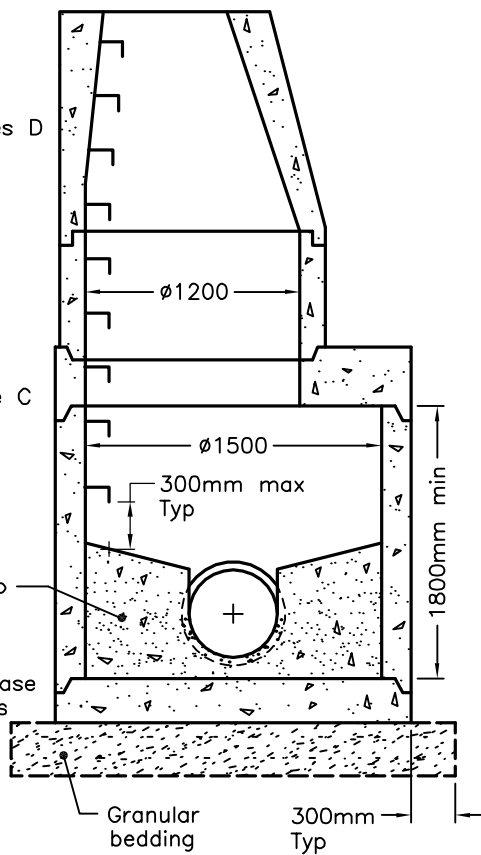
ONTARIO PROVINCIAL STANDARD DRAWING

**PRECAST CONCRETE
MAINTENANCE HOLE
1200mm DIAMETER**

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OPSD 701.010



Tapered top
See alternatives D
and E

Riser sections
as required

Transition slab
See alternative C

Riser sections
as required

Bench or sump
as specified
Note 1

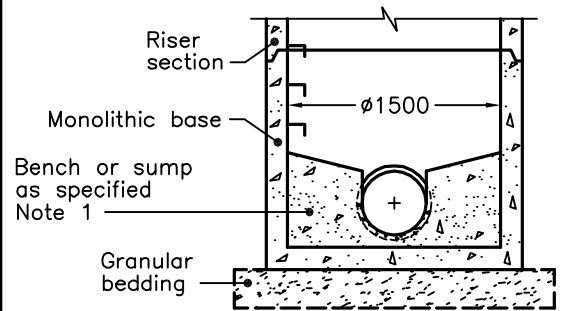
Precast slab base
See alternatives
A and B

Granular
bedding 300mm
Typ

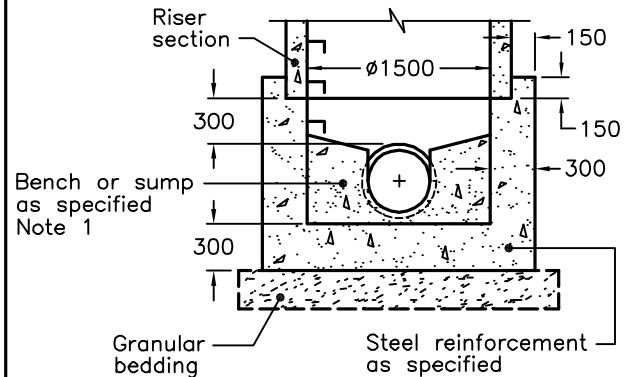
NOTES:

- 1 For sump detail, see OPSD 701.010.
- A Granular backfill shall be placed to a minimum thickness of 300mm all around the maintenance hole.
- B Precast concrete components shall be according to OPSD 701.030, 701.031, 701.040, 701.041, 703.011, 703.021, and 706.010.
- C Structures exceeding 5.0m in depth shall include safety platform according to OPSD 404.020 or 404.021.
- D Pipe support shall be according to OPSD 708.020.
- E For benching and pipe opening details, see OPSD 701.021.
- F For adjustment unit and frame installation, see OPSD 704.010.
- G All dimensions are nominal.
- H All dimensions are in millimetres unless otherwise shown.

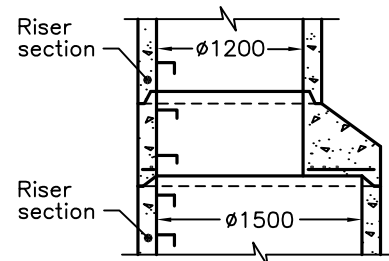
ALTERNATIVES



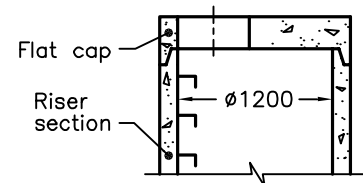
A PRECAST MONOLITHIC BASE



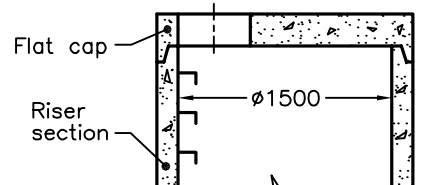
B CAST-IN-PLACE BASE



C TAPERED TRANSITION SLAB



D 1200mm PRECAST FLAT CAP



E 1500mm PRECAST FLAT CAP

ONTARIO PROVINCIAL STANDARD DRAWING

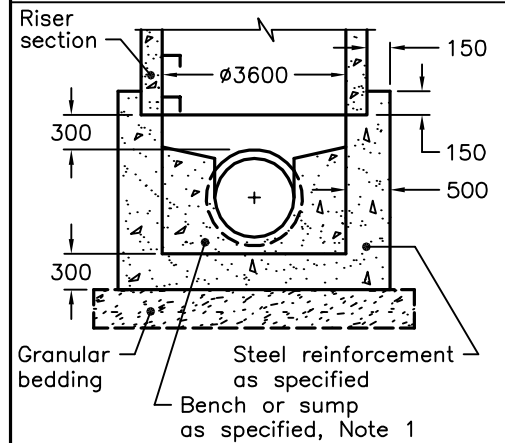
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**PRECAST CONCRETE
MAINTENANCE HOLE
1500mm DIAMETER**

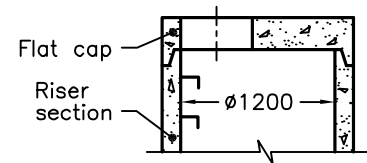


OPSD 701.011

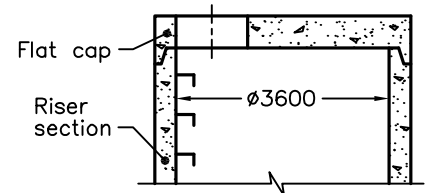
ALTERNATIVES



A CAST-IN-PLACE BASE



B 1200mm PRECAST FLAT CAP



C 3600mm PRECAST FLAT CAP

Tapered top
See alternatives B
and C

Riser sections
as required

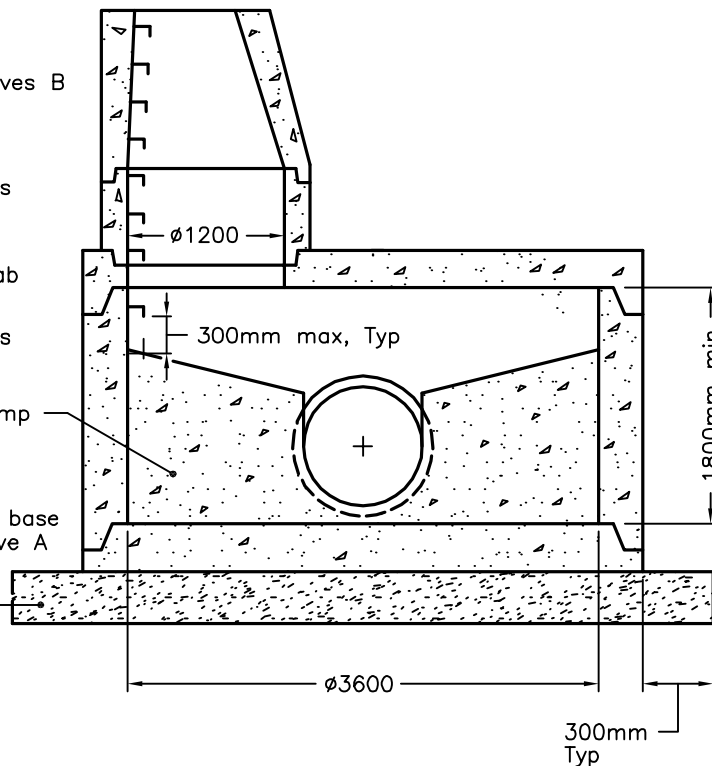
Transition slab

Riser sections
as required

Bench or sump
as specified
Note 1

Precast slab base
See alternative A

Granular
bedding



NOTES:

- 1 For sump detail, see OPSD 701.010.
- A Granular backfill shall be placed to a minimum thickness of 300mm all around the maintenance hole.
- B Precast concrete components shall be according to OPSD 701.030, 701.031, 701.080, 701.081, and 703.015.
- C Structures exceeding 5.0m in depth shall include safety platform according to OPSD 404.020.

- D Pipe support shall be according to OPSD 708.020.
- E For benching and pipe opening details, see OPSD 701.021.
- F For adjustment unit and frame installation, see OPSD 704.010.
- G All dimensions are nominal.
- H All dimensions are in millimetres unless otherwise shown.

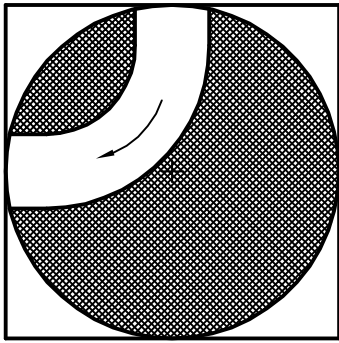
ONTARIO PROVINCIAL STANDARD DRAWING

**PRECAST CONCRETE
MAINTENANCE HOLE**
3600mm DIAMETER

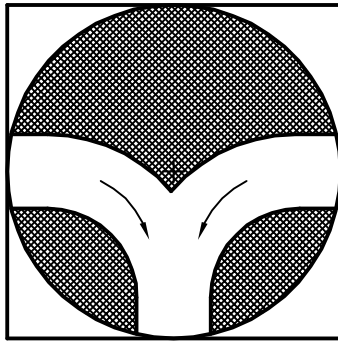
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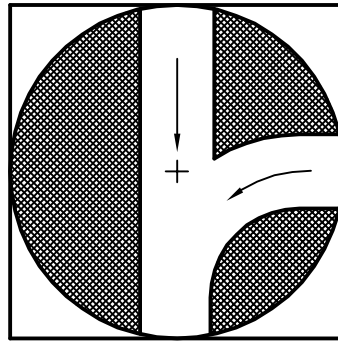
OPSD 701.015



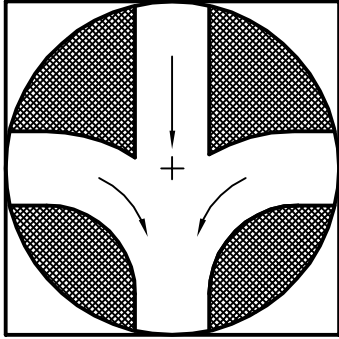
1. Right angle bend



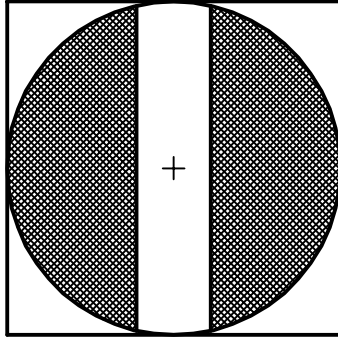
2. Tee connection



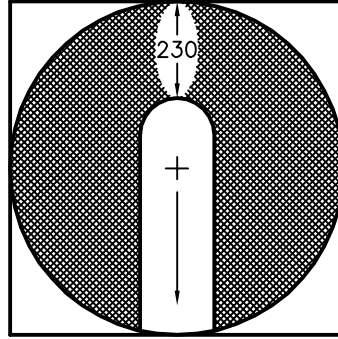
3. Three way junction



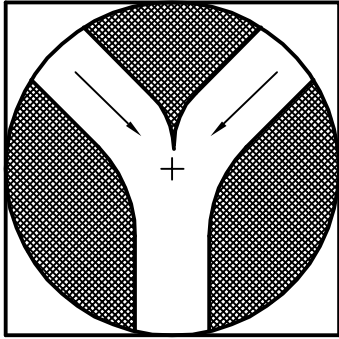
4. Four way junction



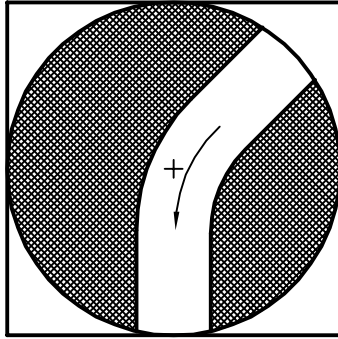
5. Straight through



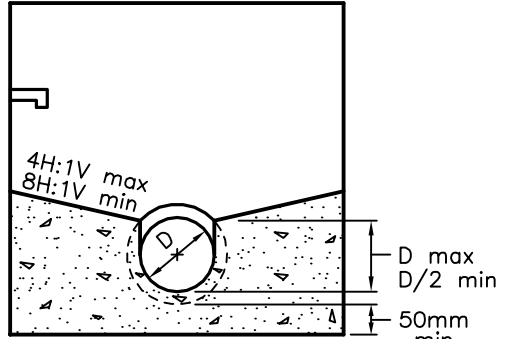
6. Dead end



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.

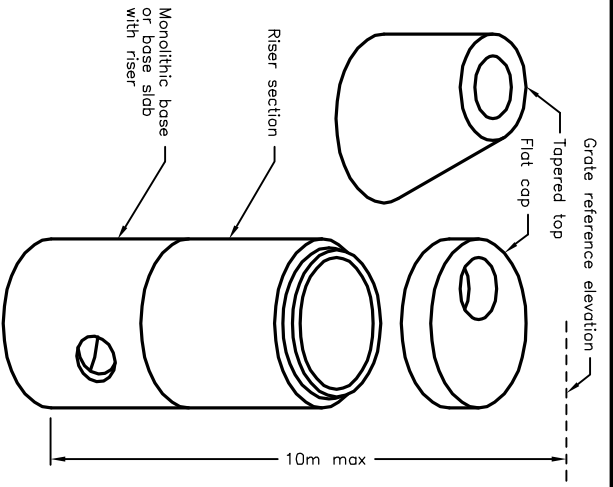
ONTARIO PROVINCIAL STANDARD DRAWING

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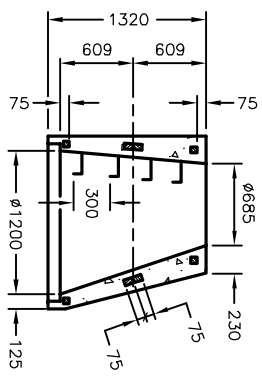
**MAINTENANCE HOLE BENCHING
AND PIPE OPENING ALTERNATIVES**



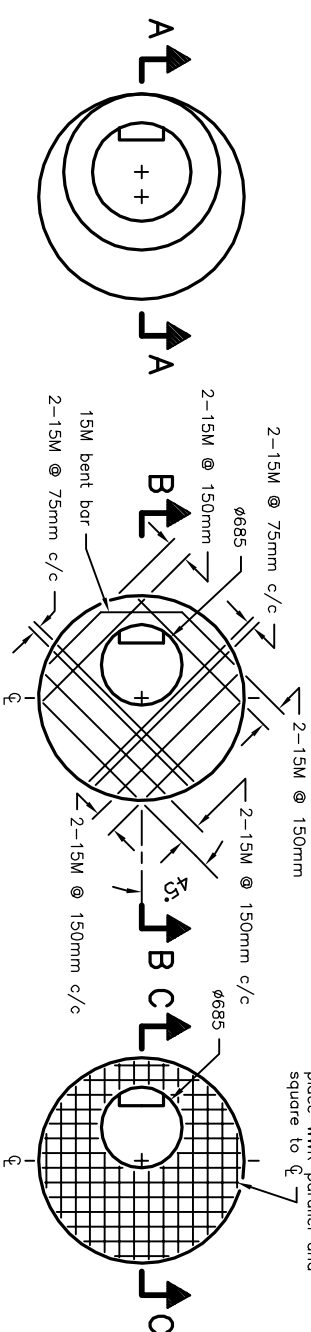
OPSD 701.021



1200mm DIAMETER MAINTENANCE HOLE



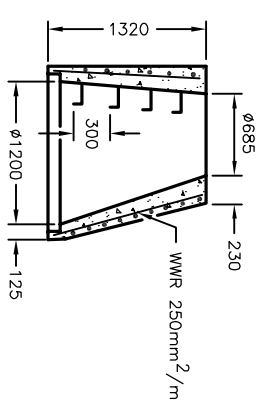
**SECTION A-A
TAPERED TOP WITH HOOP STEEL**



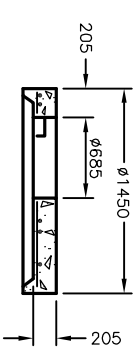
PLAN OF TAPERED TOP WITH REINFORCING STEEL BARS

PLAN OF FLAT CAP WITH REINFORCING STEEL BARS

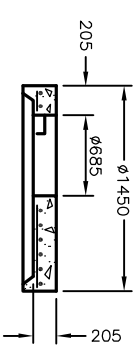
PLAN OF FLAT CAP WITH WWR



**SECTION A-A
TAPERED TOP WITH WWR**



SECTION B-B



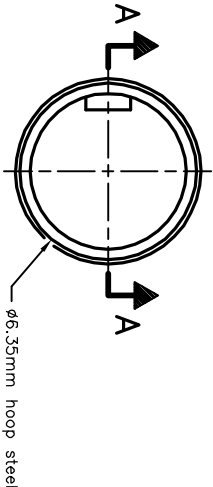
SECTION C-C

NOTES:

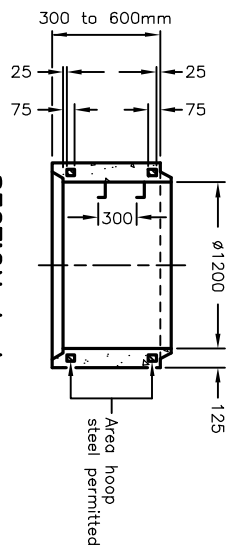
- A This drawing shall be read in conjunction with OPSPD 701.031 and 701.032.
- B Centre reinforcing steel in riser ± 20 mm. All other reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSPD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev 4
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS			
1200mm DIAMETER TAPERED TOP AND FLAT CAP			
OPSPD 701.030			

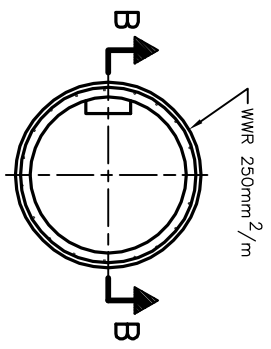




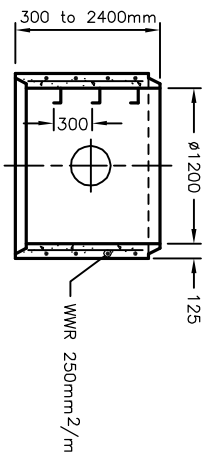
PLAN OF RISER WITH HOOP STEEL



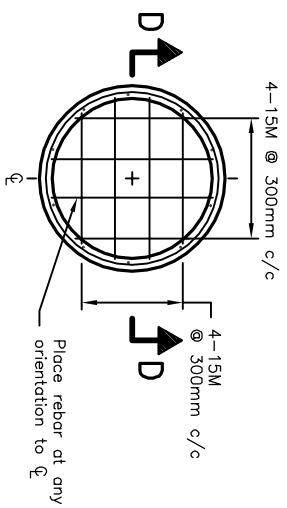
SECTION A-A RISERS < 900mm HIGH



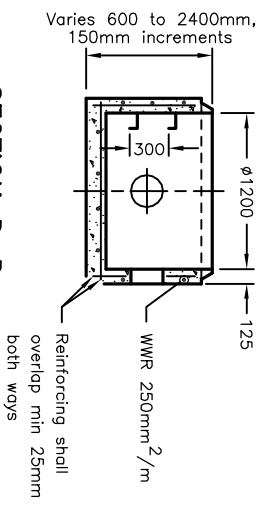
PLAN OF RISER WITH WWR



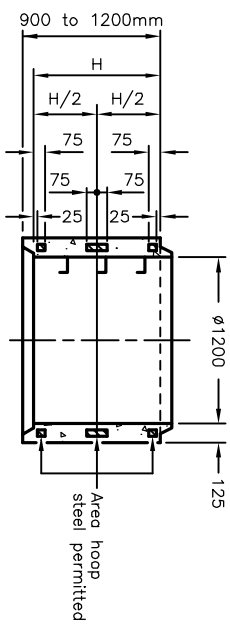
SECTION B-B



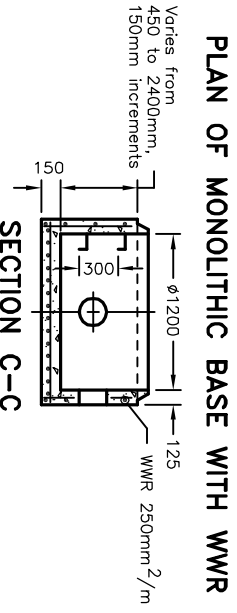
PLAN OF MONOLITHIC BASE WITH REINFORCING STEEL BARS AND WWR



SECTION D-D

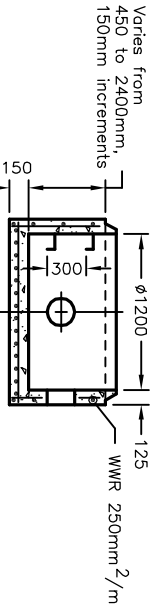


SECTION A-A RISERS ≥ 900mm



PLAN OF MONOLITHIC BASE WITH WWR

SECTION C-C



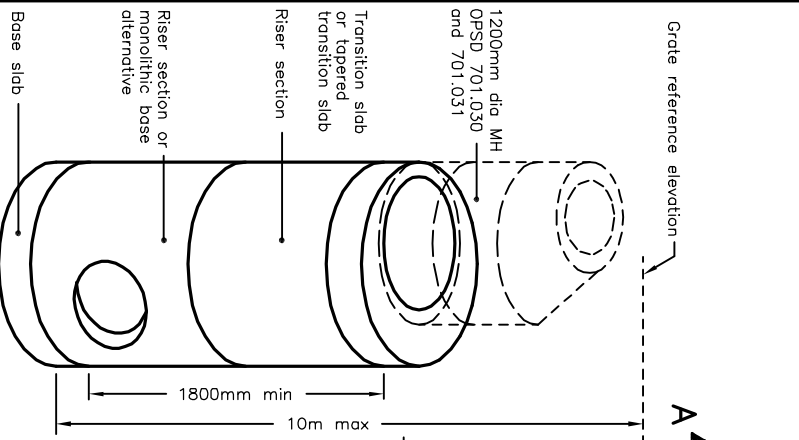
SECTION C-C

NOTES:

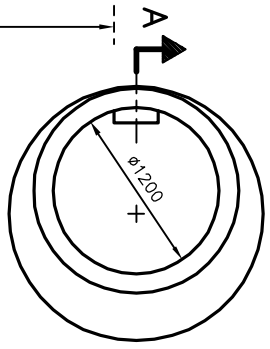
- A This drawing shall be read in conjunction with OPSPD 701.030 and 701.032.
- B Centre reinforcing steel in riser ±20mm. All other reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSPD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev 2
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS			
1200mm DIAMETER RISER AND MONOLITHIC BASE			
OPSPD 701.031			

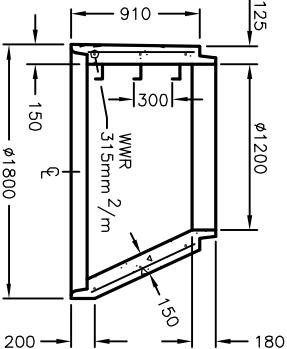




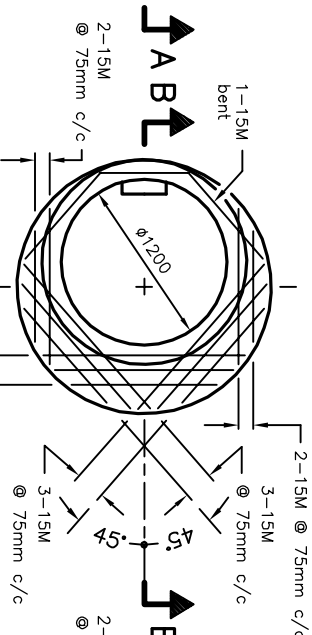
1500 to 1200mm DIAMETER MAINTENANCE HOLE



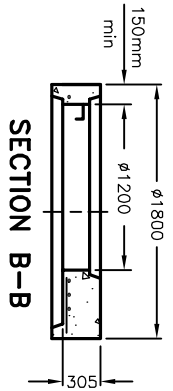
PLAN OF CONE



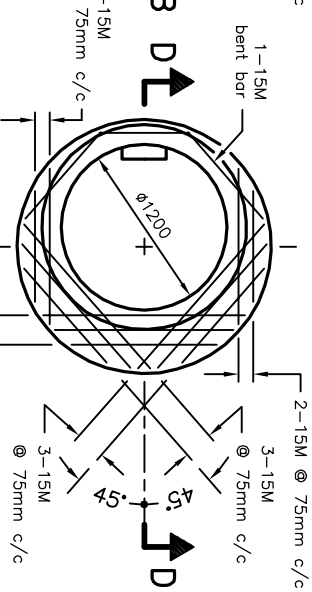
SECTION A-A



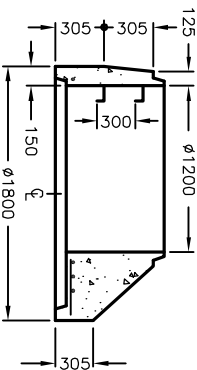
PLAN OF TRANSITION SLAB WITH REINFORCING STEEL BARS



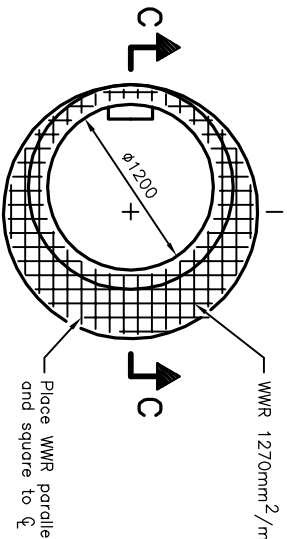
SECTION B-B



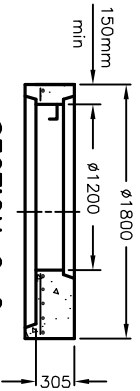
PLAN OF TAPERED TRANSITION SLAB WITH REINFORCING STEEL BARS



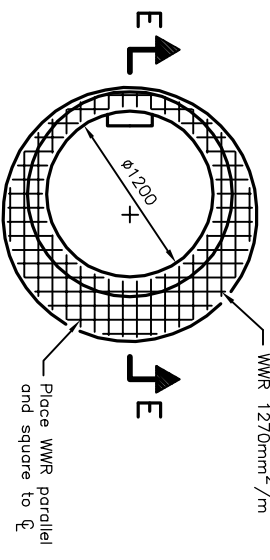
SECTION D-D



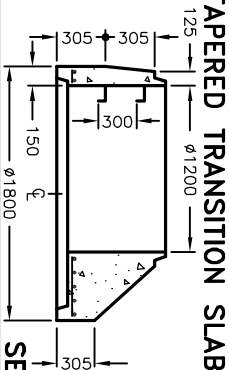
PLAN OF TRANSITION SLAB WITH WWR



SECTION C-C



PLAN OF TAPERED TRANSITION SLAB WITH WWR

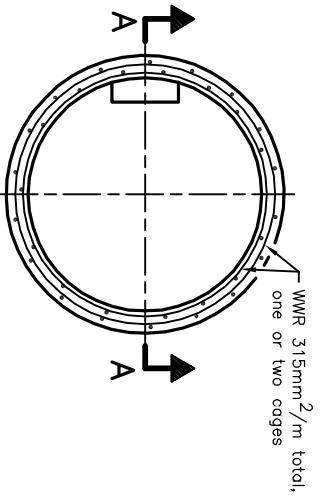


SECTION E-E

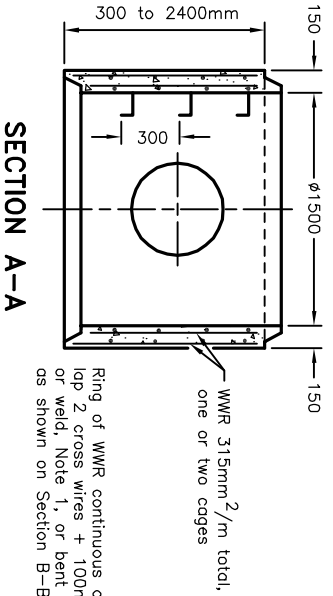
NOTES:

- A This OPSPD shall be read in conjunction with OPSPD 701.041.
- B Centre reinforcing in transition cone ± 25 mm.
- C All other reinforcing in steel shall have 25mm minimum cover.
- C Steps shall be according to OPSPD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

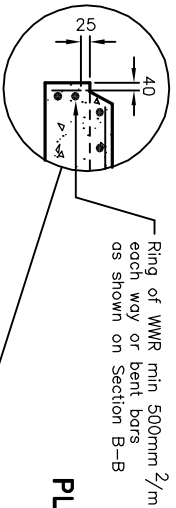
<p>ONTARIO PROVINCIAL STANDARD DRAWING</p> <p>PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS</p> <p>1500mm DIAMETER TRANSITION CONE AND SLABS</p>	<p>Nov 2014</p> <p>Rev 4</p>
	<p>OPSPD 701.040</p>



PLAN OF RISER WITH WWR

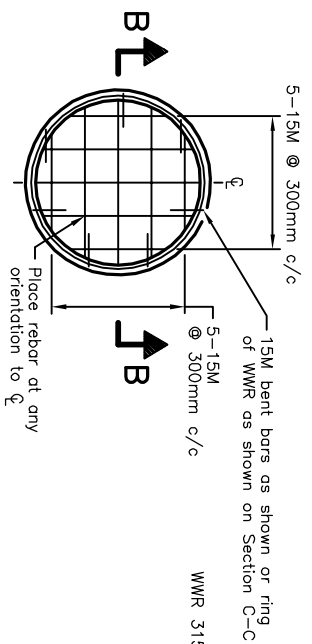


SECTION A-A

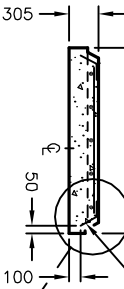


NOTES:

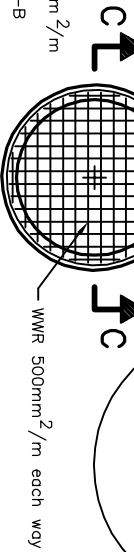
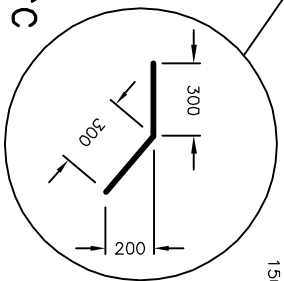
- 1 Welded splice shall develop minimum 50% yield strength of bar or wire, as applicable.
- A This OPSD shall be read in conjunction with OPSD 701.040.
- B If single cage of reinforcing in riser, centre reinforcing in wall ±25mm. All other reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.



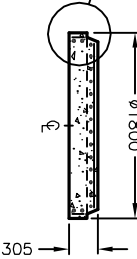
PLAN OF BASE SLAB WITH REINFORCING STEEL BARS



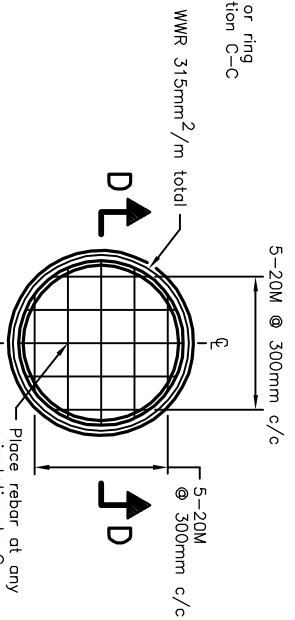
SECTION B-B



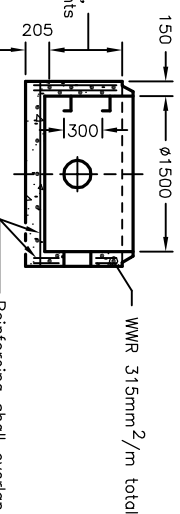
PLAN OF BASE SLAB WITH WWR



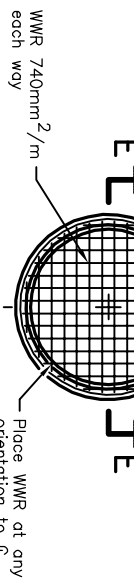
SECTION C-C



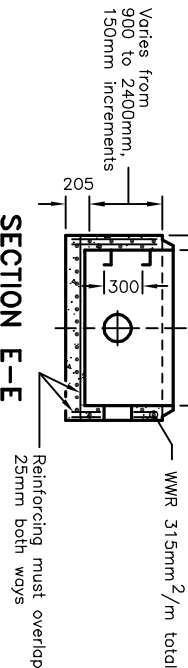
PLAN OF MONOLITHIC BASE WITH REINFORCING STEEL BARS



SECTION D-D



PLAN OF MONOLITHIC BASE WITH WWR



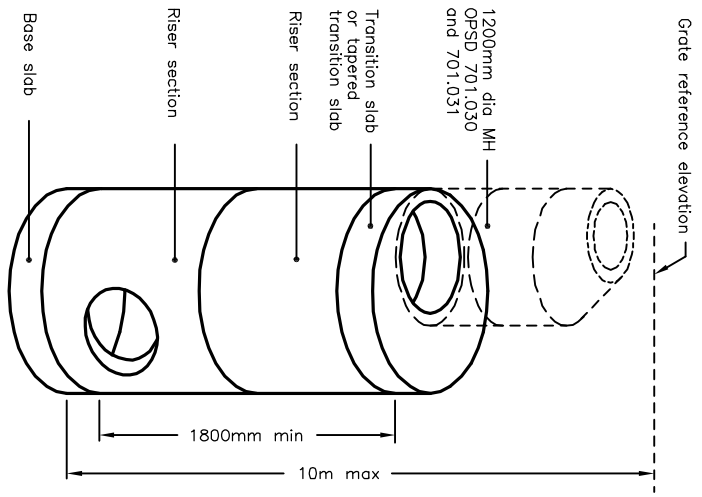
SECTION E-E

ONTARIO PROVINCIAL STANDARD DRAWING
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS
 1500mm DIAMETER
 RISER AND BASES

Nov 2014 Rev 2

OPSD 701.041

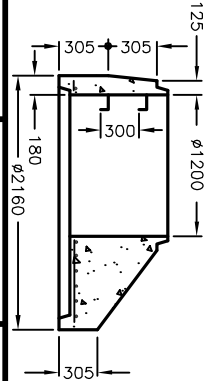
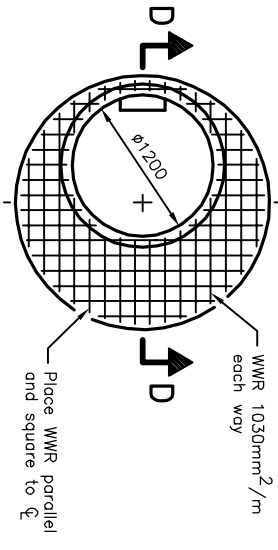
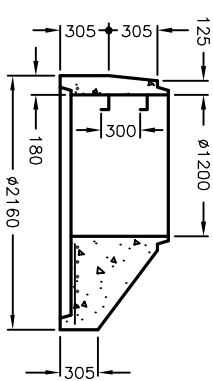
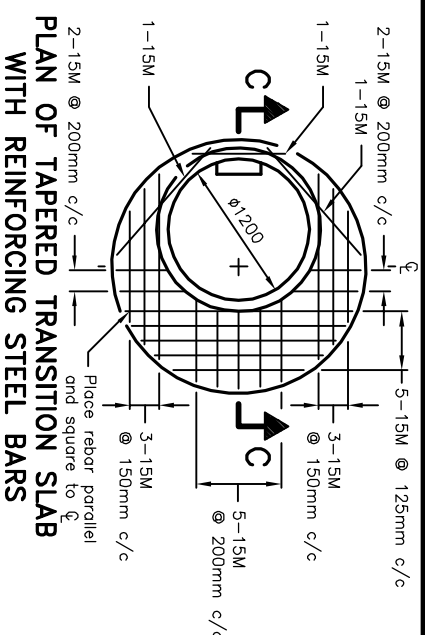
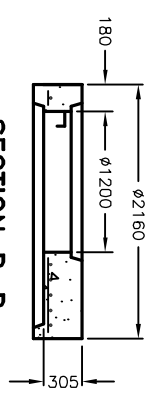
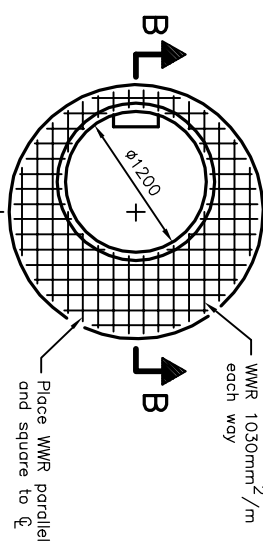
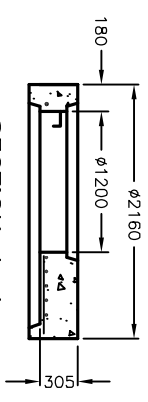
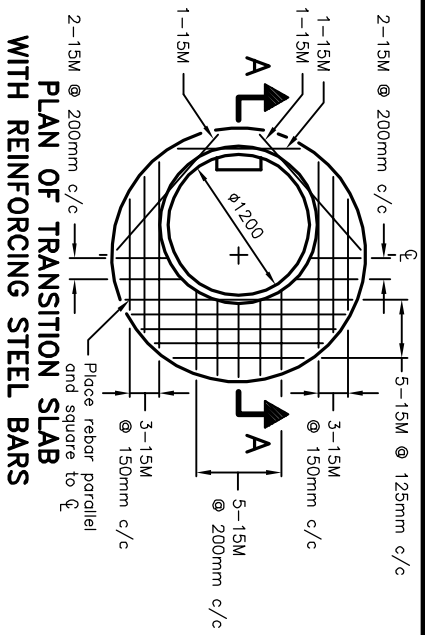




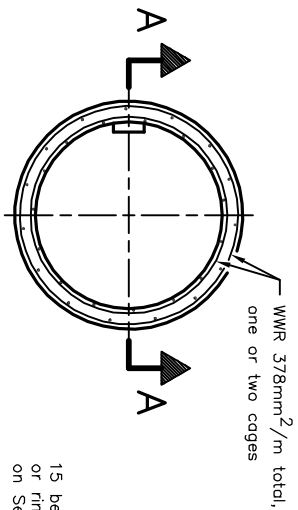
1800 to 1200mm DIAMETER MAINTENANCE HOLE

NOTES:

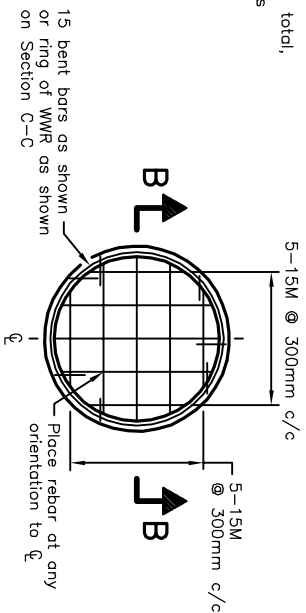
- A This OPSPD shall be read in conjunction with OPSPD 701.051.
- B All reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSPD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.



