Oxford County Design Guidelines | 5 | Stormwater

TABLE OF CONTENTS

LIST OF FIGURES

5. STORMWATER

5.1 GENERAL

The County of Oxford owns and operates the storm sewer collection system within its road right of ways which consists of storm sewers, culverts, and ditches for the conveyance of surface water runoff to mitigate flooding of private and public property. The County's Authorized System is to be designed and maintained in accordance with all specifications in the County's Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA 071-S701). The following design guidelines apply only to storm water infrastructure which will be assumed by the County. Storm water assets which expand the description of the current infrastructure under the County's Environmental Compliance Approval (ECA) may be subject to further design input to ensure compliance.

The County storm water system is generally connected to/part of the local storm sewer network which would further be owned and operated by the respective Area Municipality and governed by their respective ECAs. Storm water infrastructure to be assumed by the Area Municipality shall meet their specific design guidelines. Where work on County Infrastructure affects (either directly or indirectly) a Municipal Drain, the Engineer shall consult with the Area Municipality Drainage Superintendent during the detailed design stage.

The current Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under Environmental Compliance Approval provide the minimum requirements that must be met.

In addition, the criteria in the following sections must be included in the design presented for approval to Oxford County.

5.1.1 Study Requirements

As part of all submission packages, prior to construction, the Developer shall submit a hydrological study along with a description of how hydrological conditions have been considered and addressed in the storm water design.

The hydrological study should be conducted by a Professional Geoscientist or Professional Engineer licensed to practice in Ontario to determine critical information related to:

- Groundwater Levels
- Hydrostatic Pressures
- Seasonal High Groundwater Table

The methodology of the hydrological study should consider whether the work is a single service retrofit or an installation of a new storm sewer collection system. Common methodology suited for conducting a hydrological study are

- Borehole and/or test pits (best suited for retrofits)

- Piezometers (best suited for retrofits and new installations)

In instances where a hydrological study is not feasible, historical data completed within the last 10 years, which has been reviewed by a Professional Geoscientist or Professional Engineer licensed to practice in Ontario, could be used in lieu of the hydrological study at the sole discretion of the **County of Oxford Public Works**.

Where a hydrological study is not feasible and/or historical data is not available, the storm sewer should be designed with the assumption that the hydrostatic pressure is at the surface grade.

As part of all submission packages, prior to construction, the Developer shall complete a geotechnical investigation along with a description of how geotechnical conditions have been considered and addressed in the storm water design. The cost of required geotechnical testing and placement of suitable material will be the responsibility of the Developer. A soils investigation report shall be submitted to determine the corrosiveness of the native soils including recommendations on cathodic protection methods.

As part of all submission packages a pre-construction report should be prepared by the Developer's Geotechnical Engineer that includes soil classification, recommendations of structural requirements for pipe and bedding, measures for corrosion protection, and construction methods to be used. The soils investigation report shall be submitted to **Oxford County Public Works** for review and comment, and following this review a finalized version addressing all comments shall be submitted.

The cost of these studies, including investigations and reporting, shall be the responsibility of the Developer. The City of Woodstock and Town of Tillsonburg are Service Providers for The County. Oxford County Design Guidelines are to be followed for all storm water systems within the County. No alternate guidelines shall be permissible, and all deviations are up to the sole discretion of **Oxford County Public Works**. Full-time inspection within the public right-of-ways shall be required by the Developer's Engineer in consultation with the County and its Service Providers. Inspection fees as set out by the County and its Service Providers will apply.

5.1.2 Regional Storm

Within Upper Thames River Conservation Authority (UTRCA) jurisdiction, the regional design storm to be used will be the London 1937 Flood. Hurricane Hazel to be used within the Grand River Conservation Authority (GRCA), Long Point Region Conservation Authority (LPRCA) and the Catfish Creek Conservation Authority (CCCA) jurisdictions.

5.2 STORM SEWER DESIGN

5.2.1 Major Systems

5.2.1.1 Roadway Conveyance

Roadways shall be designed to accommodate the major system flow (i.e. overland flow in excess of the storm sewer capacity) for the 100-year storm event. Analyses must consider both the minor and major system, and the interaction between the two (i.e. inlet capacity).