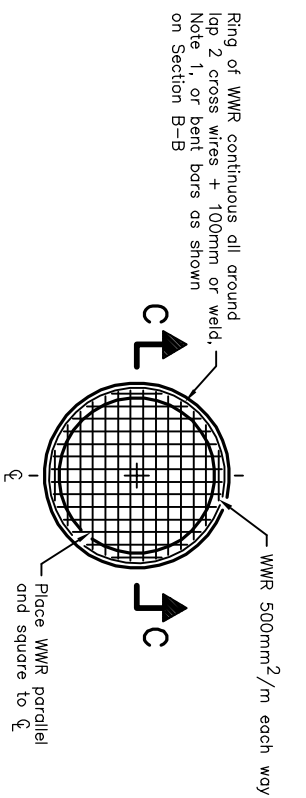
ONTARIO PROVINCIAL STANDARD DRAWING		NOV 2014	REV 4
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS			
1800mm DIAMETER TRANSITION SLABS			
OPSPD 701.050			



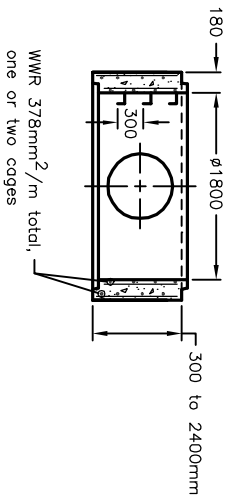
PLAN OF RISER WITH WWR



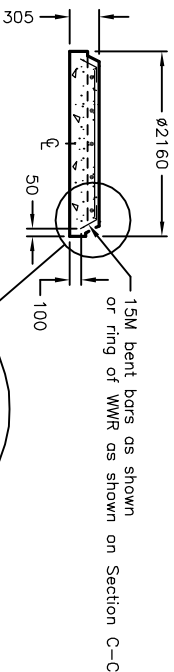
PLAN OF BASE SLAB WITH REINFORCING STEEL BARS



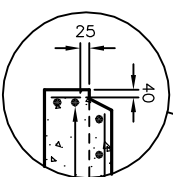
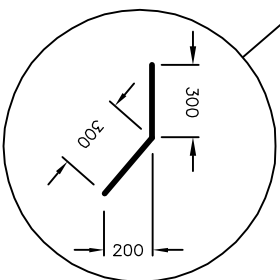
PLAN OF BASE SLAB WITH WWR



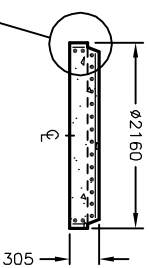
SECTION A-A



SECTION B-B



SECTION C-C



NOTES:

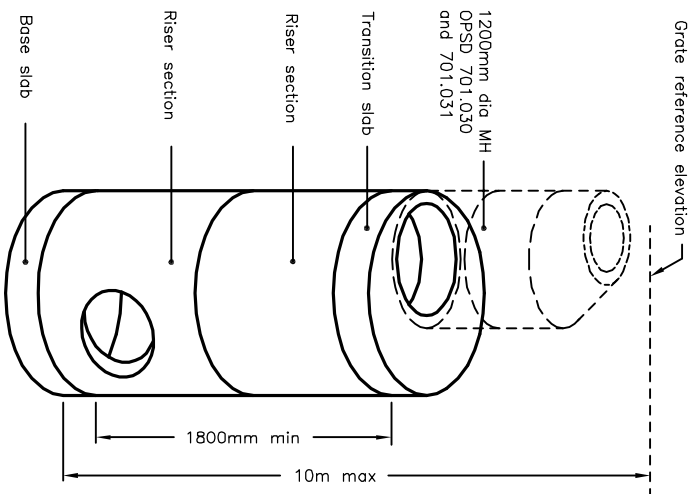
- 1 Welded splice shall develop 50% of yield strength of wires.
- A This OPSD shall be read in conjunction with OPSD 701.050.
- B If single cage of reinforcement in riser, centre reinforcing steel shall have ± 25 mm, All other reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING
PRECAST CONCRETE
MAINTENANCE HOLE COMPONENTS
 1800mm DIAMETER
 RISER AND BASE SLAB

Nov 2014 Rev 2

OPSD 701.051

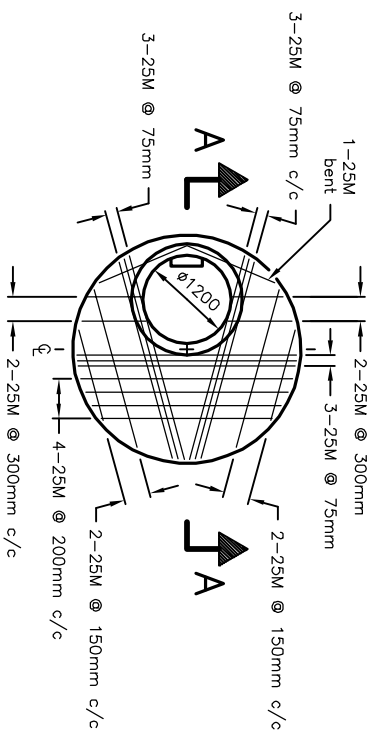




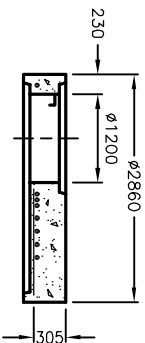
**2400 to 1200mm DIAMETER
MAINTENANCE HOLE**

NOTES:

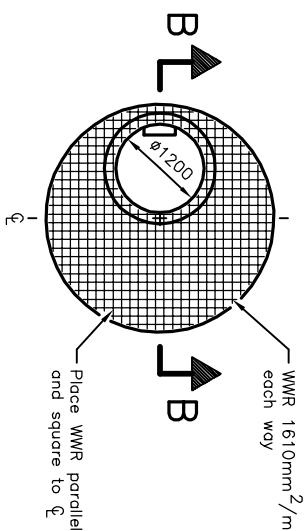
- A This OPSD shall be read in conjunction with OPSD 701.061.
- B All reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSD 405.010 or 405.020.
- D All dimensions are in millimetres
- E All dimensions are in millimetres unless otherwise shown.



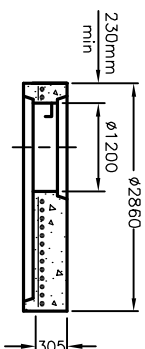
**PLAN OF TRANSITION SLAB
WITH REINFORCING STEEL BARS**



SECTION A-A



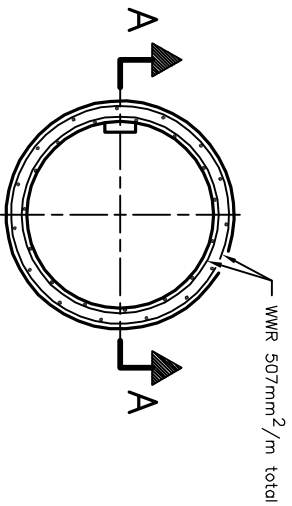
**PLAN OF TRANSITION SLAB
WITH WWR**



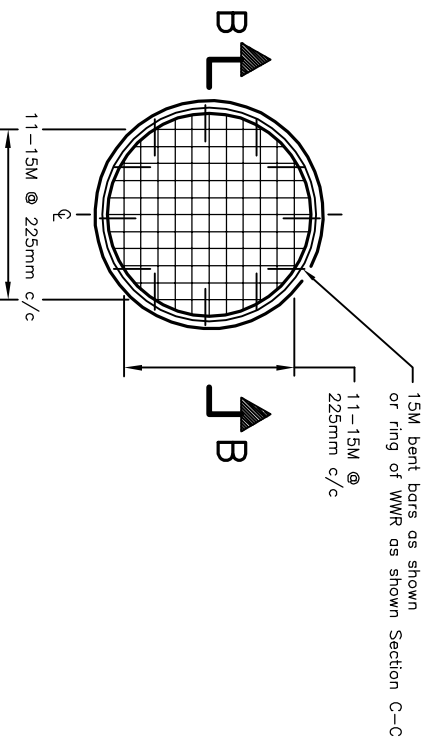
SECTION B-B

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev	4
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS 2400mm DIAMETER TRANSITION SLAB		-----		

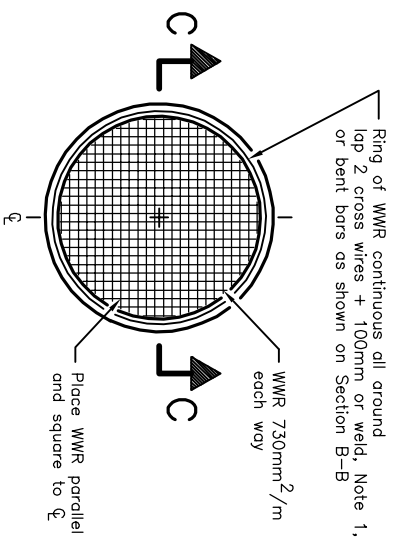
OPSD 701.060				



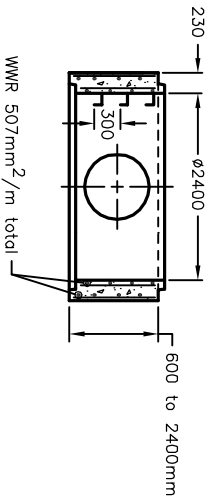
PLAN OF RISER



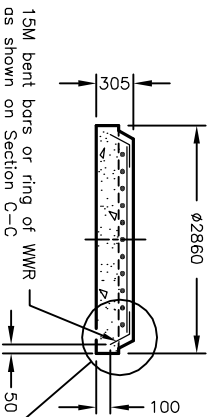
PLAN OF BASE SLAB WITH REINFORCING STEEL BARS



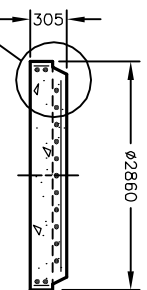
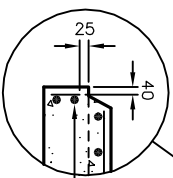
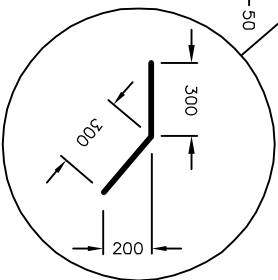
PLAN OF BASE SLAB WITH WWR



SECTION A-A




SECTION B-B

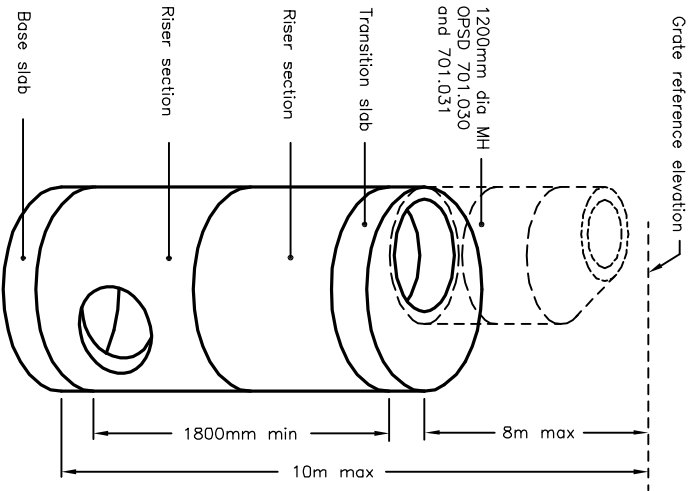


SECTION C-C

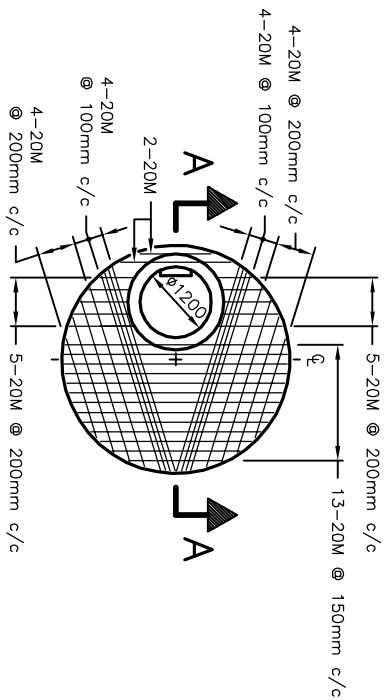
NOTES:

- 1 Welded splice shall develop minimum 50% of yield strength of wires.
- A This OPSPD shall be read in conjunction with OPSPD 701.060.
- B All reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSPD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

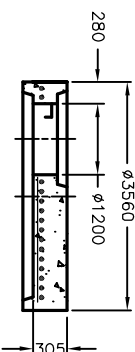
ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev	2
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS 2400mm DIAMETER RISER AND BASE SLAB				
		OPSPD 701.061		



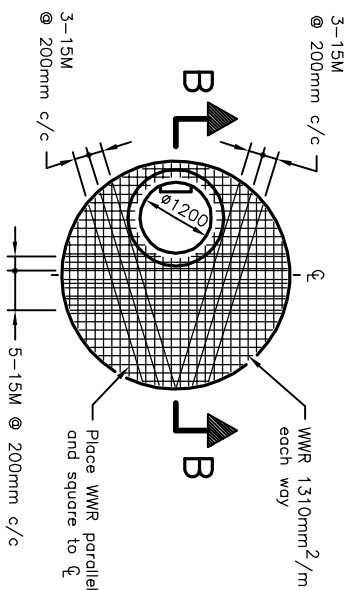
**3000 to 1200mm DIAMETER
MAINTENANCE HOLE**



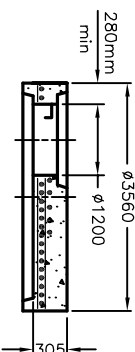
**PLAN OF TRANSITION SLAB
WITH REINFORCING STEEL BARS**



SECTION A-A



**PLAN OF TRANSITION SLAB WITH WWR
AND REINFORCING STEEL BARS**



SECTION B-B

NOTES:

- A This OPSD shall be read in conjunction with OPSD 701.071.
- B All reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2014

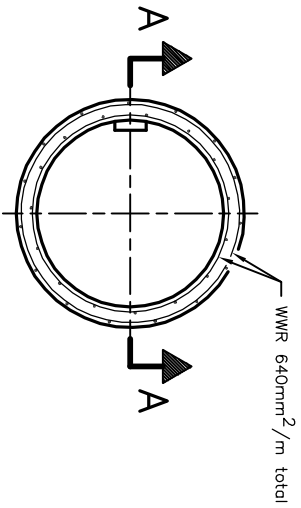
Rev 3

**PRECAST CONCRETE
MAINTENANCE HOLE COMPONENTS**

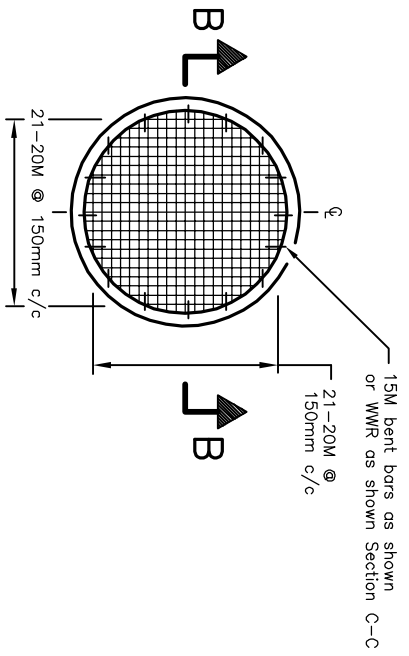
**3000mm DIAMETER
TRANSITION SLAB**



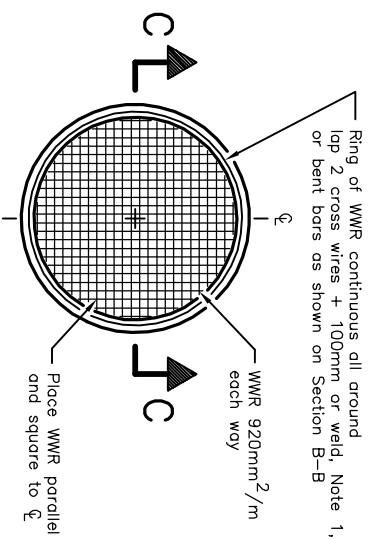
OPSD 701.070



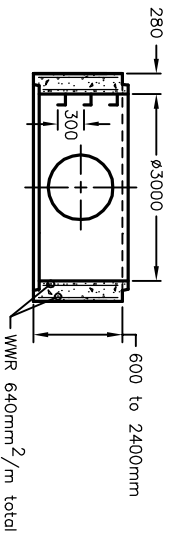
PLAN OF RISER



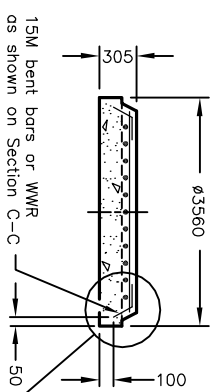
PLAN OF BASE SLAB WITH REINFORCING STEEL BARS



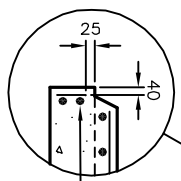
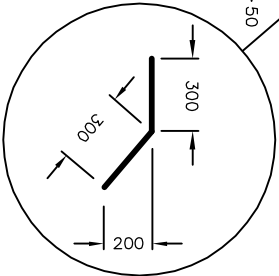
PLAN OF BASE SLAB WITH WWR



SECTION A-A



SECTION B-B



SECTION C-C

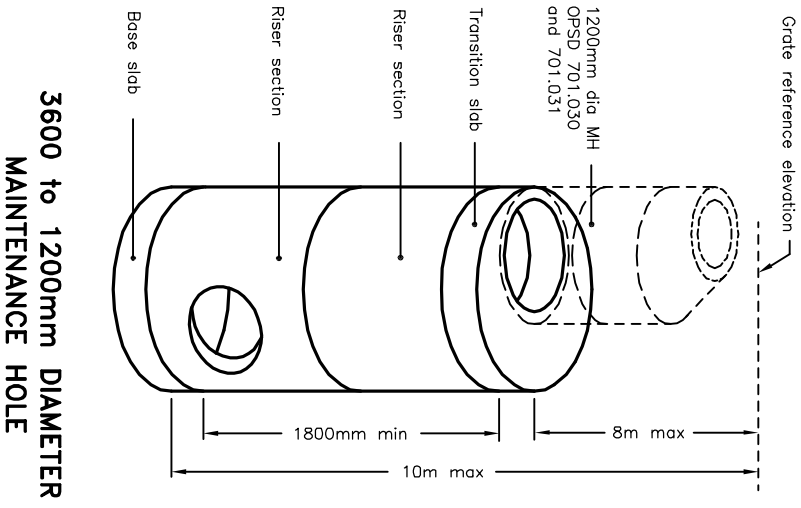
Ring of WWR min 500mm²/m each way or bent bars as shown on Section B-B

NOTES:

- 1 Welded splice shall develop minimum 50% of yield strength of reinforcing steel bars or wire, as applicable.
- A This OPSPD shall be read in conjunction with OPSPD 701.070.
- B All reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSPD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

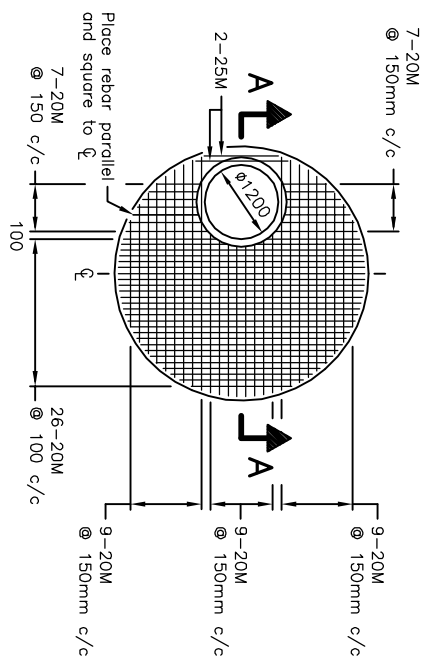
ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev	2
<p align="center">PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS</p> <p align="center">3000mm DIAMETER RISER AND BASE SLAB</p>		-----		

OPSPD 701.071				

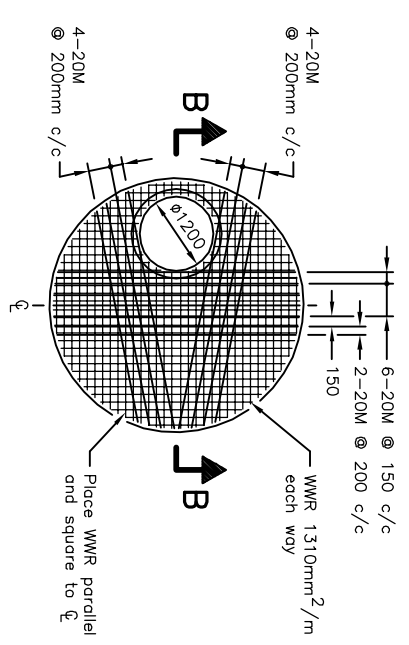


- NOTES:**
- A This OPSD shall be read in conjunction with OPSD 701.081.
 - B All reinforcing steel shall have 25mm minimum cover.
 - C Steps shall be according to OPSD 405.010 or 405.020.
 - D All dimensions are nominal.
 - E All dimensions are in millimetres unless otherwise shown.

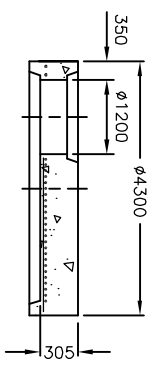
PLAN OF TRANSITION SLAB WITH REINFORCING STEEL BARS



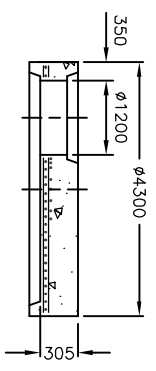
PLAN OF TRANSITION SLAB WITH REINFORCING STEEL BARS AND WWR



SECTION A-A



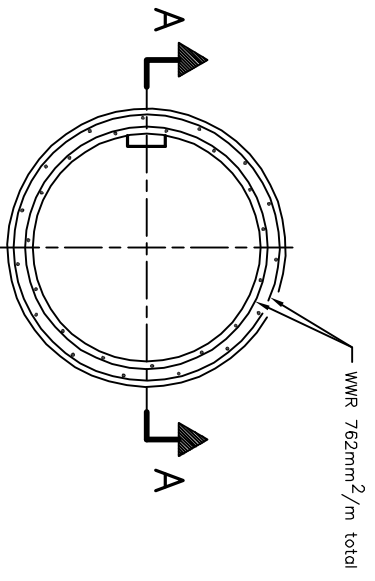
SECTION B-B



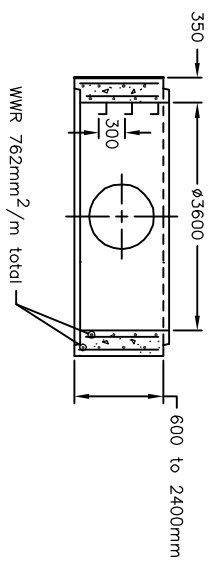
ONTARIO PROVINCIAL STANDARD DRAWING	
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS	
3600mm DIAMETER TRANSITION SLAB	

Nov 2014	Rev	3
OPSD 701.080		

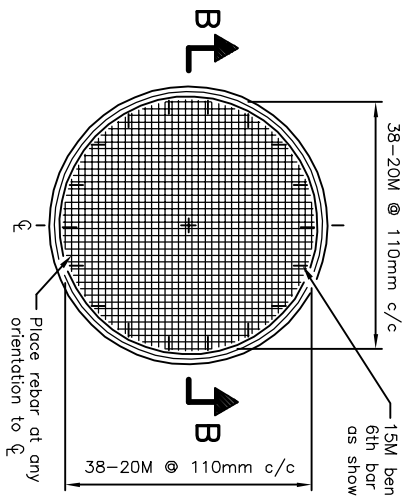




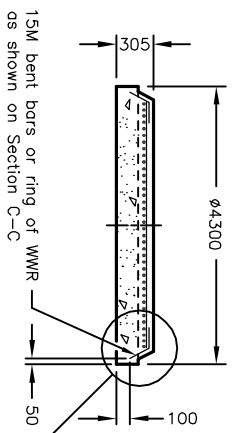
PLAN OF RISER



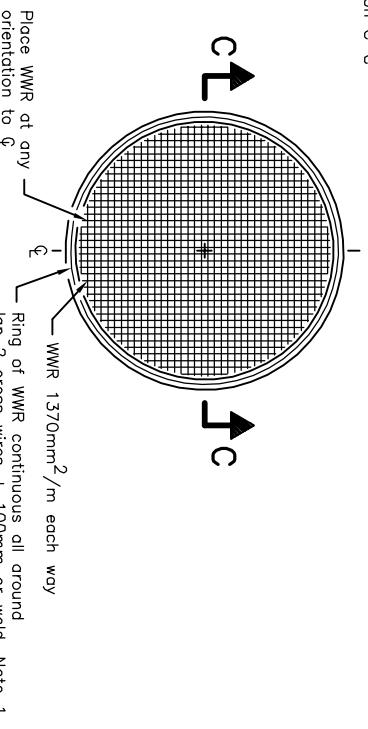
SECTION A-A



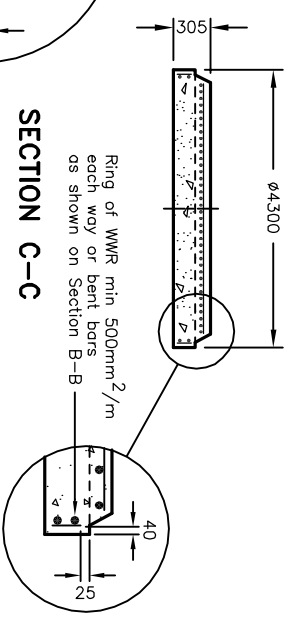
PLAN OF BASE SLAB WITH REINFORCING STEEL BARS



SECTION B-B



PLAN OF BASE SLAB WITH WWR

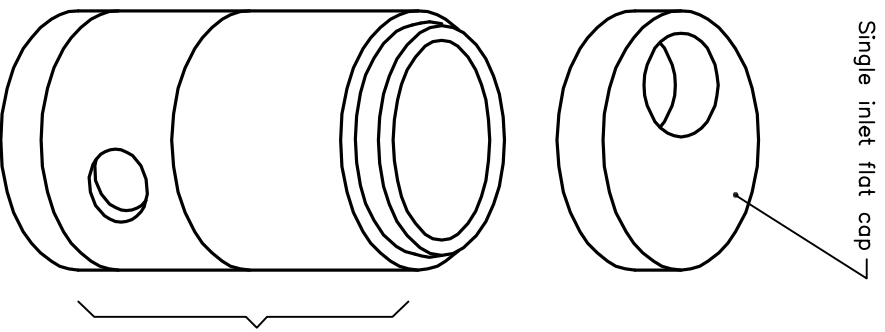


SECTION C-C

NOTES:

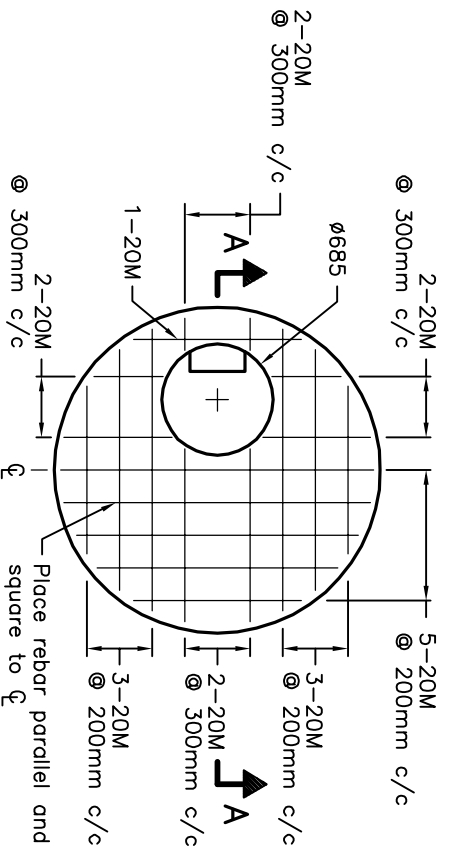
- 1 Welded splice shall develop minimum 50% of yield strength of reinforcing steel bars or wires, as applicable.
- A This OPSD shall be read in conjunction with OPSD 701.080.
- B All reinforcing steel shall have 25mm minimum cover.
- C Steps shall be according to OPSD 405.010 or 405.020.
- D All dimensions are nominal.
- E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev 2
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS			
3600mm DIAMETER			
RISER AND BASE SLAB			
OPSD 701.081			

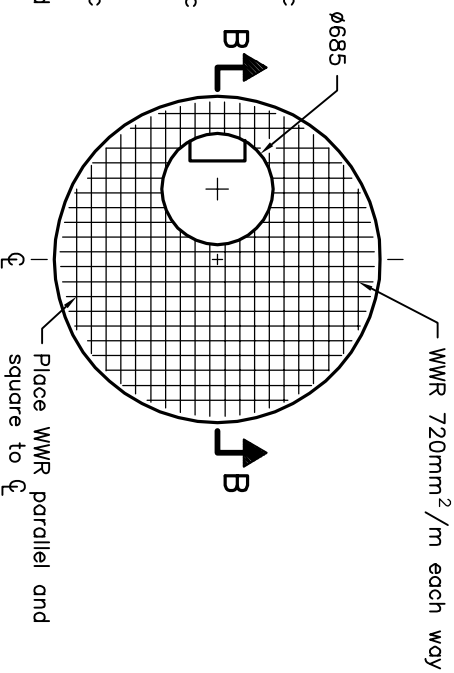


Precast units,
OPSD 701.041

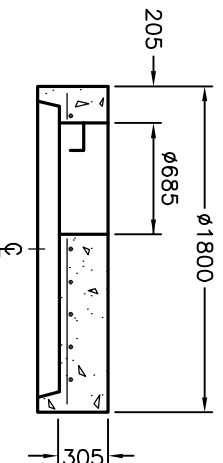
**1500mm DIAMETER
MAINTENANCE HOLE**



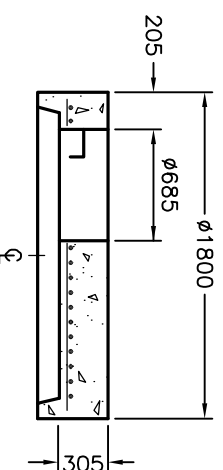
**PLAN OF FLAT CAP
WITH REINFORCING STEEL BARS**



**PLAN OF FLAT CAP
WITH WWR**



SECTION A-A



SECTION B-B

NOTES:

- A All reinforcing steel shall have 25mm minimum cover.
- B All dimensions are nominal.
- C All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2014

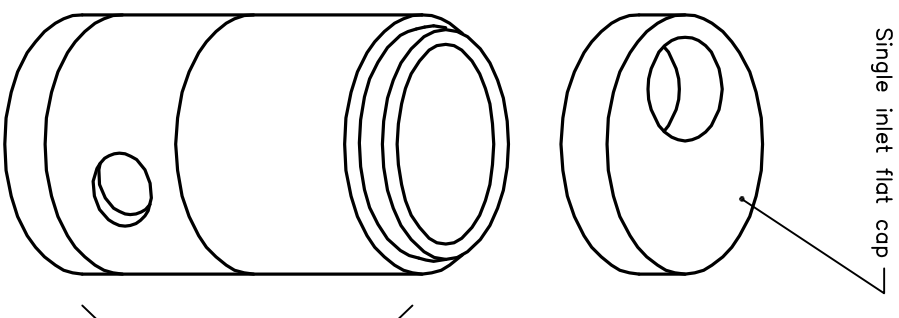
Rev 2

**PRECAST CONCRETE
SINGLE INLET FLAT CAP**

1500mm DIAMETER

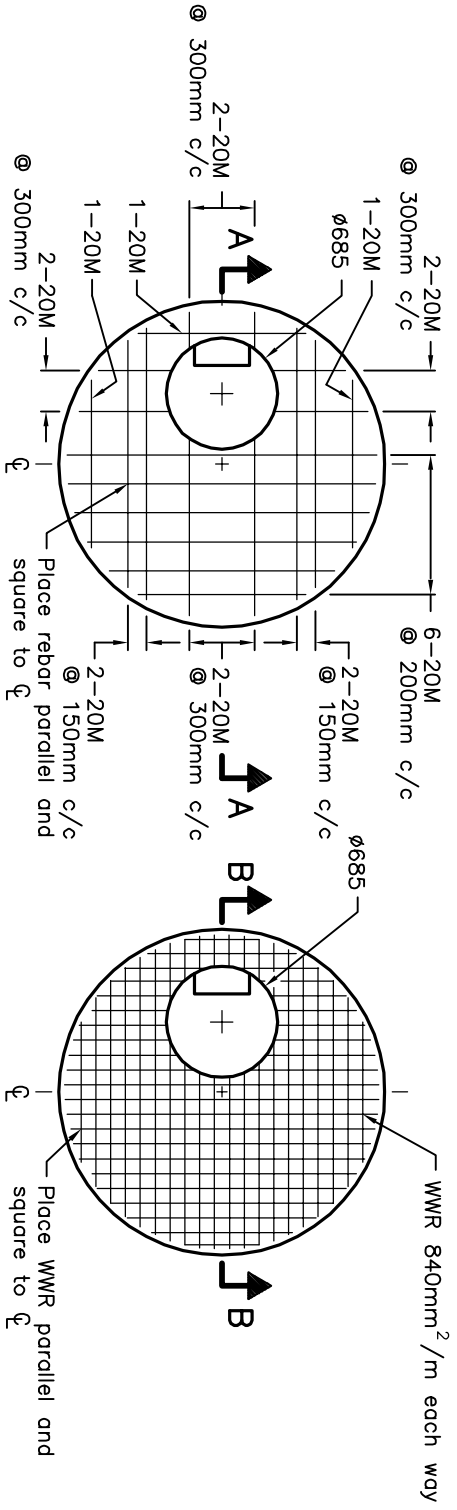


OPSD 703.011



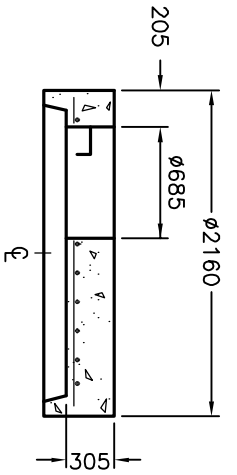
**1800mm DIAMETER
MAINTENANCE HOLE**

Precast units,
OPSD 701.051

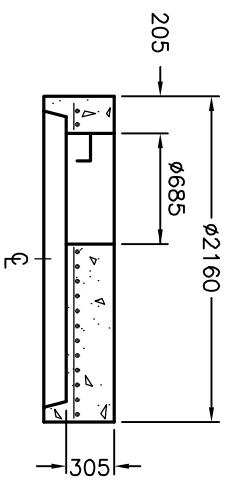


**PLAN OF FLAT CAP
WITH REINFORCING STEEL BARS**

**PLAN OF FLAT CAP
WITH WWR**



SECTION A-A

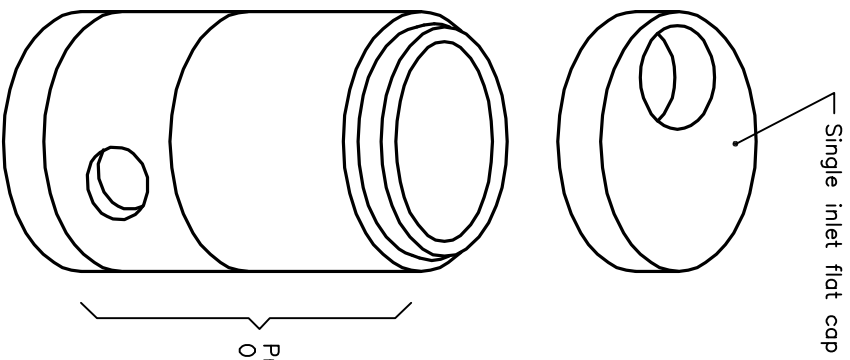


SECTION B-B

NOTES:

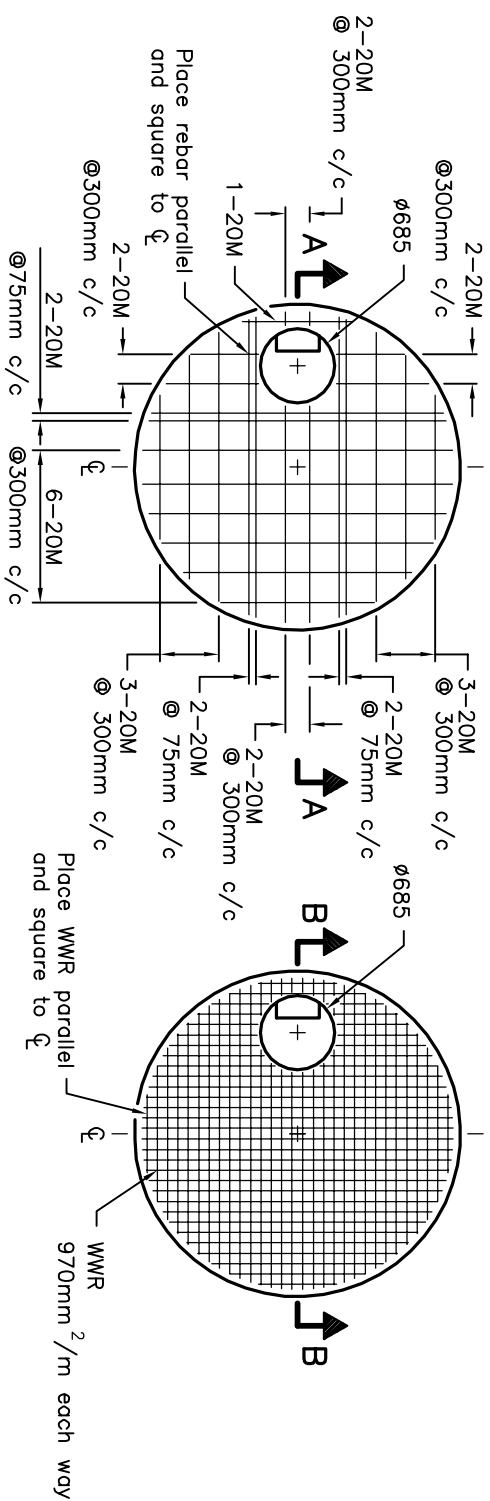
- A All reinforcing steel shall have 25mm minimum cover.
- B All dimensions are nominal.
- C All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev	2
PRECAST CONCRETE SINGLE INLET FLAT CAP		1800mm DIAMETER		
OPSD 703.012				