Reverse crowned roadways for private roadways are strongly discouraged. Depth of flooding within roadways shall be limited in order to provide public safety and protect adjacent properties. Depth of flooding within Oxford County roadways shall be as follows with respect to urban (pluvial) flooding conditions:

- **Urban Arterial**, Emergency Routes One lane open in either direction (0mm at crown).
- **Rural Arterial**, Collector One lane open (0mm at crown).
- **Local,** 150mm above crown and 300mm at the edge of pavement.

Depth of flooding within roadways shall also be limited to the of the right-of-way limits so as not to impact adjacent properties. Roadways shall be positively graded to continuously convey overland flow to suitable outlets or other overland flow route, unless otherwise approved by the County and the appropriate authorities.

The requirements outlined herein shall apply both to roadways with urban servicing (curb and gutter) and rural servicing (ditches).

Flooding depths on roadways due to riverine (fluvial) conditions for the Regional Storm Event should also be determined based on providing access and egress in accordance with the Ontario Ministry of Natural Resources River and Stream Systems: Flooding Hazard Limit Technical Guidelines (2002 or latest revision).

5.2.1.2 Overland Flow

Overland flow routes are commonly used to provide a linkage of overland flow conveyance between roadways and stormwater management facilities, channels/watercourses, or other suitable storm drainage outlets. Overland flow routes shall be appropriately sized to convey the peak flows which they capture and intercept, up to and including the 100-year storm event (and the Regional Storm, in those locations where the Regional Storm may exceed the 100-year storm event). Depth of flooding within overland flow routes shall be limited to 300mm to protect public safety.

5.2.2 Design Flows

5.2.2.1 Design Criteria

For further Storm Sewer Design Guidelines refer to Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Pre-Authorized under a CLI ECA.

5.2.2.2 Permitted Flows

Storm drainage shall be designed to collect storm water discharge from pervious and impervious areas, both on private lands via catchbasins and private drain connections. Indirect connections i.e. surface discharge of foundation and/or footing drains is permitted. Direct connections to storm sewers via private drain connections or storm service connections are not permitted.

5.2.2.3 Storm Sewer Design Sheet

Storm sewer design calculations for approved drainage area plans are to be completed on the standard design sheet as per **Figure 5.1** for details and additional design information.

5.2.2.4 Rational Method Formula for Peak Flow

Flows shall be calculated using the Rational Method formula:

$$Q = 2.78 \times A \times C \times I$$

Where: Q = peak flow (L/s)

A = area (hectares)

C = runoff coefficient (unitless)

I = average rainfall intensity (mm/hr)

5.2.2.5 Storm Design Curve

Intensity duration frequency (IDF) curves from Canada Atmospheric Environment Service (AES) for weather stations within a 50 kilometres radius of Oxford County are acceptable.

Where an Area Municipality has their own IDF curves they use for their storm sewer infrastructure, the Designer shall review and compare with the County-required IDF curves and use the more conservative data.

5.2.2.6 Time of Concentration

The time of concentration for residential areas at the upstream end of a system shall be a minimum of 15 minutes.

The time of concentration is to be adjusted when lateral flows account for 50% or more in the design flows.

i) Adjusted time of concentration shall be calculated using the formula:

$$T_{c-adj} = \frac{(T_{et})(Q_t) + (T_{cl})(Q_l)}{(Q_t \rightarrow Q_l)}$$

Where: $T_{c\text{-}adj}$ = adjusted time of concentration (min)

T_{ct} = time of concentration in the trunk sewer (min)

Q_t = design flow in the trunk sewer (L/s)

T_{cl} = time of concentration in the lateral sewer (min)

Q_l = design flow in the lateral sewer (L/s)

ii) The adjusted time of concentration is used downstream of the junction manhole.

The owner shall provide calculations to demonstrate the expected time of concentration (tc or td) applied for calculations of peak rainfall intensity.

The actual expected time of concentration is however to be calculated based on contributing drainage area to the point of interest. An appropriate empirical equation shall be applied, or the value shall be calculated based on the length of storm sewer to the point of interest and an assumed average velocity of 2m/s, plus an additional inlet time of 15 minutes.

5.2.2.7 Mannings Roughness Coefficient

A coefficient of 0.013 is to be used for all smooth concrete, HDPE, and polyvinyl chloride (PVC) pipe. An alternative coefficient may be used at the discretion and approval of the County.

5.2.3 Rational Method

The Rational Method should be limited to the design of flow conveyance features, such as storm sewers and associated overland flow conveyance. Refer to **Section 5.2.2.4 Rational Method Formula for Peak Flow**.

The Rational Method is not approved for use in establishing stormwater management criteria (i.e. sizing stormwater management facilities for flood control or erosion control). Further, the application of the Rational Method should be limited to a maximum drainage area of 5ha due to its conservatism in estimating peak flows.

5.2.3.1 Coefficient Of Runoff

The currently approved Rational Method Runoff Coefficients are presented in Table 5-1 below.

Table 5-1 Runoff Coefficients

Area Type	Runoff Coefficient (C)
Where Impervious/Pervious Areas Are Directly Measured	
Impervious Areas (Asphalt, Concrete, Rooftop)	0.95
Gravel Surfaces	0.80
Permeable Pavement	0.80
Pervious Areas (Grass, Meadow, Forest)	0.25
For Use In Design Without Detailed Site Plans/Plot Plans and Area Breakdown	
Road ROW	0.75

Parks	0.35
Commercial	0.90
Industrial	0.90
Institutional (Schools and Churches)	0.75
Greenfield Residential:	
Single Family (under 10m width)	0.65
Single family (between 10 and 15m width)	0.60
Single Family (greater than 15m width)	Consult **Oxford County Public Works**
Semi-detached	0.70
Row Housing, Town Houses	0.75

Where impervious and pervious areas are directly measured, the owner must also account for proposed amenity areas if not indicated on the drawing (i.e. areas beyond the rooftop – driveway, walkways, patios, etcetera). For detached and semi-detached residential properties (including row houses and townhouses), if no additional information is available, amenity areas shall be calculated as 90% of the rooftop area (including the driveway). The revised combined Runoff Coefficient should however not exceed 0.9.

These Runoff Coefficient values apply for storms up to and including the 10-year event. For storms greater than this return period, an adjustment factor shall be applied to account for expected soil saturation. Runoff Coefficients shall be multiplied by factors of 1.1, 1.2 and 1.25 for the 25, 50- and 100-year return periods respectively, to a maximum runoff coefficient of 1.0.

At the detailed design stage, storm sewer sizing and stormwater management calculations cannot be completed using generic runoff coefficients. Rather, weighted runoff coefficients must be calculated based on the proposed pervious and impervious surfaces. Supporting calculations demonstrating the calculated imperviousness ratio must be provided for all developments. Impervious area should include the roof, driveway, walkways, and an allowance for hard-surfaced patios in the backyard, all to the satisfaction of the County.

5.2.4 Site And Lot Grading

- Minimum hard surface slope to be 1%, asphalt surfaces 0.5%.
- Minimum soft surface slope to be 2%.
- Maximum desirable driveway slope is 6%.
- Reverse crown roadways will be discouraged on private development unless the owner/developer can demonstrate that the center line gradient exceeds 1%.

- Minimum swale slope for all types of residential properties to be 2%.
- Minimum swale slope for commercial and industrial properties to be 1.5%.
- Minimum slope 0.6m from building foundations is to be 2% away from building.

5.2.5 Foundation Drains

The County of Oxford strongly discourages any foundations that intersect the groundwater table. Where the proposed development may intersect the seasonally high groundwater table, the owner shall perform groundwater investigations to confirm seasonally high groundwater level and expected pumping needs. Additional on-site controls may be required where the anticipated groundwater pumping rate cannot be accommodated by existing drainage infrastructure.

Foundation drains should discharge to surface (via a sump pump system). Direct connections to storm sewer is not permitted, however design should account for flow to storm sewer when infiltration does not occur. Foundation drain connections to the sanitary sewer system **are not permitted.** Where a sump pump is proposed, a “goose neck” connection should be provided that ensures the pumped flows are discharged to an elevation of at least 0.15m above final ground elevation. A backflow valve must be implemented.

Foundation drain laterals, where required, shall have a minimum diameter of 150mm and a minimum slope of 2%.