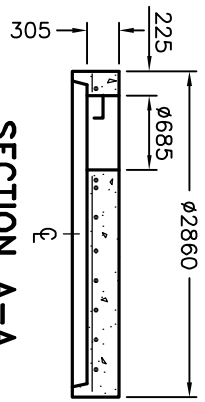
Precast units,
OPSD 701.061

**2400mm DIAMETER
MAINTENANCE HOLE**

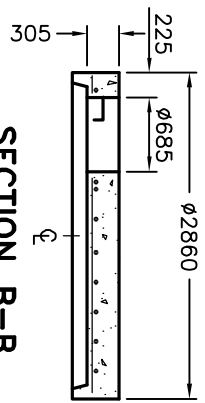


**PLAN OF FLAT CAP
WITH REINFORCING STEEL BARS**

**PLAN OF FLAT CAP
WITH WWR**



SECTION A-A

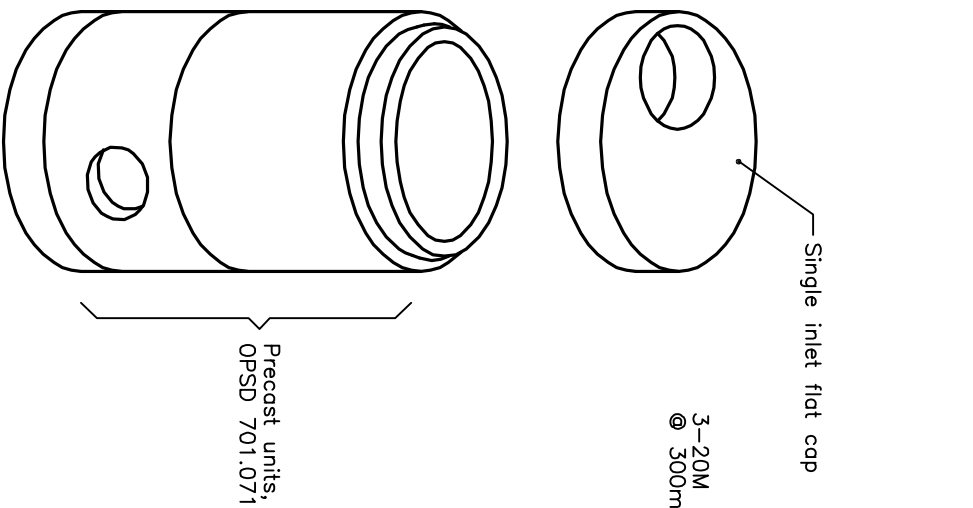


SECTION B-B

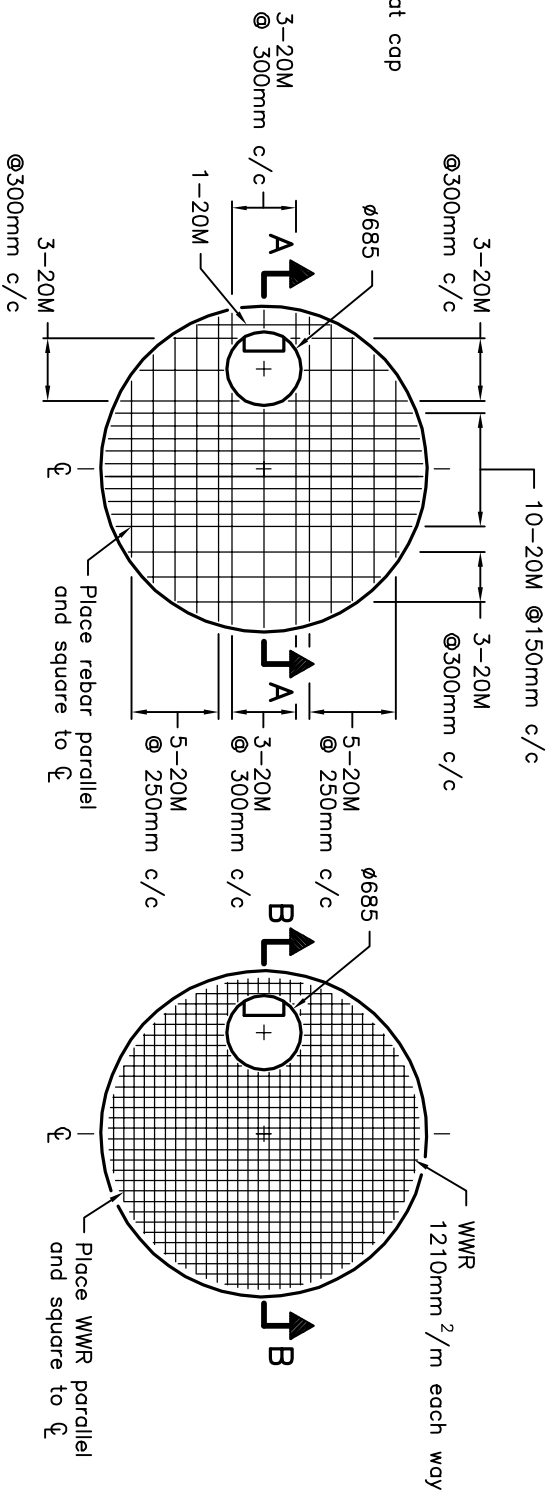
NOTES:

- A All reinforcing steel shall have 25mm minimum cover.
- B All dimensions are nominal.
- C All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev	2
PRECAST CONCRETE SINGLE INLET FLAT CAP				
2400mm DIAMETER				
OPSD 703.013				

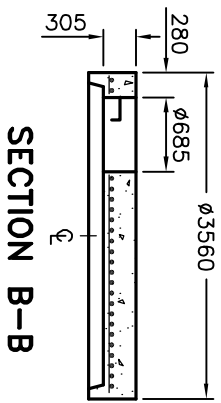
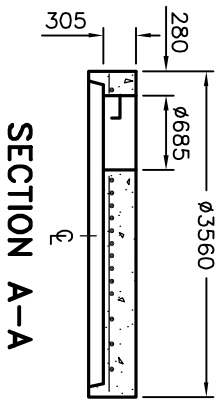


**3000mm DIAMETER
MAINTENANCE HOLE**



**PLAN OF FLAT CAP
WITH REINFORCING STEEL BARS**

**PLAN OF FLAT CAP
WITH WWR**



ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2014 Rev 2

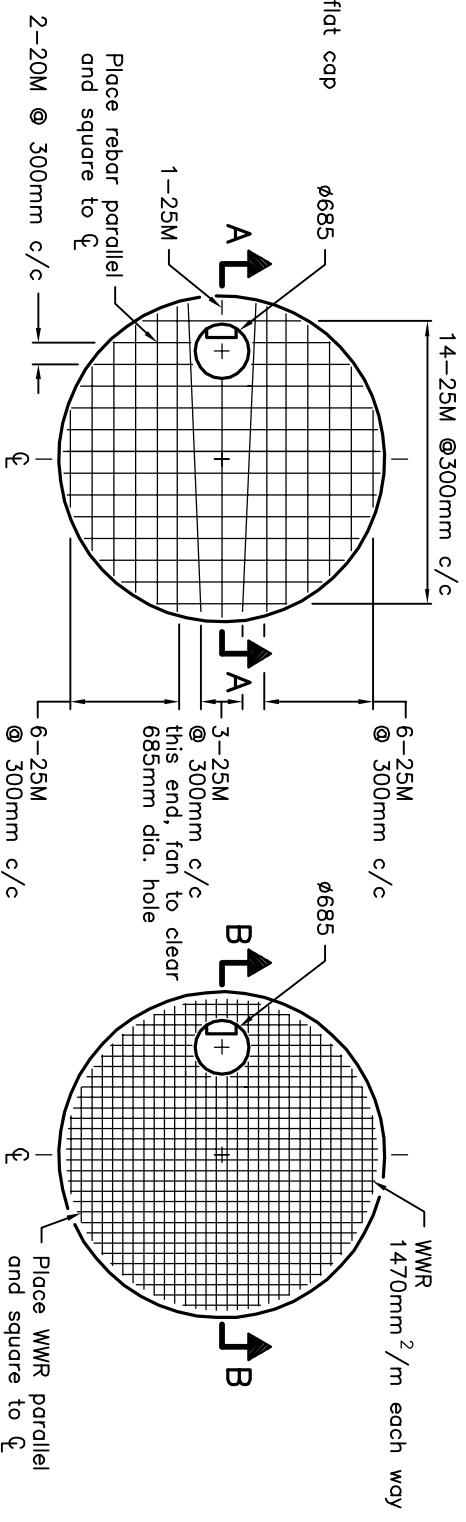
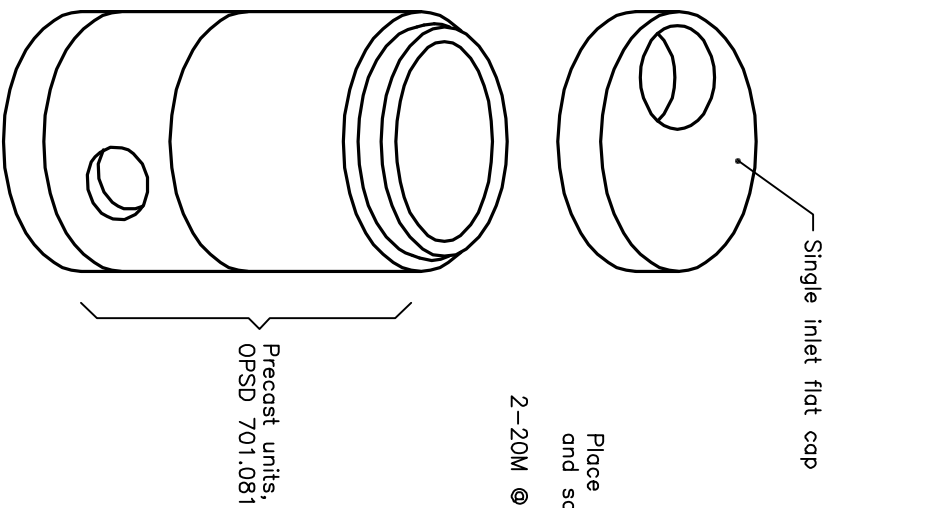
**PRECAST CONCRETE
SINGLE INLET FLAT CAP**

3000mm DIAMETER

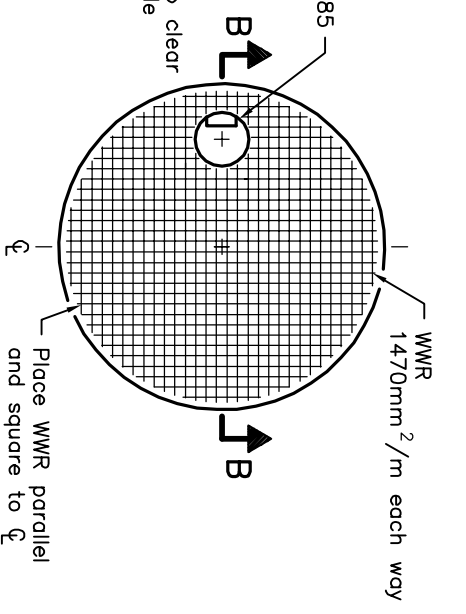
OPSD 703.014



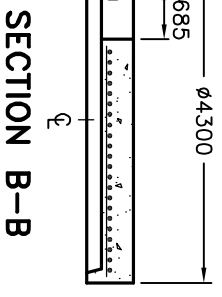
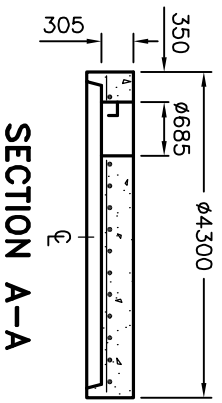
NOTES:
 A All reinforcing steel shall have 25mm minimum cover.
 B All dimensions are nominal.
 C All dimensions are in millimetres unless otherwise shown.



PLAN OF FLAT CAP WITH REINFORCING STEEL BARS



PLAN OF FLAT CAP WITH WWR

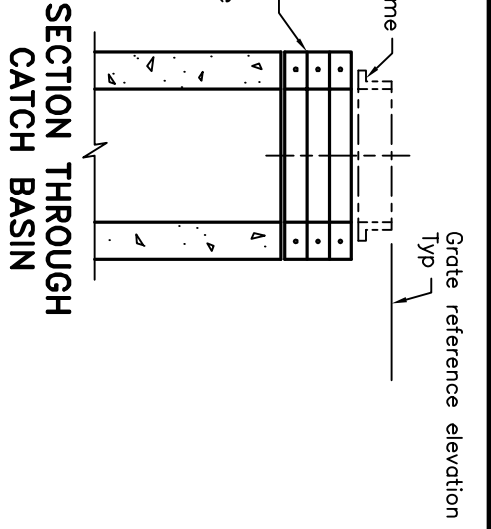
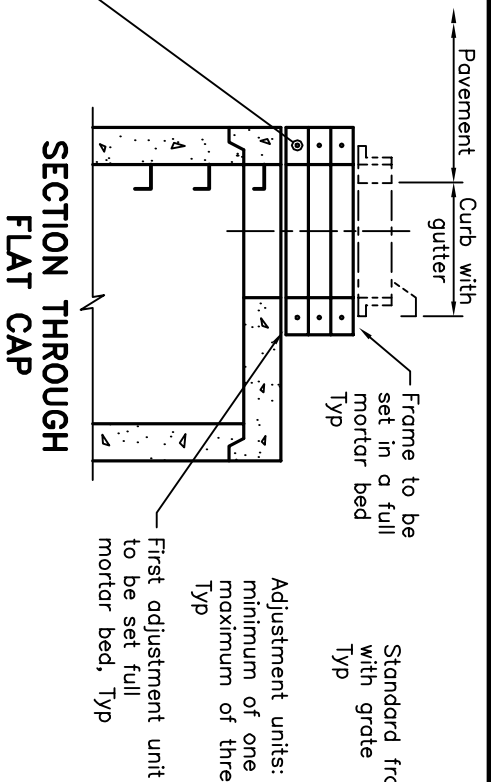
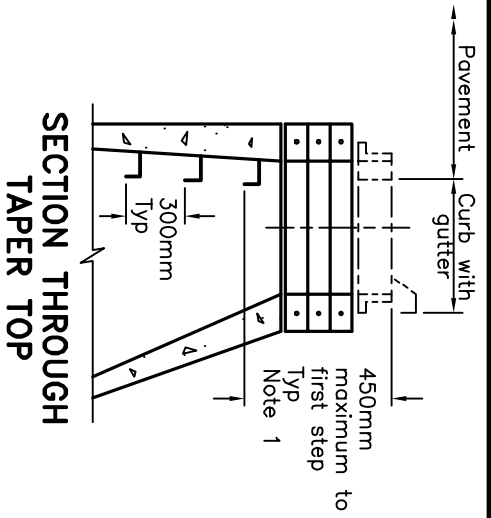


3600mm DIAMETER MAINTENANCE HOLE

- NOTES:**
- A All reinforcing steel shall have 25mm minimum cover.
 - B All dimensions are in nominal.
 - C All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev	2
<p align="center">PRECAST CONCRETE SINGLE INLET FLAT CAP</p> <p align="center">3600mm DIAMETER</p>		-----		
		<p align="center">OPSD 703.015</p>		



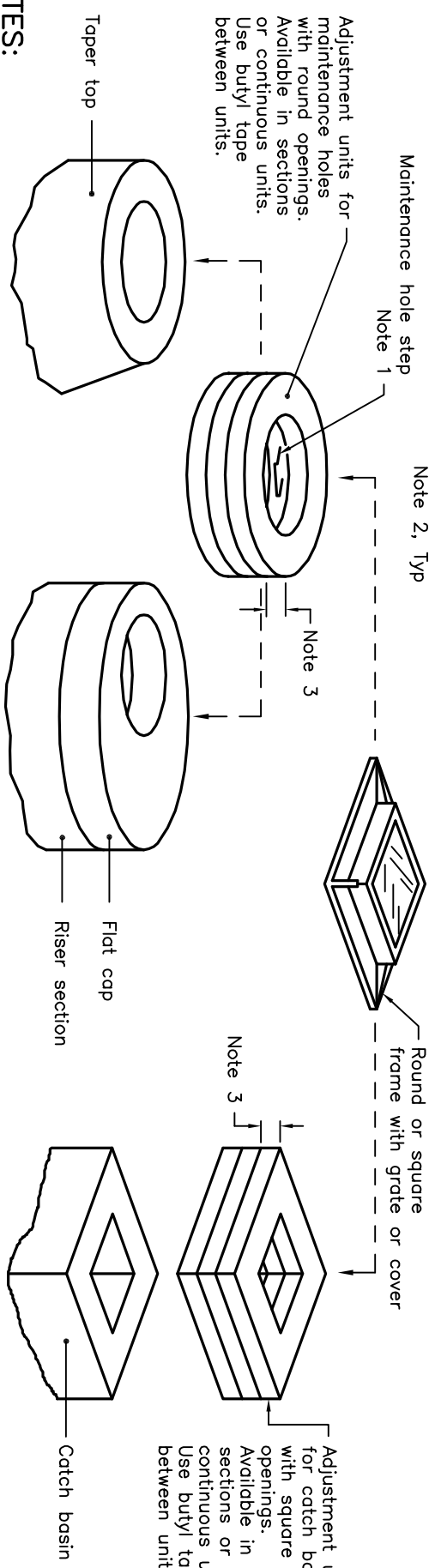


Maintenance hole step Note 1

Reinforce each adjustment unit with a minimum of 1 wire with an end area of at least 15mm².
Lap wire 150mm or butt weld.
Note 2, Typ

Adjustment units for maintenance holes with round openings. Available in sections or continuous units. Use butyl tape between units.

Adjustment units for catch basins with square openings. Available in sections or continuous units. Use butyl tape between units.

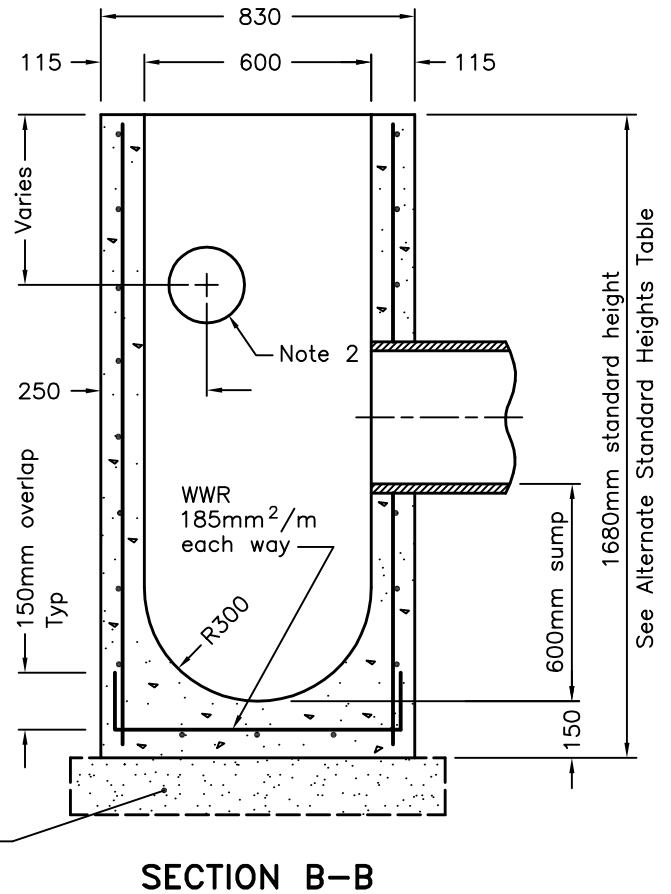
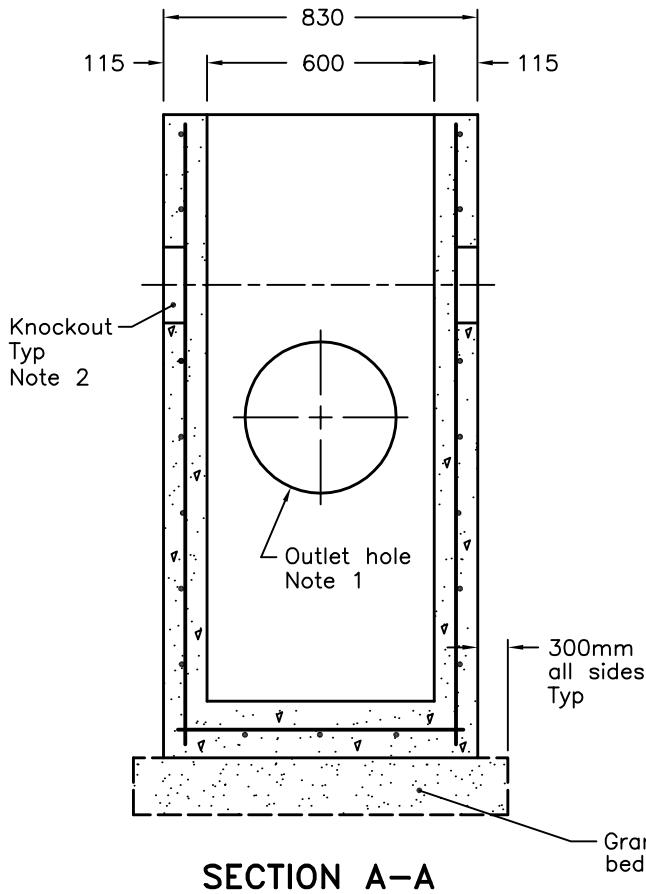
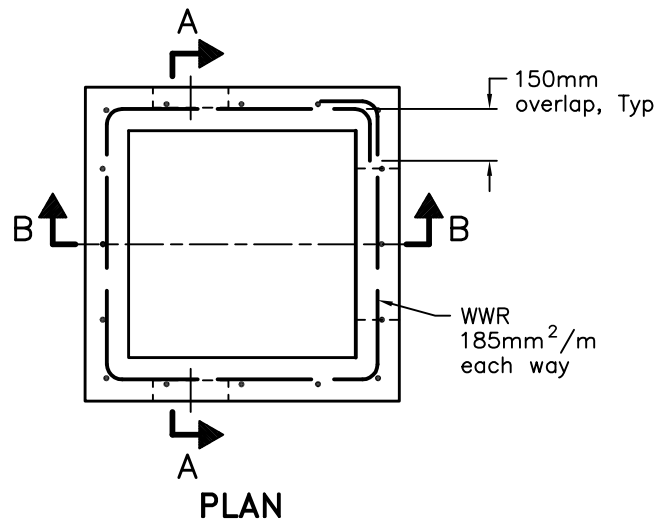


NOTES:

- 1 If first step is in an adjustment unit, the adjustment unit shall be of the type manufactured with a step in place.
 - 2 Centre reinforcing in adjustment unit ±10mm.
 - 3 Round and square adjustment units are available in sizes of 50, 75, 100, 150, and 300mm.
- A Adjustment units shall not extend beyond the outside edge of the structure.
B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014	Rev 3	
PRECAST CONCRETE ADJUSTMENT UNITS FOR MAINTENANCE HOLES, CATCH BASINS, AND VALVE CHAMBERS				
OPSD 704.010				

ALTERNATE STANDARD HEIGHTS	
ALTERNATIVE	DIMENSION
A	1980
B	1830
C	1520
D	1380



NOTES:

- 1 Outlet hole size 525mm diameter maximum, location as required.
- 2 200mm diameter knockout to accommodate subdrain. Knockout shall be 60mm deep.
- A Centre reinforcing in base slab and walls ± 20 mm.
- B Granular backfill shall be placed to a minimum thickness of 300mm all around the catch basin.

- C Frame, grate, and adjustment units shall be installed according to OPSD 704.010.
- D Pipe support shall be according to OPSD 708.020.
- E All dimensions are nominal.
- F All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

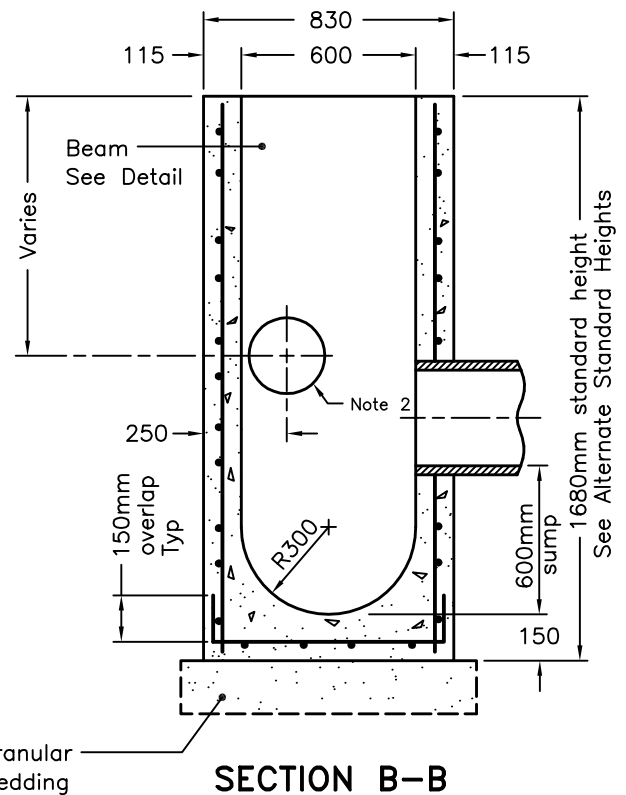
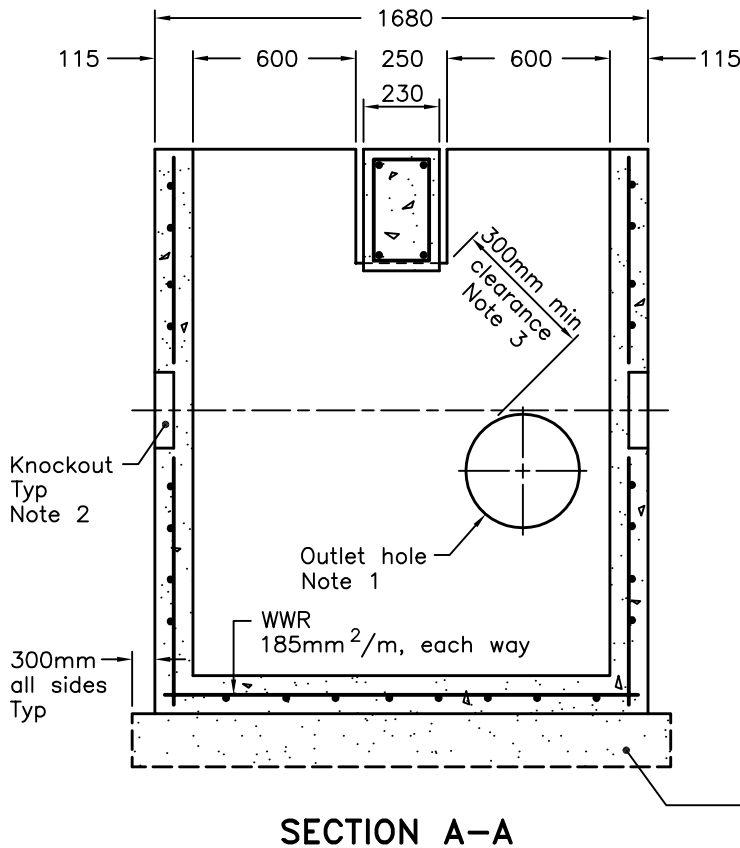
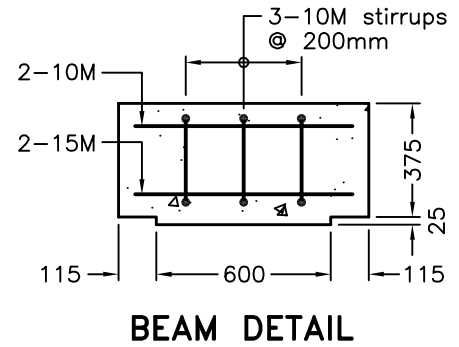
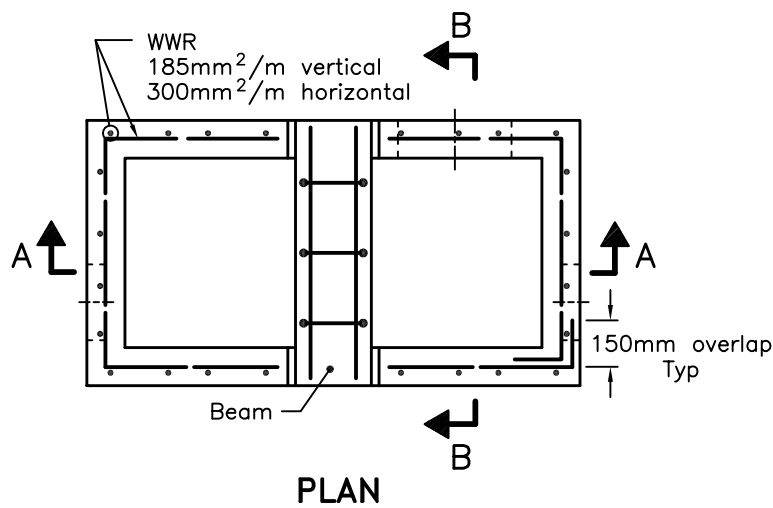
Nov 2019

Rev 4

PRECAST CONCRETE CATCH BASIN
600x600mm

OPSD 705.010





NOTES:

- 1 Outlet hole size 525mm diameter maximum, location as required.
 - 2 200mm diameter knockout to accommodate subdrain. Knockout shall be 60mm deep.
 - 3 Minimum clearance between beam recess and hole for pipe shall be 300mm or minimum clearance can be 150mm with addition of two 15M size rebar on 45 degree diagonal.
- A Centre reinforcing in base slab and walls ±20mm.
 B Granular backfill shall be placed to a minimum thickness of 300mm all around the catch basin.
 C Frame, grate, and adjustment units shall be installed according to OPSD 704.010.
 D Pipe support shall be according to OPSD 708.020.
 E All dimensions are nominal.
 F All dimensions are in millimetres unless otherwise shown.

ALTERNATE STANDARD HEIGHTS	
ALTERNATIVE	DIMENSION
A	1980
B	1830
C	1680

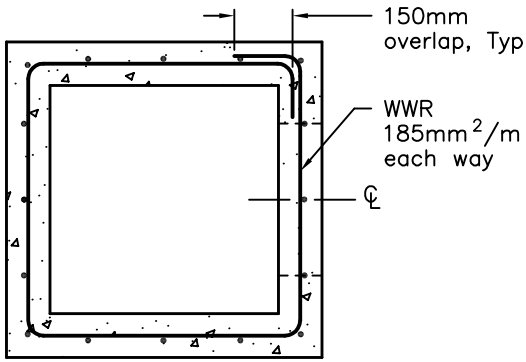
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2019 Rev 4

PRECAST CONCRETE
TWIN INLET CATCH BASIN
600 x 1450mm

OPSD 705.020

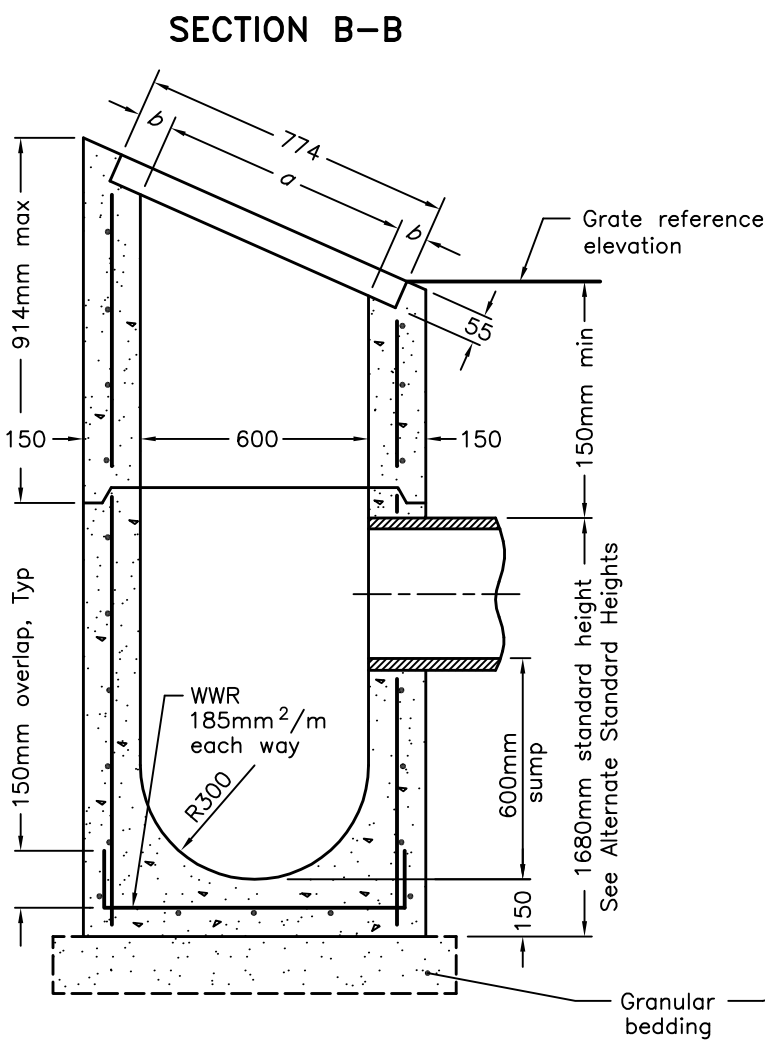




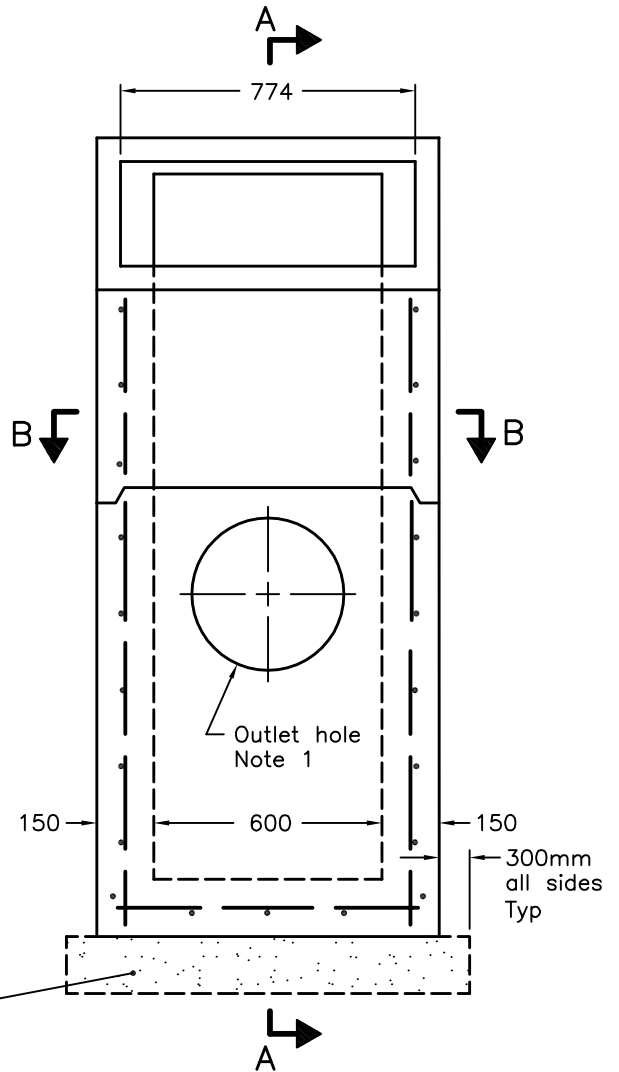
SECTION B-B

Alternate Standard Heights	
Alternate	Dimension
A	1980
B	1520
C	1380

Opening Dimensions			
Grate		a	b
Type	Slope		
A	2H:1V	670	52
	3H:1V	632	71
	4H:1V	618	78
	6H:1V	608	83
	HOR	600	87



SECTION A-A



FRONT VIEW

NOTES:

- 1 Outlet hole size 525mm maximum diameter, location as required.
- A Where inlet is placed across ditch and is accessible to vehicular traffic, grating slope shall be 6H:1V or flatter.
- B Center reinforcing in wall and slab ± 25 mm.
- C Granular backfill shall be placed to a minimum thickness of 300mm all around the ditch inlet.
- D Grating shall be according to OPSD 403.010.
- E Pipe support shall be according to OPSD 708.020.
- F All dimensions are nominal.
- G All dimensions are in millimetres unless otherwise shown.

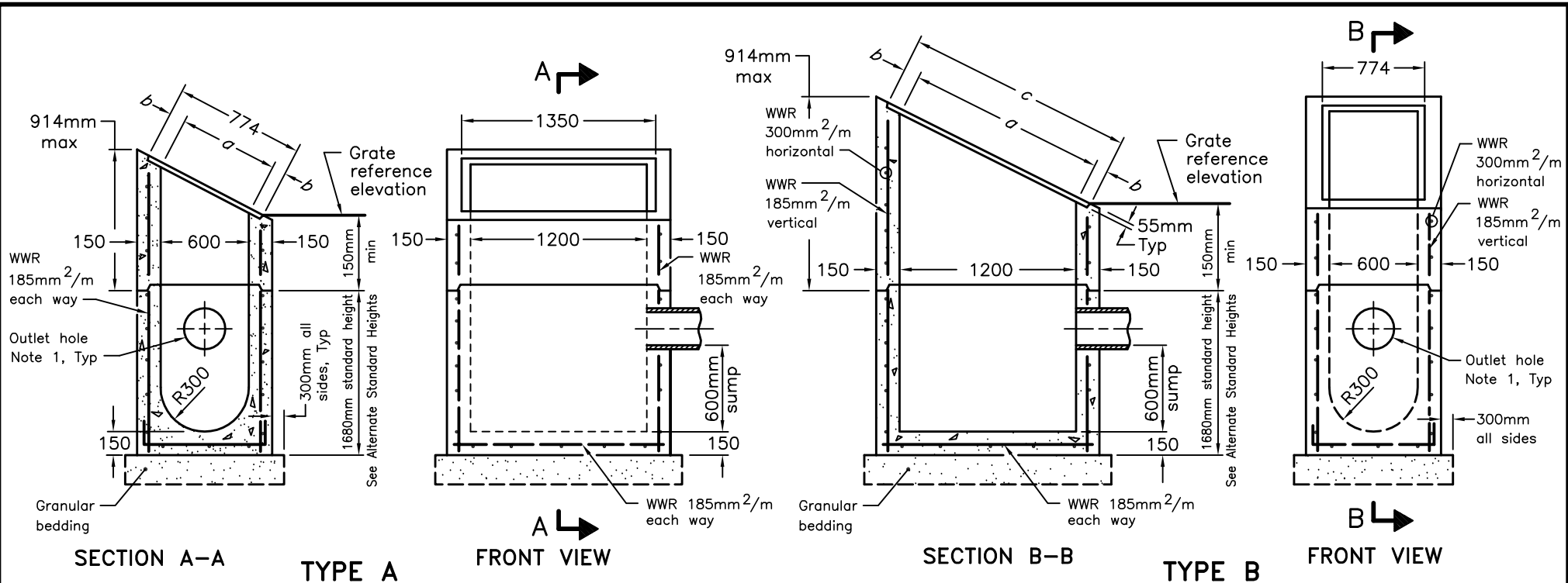
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2019 Rev 4

PRECAST CONCRETE DITCH INLET
600 x 600mm



OPSD 705.030



Opening Dimensions			
Grate		a	b
Type	Slope		
B	2H:1V	670	52
	3H:1V	632	71
	4H:1V	618	78
	HOR	600	87

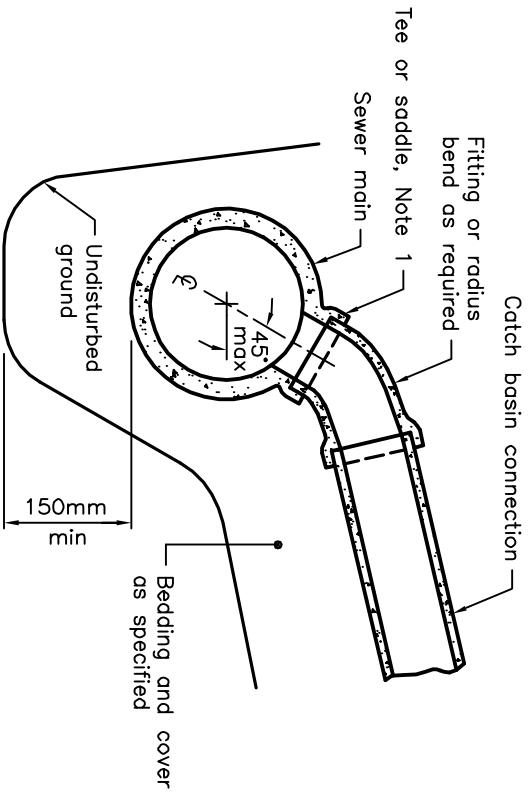
Alternate Standard Heights	
Alternate	Dimension
A	1980
B	1520
C	1380

Opening Dimensions				
Grate		a	b	c
Type	Slope			
C	2H:1V	1341	66	1473
	3H:1V	1265	104	1473
	4H:1V	1237	118	1473
B	6H:1V	1216	65	1346
	HOR	1200	73	1346

NOTES:

- 1 Outlet hole size 525mm max diameter.
- A Where inlet is placed across ditch and is accessible to vehicular traffic, grating slope shall be 6H:1V or flatter.
- B Center reinforcing in wall and base slab ± 25 mm.
- C Lap riser horizontal wires 300mm. Laps shall be placed at corners.
- D Granular backfill shall be placed to a minimum thickness of 300mm all around the ditch inlet.
- E Grating shall be according to OPSD 403.010.
- F Pipe support shall be according to OPSD 708.020.
- G All dimensions are nominal.
- H All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev	4	
PRECAST CONCRETE DITCH INLETS				
600 x 1200mm				
OPSD 705.040				

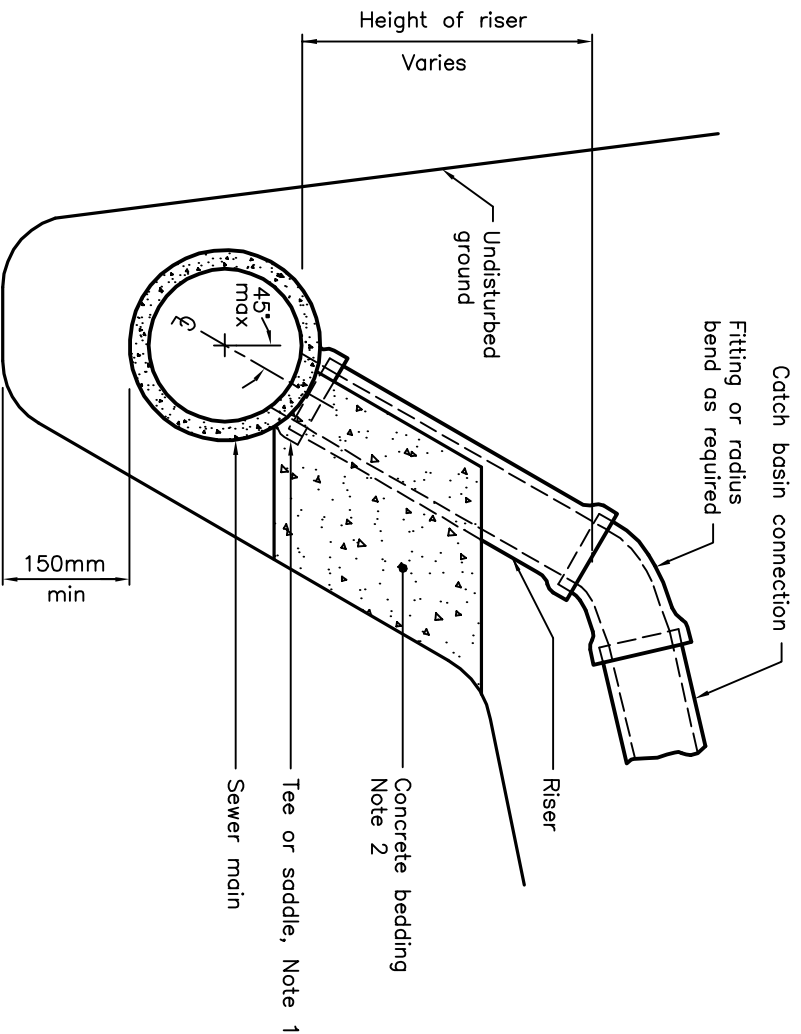


CONNECTION WITHOUT RISER

NOTES:

- 1 For sewers smaller than 450mm dia, connections shall be made using approved factory made tees. For all other sizes, either factory made tees or approved saddles may be used.
- 2 Riser bedding shall have a minimum width of riser pipe outside diameter plus 600mm.

- A Approved cut-in tool shall be used for field installed tees and saddles.
- B Maintenance holes shall be used at the main sewer to connect catch basin connections greater than 300mm.
- C All dimensions are in millimetres unless otherwise shown.



CONNECTION WITH RISER

ONTARIO PROVINCIAL STANDARD DRAWING

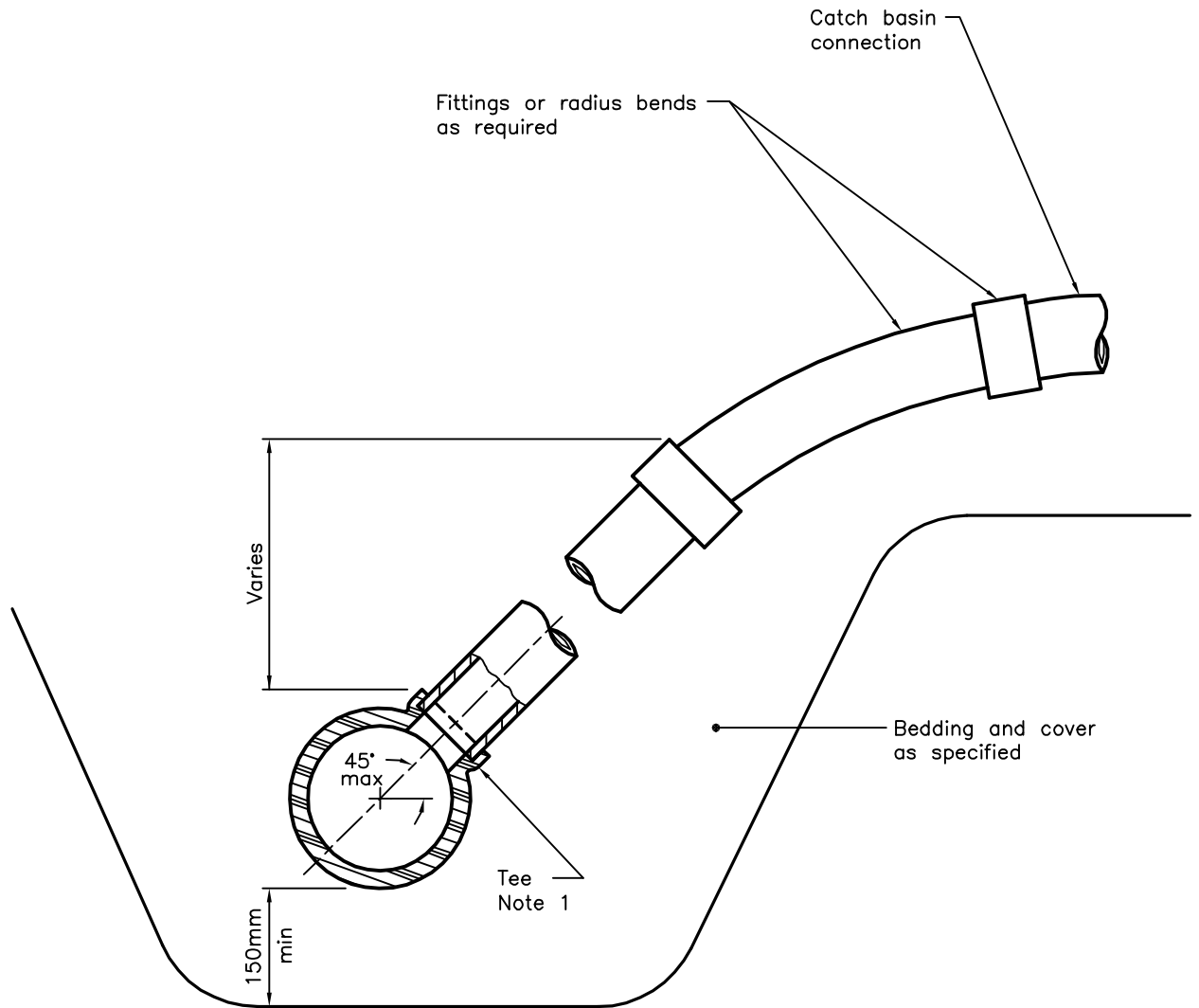
Nov 2016

Rev 3

**CATCH BASIN CONNECTION
FOR RIGID MAIN PIPE SEWER**

OPSD 708.010






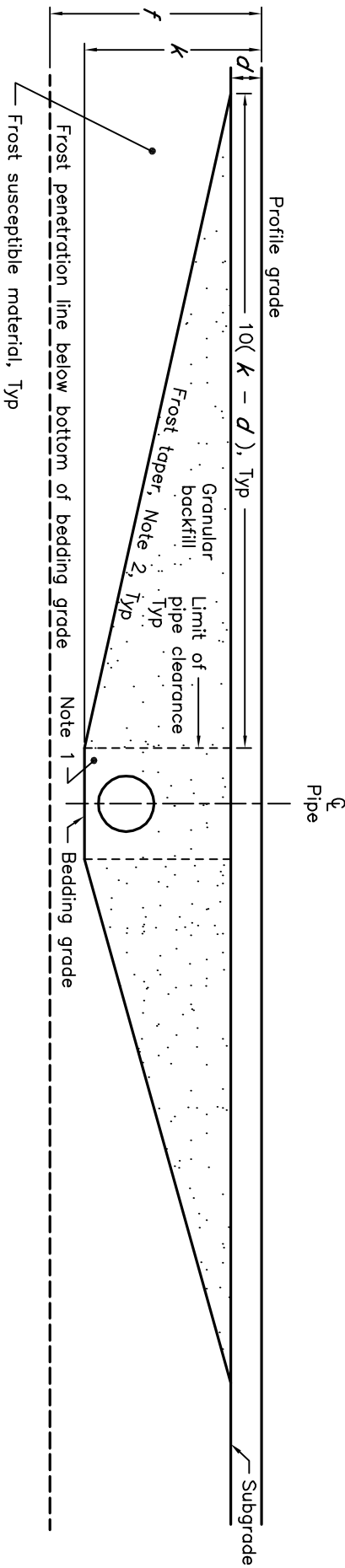
NOTES:

1 For catch basin connections 300mm in diameter or less, factory made tees shall be used.

A For catch basin connections greater than 300mm in diameter, maintenance holes shall be used at the main sewer.

B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2016	Rev 3	
<p style="text-align: center;">CATCH BASIN CONNECTION FOR FLEXIBLE MAIN PIPE SEWER</p>	<p style="text-align: center;">----- -----</p>		
	<p>OPSD 708.030</p>		




**FROST TREATMENT
RIGID AND FLEXIBLE PIPE**

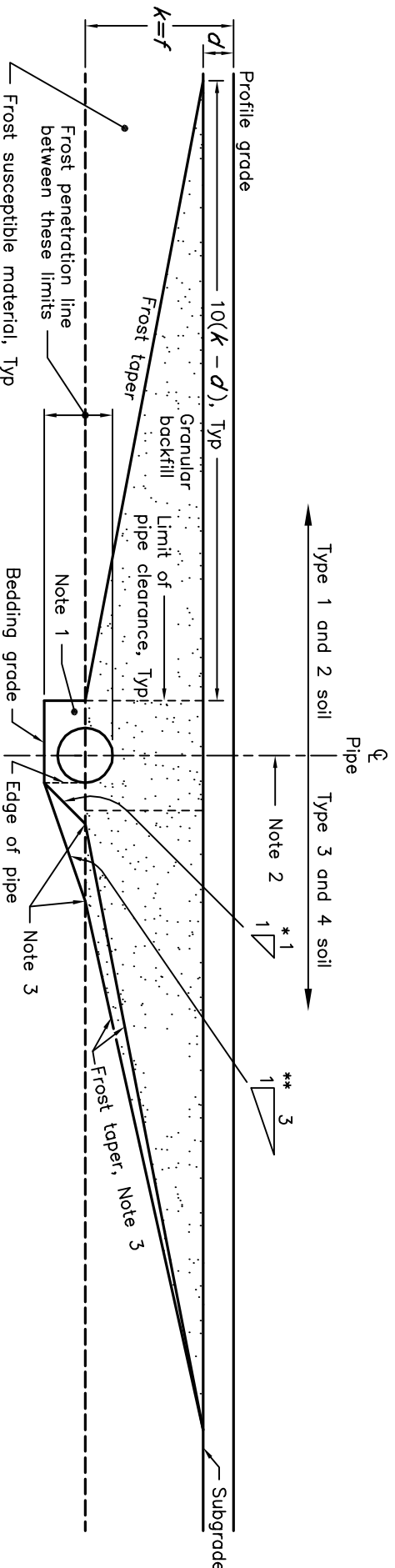
NOTES:

- 1 Pipe embedment or bedding, cover, and backfill shall be according to:
 - a) Flexible OPSD 802.010, 802.013, 802.014, 802.020, 802.023, and 802.024.
 - b) Rigid – OPSD 802.030, 802.031, 802.032, 802.033, 802.034, 802.050, 802.051, 802.052, 802.053, and 802.054.
- 2 Frost tapers shall start at bedding grade.

LEGEND:

- d –depth of roadbed granular
- k –depth of frost treatment below profile grade
- f –depth of frost penetration below profile grade

ONTARIO PROVINCIAL STANDARD DRAWING FROST TREATMENT – PIPE CULVERTS FROST PENETRATION LINE BELOW BEDDING GRADE	Nov 2015	Rev 3	
OPSD 803.030			




FROST TREATMENT RIGID AND FLEXIBLE PIPE

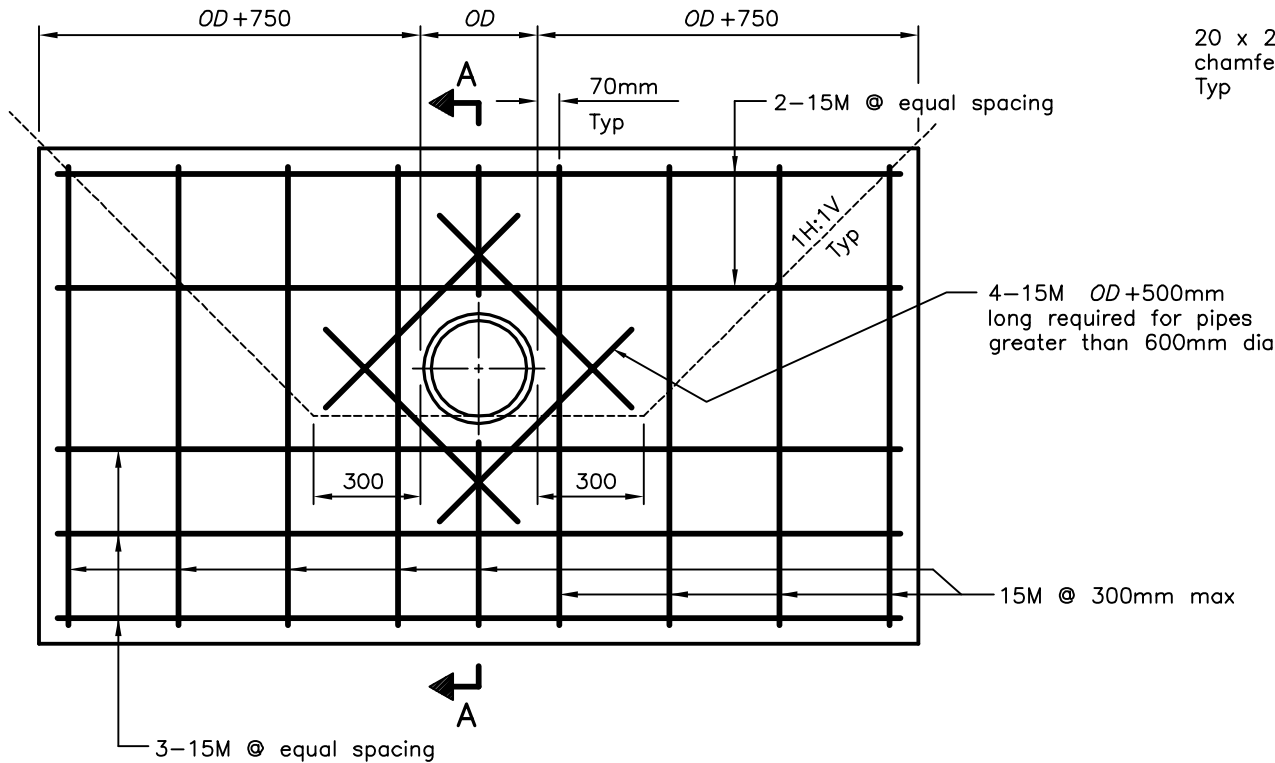
NOTES:

- 1 Pipe embedment or bedding, cover, and backfill shall be according to:
 - a) Flexible OPSD 802.010, 802.013, 802.014, 802.020, 802.023, and 802.024.
 - b) Rigid – OPSD 802.030, 802.031, 802.032, 802.033, 802.034, 802.050, 802.051, 802.052, 802.053, and 802.054.
- 2 Condition of frost treatment symmetrical about centreline of pipe.
- 3 Frost tapers shall start at the intersection of the 1H:1V or 3H:1V slope and the frost penetration line.
- A Soil types as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.

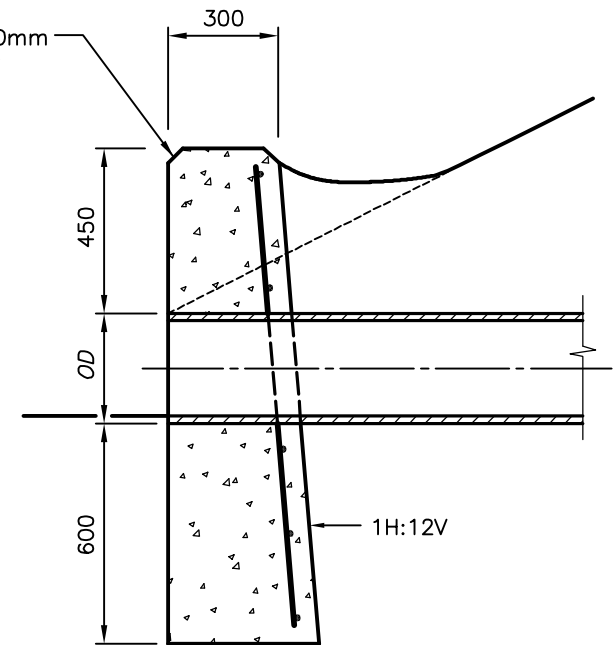
LEGEND:

- d – depth of roadbed granular
- k – depth of frost treatment below profile grade
- f – depth of frost penetration below profile grade
- * – Type 3 soil
- ** – Type 4 soil

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 4	
FROST TREATMENT – PIPE CULVERTS FROST PENETRATION LINE BETWEEN TOP OF PIPE AND BEDDING GRADE			
OPSD 803.031			



FRONT ELEVATION




SECTION A-A

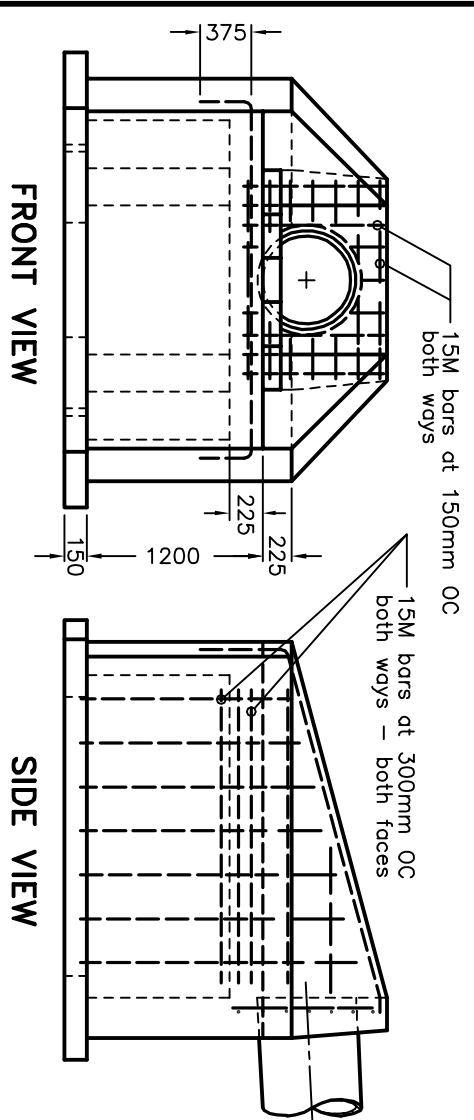
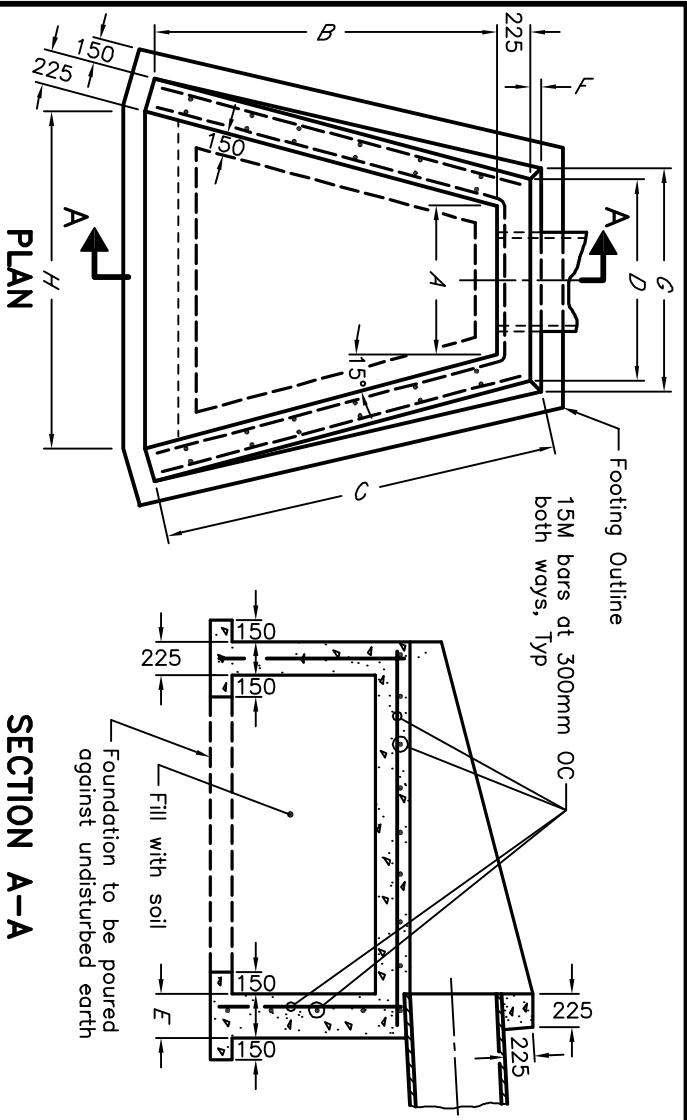
LEGEND:

OD – Outside diameter of pipe

NOTES:

- A This OPSD to be read in conjunction with OPSD 3940.150.
- B If a steel grate is required, refer to OPSD 804.05.
- C Class of concrete: 30MPa.
- D Cover to reinforcing bars 70mm ± 20mm.
- E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2017	Rev	2	
CONCRETE HEADWALL				
FOR PIPE LESS THAN 900mm DIAMETER				OPSD 804.030



PIPE DIA	ENDWALL DIMENSIONS							
	A	B	C	D	E	F	G	H
600	1050	2400	2725	1400	300	75	1525	2350
675	1125	2400	2725	1475	300	75	1600	2425
750	1200	2400	2725	1550	300	75	1675	2500
825	1275	2400	2725	1625	300	75	1755	2575
900	1350	2400	2725	1700	300	75	1825	2650
975	1425	2400	2725	1775	375	150	1975	2725
1050	1500	3000	3400	1850	375	150	2050	3100
1200	1650	3000	3400	2000	375	150	2200	3250
1350	1800	3000	3400	2150	375	150	2350	3400
1500	1950	3000	3400	2300	375	150	2500	3550
1650	2100	3000	3400	2450	375	150	2650	3700
1800	2250	3000	3400	2600	375	150	2800	3850
2400	3000	3000	3400	3350	375	150	3550	4600

- NOTES:**
- A This OPSD to be read in conjunction with OPSD 3940.150.
 - B Class of concrete: 30MPa.
 - C Cover to reinforcing bars: 75mm ±20mm.
 - D Granular backfill to be placed to 300mm min thickness on all sides.
 - E All dimensions are in millimetres unless otherwise shown.

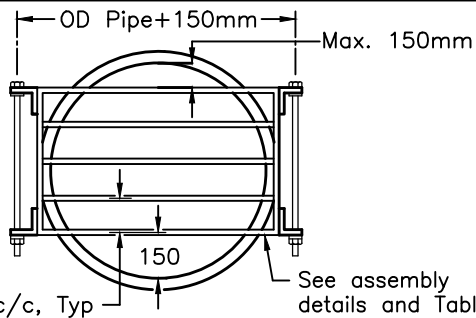
ONTARIO PROVINCIAL STANDARD DRAWING

CONCRETE HEADWALL

FOR SEWER OR CULVERT PIPE OUTLET

Nov 2017 Rev 1

OPSD 804.040



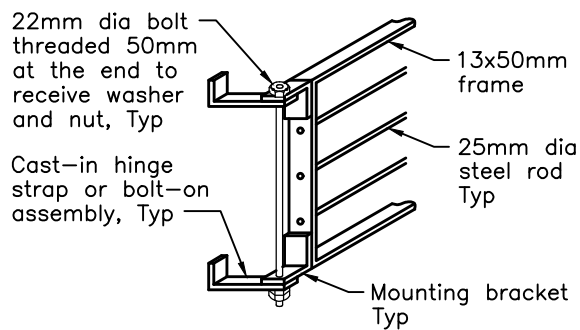
125mm c/c, Typ See assembly details and Table 1

PIPE DIA	No of RODS
450	1
525	1
600	2
675	3
750	3
825	4
900	4
975	5
1050	6
1200	7

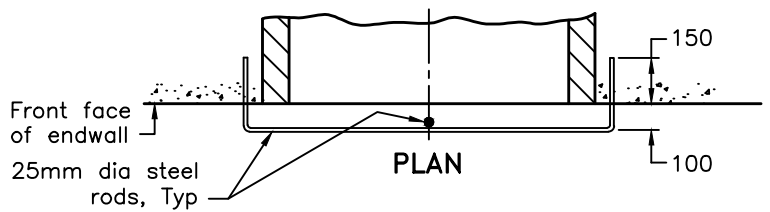
PIPE DIA up to 1200mm

PIPE DIA	No of RODS
1350	3
1500	4
1650	5
1800	6
1950	7
2100	8
2250	9
2400	10

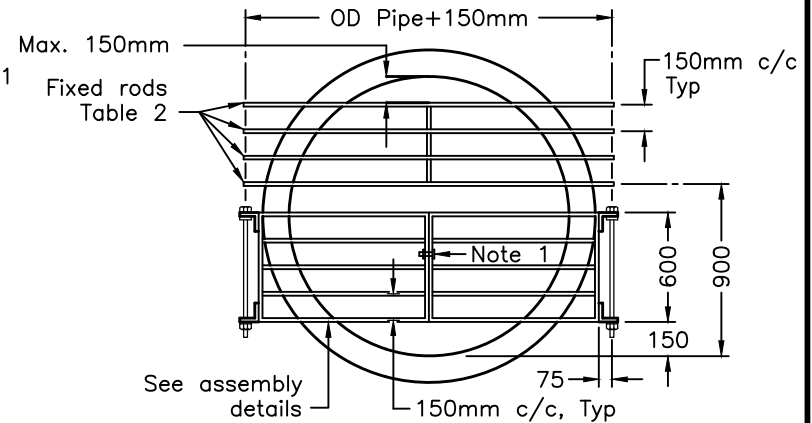
PIPE DIA 1350 to 2400mm



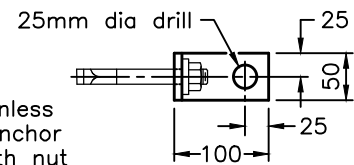
ASSEMBLY



PLAN

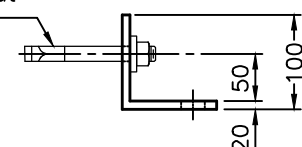


See assembly details



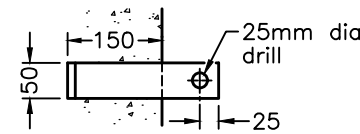
TOP VIEW

Type 304 stainless steel wedge anchor 16x150mm with nut and lock washer

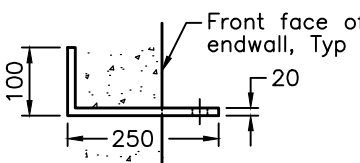


SIDE VIEW

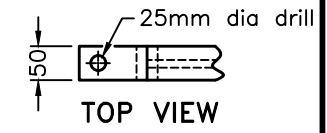
BOLT-ON ASSEMBLY DETAIL



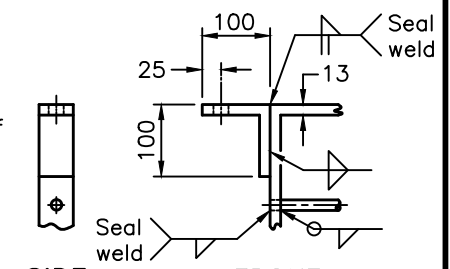
TOP VIEW



SIDE VIEW
HINGE STRAP



TOP VIEW



SIDE VIEW
FRONT VIEW
MOUNTING BRACKET

CAST-IN HINGE STRAP ASSEMBLY DETAILS

NOTES:

- 1 Grates shall be secured by either a bolt and nut or a locking device as specified.
- A Metal surfaces shall be either painted with 2 coats of self priming abrasion resistant immersion grade epoxy or hot dip galvanized as specified.
- B Frame, hinge strap, mounting bracket, and steel rods shall be medium grade steel.
- C All welding shall be according to CSA W59.
- D All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2021 Rev 3

GRATING
FOR CONCRETE ENDWALL

OPSD 804.050




PIPE DIA mm	BEDDING CLASS	CONFINED TRENCH				
		HEIGHT OF FILL 0.3 to 0.6m	MAXIMUM HEIGHT OF FILL FOR DEPTHS > 0.6m			
		PIPE CLASS	50-D	65-D	100-D	140-D
300	B	140-D	2.2	3.1	6.7	NL
	C	SD	1.6	2.4	4.3	10.2
375	B	140-D	2.3	3.4	8.3	NL
	C	140-D	1.7	2.5	4.9	15.5
450	B	100-D	2.5	3.6	9.5	NL
	C	140-D	1.8	2.7	5.3	22.6
525	B	100-D	2.6	3.9	10.4	NL
	C	100-D	1.9	2.8	5.6	30.7
600	B	65-D	2.7	4.0	10.8	NL
	C	100-D	2.0	2.9	5.9	30.3
675	B	50-D	2.8	4.1	11.0	NL
	C	65-D	2.0	2.9	6.0	24.6
750	B	50-D	2.8	4.2	10.8	NL
	C	65-D	2.0	3.0	6.1	19.8
825	B	50-D	2.9	4.3	10.7	NL
	C	50-D	2.1	3.0	6.2	17.7
900	B	50-D	2.7	3.7	6.6	12.5
	C	50-D	2.2	2.9	4.9	8.0
975	B	50-D	2.7	3.7	6.7	12.8
	C	50-D	2.2	2.9	4.9	8.2
1050	B	50-D	2.7	3.8	6.8	12.9
	C	50-D	2.3	2.9	5.0	8.3
1200	B	50-D	2.9	3.9	7.0	13.1
	C	50-D	2.4	3.0	5.1	8.4
1350	B	50-D	3.0	4.0	7.3	13.7
	C	50-D	2.5	3.2	5.3	8.8
1500	B	50-D	3.1	4.0	7.2	13.1
	C	50-D	2.6	3.2	5.3	8.7
1650	B	50-D	3.2	4.1	7.3	12.9
	C	50-D	2.6	3.3	5.3	8.6
1800	B	50-D	3.3	4.2	7.3	12.7
	C	50-D	2.7	3.4	5.3	8.6
1950	B	50-D	3.3	4.2	7.3	12.8
	C	50-D	2.7	3.4	5.4	8.7
2100	B	50-D	3.4	4.3	7.3	12.6
	C	50-D	2.7	3.5	5.4	8.6
2250	B	50-D	3.4	4.3	7.3	12.4
	C	50-D	2.8	3.5	5.4	8.6
2400	B	50-D	3.4	4.4	7.1	12.2
	C	50-D	2.3	3.5	5.4	8.5
2550	B	50-D	3.5	4.4	7.2	12.0
	C	50-D	2.8	3.6	5.4	8.4
2700	B	50-D	3.5	4.4	7.0	11.9
	C	50-D	2.8	3.6	5.5	8.3
3000	B	50-D	3.5	4.4	7.1	11.9
	C	50-D	2.8	3.6	5.5	8.3

LEGEND:

SD = Special Design
NL = No Limit

NOTES:


- A Height of fill is measured from the finished surface to top of pipe.
- B Minimum design height of fill over the top of pipe shall be greater than 600mm. Contact the concrete pipe supplier for special pipe designs 600mm or less.
- C For pipe-to-structure connections, the recommended minimum height of fill over the top of pipe shall be 600mm. Refer to OPSS 401.07.10 for minimum height of fill for backfilling and use of heavy equipment.
- D The excavation width is based on OPSD 802.030 and is the width of the excavation measured at the top of the pipe.
- E Strength designations are pipe Class 50-D, 65-D, 100-D, and 140-D according to CSA A257.2.
- F The table is based on backfill density of 2,243 kg/m³, truck axle loads as per CHBDC Annex A3.4.1.
- G For confined trench, the load factor used for the calculation of the variable bedding factor is:
Class B bedding=1.9, and Class C bedding=1.5.
- H For confined trench, $K_{\mu}'=0.165$. This represents a sand and gravel soil material in the trench walls, similar to Granular A or Granular B Type II as per OPSS 1010.
- I This Fill Height Table was established using assumed design parameters, and should be used for guideline purposes only. The user should verify site specific design requirements for the pipe design.
- J Conditions other than those indicated shall be calculated from first principles.
- K All dimensions are in metres unless otherwise shown.

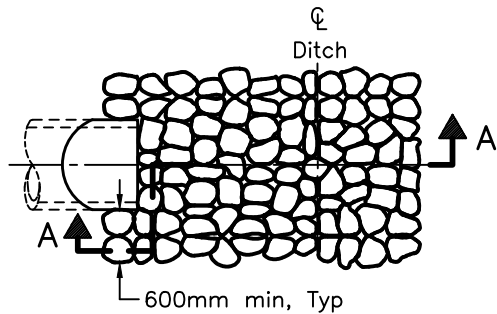
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev	4	
HEIGHT OF FILL TABLE	-----			
REINFORCED CONCRETE PIPE – CONFINED TRENCH CLASS 50-D, 65-D, 100-D, and 140-D	-----			
OPSD 807.010				

PIPE DIA mm	BEDDING CLASS	POSITIVE PROJECTING EMBANKMENT			
		MAXIMUM HEIGHT OF FILL FOR DEPTHS > 0.6m			
		50-D	65-D	100-D	140-D
300	B	2.2	3.1	4.9	6.9
	C	1.7	2.4	3.9	5.5
375	B	2.4	3.2	5.1	7.2
	C	1.8	2.5	4.1	5.9
450	B	2.5	3.3	5.3	7.4
	C	1.9	2.6	4.2	6.0
525	B	2.5	3.4	5.4	7.6
	C	1.9	2.7	4.3	6.2
600	B	2.6	3.5	5.5	7.7
	C	2.0	2.7	4.4	6.3
675	B	2.6	3.5	5.5	7.8
	C	2.0	2.8	4.5	6.3
750	B	2.6	3.6	5.6	7.9
	C	2.1	2.8	4.5	6.4
825	B	2.7	3.6	5.6	7.9
	C	2.1	2.8	4.6	6.5
900	B	2.7	3.6	5.7	8.0
	C	2.2	2.9	4.6	6.5
975	B	2.7	3.6	5.7	8.1
	C	2.2	2.9	4.6	6.5
1050	B	2.8	3.7	5.7	8.1
	C	2.3	2.9	4.6	6.6
1200	B	2.9	3.7	5.8	8.2
	C	2.4	3.0	4.7	6.3
1350	B	3.0	3.8	6.0	8.4
	C	2.5	3.1	4.8	6.8
1500	B	3.1	3.8	6.0	8.4
	C	2.6	3.2	4.8	6.8
1650	B	3.2	3.9	6.0	8.4
	C	2.6	3.3	4.8	6.8
1800	B	3.3	4.0	6.0	8.5
	C	2.7	3.4	4.9	6.9
1950	B	3.3	4.1	6.0	8.5
	C	2.7	3.5	4.9	6.9
2100	B	3.4	4.2	6.0	8.5
	C	2.8	3.5	5.0	6.9
2250	B	3.4	4.3	6.0	8.5
	C	2.8	3.6	5.1	6.9
2400	B	3.5	4.3	6.1	8.5
	C	2.8	3.6	5.2	6.9
2550	B	3.5	4.4	6.2	8.5
	C	2.8	3.6	5.2	6.9
2700	B	3.6	4.5	6.3	8.5
	C	2.9	3.7	5.3	6.9
3000	B	3.6	4.6	6.4	8.5
	C	2.8	3.7	5.4	7.1

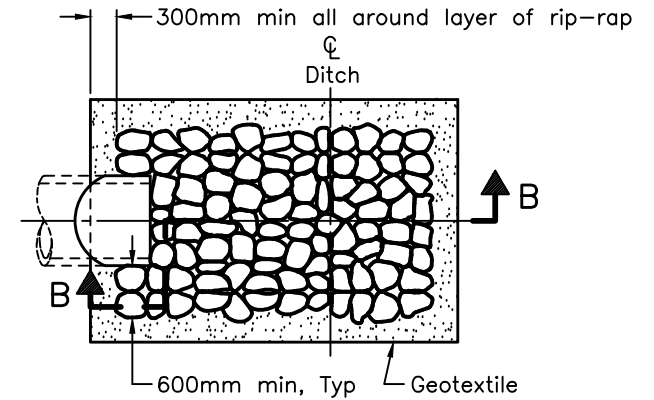
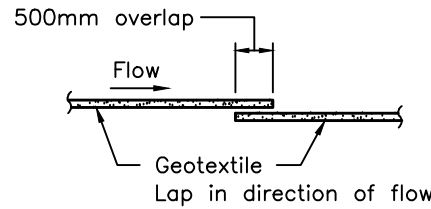
NOTES:

- A Height of fill is measured from the finished surface to top of pipe.
- B Minimum design height of fill over the top of pipe shall be greater than 600mm. Contact the concrete pipe supplier for special pipe designs 600mm or less.
- C For pipe-to-structure connections, the recommended minimum height of fill over the top of pipe shall be 600mm. Refer to OPSS 401.07.10 for minimum height of fill for backfilling and use of heavy equipment.
- D The excavation width is based on OPSD 802.030 and is the width of the excavation measured at the top of the pipe.
- E Strength designations are pipe Class 50-D, 65-D, 100-D, and 140-D according to CSA A257.2.
- F The table is based on backfill density of 2,243 kg/m³, truck axle loads as per CHBDC Annex A3.4.1.
- G For positive projecting embankment, the load factor used for the calculation of the variable bedding factor is: Class B bedding=1.9, and Class C bedding=1.5.
- H For positive projecting embankment $K_u=0.165$, $p=0.8$, and $r_{sd}=0.7$. This represents a sand and gravel soil material as the embankment backfill, similar to Granular A or Granular B Type II as per OPSS 1010.
- I This Fill Height Table was established using assumed design parameters, and should be used for guideline purposes only. The user should verify site specific design requirements for the pipe design.
- J Conditions other than those indicated shall be calculated from first principles.
- K All dimensions are in metres unless otherwise shown.