5.2.6 Downspouts

Downspouts shall discharge to surface, at or above grade. Downspouts are not permitted to connect to foundation drains. Downspouts are not permitted to connect directly to storm sewer. Downspouts are not permitted to be connected directly or indirectly to sanitary sewer.

5.2.7 Pipe Location

Any deviation from these standards must be submitted in writing to the **Oxford County Public Works** for approval.

Storm sewers on private property are regulated by the Ontario Building Code (OBC). Where there are no specific regulations in the OBC, details from this manual shall apply.

5.2.8 Pipe Depth Of Cover

5.2.8.1 Minimum Depth of Cover

The minimum depth of a storm sewer shall be 1.5m from the finished ground elevation to the obvert of the pipe.

5.2.8.2 Maximum Depth of Cover

The maximum allowable cover permitted on rigid or flexible pipe shall be as per applicable OPSs or manufacturer specification.

5.2.9 Pipe Diameter (Minimum)

Pipe size is determined using the formula where the pipe design flow is equal to or greater than the calculated peak design flow:

$$Q = \left(\frac{1}{n}\right) \times A \times R^{2/3} \times S^{1/2}$$

Where: Q = Design Flow (m^3/s)

n = manning's roughness coefficient

A = cross-sectional area of flow (m^2)

R = hydraulic radius ($area/wetted\ perimeter$)

S = slope of pipe (%)

The minimum allowable size of a storm sewer shall be 300mm.

The minimum allowable size of a single catchbasin lead shall be 250mm. The minimum allowable size of a double catchbasin lead shall be 300mm.

5.2.10 Minimum / Maximum Velocity And Minimum Grade

Velocities in storm sewers shall be calculated using the following formula:

$$V = \frac{Q}{A}$$

Where: V = flow velocity (m/s)

Q = Design flow (m^3/s)

A = cross sectional area of flow (m^2)

5.2.10.1 Minimum and Maximum Velocities

The minimum velocity permitted in storm sewers is 1.0m/s.

The maximum velocity permitted in storm sewers are:

a) 4.5m/s for 300mm to 825mm diameter sewer, and

b) 6.0m/s for 900mm diameter and greater storm sewer

Figure 5.2 "Hydraulic Elements of Circular Pipe" may be used to determine velocities based on actual flow.

5.2.10.2 Minimum Grades

a) The minimum grade on a 300mm diameter storm sewer is 0.5%

b) The minimum grade on all other sewer sizes shall be established by determining the minimum grade required to achieve a velocity of at least 1.0m/s.

c) All catchbasin leads to be 1% minimum grade.

5.2.11 Curved Sewers

Curved sewers are not allowed unless otherwise stated by **Oxford County Public Works**.

5.2.12 Maintenance Holes

Maintenance holes shall be constructed as per OPSS.MUNI 407. Where required, frost straps shall be installed as per OPSD 701.100

The void between the sewer pipe and the cored hole of the precast maintenance hole shall be filled with cement bricks and approved non-shrinkable grout. All joints between bricks are to be completely filled with concrete mortar. Bricks shall be parged on the outside and inside of the maintenance hole. Parging shall contain an approved bonding agent. All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with manufacturers specifications.

5.2.12.1 Maintenance Hole Spacing

A maximum spacing between storm maintenance holes of no more than 110m measured horizontally from centre of chamber to centre of chamber is required when pipe diameter is 300mm to 975mm diameter. The maximum allowable horizontal spacing for the corresponding pipe sizes larger than 975mm are as follows:

Table 5-1 Maximum Spacing Between Storm Maintenance Holes

Length	Sewer Diameter
130 m	1050-1350mm
160 m	1500-1650mm
305 m	1800mm and larger

When placing a maintenance hole in the vicinity of a roundabout, storm maintenance holes should be placed within the inner area of a roundabout. Storm maintenance holes are permitted to be located within the grassed area of the roundabout provided any proposed landscaping does not hinder the access to the maintenance hole.

5.2.12.2 Precast Maintenance Hole Sizing Criteria

All sizing of storm precast maintenance holes is based on incoming and outgoing pipe sizes and should be sized and conform to **Figure 5.3**.

5.2.12.3 Maintenance Hole Diameter

Precast maintenance hole diameter requirements shall be as per OPSD 701.

5.2.12.4 Maintenance Hole Frame and Cover

Maintenance hole frames and covers are required for all maintenance holes. Maintenance hole frames and covers shall be as per OPSD 401.010. This should be outlined on the contract drawings, in the general notes.

If **Oxford County Public Works** feels that a public safety issue is possible in a designed area, they may require that a lockable maintenance lid be placed. These conditions may arise in proposed park areas.

5.2.12.5 Maintenance Hole Steps

Maintenance hole steps are required for access as per OPSD 405.010 or 405.020. Only steps supplied by the maintenance hole supplier will be accepted. They must be made of galvanized steel or aluminum. The reuse of existing steps is not acceptable.

5.2.12.6 Maintenance Hole Drop Structures

For external drop structures on 1200mm manholes, OPSD 1003.020 will be accepted. External drop structures are preferred to internal drop structures.

Internal drop structures shall be used in maintenance holes 1800mm diameter and larger where a minimum height of 600mm from the inlet pipe invert to the bottom of the outlet pipe invert. Drop pipes shall be one size smaller than the incoming sewer with a minimum of 150mm diameter and a maximum of 375mm diameter. Anchor straps shall not be placed within 150mm of any maintenance hole section joint. New internal drop structure system shall be as per OPSD 1003.031 and must be approved by **Oxford County Public Works**.

5.2.12.7 Maintenance Hole Safety Landing

Maintenance hole safety landings shall be as per OPSD 404.020. Maintenance hole safety landings are required in maintenance holes with a depth of greater than5.0m and should be shown on all proposed drawings or outlined in the general notes. All incoming pipes should be below any safety platform. Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0m deep.

5.2.12.8 Waterproofing of Chambers and Manholes

In areas of high groundwater waterproofing of chambers and manholes is required.

Waterproofing membrane shall be supplied and installed on all exterior concrete surfaces of the chambers and manholes, including the edges of the base slab, up to within 300mm of the cover elevation.

The membrane shall be applied over a prime or tack coat and hand rolled to assure positive adhesion. A compatible elastomeric mastic shall be applied to seal horizontal and vertical terminations, as a flashing and to form corner fillets. Openings in walls or roof slabs for piping, valve boxes or access chimneys shall be sealed with two layers of membrane material and mastic to provide a tight seal.

Waterproofing membrane shall be Sealtight Mel-Rol waterproofing system as manufactured by W.R. Meadows or approved equal.

5.2.12.9 Benching

All mainline maintenance holes require benching at the bottom of the maintenance hole. Catchbasin maintenance holes shall not be benched.

Benching shall be as per OPSD 701.021. Where benching is different from OPSD 701.021, a benching detail is required.

Should an existing maintenance hole require additional benching to improve the hydraulics then the existing benching should be removed and new benching placed to the obvert of the existing pipes.

5.2.12.10 Adjustment Units

Maintenance hole adjustment units shall be as per OPSD 704.010. Maintenance hole adjustment units are required on all maintenance holes to ensure that proper grade is provided between the top of the maintenance hole and the top of the maintenance hole lid. The difference in grade between the top of the maintenance hole lid and the first ladder rung shall not exceed 450mm.

A maximum of 150mm of adjustment rings will be allowed. This will be affected by either the use of precast concrete adjustment units or “Lifesaver” Adjusting Units as manufactured by IPEX or approved equal.

When using precast concrete adjustment units, only approved PVC shims will be allowed. Alternative shim products may be allowed at the approval of the County. Concrete, clay brick and wood spacers will not be allowed.

5.2.13 Catchbasins

Catchbasins shall be constructed as per OPSS.MUNI 407 with standard 600mm sump depth unless otherwise specified. Catchbasins are to be provided to collect drainage from both pervious and impervious areas. The following are the general guidelines to be used in the provision of catchbasins and catchbasin leads.

5.2.13.1 Location

Street - On street corners and intersections, the catchbasin is to be located 0.6m from the beginning of curve or end of curve of the curvature.

Lot/Rear Yard - the catchbasin and lead are to be located 0.6m from the property line, entirely on one lot or block.