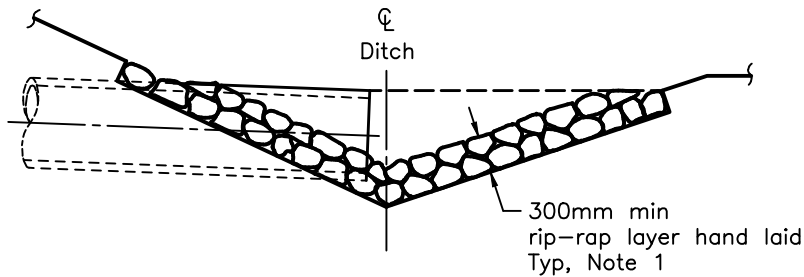
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev	4	
HEIGHT OF FILL TABLE				
REINFORCED CONCRETE PIPE – EMBANKMENT CLASS 50-D, 65-D, 100-D, and 140-D				
OPSD 807.030				



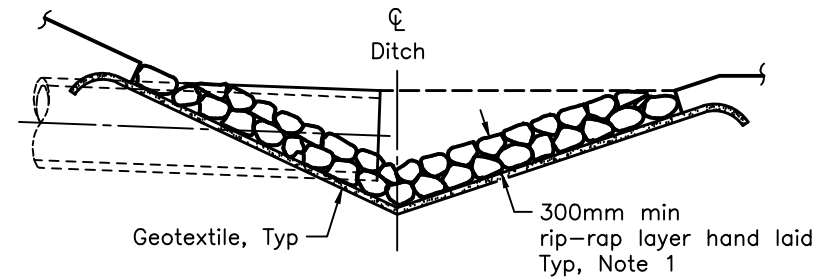
PLAN
CUT OR FILL



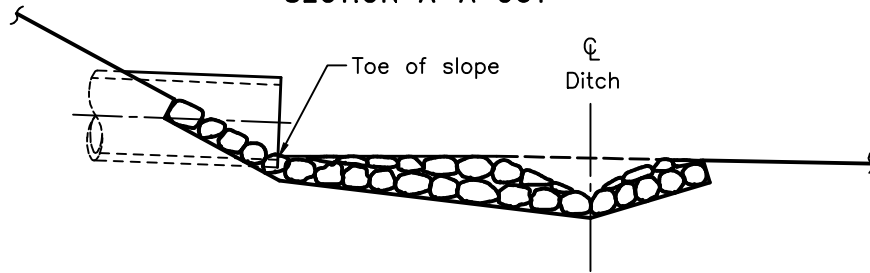
PLAN
CUT OR FILL



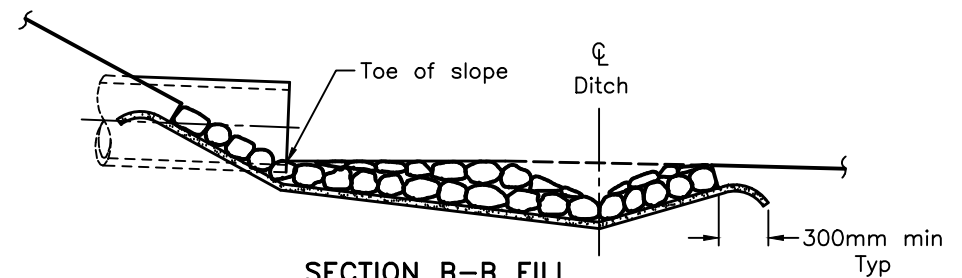
SECTION A-A CUT



SECTION B-B CUT



SECTION A-A FILL



SECTION B-B FILL

TYPE A - WITHOUT GEOTEXTILE

TYPE B - WITH GEOTEXTILE

NOTES:

1 The thickness of the rip-rap layer shall be at least 1.5 times the rip-rap mean diameter.

A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

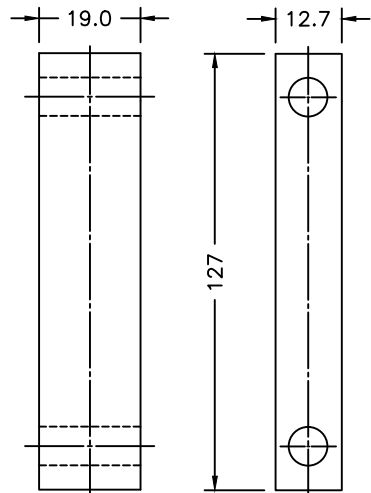
Nov 2018

Rev 3

**GENERAL RIP-RAP LAYOUT
FOR SEWER AND CULVERT OUTLETS**

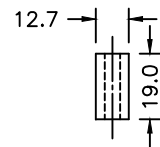


OPSD 810.010



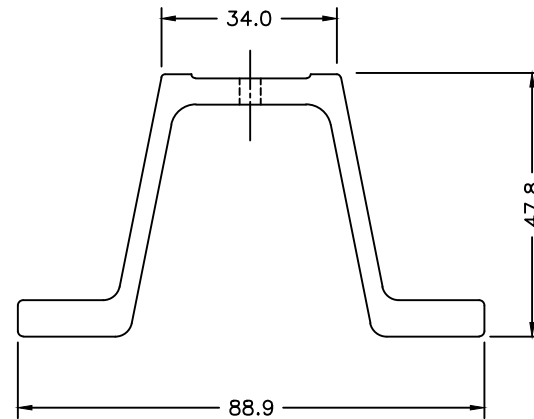
SIDE

FRONT

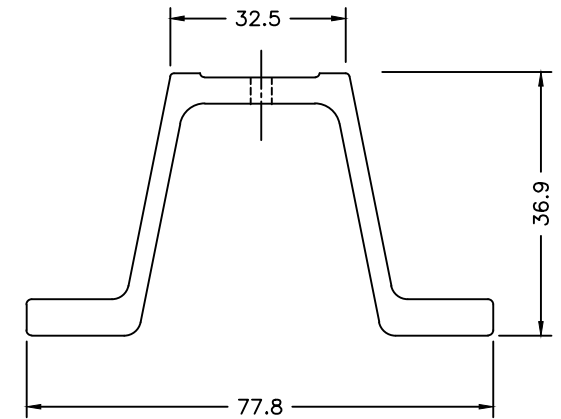


TOP

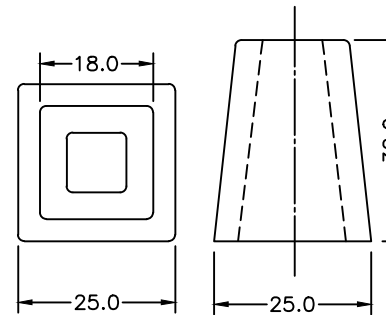
LAP SPLICE SPACER
Gold coloured nickel/steel



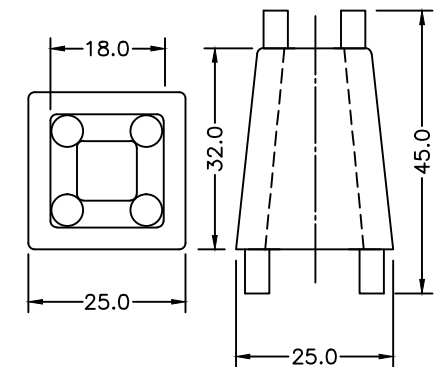
4.46 kg/m RIB-BAK POST



2.61 kg/m RIB-BAK POST



Front View Top View
TYPE A, Note 1 and 3




Front View Top View
TYPE B, Note 2 and 3

SPACER FOR SIGN TO POST

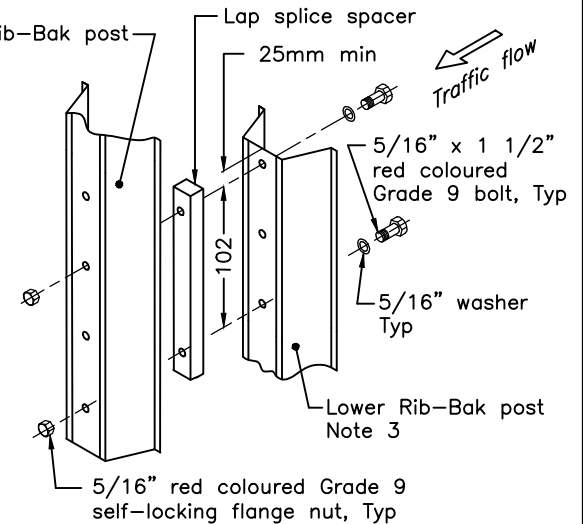
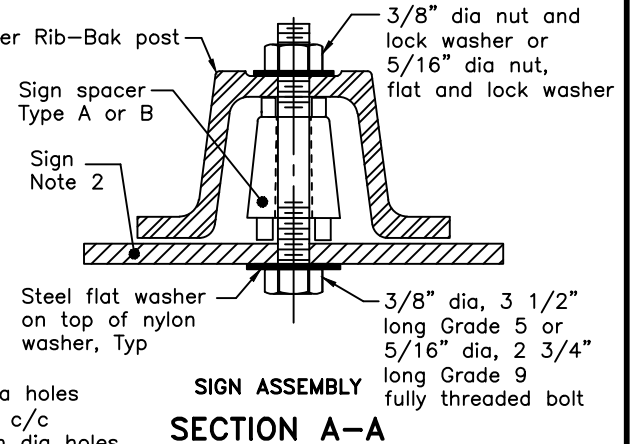
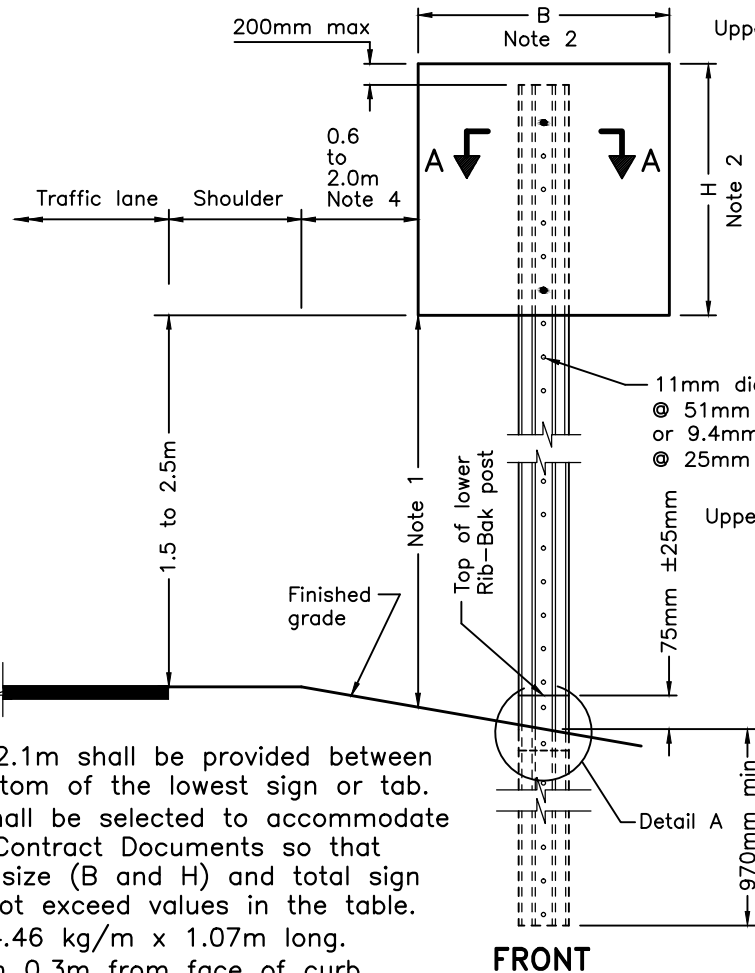
NOTES:

- 1 Type A sign spacer shall be used with 2.61 kg/m upper post.
 - 2 Type B sign spacer shall be used with 4.46 kg/m upper post.
 - 3 Sign spacers shall be molded from Acrylonitrile Butadiene Styrene thermoplastic resin with an ultraviolet inhibitor finish.
- A Posts and hardware depicted on this OPSD are proprietary.
 B Posts shall be manufactured from hot rolled carbon steel bars according to Marion Steel Company Grade SP-80 having minimum yield strength of 552 MPa according to ASTM A 499.
 C Posts shall be perforated with 11mm diameter holes @ 51mm c/c spacing or 9.4mm diameter holes @ 25mm c/c spacing.
 D Posts shall be hot dip galvanized after fabrication.
 E Lap splice spacer shall be fabricated from hot rolled carbon steel bars according to ASTM A36M.
 F All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Apr 2019	Rev 1	
SMALL SIGN SUPPORT SYSTEM LAP SPLICE RIB-BAK BREAKAWAY SYSTEM COMPONENTS	-----		
OPSD 987.101			

SIGN SUPPORT REQUIREMENTS
Note 2

Max. Sign Dimensions		Max. Sign Area	Upper Post
B cm	H cm	A m ²	kg/m
90	135	0.45	2.61
	150	0.81	4.46

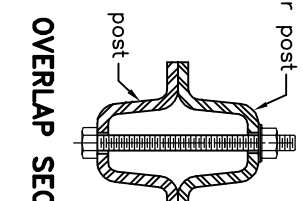
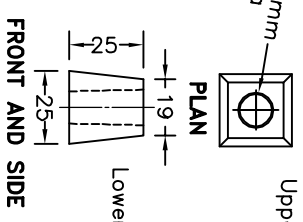
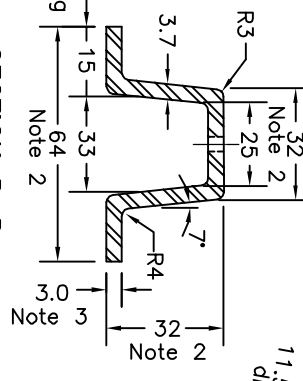
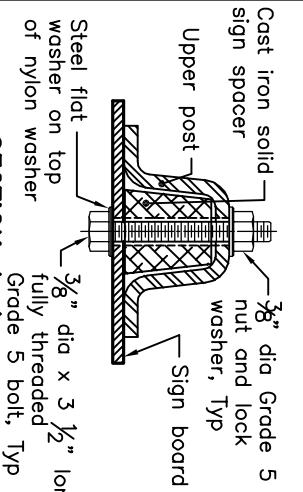
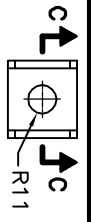
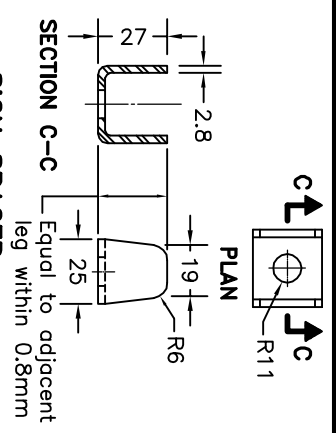
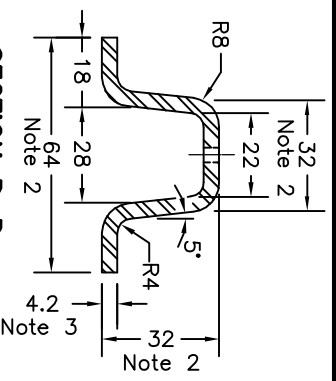
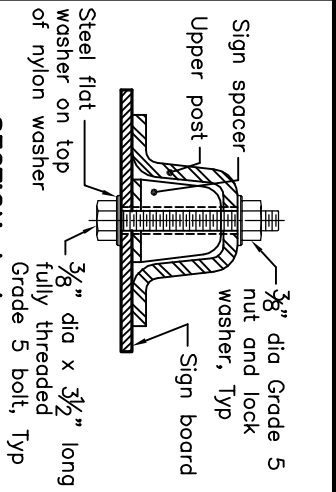


NOTES:

- 1 Minimum vertical clearance of 2.1m shall be provided between the finished grade and the bottom of the lowest sign or tab.
- 2 The upper post size (kg/m) shall be selected to accommodate the sign size specified in the Contract Documents so that maximum dimensions for sign size (B and H) and total sign area (A) including tabs shall not exceed values in the table.
- 3 Lower Rib-Bak post shall be 4.46 kg/m x 1.07m long.
- 4 When curb is present, minimum 0.3m from face of curb.
When guide rail is present, minimum 1.0m behind face of guide rail.

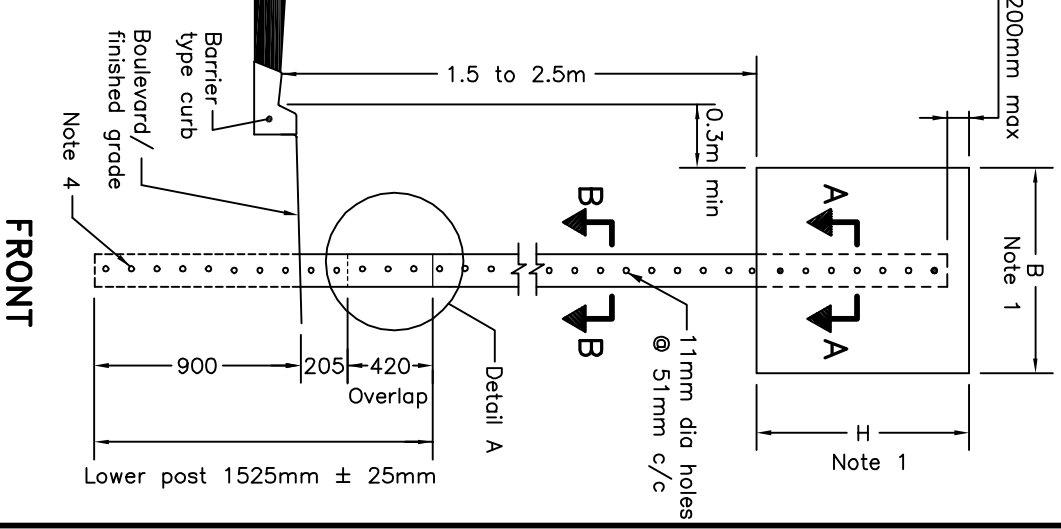
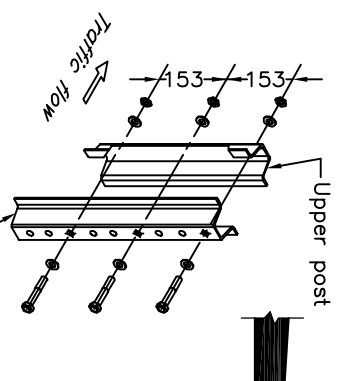
- A The system depicted on this OPSD is a propriety system and shall be installed according to manufacturer's specifications.
- B This OPSD shall be read in conjunction with OPSD 987.101.
- C System configuration meets NCHRP Report 350 TL-3.
- D All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Apr 2019	Rev 1	
SMALL SIGN SUPPORT SYSTEM LAP SPLICE RIB-BAK BREAKAWAY SYSTEM INSTALLATION-SINGLE POST ASSEMBLY	-----		
OPSD 987.110			



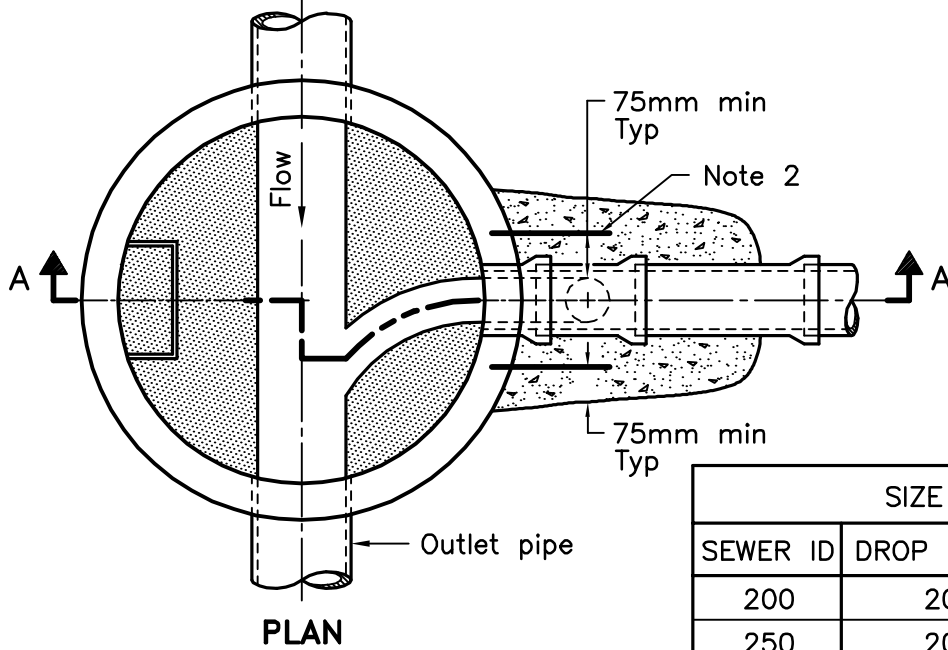
NOTES:

- 1 Sign dimensions shall be selected up to maximum sign width (B) of 90cm, up to maximum sign height (H) of 90cm, and the total sign area including tabs shall not exceed 0.56 square metres.
- 2 Tolerance shall be ± 1.6 mm.
- 3 Tolerance for thickness shall be ± 0.38 mm. All other tolerances shall be ± 0.8 mm.
- 4 Holes below grade in lower post shall be optional.
- A This system may be installed on low speed roadways with barrier type curb and posted speeds less than 70 km/h.
- B Posts shall be manufactured from either cold formed steel or hot formed steel.
- C Cold formed steel shall have a minimum yield strength of 345 MPa and weigh a minimum of 3.36 kg/m.
- D Hot formed steel shall have a minimum yield strength of 380 MPa and weigh a minimum of 3.02 kg/m.
- E Post and hardware shall be hot dip galvanized after fabrication.
- F All dimensions are in millimetres unless otherwise shown.

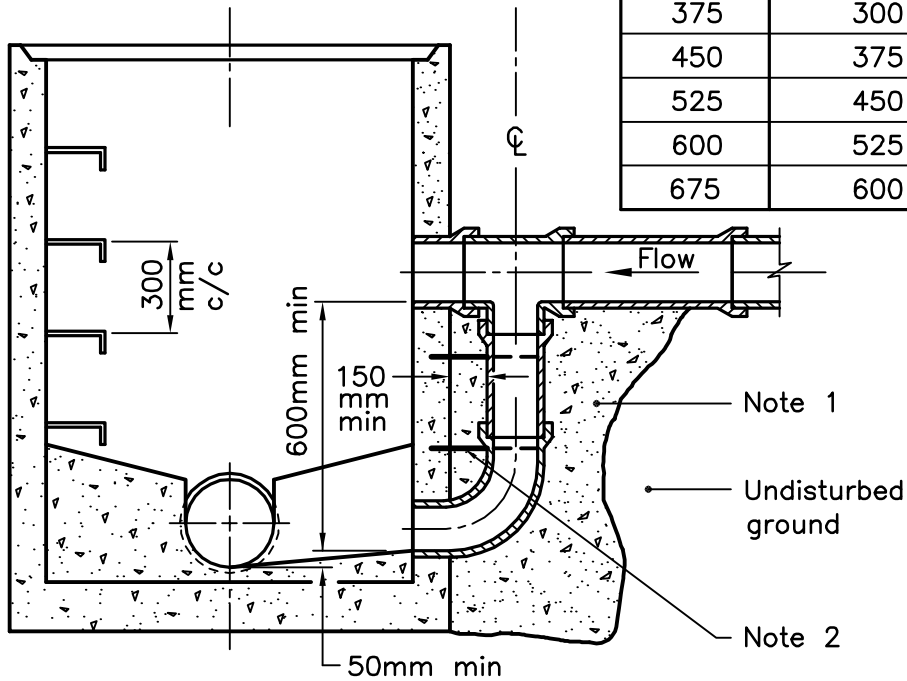


ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2014		Rev 1	
SMALL SIGN SUPPORT SYSTEM		NON-BREAKAWAY U-FLANGE POST SYSTEM		OPSD 990.110	
NON-BREAKAWAY U-FLANGE POST SYSTEM		INSTALLATION-SINGLE POST ASSEMBLY		OPSD 990.110	






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



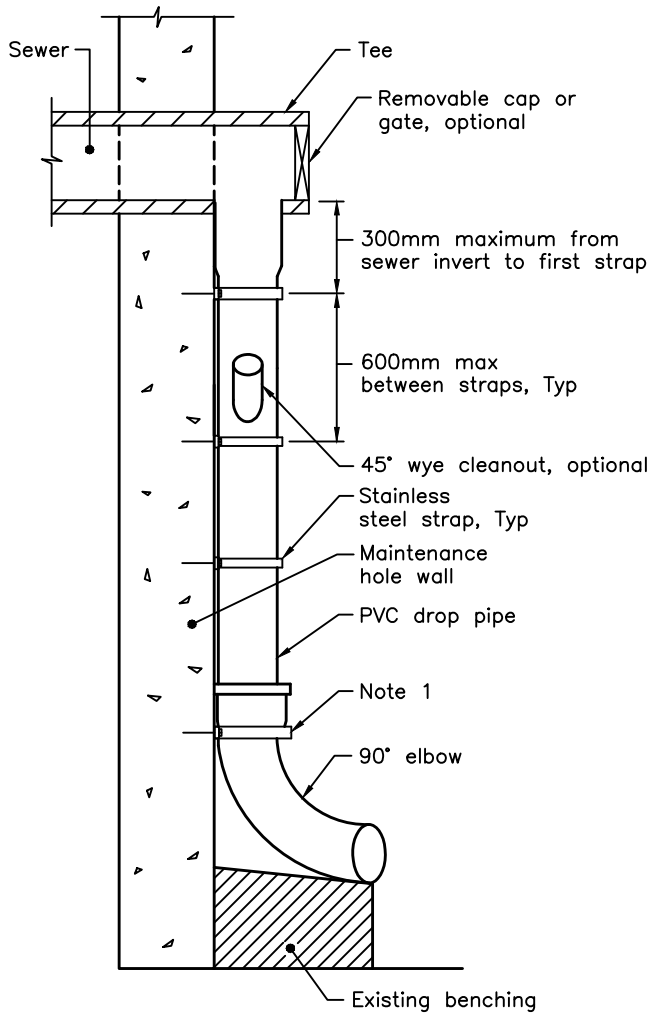
SECTION A-A

NOTES:

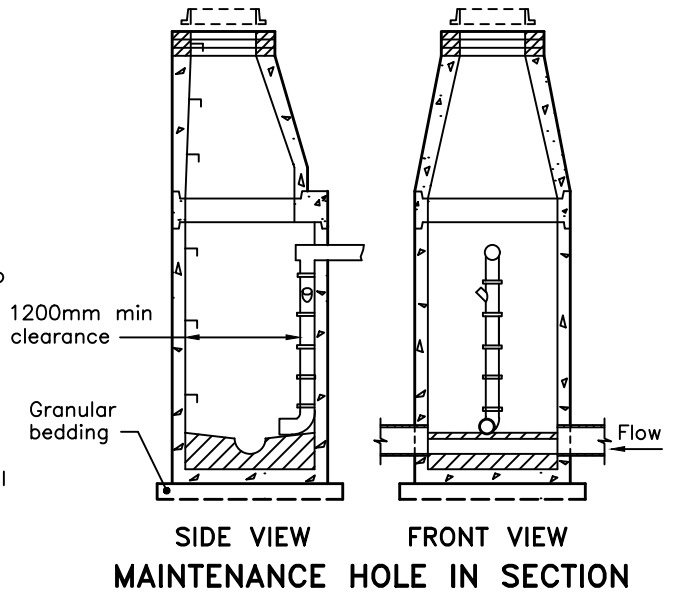
- Concrete shall be placed to undisturbed ground and the outside face of the maintenance hole, but there shall be a minimum of 150mm of 15MPa concrete around the drop pipe.
 - Concrete shall be secured to the maintenance hole with 450mm long, 13mm diameter threaded rods and drilled expansion anchors 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		-----		

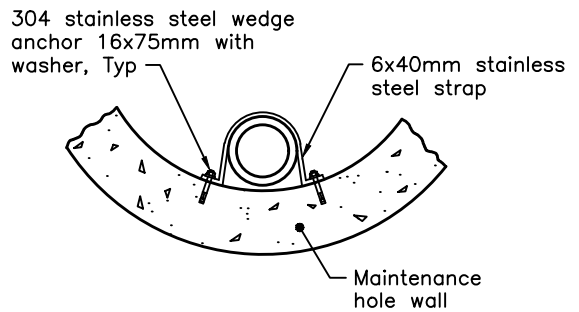
		OPSD 1003.010		



INTERNAL DROP STRUCTURE DETAIL



MAINTENANCE HOLE IN SECTION



FASTENER DETAIL

NOTES:

- 1 At the elbow, a stainless steel strap is required at bottom of bell.
- A Internal drop structure shall be used on existing maintenance holes 1500mm diameter and larger with a minimum height of 600mm from the inlet pipe invert to the top of benching. The existing benching shall be modified as required.
- B Drop pipe shall be one size smaller than the incoming sewer with a minimum 150mm diameter and maximum of 375mm diameter. A maximum of 300mm diameter for 1500mm maintenance holes.
- C Straps shall not be placed within 150mm of any maintenance hole section joint.
- D All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

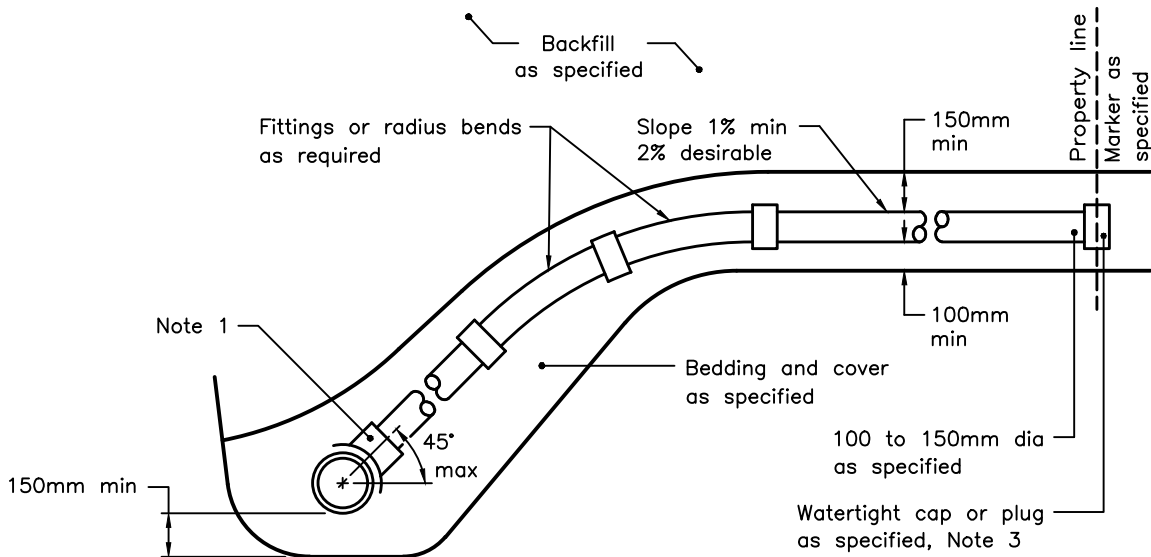
**INTERNAL DROP STRUCTURE
FOR EXISTING MAINTENANCE HOLES
WITH OPTIONAL SIDE CLEANOUT**

Nov 2021

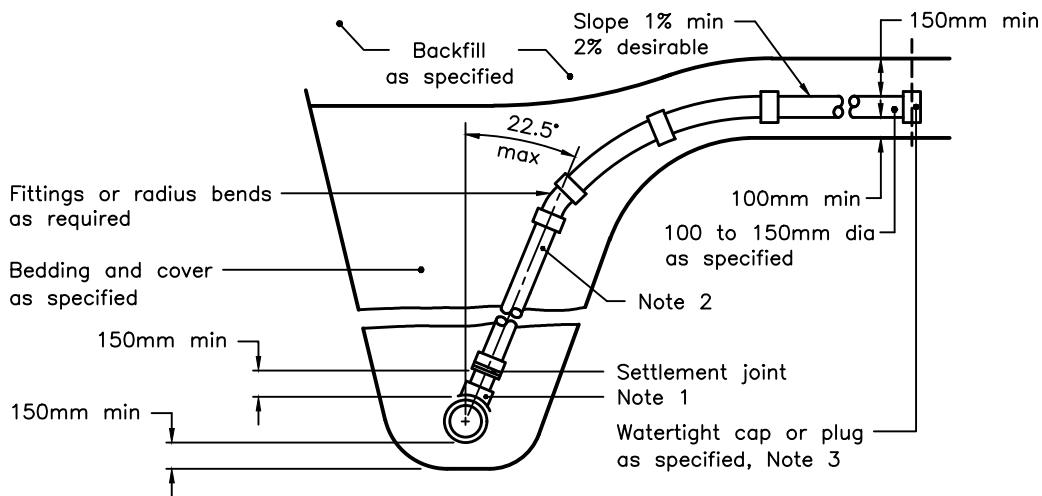
Rev 5



OPSD 1003.030



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 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.

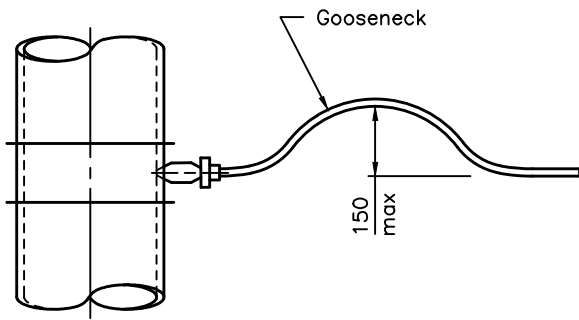
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2021 Rev 4

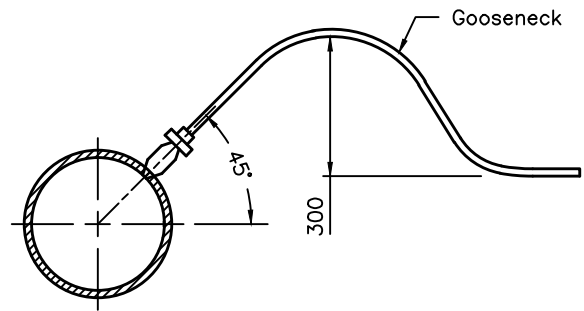
**SEWER SERVICE CONNECTIONS
FOR MAIN PIPE SEWER**



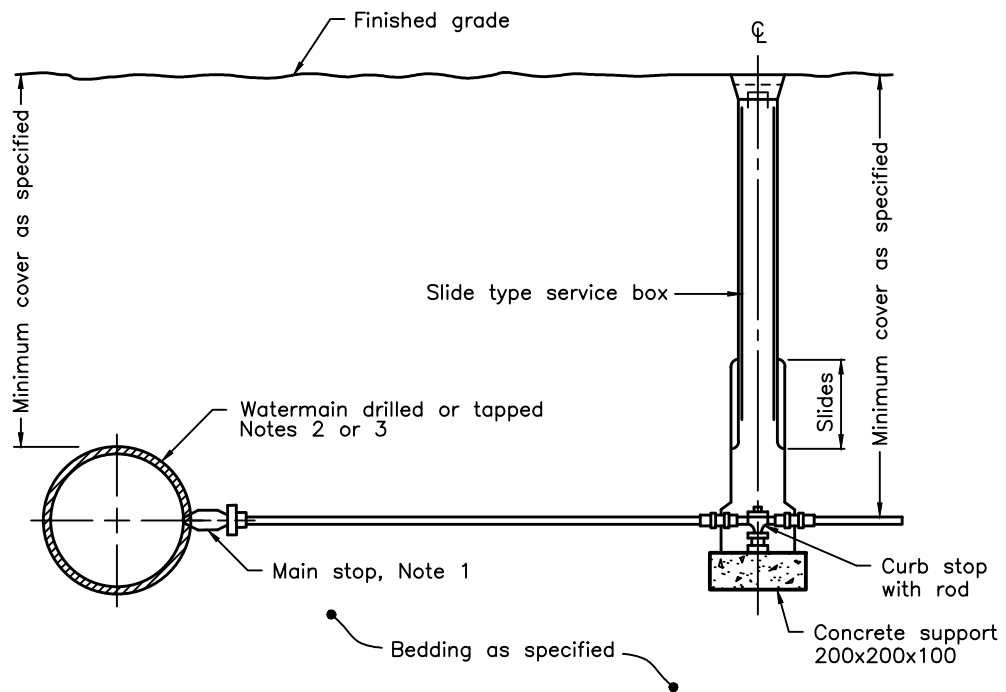
OPSD 1006.010



HORIZONTAL GOOSENECK



VERTICAL GOOSENECK OPTION



VERTICAL SECTION

NOTES:

- 1 For plastic service pipes, install main stop at 15° above horizontal with a minimum 1.2m long gooseneck.
- 2 Direct tap ductile iron pipe with approved tool with standard AWWA inlet thread.
- 3 Service connections to plastic watermains shall be made using service saddles or factory made tees.
- A When specified, the vertical gooseneck option shall be used.
- B Couplings shall not be permitted unless the service length exceeds 20m between the main stop and curb stop.
- C All water services shall be installed 90° to the longitudinal axis of the watermain.
- D Backfill material within 500mm of service box shall be native or imported, as specified.
- E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2018

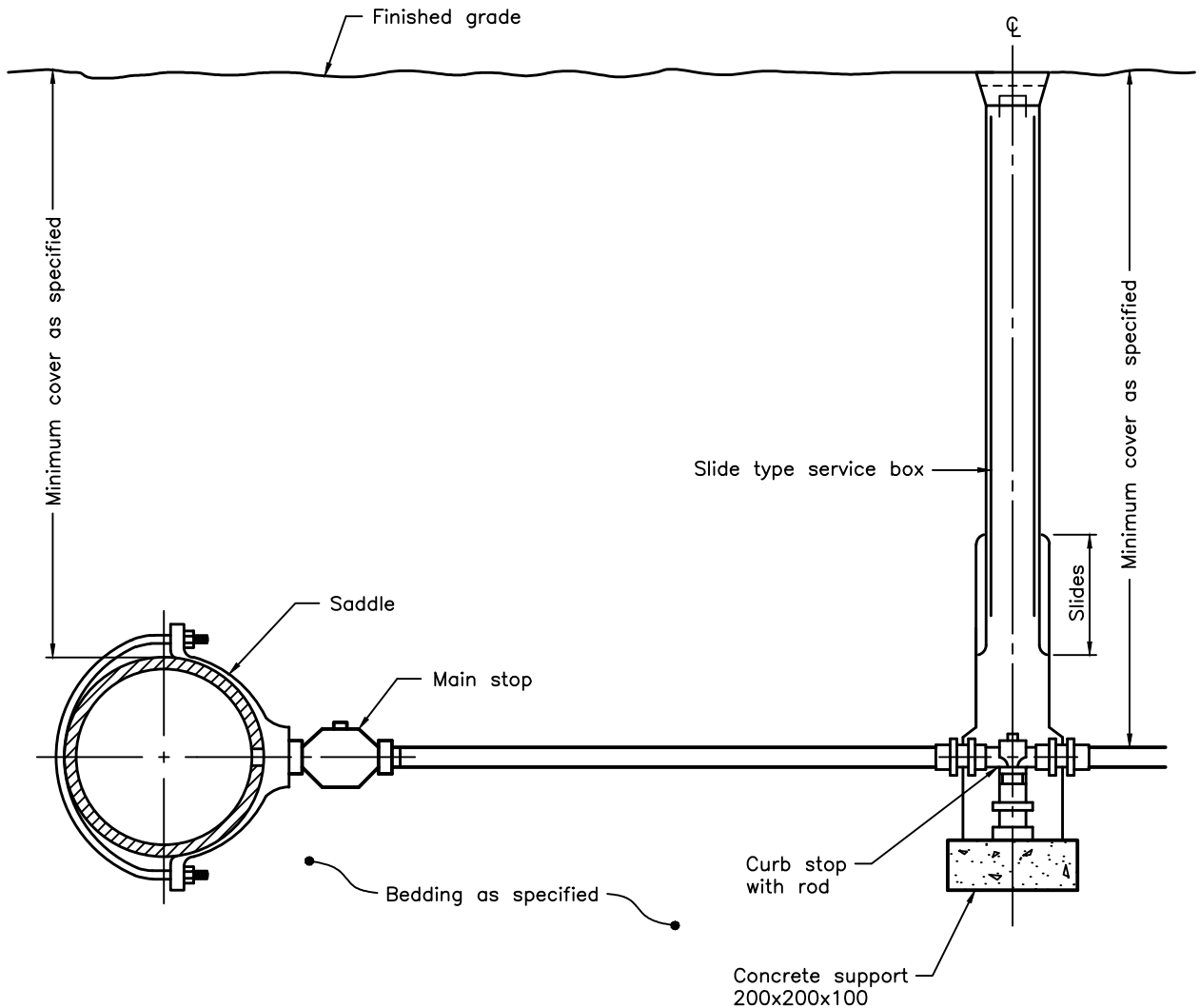
Rev 4

WATER SERVICE CONNECTION

19 and 25mm DIAMETER SIZES



OPSD 1104.010



NOTES:

- A Couplings shall not be permitted unless the service length exceeds 20m between the main stop and curb stop.
- B All water services shall be installed 90° to the longitudinal axis of the watermain.
- C Backfill material within 500mm of service box shall be native or imported, as specified.
- D All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2018

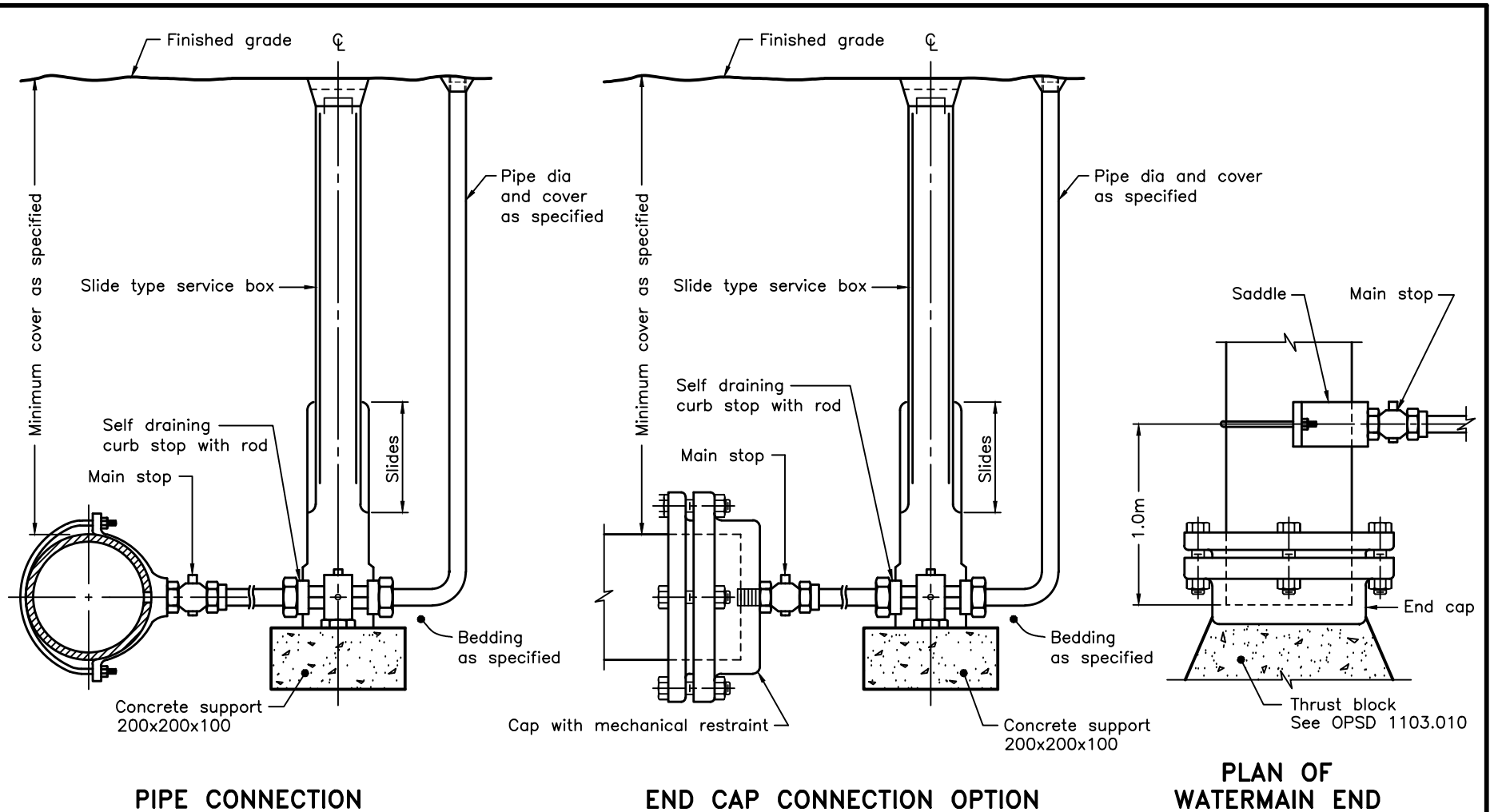
Rev 3

**WATER SERVICE
CONNECTION**

32, 38, and 50mm DIAMETER SIZES




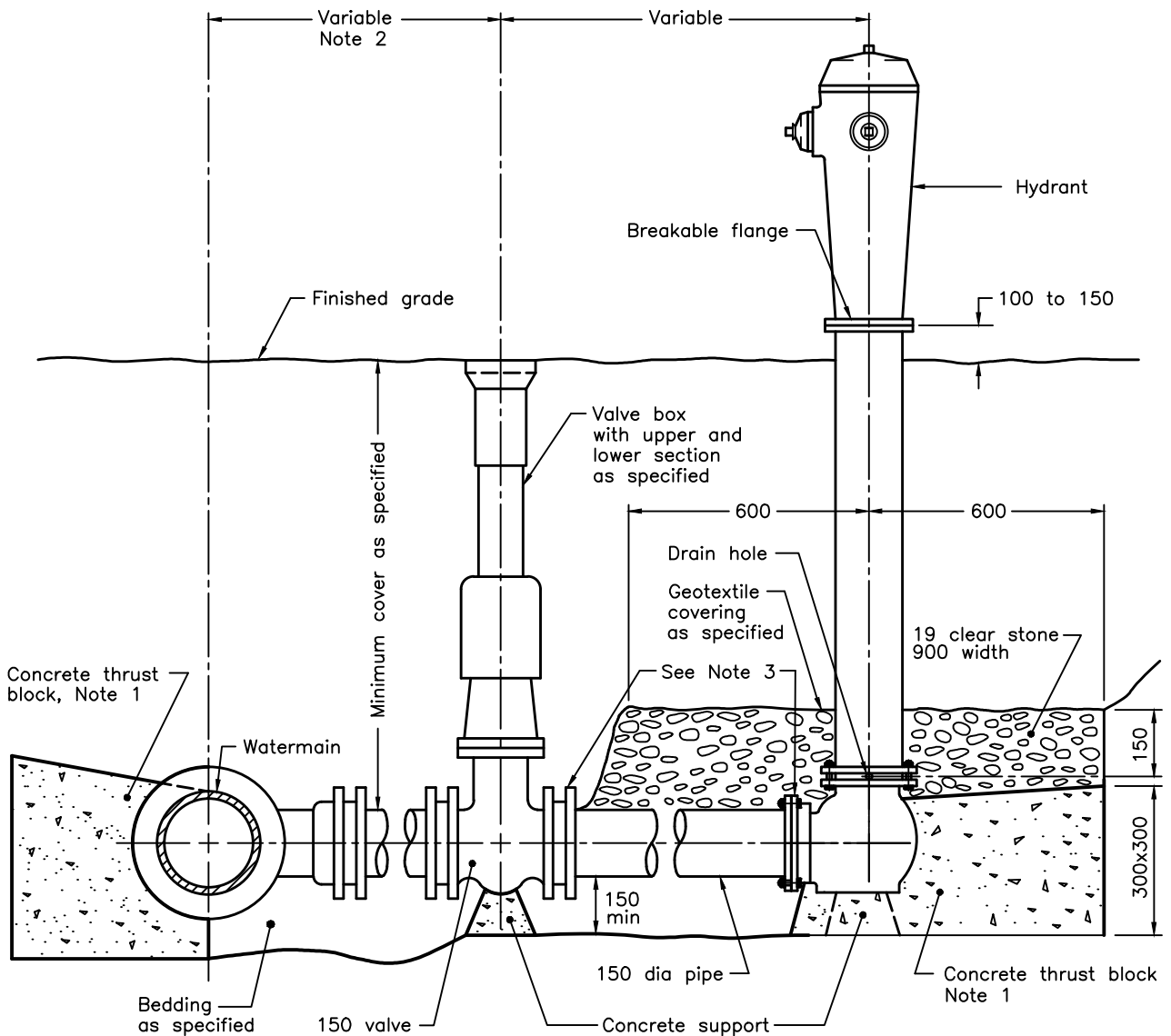
OPSD 1104.020



NOTES:

- A Backfill material within 500mm of service box shall be native or imported, as specified.
- B Refer to applicable regulations for end of pipe treatment.
- C All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3	
BLOW OFF INSTALLATION	-----		
OPSD 1104.030			



NOTES:

- 1 All concrete thrust blocks shall be poured against undisturbed ground.
- 2 When specified, for watermains 400mm and less, locate valve within 1.0m of centreline of watermain. Retaining and restraining devices shall be utilized. For watermains 600mm and over, bolt valve with flanged end directly to flanged tee.
- 3 Retaining and restraining devices shall be as specified.
- A Bond breaker shall be used between the concrete and the fittings and appurtenances.
- B Bolts and nuts for buried flange to flange connections shall be stainless steel.
- C When required, flange of standpipe extensions shall not be in frost zone.
- D This OPSD shall be read in conjunction with OPSD 1103.010 and 1103.020.
- E Backfill material within 500mm of service box shall be native or imported, as specified.
- F Tracer wire shall be installed as specified.
- G All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

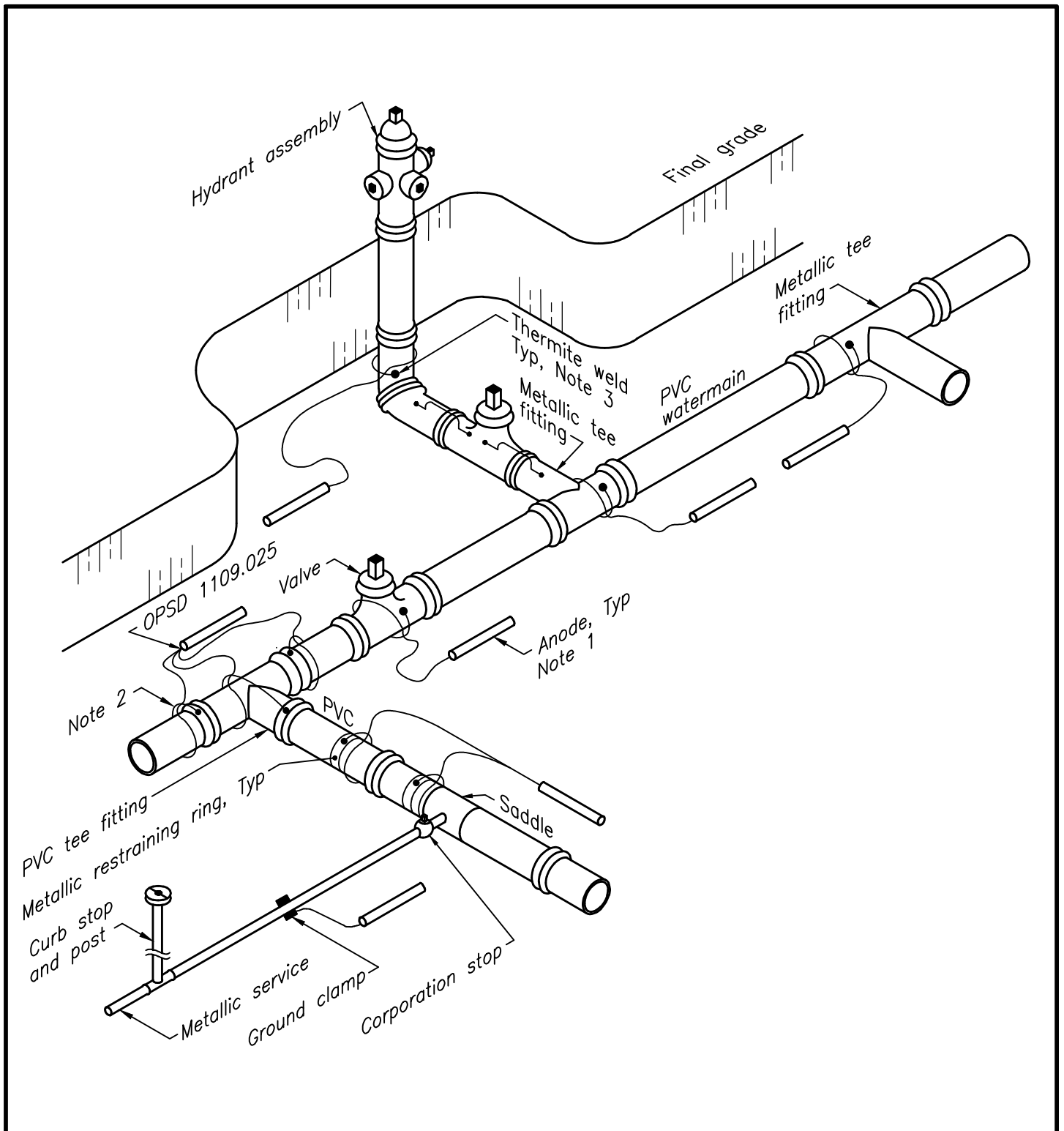
Nov 2018

Rev 3

HYDRANT INSTALLATION




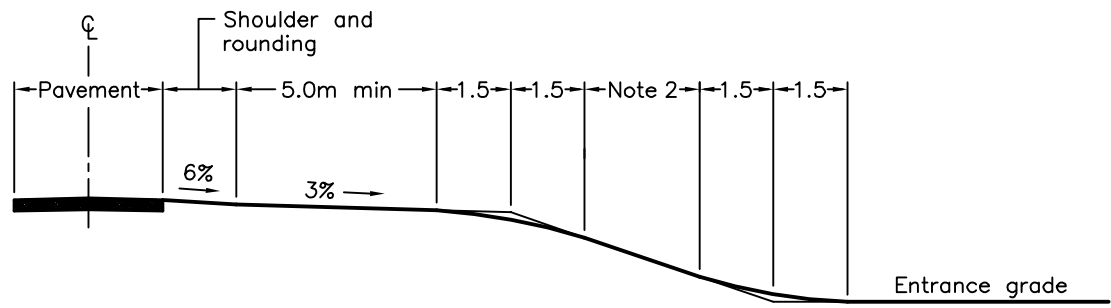
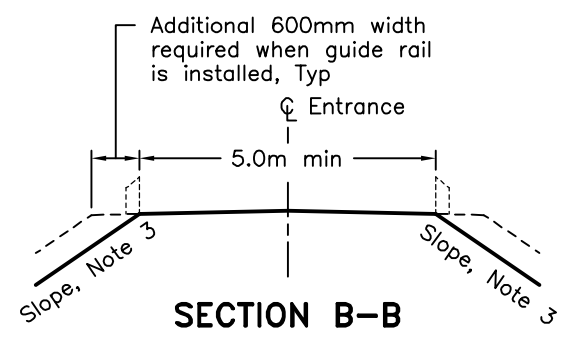
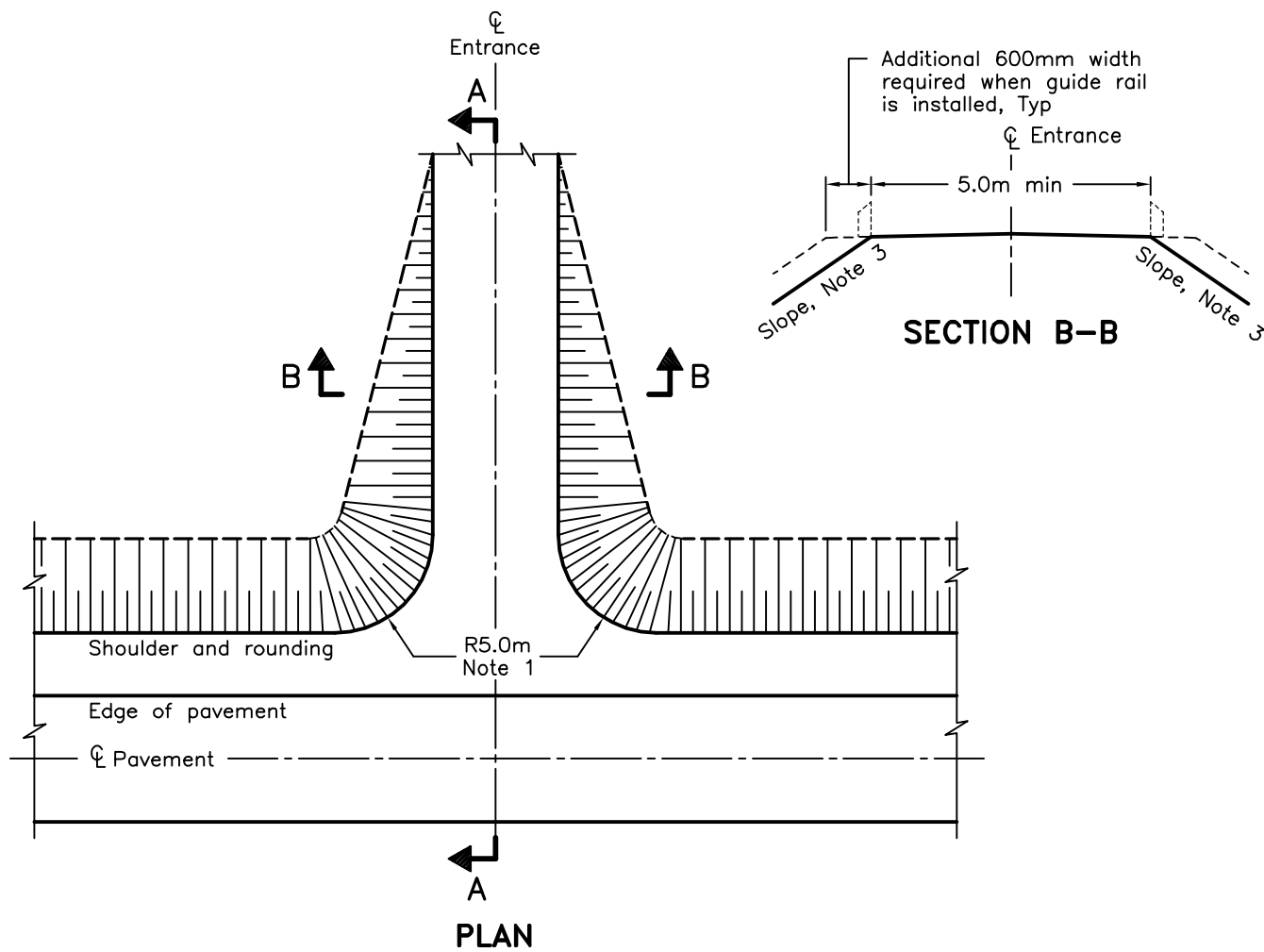
OPSD 1105.010



NOTES:

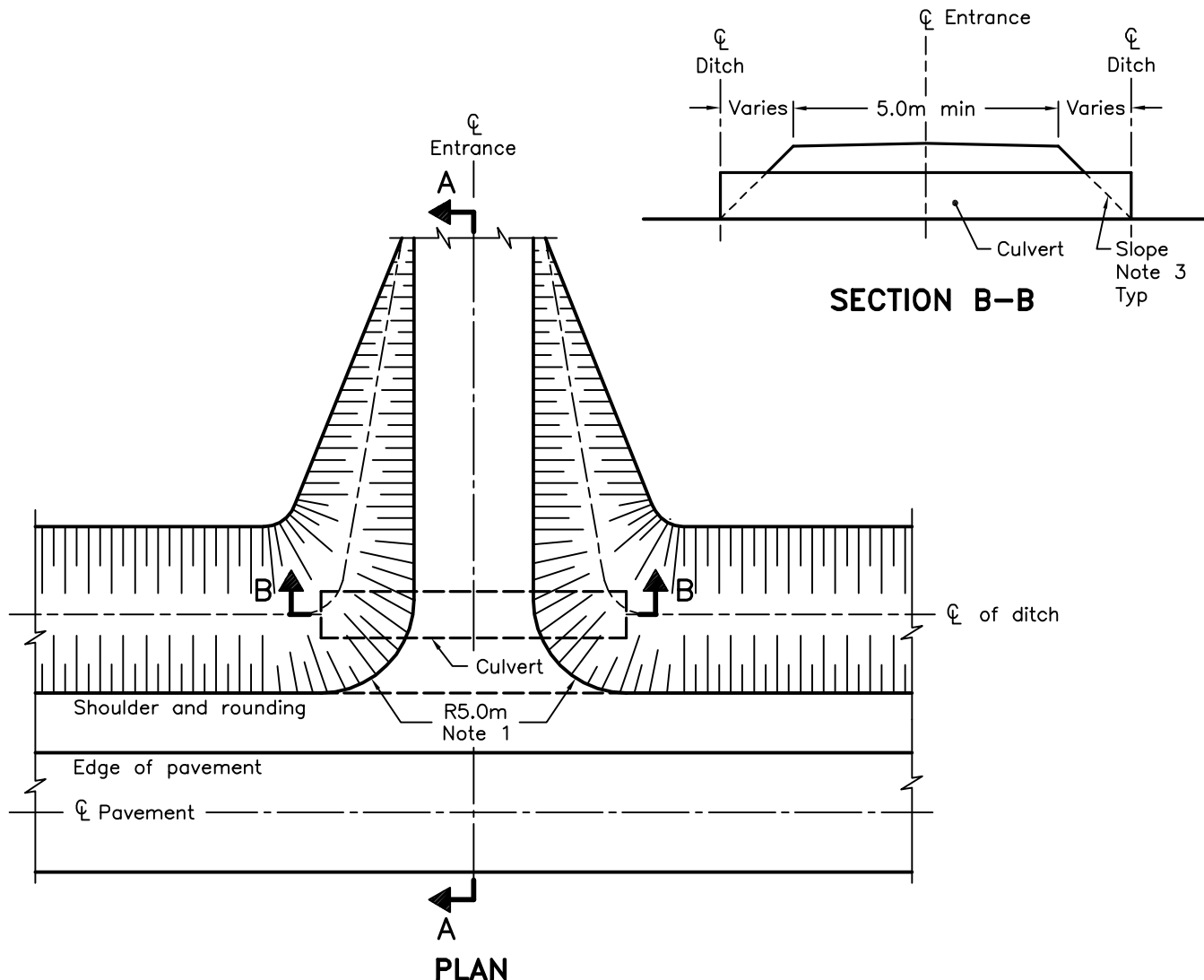
- 1 Anode shall be placed at least 1.0m away from the water system pipe and appurtenances and as deep as the bottom of the pipe and appurtenances or as specified in Contract Documents.
- 2 Anode connecting wire shall be loosely wrapped around pipes and fittings and knotted.
- 3 Protective coating shall be applied to all thermite welds.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2020	Rev 3	
CATHODIC PROTECTION FOR PVC WATERMAIN SYSTEMS	----- ----- -----		

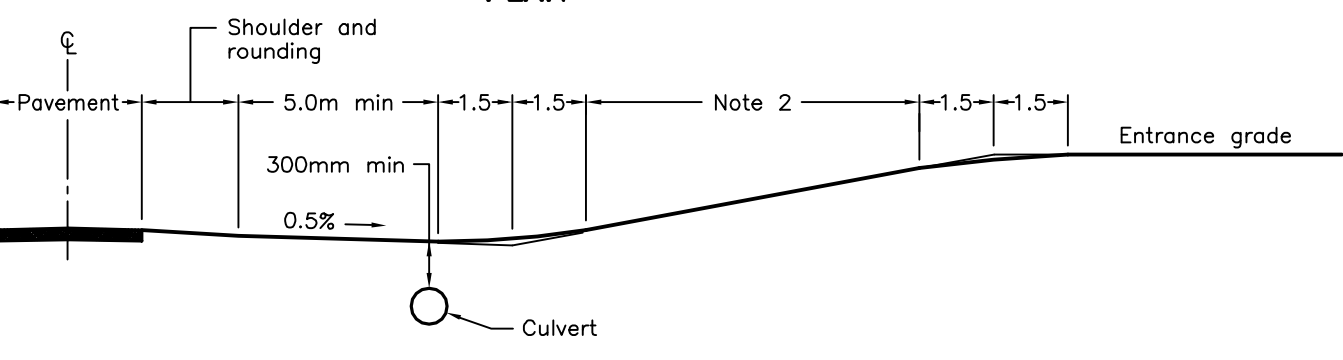


- NOTES:**
- 1 Radius shall be 8.0m when entrance is used for farm equipment.
 - 2 Maximum gradient: 6% for residential entrances and 10% for farm and field entrances.
 - 3 Slope shall be 3H:1V or flatter when specified.
- A All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2010	Rev 2	
RURAL ENTRANCES TO ROADS ON FILL	-----		
OPSD 301.010			



SECTION B-B




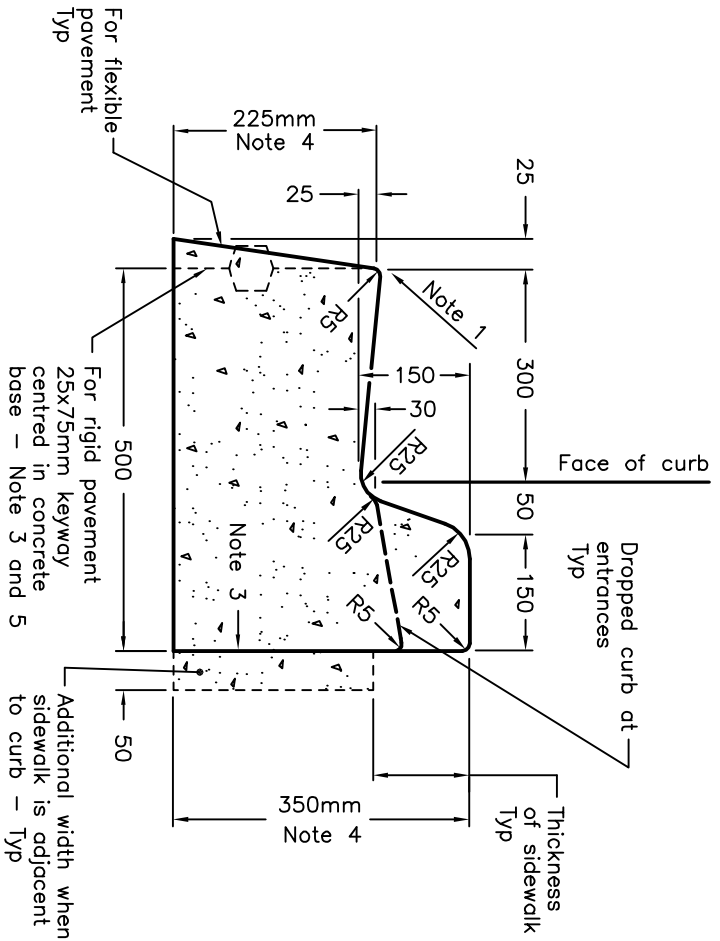
PLAN

SECTION A-A

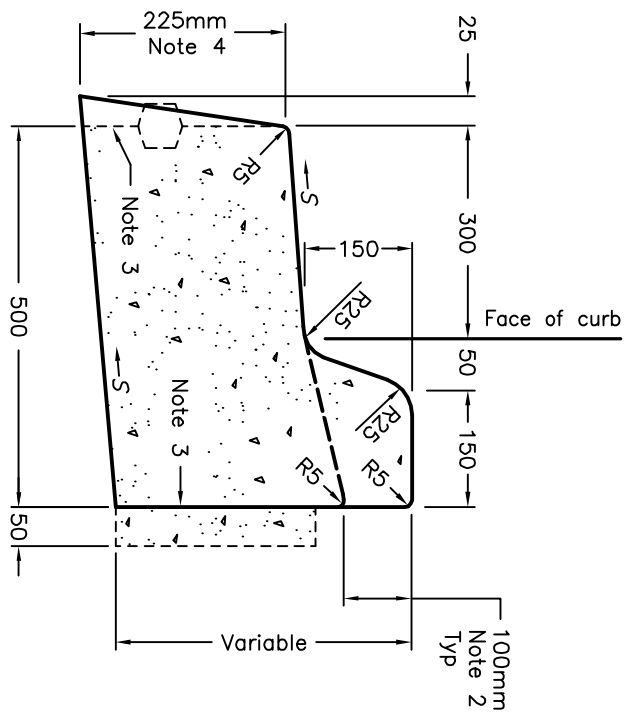
NOTES:

- 1 Radius shall be 8.0m when entrance is used for farm equipment.
- 2 Maximum gradient: 6% for residential entrances and 10% for farm and field entrances.
- 3 Slope shall be 3H:1V or flatter when specified.
- A All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2010	Rev 2	
RURAL ENTRANCES TO ROADS IN EARTH CUT	-----		
OPSD 301.020			



TANGENT



SUPERELEVATED

LEGEND:

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

NOTES:

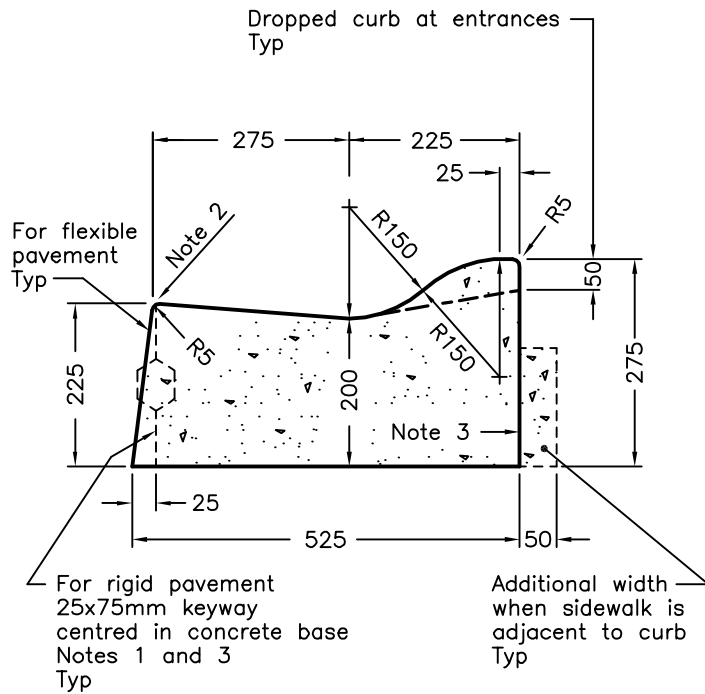
- 1 Flexible and composite pavement shall be placed 5mm above the adjacent edge of gutter.
- 2 When sidewalk is continuously adjacent, the dropped curb at entrances shall be reduced to 75mm.
- 3 For slipforming procedure a 5% batter is acceptable.
- 4 For composite pavement the depth of concrete curb 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,

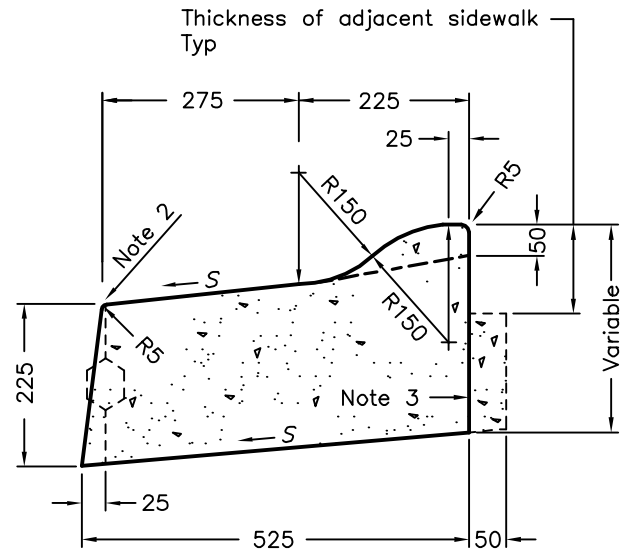
- except in conjunction with guide rail where it shall be according to the OPSD 900 Series.
 D All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2012	Rev	2
CONCRETE BARRIER CURB WITH STANDARD GUTTER		-----		
		OPSD 600.040		





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.

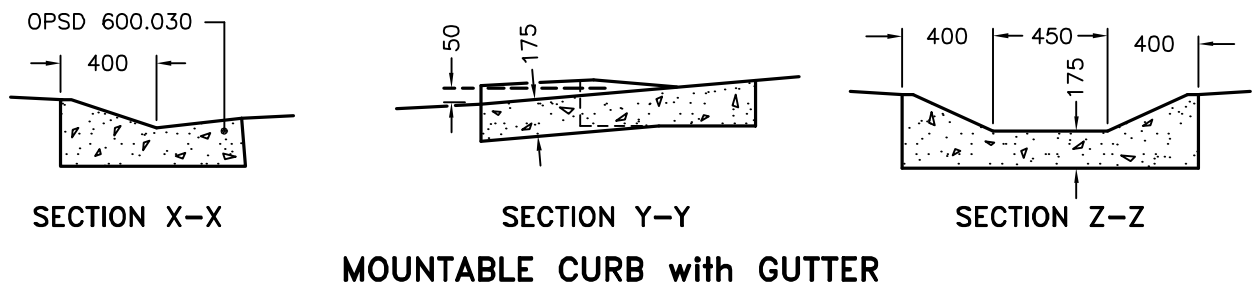
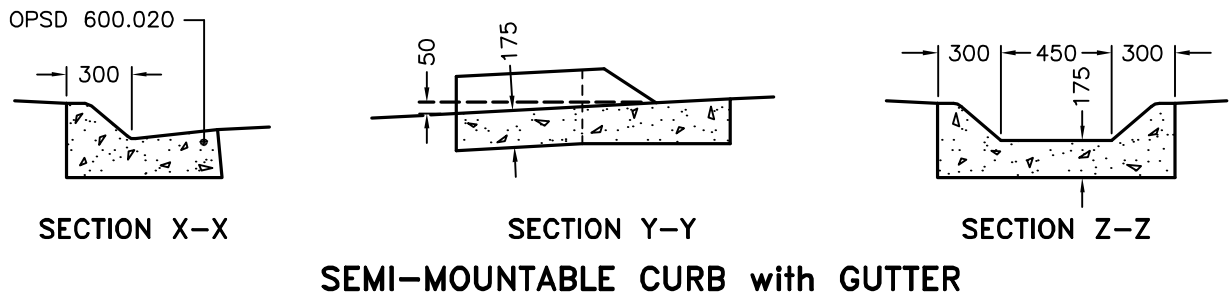
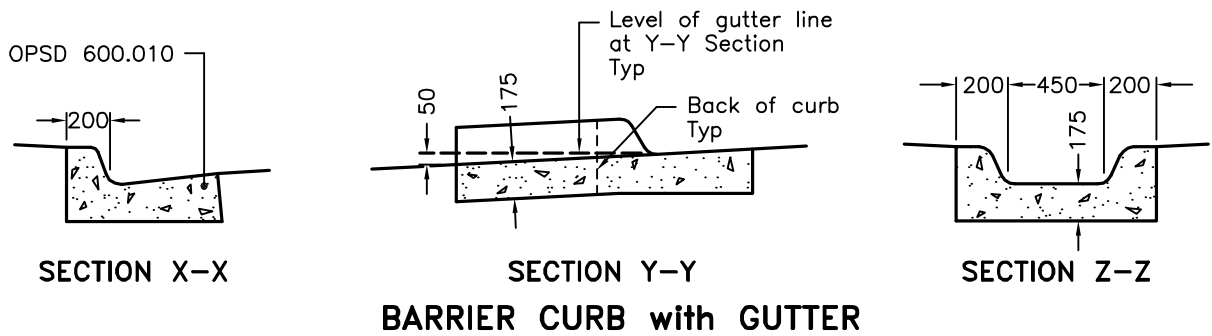
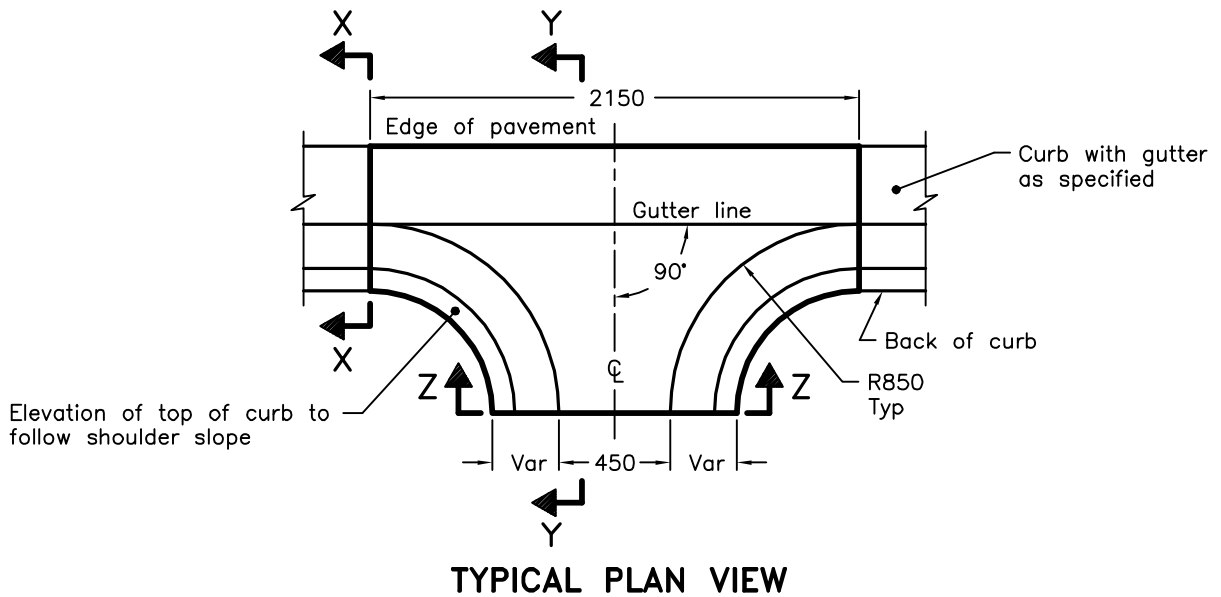
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2012 | Rev | 2

**CONCRETE SEMI-MOUNTABLE
CURB WITH STANDARD GUTTER**



OPSD 600.060



NOTES:

- A For asphalt spillway details refer to OPSD 605.040.
- B All dimensions are in millimetres unless otherwise shown.