Parks - Catchbasins are to be located to minimize flow across pathways and provide positive drainage from park facility.

5.2.13.2 Minimum Lead Diameter and Grade

Street - The minimum diameter and grade of a catchbasin lead on a street is 250mm at 1% (velocity of 1.0m/s)

Lot/Rear Yard - The minimum diameter and grade of a catchbasin lead in a rear yard is 300mm at 0.5% (velocity of 1.0m/s)

Parks - The minimum diameter and grade of a catchbasin lead in a park is 250mm at 1% (velocity of 1.0m/s)

5.2.13.3 Spacing

See table below for desired maximum distance between catchbasins, measured along the curb line.

Table 5-2 Catchbasin Spacing

Number of Lanes	Gutter Grade		
	< 3%	3% to 5%	> 5%
For two (2) lane roads	90m	75m	60m
For four (4) lane roads	75m	60m	60m

5.2.13.4 Depth of Cover

The minimum depth of cover over a catchbasin lead is to be 1.5m within the road allowance and 1.2m off the road allowance, unless otherwise approved by the County. Where minimum depths cannot be achieved and therefore frost protection is warranted, insulation shall be required as per **Figure 6.04**.

5.2.13.5 Allowable Ponding

No surface ponding is allowed to develop under a 5-year design storm event. Ponding on major overland flow routes allows for 300mm on street catchbasins and 450mm on rear yard catchbasins.

5.2.13.6 Requirements for Length of Leads

Standard catchbasins (600mm x 600mm), maintenance hole catchbasins and maintenance holes are to be constructed/connected in accordance with the following:

a) Catchbasins within 9.0m of a maintenance hole are to have their leads connected into the maintenance hole.

b) Catchbasin leads 9.0 to 15.0m may have their leads connected into the main sewer.

c) Catchbasin leads 15.0 to 30.0m in length may be constructed by:

   i. Having a catchbasin at one end and the other connected into a maintenance hole or a sewer 900mm in diameter and larger, or by

   ii. Having the lead connected into a sewer 825mm in diameter or smaller at one end with a maintenance hole catchbasin at the other end.

   Catchbasin leads over 30.0m in length, are to be connected into a maintenance hole or a sewer 900mm in diameter or larger at one end and have a maintenance hole catchbasin at the other end.

5.2.13.7 Catchbasin Frame and Grates

a) Catchbasin Cast Iron Frame and Flat Square Grate

   To be designed in conjunction with a catchbasin 600mm x 600mm as per OPSD 400.02.

b) Catchbasin Cast Iron Curb Inlet Overflow Plate

   To be designed in conjunction with curb inlet catchbasin as per OPSD 400.09.

c) Ditch Inlet, Galvanized Steel, Honeycomb - Grating

To be designed in conjunction with ditch inlet catchbasin as per OPSD 403.01.

5.2.13.8 Catchbasin Maintenance Hole Steps

a) Maintenance Hole Steps – Hollow

To be designed as per OPSD 405.010.

b) Maintenance Hole Steps – Solid

To be designed as per OPSD 405.020.

5.2.13.9 Catchbasin Subdrains

Road subdrain inlets shall be provided on both sides of all catchbasins installed in hard surface areas. Subdrains are not required in rear lot catchbasins or in a catchbasin located in grassed areas.

All subdrains shall be 150mm diameter, minimum 3.0m long, of perforated PVC pipe with geotextile filter sock MIRAFI 150N or Terrafix 200R or approved equal. Pipe ends to be capped.

5.2.14 Swales and Ditches

Private swales and ditches shall be constructed to convey private surface drainage towards safe, appropriate outlets as approved by the County, in conjunction with the overall provision of overland flow routes.

Swales shall be constructed at the lot level to direct discharge from roof leaders away from buildings and toward the municipal right-of-way or a rear yard catchbasin. Longitudinal grading of swales should follow the lot grading (i.e. minimum of 2%, maximum of 5%). Side slopes shall be a maximum of three horizontal to one vertical. Swale depth shall be a minimum of 150mm and a maximum of 300mm.