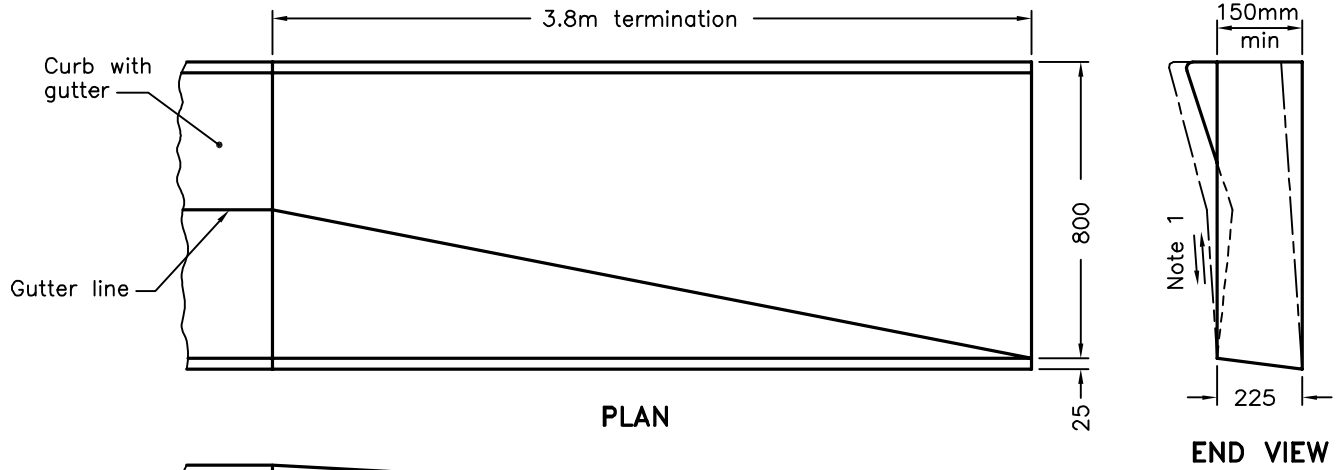
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2012 Rev 2

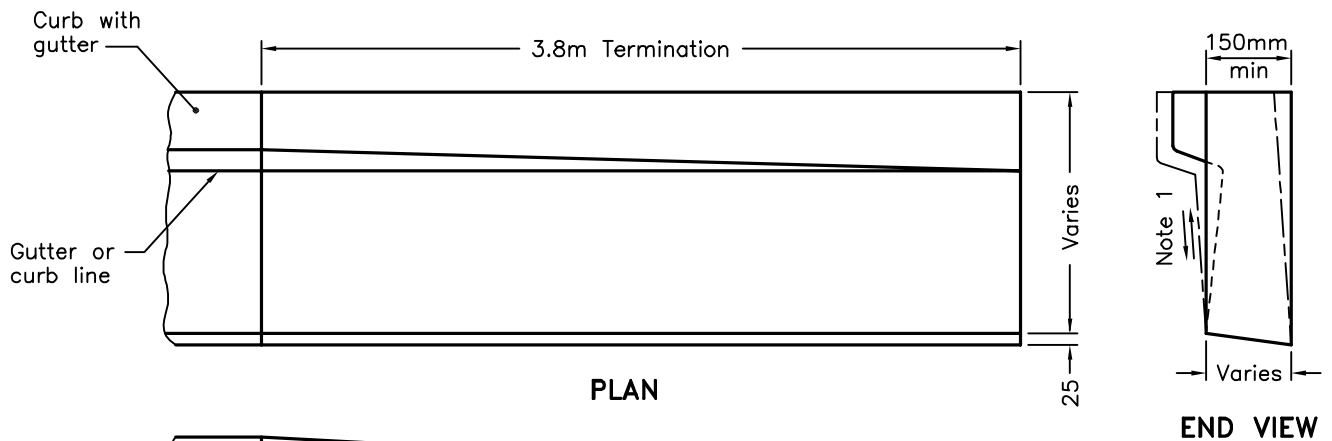


**90° CONCRETE OUTLET
FOR CONCRETE CURB WITH GUTTER**

OPSD 604.010



**ELEVATION
MOUNTABLE CURB WITH GUTTER**



**ELEVATION
BARRIER AND SEMI-MOUNTABLE CURB WITH GUTTER**

NOTES:

- 1 Slope shall match existing shoulder.
- A This drawing shall be read in conjunction with OPSD 600 series curb with gutter drawings.
- B All dimensions are in millimetres unless otherwise shown.

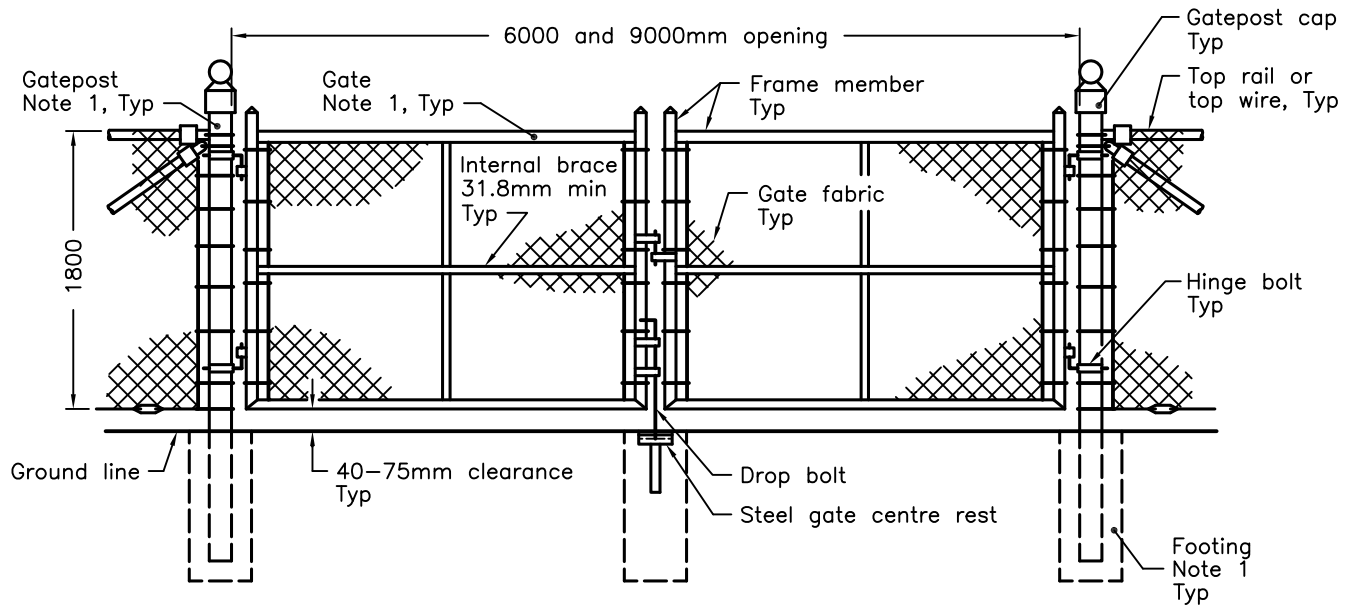
ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2012 Rev 2

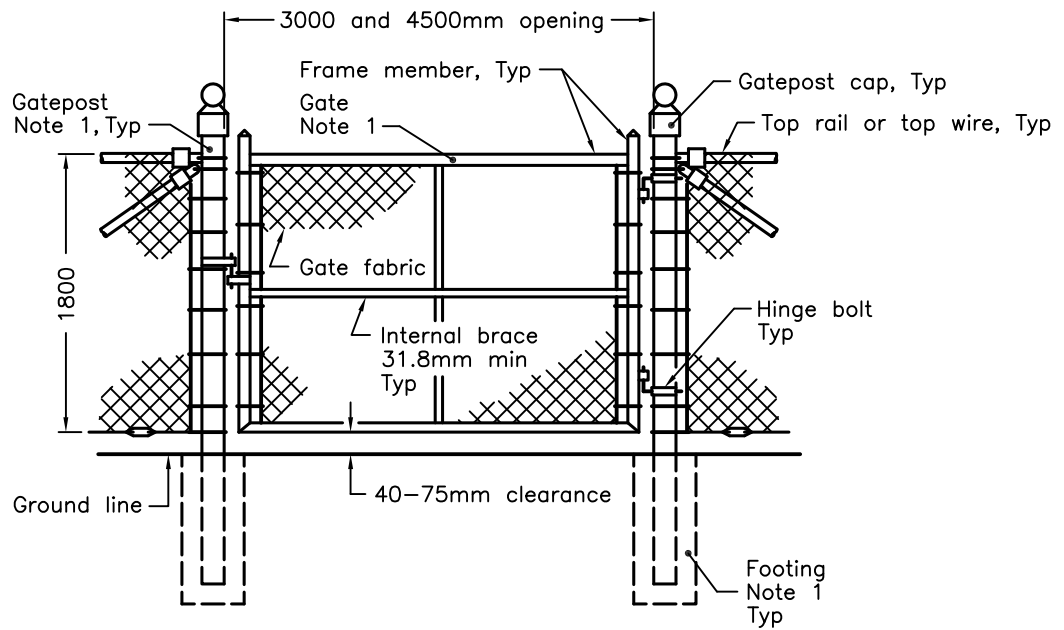
**METHOD OF TERMINATION
FOR CONCRETE CURB WITH GUTTER**



OPSD 608.010



DOUBLE SWING GATE OPENING



SINGLE SWING GATE OPENING

NOTES:

- 1 For footing details and Gate and Gatepost Details Table refer to OPSD 972.132.
- A Gates as viewed from the roadway.
- B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING

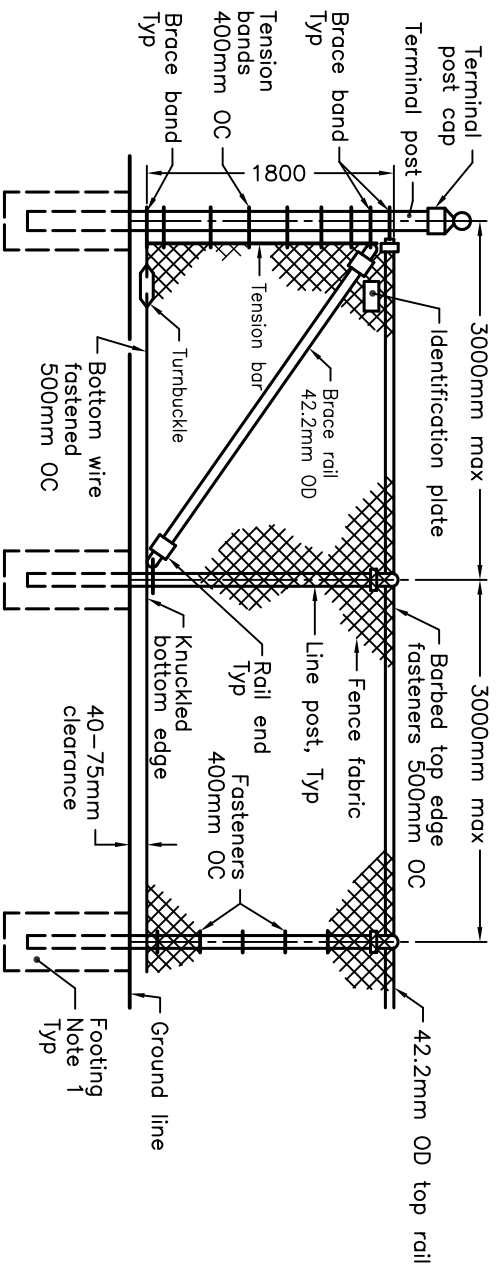
Nov 2012

Rev 2

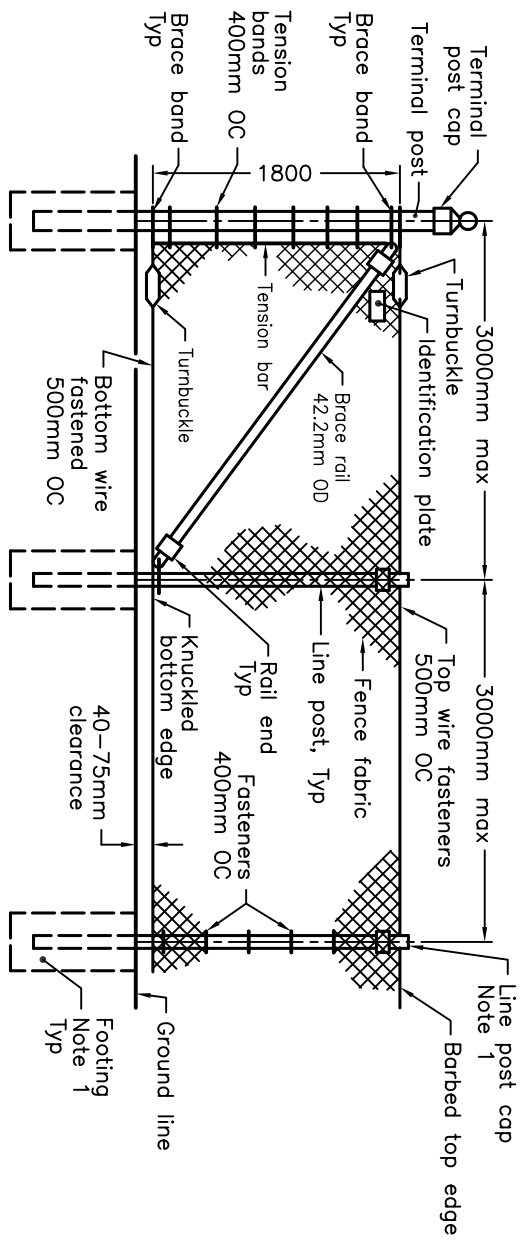
FENCE, CHAIN-LINK
COMPONENT - GATE



OPSD 972.102



CHAIN-LINK FENCE WITH TOP RAIL



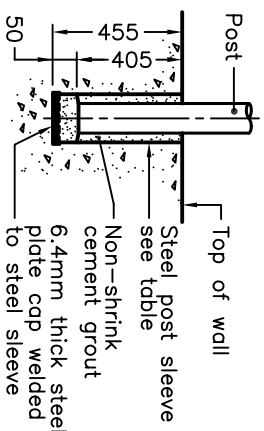
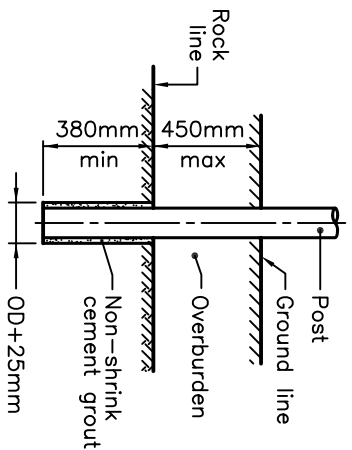
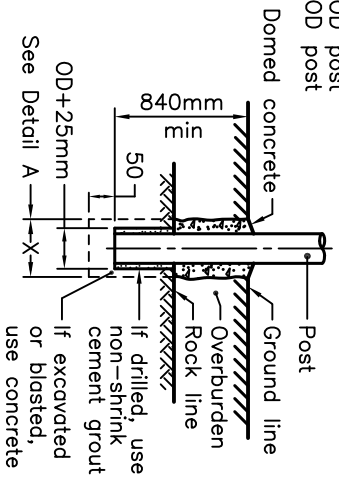
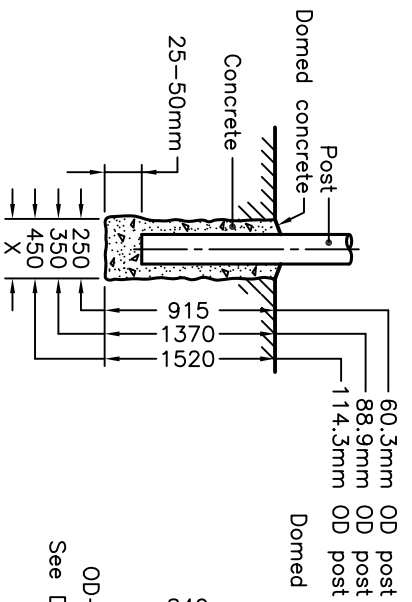
CHAIN-LINK FENCE WITH TOP WIRE

NOTES:

- 1 For footing details and line post cap detail refer to OPSPD 972.132.
- A Fence as viewed from the roadway.
- B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2012	Rev 2
FENCE, CHAIN-LINK INSTALLATION - ROADWAY		OPSPD 972.130	



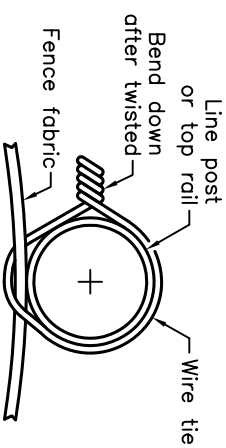
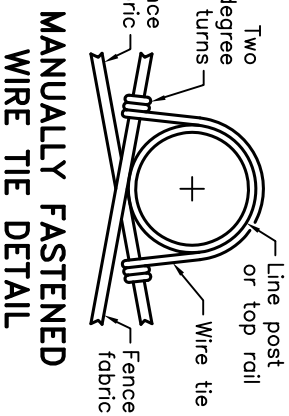
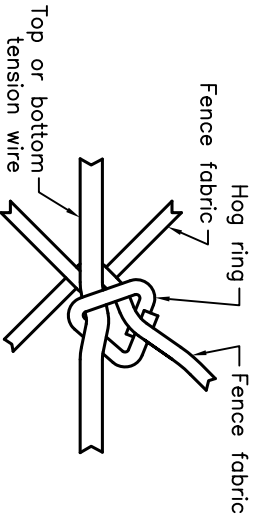


**DETAIL A
FOOTING IN EARTH**

**DETAIL B
FOOTING IN SHALE, LOOSE OR FRIABLE ROCK, OR SOLID ROCK WITH MORE THAN 450mm OVERBURDEN**

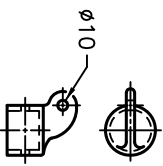
**DETAIL C
FOOTING IN SOLID ROCK LESS THAN 450mm OVERBURDEN**

**DETAIL D
FOOTING IN RETAINING WALL**



POWER FASTENED WIRE TIE DETAIL

62mm ID LINE POST CAP DETAIL



NOTES:

- 1 All posts and frame members are Schedule 40, Regular Grade, steel pipe.
 - 2 The actual weight shall not vary by more than 10% of the nominal weight.
- A All dimensions are in millimetres unless otherwise shown.

POST DETAILS TABLE (Note 1)						
Post/Frame Member Type	OD	Post Length		Wall Thickness	Nominal Weight kg/m (Note 2)	
		Standard	Retaining Walls			
Line post	60.3	2.6	2.0	3.91	5.4	
Terminal Post	88.9	2.9	2.3	5.49	11.3	
Gates (Single 3.0m, Double 6.0m)	88.9	2.6	n/a	5.49	11.3	
Gates (Single 4.5m, Double 9.0m)	42.2	n/a	n/a	3.56	3.4	
Gatepost	114.3	2.9	n/a	6.02	16.1	
Frame Members	48.3	n/a	n/a	3.68	4.0	
Line Post	88.9	n/a	0.455	5.49	11.3	
Terminal Post	114.3	n/a	0.455	6.02	16.1	

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2012 Rev 0

FENCE, CHAIN-LINK
DETAILS AND TABLE

OPSD 972.132

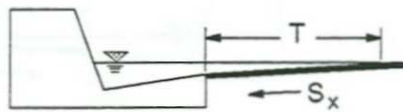
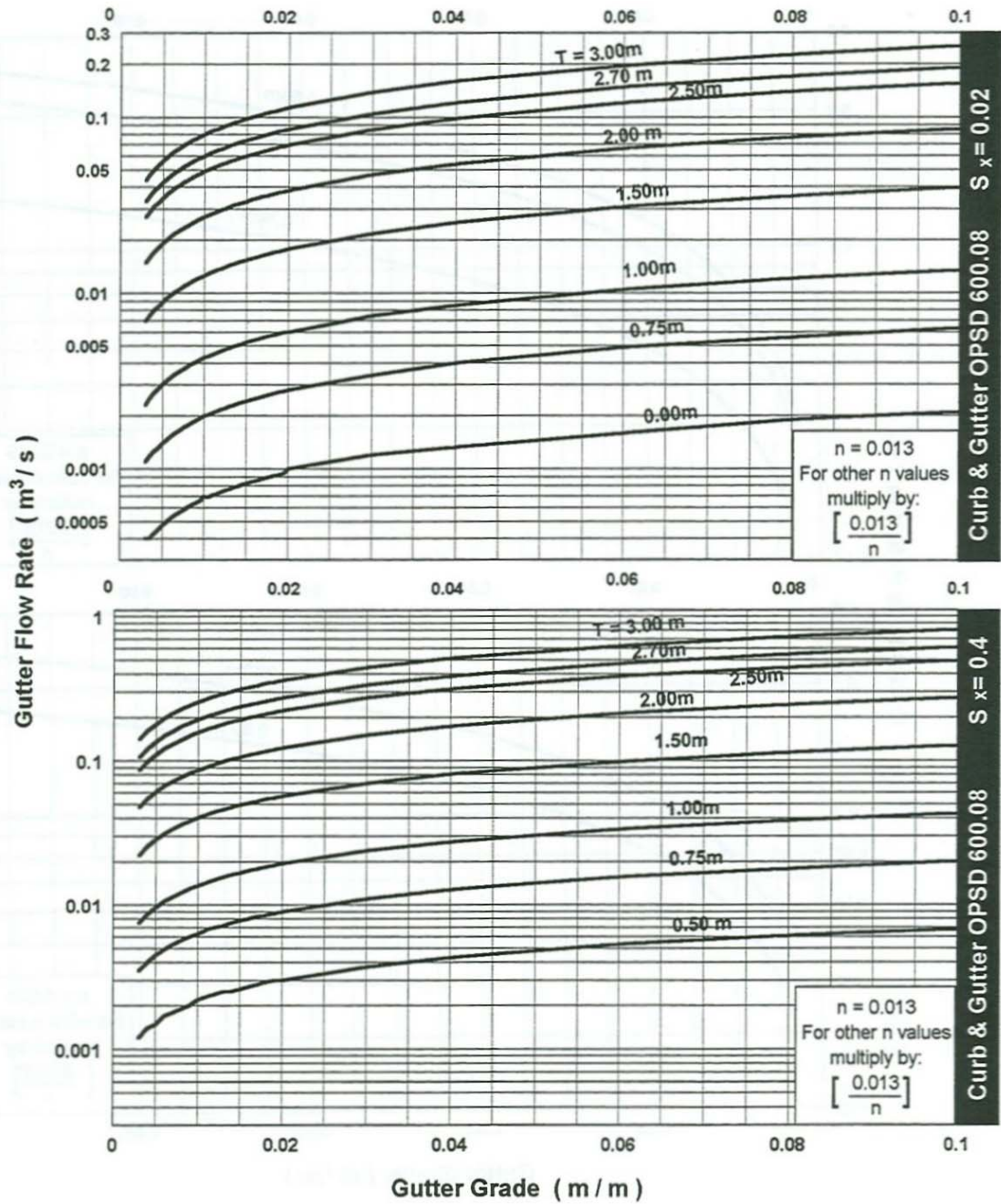


Appendix D

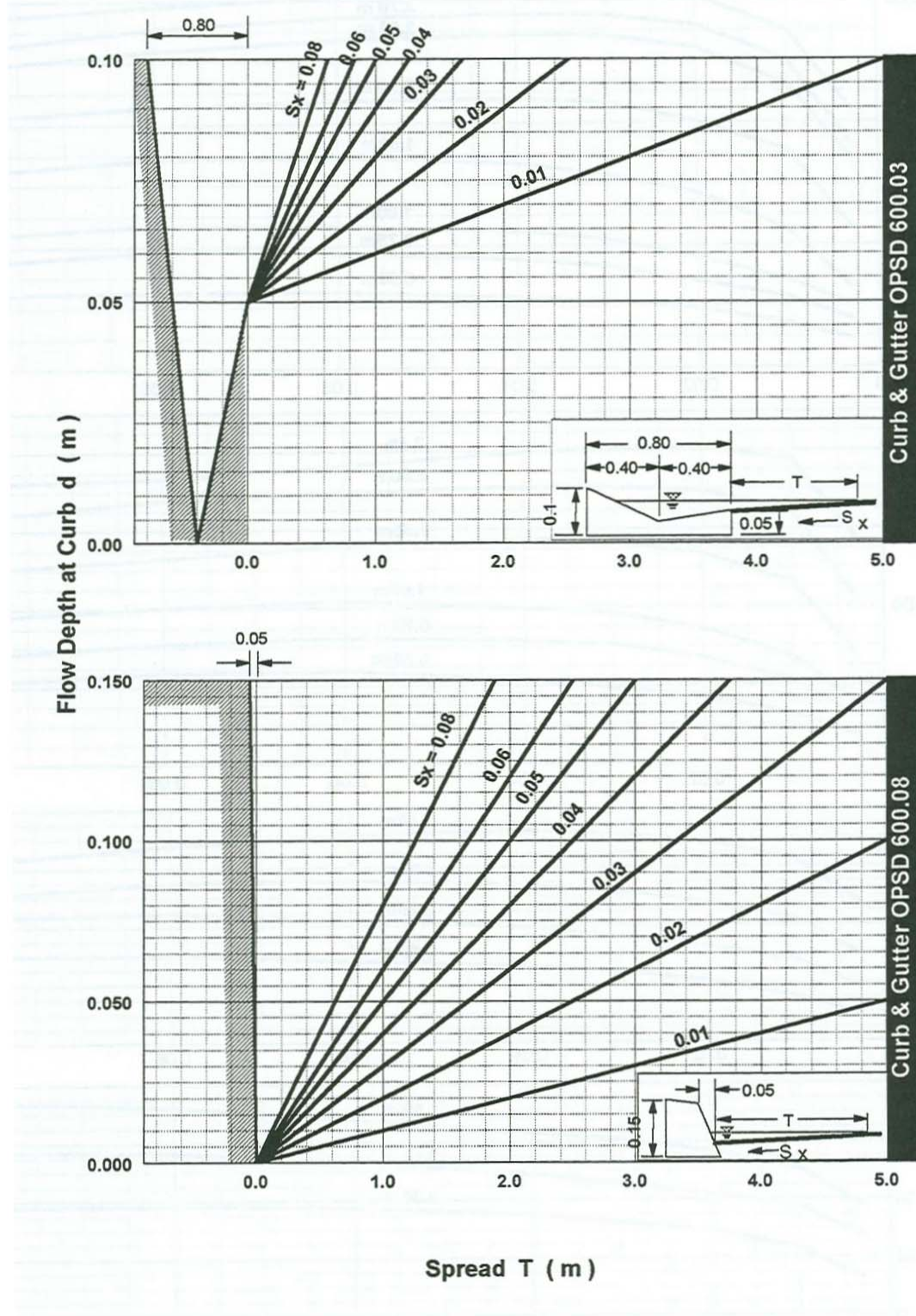
Rating Curves

Source: MTO Drainage Management Manual (1995-1997)

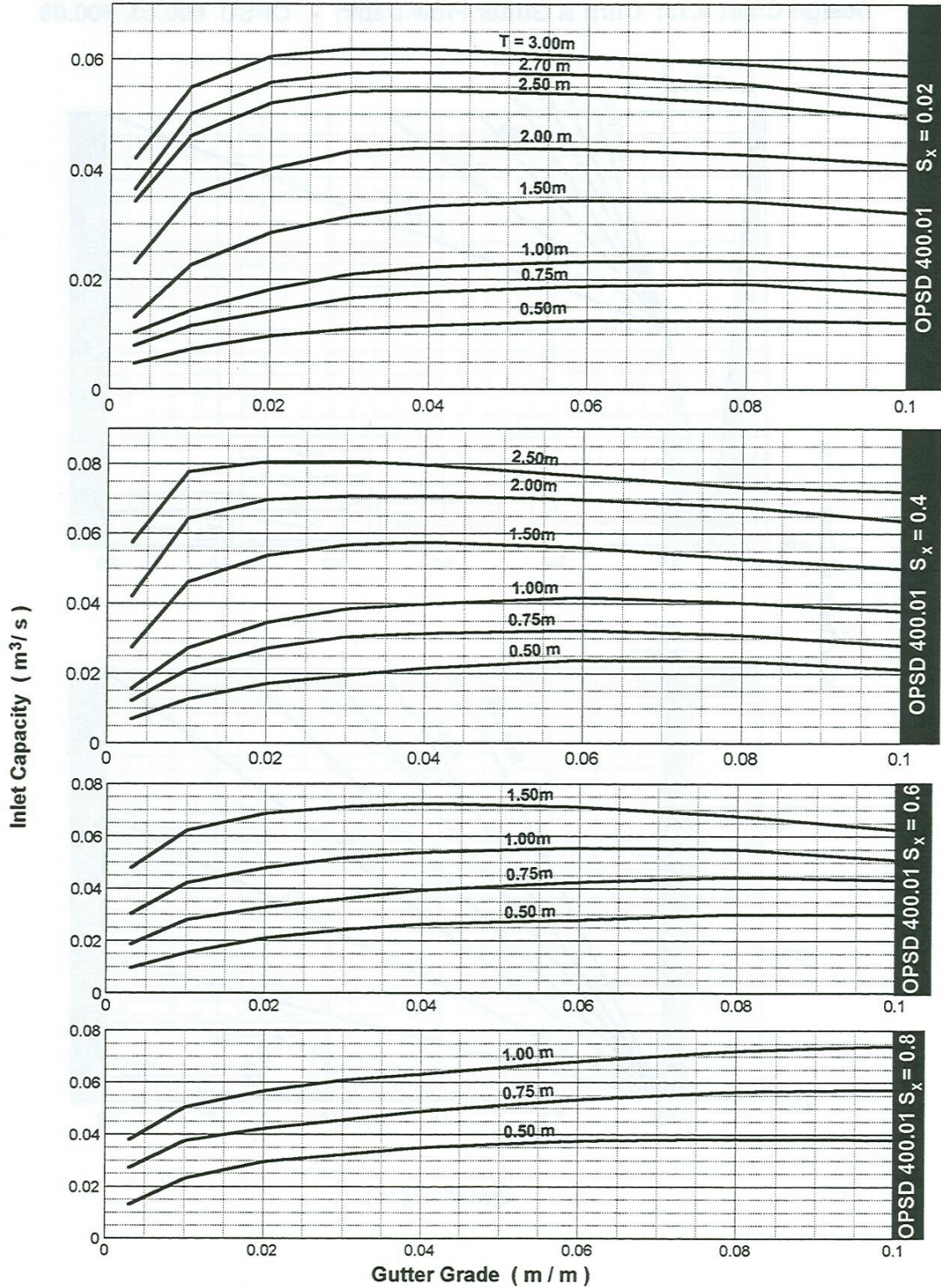
Design Chart 4.10: Gutter Flow Rate - Curb & Gutter OPSD 600.08



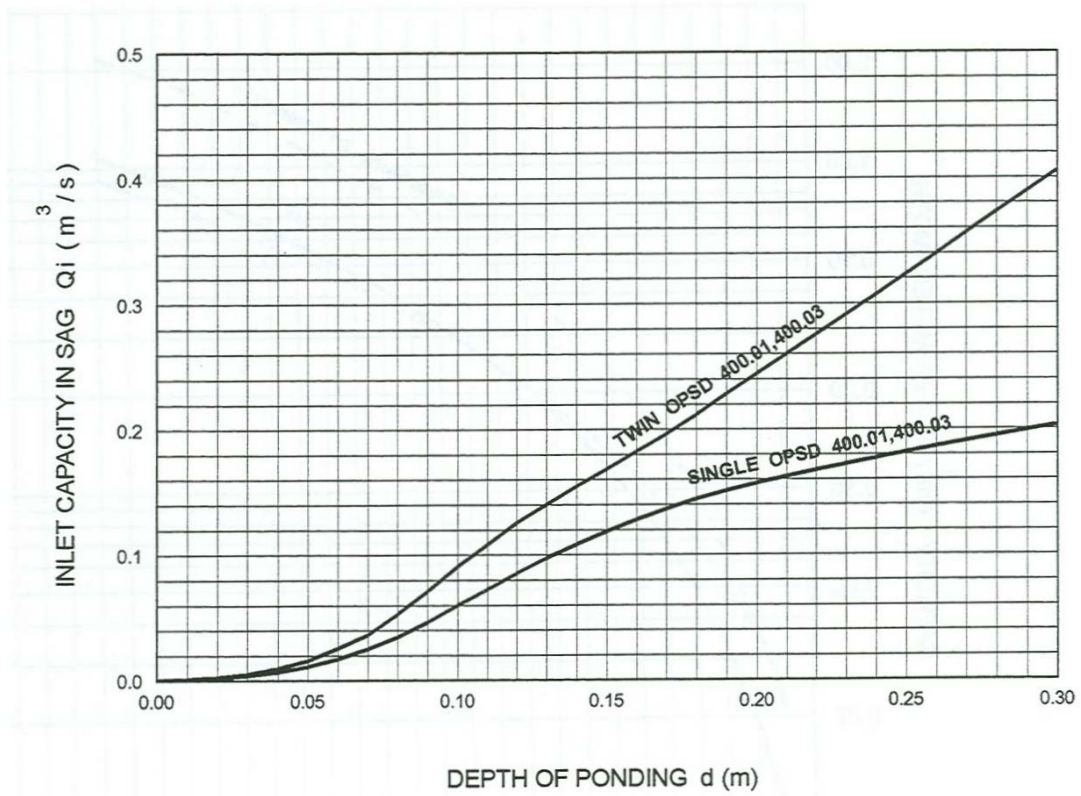
Design Chart 4.13: Curb & Gutter Flow Depth - OPSD 600.03, 600.08



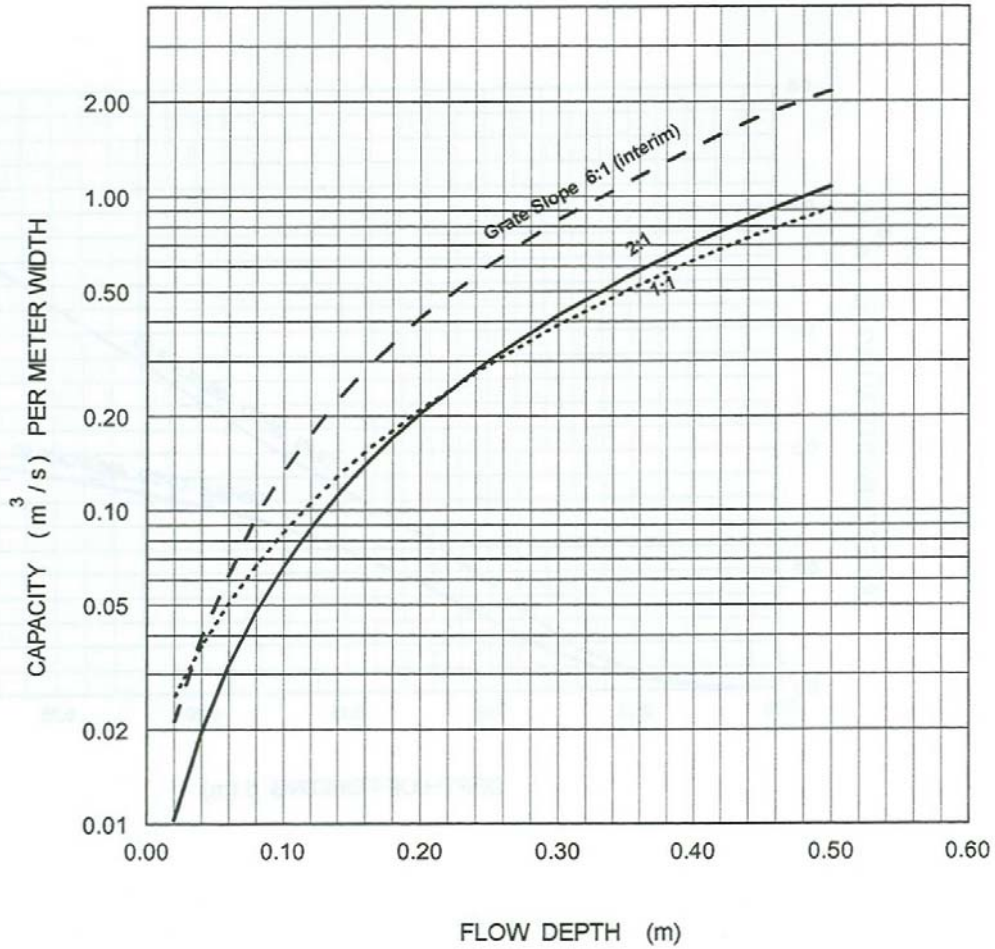
Design Chart 4.14: Inlet Capacity OPSD 400.01 (C & G OPSD 600.01)



Design Chart 4.19: Inlet Capacity at Road Sag



Design Chart 4.20: Ditch Inlet Capacity



Notes:

1. Curves apply to grate Type 403.01, but may be used for straight - bar inlets without significant loss of accuracy.
2. Capacities given by curves are for unobstructed grates only. For design use working capacity $\approx 0.5 \times$ unobstructed capacity.
3. Capacities of grates operating in high velocity flows are less than indicated.

Appendix E

Culvert Hydraulics

Source: MTO Drainage Management Manual (1995-1997)

Culvert Hydraulics

Typically, in design applications, culvert hydraulics is used to determine culvert capacity. Laboratory tests and field observations have shown that there are two major types of culvert flow.

- **Flow with inlet control** means that the discharge capacity of a culvert is controlled at the culvert entrance by the depth of headwater and the entrance geometry, including the barrel shape, cross sectional area and the type of inlet edge. The roughness and length of the culvert barrel, and the outlet conditions are not factors in determining the culvert capacity. The longitudinal slope reduces headwater only to a small degree, and can normally be neglected for conventional culverts flowing in inlet control.
- **Flow with outlet control** means that the discharge capacity of a culvert is controlled by the depth of tailwater including the velocity head within the barrel, entrance losses and friction losses. The roughness, length of the culvert barrel, and slope are factors in determining the culvert capacity; the inlet geometry is of lesser importance.

In most cases the operating flow condition of the culvert is not known. The culvert may flow in either inlet or outlet control depending on the flow rates. For this reason, the headwater depth is computed, for the same flow rate, in both the inlet and outlet controls conditions. The higher value indicates the type of control, and should be used as the governing depth in design (refer to Chapter 5 for details). This method is relatively accurate except for the few cases where the headwater is approximately the same for both types of control. Computational procedures are simplified with the use of design nomographs (refer to the Design Charts) and computer programs (see Table 8.5).

In addition to inlet and outlet control, other culvert hydraulic factors discussed in this section are:

- inlet efficiency;
- non-standard roughness coefficients; and
- performance curves for conventional culverts.

Note: For the purpose of this manual, a conventional culvert is a closed invert culvert having a uniform barrel section throughout, no side-tapering and without a slope-tapered inlet. Nearly all existing and most new culverts fall in the conventional culvert category, including those with minor improvements such as bevelled edges, headwalls, wingwalls, or a standard prefabricated end section.

Culverts Flowing in Inlet Control

Sketches of inlet control flow for both unsubmerged and submerged projecting entrances are shown in Figure 8.30 a and b. Figure 8.30 c shows a mitered entrance flowing submerged with inlet control. An increase in barrel slope reduces headwater only to a small degree, and can normally be neglected for conventional culverts flowing in inlet control.

When the headwater (HW) exceeds 1.5D, true orifice flow exists and can be represented by:

$$Q = C_d \sqrt{2g(HW - D/2)} \quad (8.80)$$

where:

- C_d = coefficient of discharge (see Table 8.6)
- A = cross section area of discharge of the culvert, m^2
- g = the acceleration due to gravity, m/s^2
- HW = headwater depth, m (refer to Figure 8.30)
- D = diameter of the culvert, m

Table 8.6: Inlet Loss Coefficients (C_d)

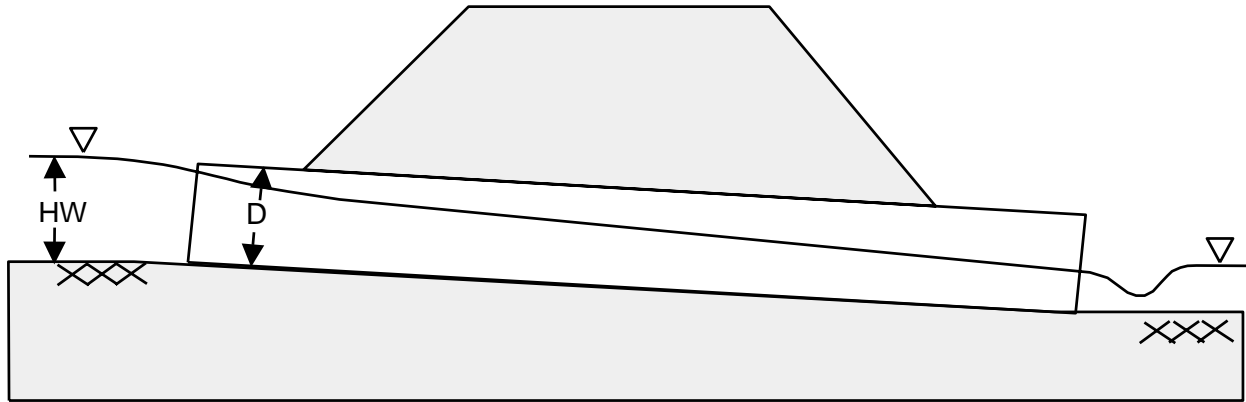
Inlet Type	Discharge Coefficient
Thin Walled Projecting (CSP)	0.50
Flush Headwall	0.60
Cylinder Inlet (1.25 D)	0.67
Socket Inlet (RCP)	0.70
Bellmouth Inlet	0.97

Design Charts 5.39 to 5.45 can be applied in place of Equation 8.80.

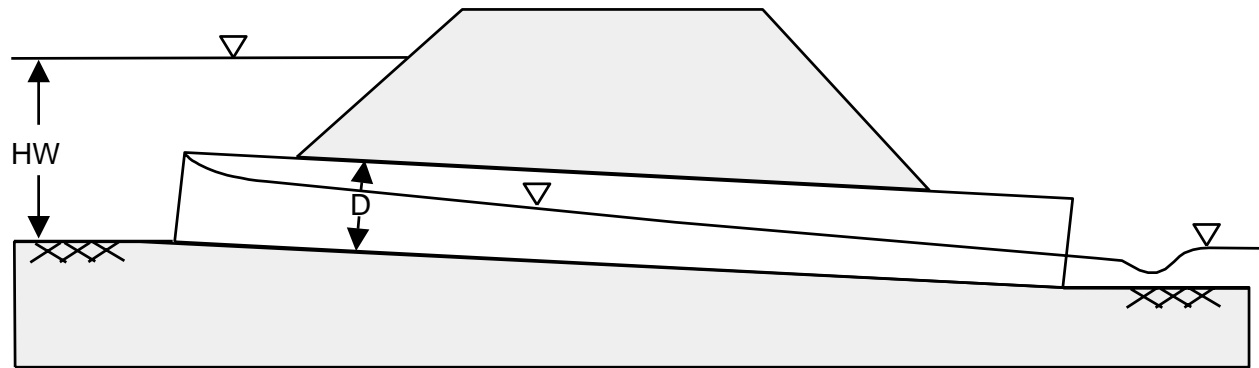
When the headwater HW is less than 1.5D, the culvert acts as a weir with a circular cross section; however, the weir equation cannot be solved analytically for such an application and it is not used in practice. Design Charts 2.31 to 2.33 and 5.39 to 5.45 can be used in such cases.

In all culvert design applications, it is important to recognize that headwater, or depth of ponding at the entrance to a culvert, is an important factor in culvert capacity. The headwater depth (HW) is the vertical distance from the culvert invert at the entrance to the energy gradeline of the headwater pool (depth + velocity head - refer to Figure 8.30). Because of the low velocities in most entrance pools, the water surface and the energy line at the entrance are usually assumed to be coincident, thus the headwater depths given by the inlet control charts (Design Charts 2.31 to 2.33 and 5.59 to 5.46) will be higher than will actually occur, by the amount of the velocity head $V^2/2g$ (refer to Figure 8.32). The difference may be ignored unless the approach velocity V_1 is exceptionally high.

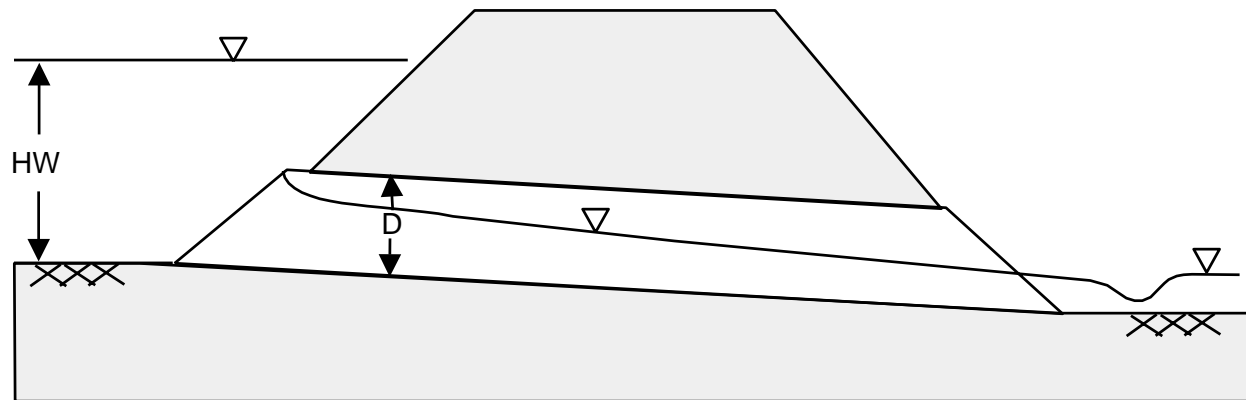
Figure 8.30: Flow Profiles for Culvert in Inlet Control



a. Projected End - Unsubmerged Inlet

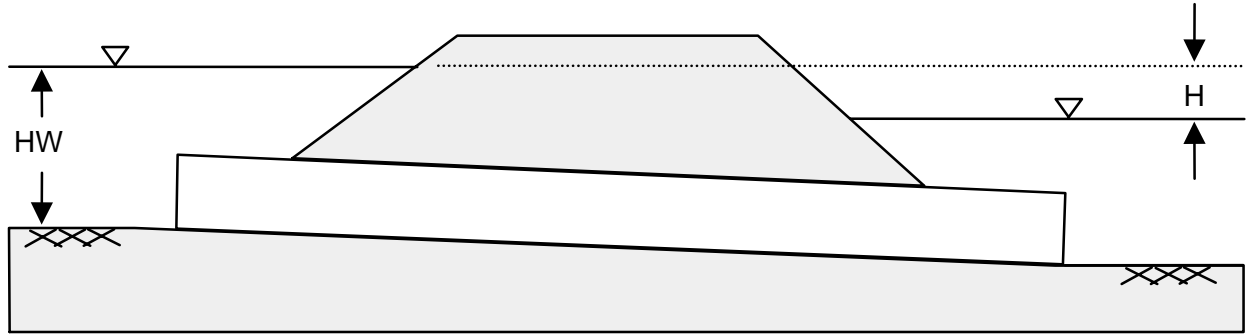


b. Projected End - Submerged Inlet

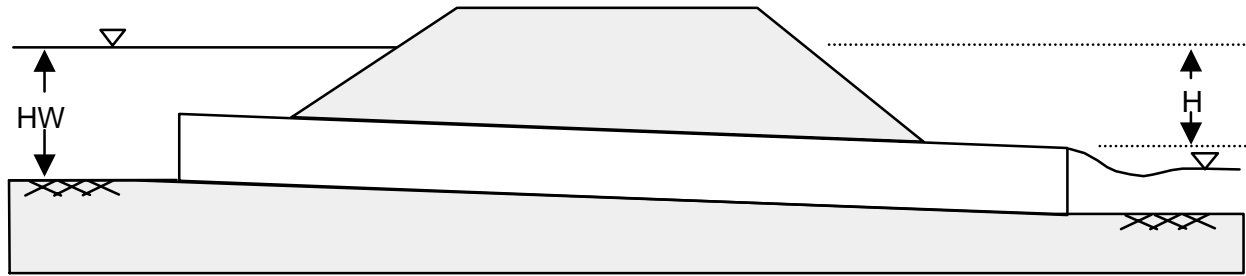


c. Mitered End - Submerged Inlet

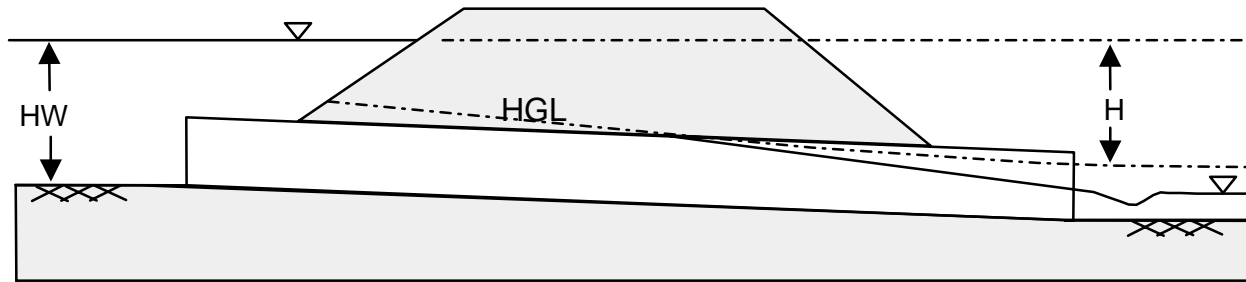
Figure 8.31: Flow Profiles for Culvert in Outlet Control



a. Culvert Flowing Full, Submerged Outlet



b. Culvert Flowing Full, Unsubmerged Outlet



c. Culvert Flowing Full For Part Of Its Length

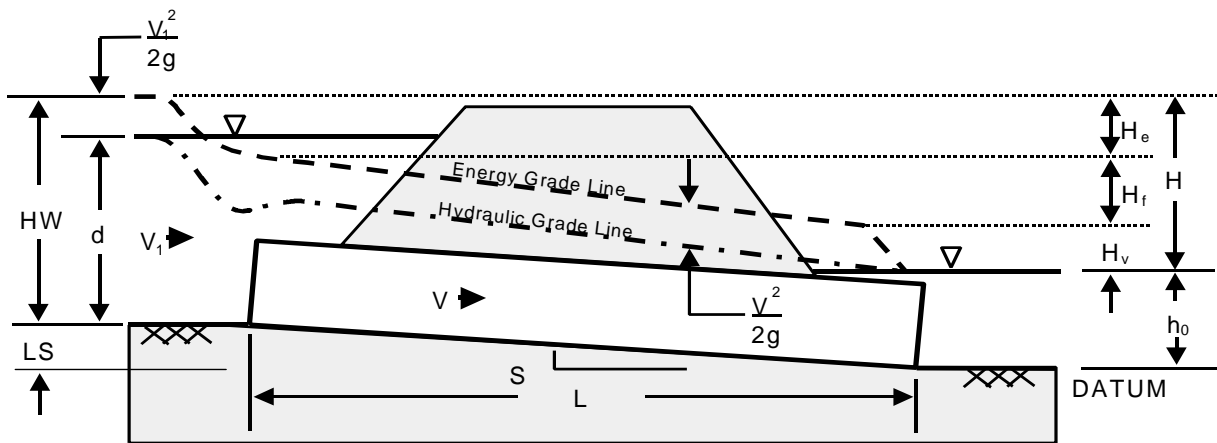


d. Culvert Not Flowing Full

Culverts Flowing in Outlet Control

Culverts in outlet control can flow with the culvert barrel full or partly full (see Figure 8.31). If the entire cross section of the barrel is filled with water for the total length of the barrel, the culvert is said to be flowing full, Figure 8.31 a and b. Two other common types of outlet control flow are shown in Figures 8.31c and d.

Figure 8.32: Hydraulics of Culvert Flowing Full in Outlet Control



The expression for determining the head H is derived by equating the total energy upstream the culvert entrance to the energy just inside the culvert outlet, considering all the major losses in energy. By referring to Figure 8.32 and using the culvert invert at the outlet as a datum, the result is:

$$d + \frac{V_1^2}{2g} + LS = h_0 + H_v + H_e + H_f \quad (8.81)$$

where:

- d = depth of flow at inlet, m
- $V_1^2/2g$ = velocity head in entrance pool, m
- LS = length of culvert multiplied by the culvert barrel slope, m
- h_0 = depth of flow at outlet, m
- H_v = the velocity head within the barrel, m
- H_e = the entrance loss, m
- H_f = the friction loss, m

Rearranging Equation 8.81:

$$d + \frac{V_1^2}{2g} + LS - h_0 = H_v + H_e + H_f .$$

Head (H)

Head (H) is expressed as an equivalent depth of water (m), and comprises the velocity head within the barrel H_v , the entrance loss H_e , and the friction loss H_f (refer to Figure 8.32),

$$H = H_v + H_e + H_f. \quad (8.82)$$

The velocity head is the difference in elevations between the energy grade line and the hydraulic grade line, which are parallel over the length of the barrel except in the immediate vicinity of the inlet, where the flow contracts and then expands (refer to Figure 8.32). The velocity head H_v is:

$$H_v = \frac{V^2}{2g} \quad (8.83)$$

where:

- V = the mean velocity in the culvert barrel, m/s
(the mean velocity is the discharge Q , divided by the barrel cross sectional area A)
- g = acceleration due to gravity, m/s^2

H_e accounts for entrance losses and depends upon the geometry of the inlet edge. Lost energy is expressed as a coefficient k_e times the barrel velocity head, or:

$$H_e = k_e \frac{V^2}{2g} \quad (8.56)$$

where:

- k_e = entrance loss coefficients (Design Chart 2.08).

The friction loss H_f is the energy required to overcome the roughness of the culvert barrel. The friction loss is given by Equation 8.57, which is derived from the Manning equation.

$$H_f = \frac{19.6 n^2 L}{R^{4/3}} \frac{V^2}{2g} \quad (8.57)$$

where:

- n = Manning's roughness coefficient (Design Chart 2.01);
- R = hydraulic radius, m
- L = length of culvert barrel, m

Substituting H_v , H_e and H_f in Equation 8.83 and simplifying, the head (H) for full flow is:

$$H = \left[1 + k_e + \frac{19.6 n^2 L}{R^{4/3}} \right] \frac{V^2}{2g} \quad (8.84)$$

Equation 8.84 can be solved for H by use of the full-flow nomographs, Design Charts 2.34 to 2.36 and 5.47 to 5.50. Each nomograph is drawn for a particular barrel shape and material, and for the roughness coefficient noted on the respective charts. These nomographs can be used for other values of n by modifying the culvert length (refer to the section on non standard roughness coefficients).

By substituting H for $H_v + H_e + H_f$, Equation 8.81 can be simplified:

$$d + \frac{V_1^2}{2g} + LS - h_0 = H . \quad (8.85)$$

Headwater Depth (HW)

It can be seen from Figure 8.32 that the velocity head (i.e. $V_1^2/2g$) at the culvert entrance, is the difference between the elevations of the hydraulic grade line at the inlet and the energy line at the inlet. Because of the low velocities in most entrance pools, the water surface and the energy line at the entrance are usually assumed to be coincident. In culvert design, the difference may be ignored unless the approach velocity V_1 is exceptionally high; $V_1^2/2g$ can be assumed to be equal to zero, and, as a result, d will equal HW (refer to Figure 8.32). Substituting into Equation 8.85:

$$HW + LS - h_0 = H . \quad (8.86)$$

Determination of h_0

A detailed explanation on the determination of h_0 is provided in Smith C.D, (1985) or U.S. FHWA (1985); for convenience, a summary is provided below.

Tailwater at or Above Top of Opening

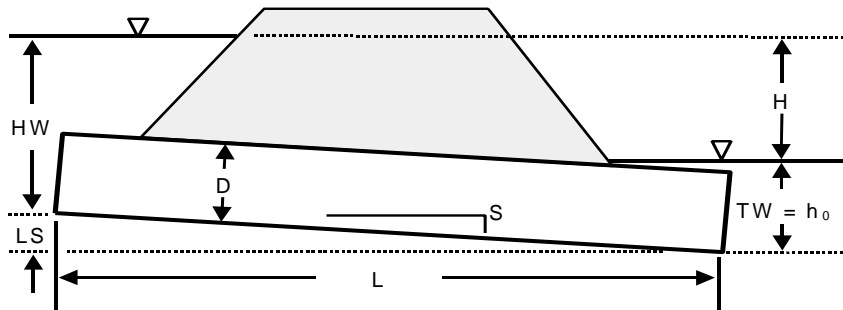
When the water surface in the outlet channel is at or above the top of the culvert outlet (refer to Figure 8.33) h_0 is equal to the tailwater depth. Tailwater depth, TW, is the depth from the culvert invert at the outlet, to the water surface in the outlet channel.

Tailwater Below Top of Opening

If the tailwater elevation is below the top of the culvert opening at the outlet, as in Figures 8.31 b, c and d, h_0 is more difficult to determine. In these cases, h_0 is the greater of two values:

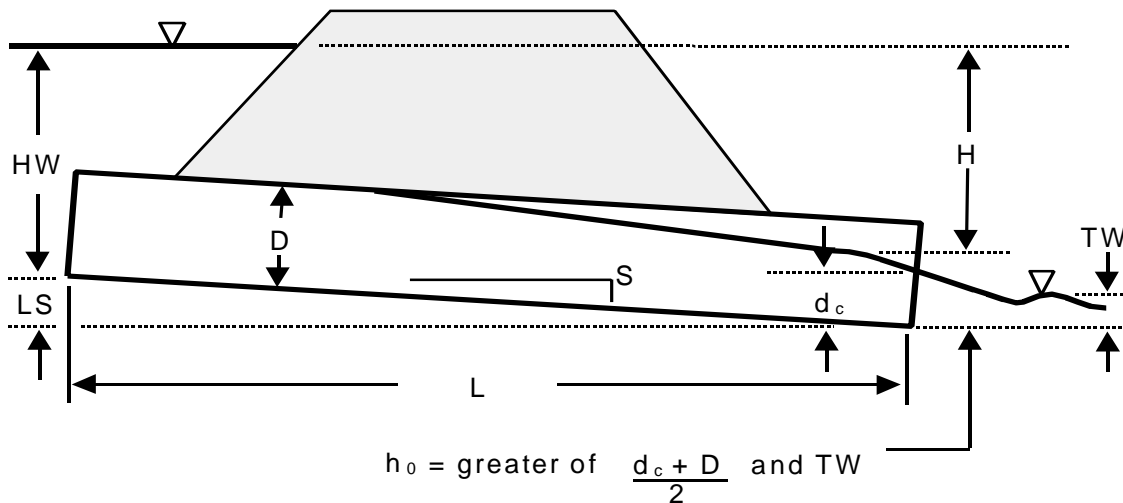
- 1) TW depth as defined above; or
- 2) $(d_c + D)/2$.

Figure 8.33: Determination of h_o for High Tailwater



The latter dimension is the height from the invert to the equivalent hydraulic grade line (located at half the height between critical depth and the culvert crown). The critical depth d_c may be obtained from Design Charts 2.37 to 2.38, and 5.50 to 5.54, where D is the culvert depth. The value of d_c can never exceed D , making the upper limit of this fraction equal to D . Where TW is the greater of values (1) and (2) above, the critical depth is submerged sufficiently to make TW effective in increasing the headwater. Figure 8.34 shows the terms of Equation 8.86 for the low tailwater condition. A change of discharge can modify the water surface profile to that of Figure 8.31 b or d. In the latter case accuracy of the results diminishes as HW approaches $0.75 D$; for smaller values of HW detailed backwater computations should be used, as necessary.

Figure 8.34: Determination of h_o for Tailwater Below Top of Opening



Summary

Rearranging Equation 8.85, the headwater depth can be isolated so that HW can be determined from one equation for all outlet control conditions:

$$HW = H + h_0 - LS \quad (8.86)$$

where:

- H = downstream head, m
(Design Charts 2.34 to 2.36 and 5.47 to 5.50 or from Equation 8.84);
- h_0 = greater of TW and $d_c + D/2$ in which $d_c \leq D$, m
(see following discussion and Figure 8.34);
- D = culvert height, m
- d_c = critical depth from Design Charts 2.37 to 2.38 and 5.51 to 5.54, m
- S = slope of culvert barrel, m/m
- L = length of culvert barrel, m

Inlet Efficiency

The capacity of a culvert operating in inlet control can be significantly increased by providing an efficient inlet, which reduces the flow contraction at the entrance and increases the flow depth in the barrel. The relative efficiencies of various inlet shapes can be judged from the entrance loss coefficients, k_e , in Design Chart 2.08, although the figures are not directly applicable to inlet control. Inlet improvements and end treatments are discussed in Chapter 5.

In outlet control, entrance losses form only a minor part of the total head losses, and major inlet improvements are not usually justified.

Thin Edged Inlets

Projecting thin edged inlets on steel culverts are relatively inefficient ($k_e = 0.9$), but are very widely used, for culvert spans of less than 3.0 m, because of their simplicity and lower cost. Standard end sections for small culverts improve their efficiency ($k_e = 0.5$), and properly bevelled concrete collars provide the greatest improvement ($k_e = 0.25$) but are costly. Culvert ends mitered to conform with the fill slope offer a slight hydraulic improvement, ($k_e = 0.7$).

Bevelled Inlets

Bevelled inlets increase the efficiency of concrete culverts ($k_e = 0.2$) and corrugated steel culverts ($k_e = 0.25$).

Socket Ends

Socket ends of concrete and plastic pipes are hydraulically efficient ($k_e = 0.2$); therefore, the inlets of these pipes may not need to be mitered or cut on skew.

Headwalls and Wingwalls

Headwalls and wingwalls improve inlet efficiency for some types of culvert, as indicated by the entrance loss coefficients in Design Chart 2.08.

Non-standard Roughness Coefficients

Roughness Coefficient Other Than Nomograph Value

If the culvert has a roughness coefficient different from that of the outlet control nomograph, as in the case of a timber box culvert, the culvert length should be adjusted to compensate for different n -values before entering the nomograph, as follows:

$$L_1 = L \left[\frac{n_1}{n} \right]^2 \quad (8.87)$$

where:

- L = actual length of culvert, m
- L_1 = adjusted length of culvert, m
- n = roughness coefficient on which the outlet control chart is based
- n_1 = actual roughness coefficient.

Composite Roughness Coefficient

Where the culvert perimeter has differing roughness coefficients, such as a corrugated steel arch with a concrete floor, the overall coefficient, n_c , is found as follows:

$$n_c = \frac{[P_1 n_1^2 + P_2 n_2^2 + \dots]^{0.5}}{P^{0.5}} \quad (8.88)$$

where:

- P_1, P_2 = wetted perimeter having roughness coefficients of n_1, n_2, \dots , m
- n_1, n_2 = roughness coefficients
- P = total wetted perimeter of culvert, m

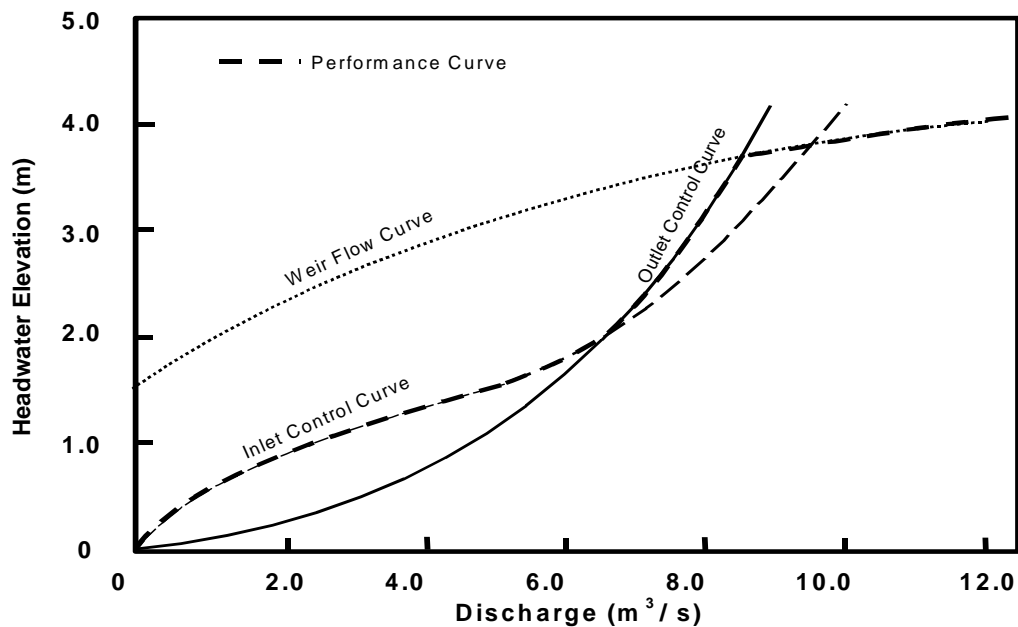
Performance Curves for Conventional Culverts

To understand how a culvert will function over a range of discharges, a performance curve, which is a plot of discharge versus headwater elevation, may be drawn. Major components of performance curves are:

- inlet performance (i.e. inlet control);
- outlet performance (i.e. outlet control); and
- roadway spill (i.e. weir flow);

A typical overall performance curve is shown in Figure 8.35. As shown, the overall performance curve is a combination of the inlet, outlet and roadway overtopping (weir flow) that best corresponds with the hydraulics of the culvert with relief.

Figure 8.35: Typical Overall Performance Curve



Performance curves for each alternative culvert size, type and entrance geometry can be developed to assist in the selection of the most appropriate design.

A minimum performance is usually assumed in culvert designs as a safety against uncertainties in flood estimation etc. The minimum performance is taken as the discharge corresponding to the highest water level as determined from an inlet and outlet analysis. In this way, the culvert will not operate at a lower level of performance than was calculated.

Appendix F

Sample Modified Rational Method Calculation

PROJECT NAME

REQUIRED STORM WATER STORAGE CALCULATION

PROJECT No.:

DESIGNED BY:

CHECKED BY:

Catchment Area = A-201

0.300 ha

C=

0.65

Total Allowable Release 5yr

15.99 l/s

5 YEAR, Required Volume

	(1)	(2)	(3)	(4)	(5)
Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m ³)
5	165.19	89.55	15.99	73.56	22.07
10	101.97	55.28	15.99	39.28	23.57
15	76.90	41.69	15.99	25.69	23.12
20	62.94	34.12	15.99	18.13	21.75
25	53.89	29.21	15.99	13.22	19.83
30	47.47	25.73	15.99	9.74	17.53
35	42.64	23.11	15.99	7.12	14.95
40	38.85	21.06	15.99	5.07	12.17

5 YEAR, Provided Volume & Orifice Flow

	(6)	(7)	(8)
Flooded Depth at Catchbasin (m)	Flooded Area (m ²)	Flooded Volume (m ³)	Orifice Diameter (mm)
0.25	283.00	23.58	80
			Head (m)
			Orifice Flow (L/s)
			1.3
			15.99

Flooded Volume = (1/3)(Area)(Depth)

Cd= 0.63

Orifice Flow =(Cd)(Ao)(2gHead)^{0.5}

g= 9.81 m/s²

(1) = Based on design storm intensity

(2) = Calculated from rational method, and catchment area's runoff coefficient & area

(3) = Allowable release rate, as calculated prior

(4) = (2) - (3)

(5) = (4) x [Time (min)] / [60 x 1,000 L / m³]

(6) = Based on site grading and formula above

(7) = Based on design inverts & top of grates

(8) = Resulting flow from orifice, based on formula above

Appendix G

Curve Numbers

Source: MTO Drainage Management Manual (1995-1997)

Source: Haestad Methods – Stormwater Conveyance Modeling and Design (2003)

Design Chart 1.08: Hydrologic Soil Groups

- Based on Surficial Geology Maps

Map Ref.No.	Soil Type or Texture	Hydrologic Soil Group (Tentative)
	<u>Ground Moraine</u>	
1a	Usually sandy till, stony, varying depth. (Most widespread type in Shield).	Usually B (shallow); may be A or AB
1b	Clayey till, varying depth.	BC-C
	<u>End or Interlobate Moraine</u>	
2a	Sand & stones, deep. (May be rough topography).	A
2b	Sand & stones capped by till, deep.	A-C depending on type of till.
2c	Sand & stones, deep. (Smoother topography).	A
	<u>Kames & Eskers</u>	
3a	Sand & stones, deep. (May be rough topography).	A
3b	Sand & stones capped by till, deep.	A-C depending on type of till.
3c	Sand & stones, deep. (Smoother topography).	A
	<u>Lacustrine</u>	
4a	Clay & silt, in lowlands.	BC-C
4b	Fine sand, in lowlands.	AB-B
4c	Sand, in lowlands.	AB
4d	Sand (deltas & valley trains).	A-AB
	<u>Outwash</u>	
5	Sand, some gravel, deep.	A
	<u>Aeolian</u>	
6	Very fine sand & silt, shallow. (Loess)	B
	<u>Bedrock</u>	
7	Bare bedrock (normally negligible areas).	Varies according to rock type.

Source: Ministry of Natural Resources - MNR

Design Chart 1.08: Hydrologic Soil Groups (Continued)**- Based on Soil Texture**

<u>Sands, Sandy Loams and Gravels</u>	
- overlying sand, gravel or limestone bedrock, very well drained	A
- ditto, imperfectly drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
<u>Medium to Coarse Loams</u>	
- overlying sand, gravel or limestone, well drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
<u>Medium Textured Loams</u>	
- shallow, overlying limestone bedrock	B
- overlying medium textured subsoil	BC
<u>Silt Loams, Some Loams</u>	
- with good internal drainage	BC
- with slow internal drainage and good external drainage	C
<u>Clays, Clay Loams, Silty Clay Loams</u>	
- with good internal drainage	C
- with imperfect or poor external drainage	C
- with slow internal drainage and good external drainage	D

Source: U.S. Department of Agriculture (1972)

Design Chart 1.09: Soil/Land Use Curve Numbers

Land Use	Treatment or Practice	Hydrologic Condition ⁴	Hydrologic Soil Group			
			A	B	C	D
Fallow	Straight row	---	77	86	91	94
Row crops	"	Poor	72	81	88	91
	"	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	"	Good	65	75	82	86
	" and terraced	Poor	66	74	8	82
	" " "	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	" and terraced	Poor	61	72	79	82
	Good	59	70	78	81	
Close-seeded legumes ² or rotation meadow	Straight row	Poor	66	77	85	89
		Good	58	72	81	85
	Contoured	Poor	64	75	83	85
		Good	55	69	78	83
	" and terraced	Poor	63	73	80	83
" and terraced	Good	51	67	76	80	
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
	Contoured	Good	39	61	74	80
		Poor	47	67	81	88
	"	Fair	25	59	75	83
	Good	6	35	70	79	
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		---	59	74	82	86
		---	72	82	87	89
		---	74	84	90	92

For average antecedent soil moisture condition (AMC II)

² Close-drilled or broadcast.

⁴ The hydrologic condition of cropland is good if a good crop rotation practice is used; it is poor if one crop is grown continuously.

Source: U.S. Department of Agriculture (1972)

Design Chart 1.09: Soil Conservation Service Curve Numbers (Continued)

Land Use or Surface	Hydrologic Soil Group						
	A	AB	B	BC	C	CD	D
Fallow (special cases only)	77	82	86	89	91	93	94
Crop and other improved land	66** (62)	70** (68)	74	78	82	84	86 AMC I
Pasture & other unimproved land	58* (38)	62* (51)	65	71	76	79	81
Woodlots and forest	50* (30)	54* (44)	58	65	71	74	77
Impervious areas (paved)							98
Bare bedrock draining directly to stream by surface flow							98
Bare bedrock draining indirectly to stream as groundwater (usual case)							70
Lakes and wetlands							50

Notes

- (i) All values are based on AMC II except those marked by * (AMC III) or ** (mean of AMC II and AMC III).
- (ii) Values in brackets are AMC II and are to be used only for special cases.
- (iii) Table is not applicable to frozen soils or to periods in which snowmelt contributes to runoff.

Table 5.5 Runoff curve numbers for urban areas (Mockus, 1969)^a

Cover Description	Average Percent Impervious Area ^b	Curve Numbers for Hydrologic Soil Group			
		A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^c :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious area only) ^d		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1 to 2 in. sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre (506 m ²) or less (town houses)	65	77	85	90	92
1/4 acre (1,012 m ²)	38	61	75	83	87
1/3 acre (1,349 m ²)	30	57	72	81	86
1/2 acre (2,023 m ²)	25	54	70	80	85
1 acre (4,047 m ²)	20	51	68	79	84
2 acres (8,094 m ²)	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded area (pervious areas only, no vegetation) ^e		77	86	91	94
Idle lands (CNs are determined using cover types similar to those in Table 5.6)					

a. Average runoff condition, and $I_a = 0.2S$.

b. The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.

c. CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

d. Composite CNs for natural desert landscaping should be computed using Figure 2.3 or 2.4 (in TR-55) based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

e. Composite CNs to use for the design of temporary measures during grading and construction should be computed using Figure 2.3 or 2.4 (in TR-55) based on the degree of development (impervious area percentage) and the CNs for the newly graded pervious areas.

Appendix H

Landscaping - List of Native Species

APPENDIX H – LIST OF NATIVE SPECIES

<i>Deciduous Trees</i>		
Name	Botanical Name	Upper Mature Height (m)
Cottonwood	<i>Populus trichocarpa</i>	35
Sugar Maple	<i>Acer saccharum</i>	35
White Oak	<i>Quercus alba</i>	35
Basswood	<i>Tilia americana</i>	35
Silver Maple	<i>Acer saccharinum</i>	35
Black Walnut	<i>Juglans nigra</i>	30
Honey Locust	<i>Gleditsia triacanthos</i>	30
Red Maple	<i>Acer rubrum</i>	25
American Beech	<i>Fagus grandifolia</i>	25
Butternut	<i>Juglans cinera</i>	25
Bitternut Hickory	<i>Carya cordiformis</i>	25
Red Oak	<i>Quercus rubra</i>	25
White Birch	<i>Betula papyrifera</i>	25
Shagbark Hickory	<i>Carya ovata</i>	25
Trembeling Aspen	<i>Populus tremuloides</i>	25
Black Cherry	<i>Prunus serotina</i>	22
Largetooth Aspen	<i>Populus grandidentata</i>	20
Bur Oak	<i>Quercus macrocarpa</i>	15
Grey Birch	<i>Betula populifolia</i>	12
Black Willow	<i>Salix nigra</i>	12

<i>Coniferous Trees</i>		
Name	Botanical Name	Upper Mature Height (m)
White Pine	<i>Pinus strobus</i>	30
White Spruce	<i>Picea glauca</i>	20
Red Pine	<i>Pinus resinosa</i>	20
Tamarack	<i>Larix laricina</i>	20
Balsam Fir	<i>Abies balsamea</i>	20
White Cedar	<i>Thuja occidentalis</i>	15

<i>Small Trees / Shrubs</i>		
Name	Botanical Name	Upper Mature Height (m)
Weeping Willow	<i>Salix alba</i>	25
Hackberry	<i>Celtis occidentalis</i>	21
Downy Serviceberry	<i>Amelanchier arborea</i>	12
Staghorn Sumac	<i>Rhus typhina</i>	10
Mountain Ash	<i>Sorbus americana</i>	10

Canada Plum	<i>Prunus nigra</i>	10
Pussy Willow	<i>Salix caprea</i>	9
Nannyberry	<i>Viburnum lentago</i>	9
American Elder	<i>Sambucus canadensis</i>	8
Common Lilac	<i>Syringa vulgaris</i>	6
Beaked Hazel	<i>Corylus cornuta</i>	6
Green Alder	<i>Alnus crispa</i>	5.5
Alternate-Leaf Dogwood	<i>Cornus alternifolia</i>	5
Speckled Alder	<i>Alnus incan</i>	4
American Hazel	<i>Corylus americana</i>	4
High bush Cranberry	<i>Viburnum trilobum</i>	3
Button Bush	<i>Cephalanthus occidentalis</i>	3
Ninebark	<i>Physocarpus opulifolius</i>	2.5
Wild Raisin	<i>Viburnum cassinoides</i>	2.5
Red Osier Dogwood	<i>Cornus stolonifera</i>	2
Sandbar Willow	<i>Salix exigua</i>	2
Swamp Rose	<i>Rosa palustris</i>	2
Grey Dogwood	<i>Cornus racemosa</i>	2
Choke Berry	<i>Aronia melanocarpa</i>	1

Groundcover		
Name	Botanical Name	Upper Mature Height (m)
Lady Fern	<i>Athyrium felix-femina</i>	2
Ostrich Fern	<i>Matteuccia struthiopteris</i>	1.7
Big blue Stem	<i>Andropogon gerardii</i>	1.65
Indian Grass	<i>Sorghastrum nutans</i>	1.5
Little Blue Stem	<i>Schizchyrium scoparium</i>	1.5
Prairie Cord Grass	<i>Spartina perctinata</i>	1.5
Switch grass	<i>Panicum virgatum</i>	1.5
Meadowsweet	<i>Spiarea alba</i>	1
Sensitive Fern	<i>Onoclea sensibilis</i>	0.55
Maidenhair Fern	<i>Adiantum pedatum</i>	0.5
Wintergreen	<i>Gaultheria procumbens</i>	0.15