In instances where a swale grade must be less than 2%, a sub-drain must be constructed along the entire length of the swale and must be connected to an adjacent storm sewer, LID feature or onto the surface where grades permit. The subdrain must be located 300mm beneath the invert of the swale and have a minimum diameter of 150mm. Subdrains should be surrounded by a minimum of 300mm deep, 19mm clearstone, wrapped in filter cloth to prevent clogging due to fine particulate matter.

5.2.15 Culverts

For the design of culverts under roads:

a) New culverts or culverts that are being redesigned, replaced, or impacted by road works/road widening must be designed to meet the hydraulic requirements established by MTO for inlet or outlet control culverts.

b) County practice requires that culverts must convey the minimum storm events as specified below:

Table 5-4 Culvert Minimum Storm Event

Classification of Roads	Minimum Storm Event To Be Conveyed By Culvert
Local Road	25-year storm event
Rural Arterial, Collector Road, Urban Arterial	50-year storm event
Bridges, Culverts (span greater than 6m)	100-year storm event or Regional storm event, subject to the Conservation Authority conditions

5.2.16 Pipe, Manhole and Bedding Materials and Specifications

Refer to existing **Oxford County Design Guidelines & Specifications**, Section 5 Storm, Part 2 – Materials, Part 3 – Installation and Part 4 – Service Installation.

5.3 OUTFALLS

Storm sewer outfalls are locations where storm sewers discharge to open watercourses or waterbodies. All new outfalls will be designed and constructed at the discretion of the area Conservation Authority and other regulatory agencies, as appropriate.

When designing a storm sewer outfall, it is important to consider the potential for erosion and scour due to the concentrated discharge and the flow characteristics of an urbanized system (steeper slopes, smooth surfaces, rapidly peaked flows/velocities, etc.).

Storm sewer outfalls (including SWM facility outlets) should be designed to mitigate impacts accordingly. Designers should confirm the expected velocity of flows at outfalls and ensure appropriate mitigation measures to slow the velocity through energy dispersion to avoid negative impacts to the receiving channel. This could include chute blocks, aggregate or vegetative protection, etc. in the vicinity of the outfall.

The alignment of proposed outfalls should also consider the primary direction of flows and attempt to match the direction of flow accordingly to the extent possible. The erodibility of the existing watercourse or waterbody should be considered accordingly, including input from a qualified fluvial geomorphologist where warranted.

Signage is required for all outfalls per Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Pre-Authorized under Environmental Compliance Approval.

5.4 STORMWATER MANAGEMENT

5.4.1 Flood Management

Uncontrolled urbanization/development results in increased runoff volume and peak flows, due to the associated increase in impervious land coverage. Without adequate quantity (flood) controls, increased peak flows could compromise the capacity of downstream conveyance systems (urban systems and open channels) and result in flooding impacts/damages to adjacent properties.

Owners are thus required to provide flood control management in accordance with the specified level of control outlined within a Watershed Study, Subwatershed Study (SWS), Stormwater Master Plan (SMP), or Master Environmental Servicing Plan (MESP) that encompasses the owner's site.

Where a SMP, SWS or MESP does not exist, the owner is required to consult with the County and Agencies (including the appropriate conservation authority) regarding the acceptable level of runoff controls to be applied to the owner's site. At a minimum, post-development to pre-development peak flow control is required for the 2 through 100-year return periods, as established through hydrologic simulation based on the County's currently specified rainfall dataset, and associated intensity-duration-frequency (IDF) values.

The County generally considers that existing systems are at, or near, full capacity, hence infills and re-developments may need to over-control flows, as specified by the County and any governing studies.

Existing drainage patterns should be maintained to the extent possible. Minor changes may be considered by the County (in consultation with Conservation Authority when appropriate), in its sole discretion. If the owner is able to justify the need for the diversion and is able to fully mitigate the impacts.

The County may (in consultation with the Conservation Authority when appropriate), in its sole discretion, consider a reduced quantity (flood) control requirement if the owner is able to clearly demonstrate that the impacts of the proposed development would not result in any off-site impacts.

Quantity controls are not currently required for the Regional Storm (Hurricane Hazel or London 1937 Flood, per Conservation Authority). Where a SMP, SWS or MESP does not exist, the County may consider the requirement for quantity controls for the Regional Storm Event should updated direction be provided by applicable governing bodies and agencies.

5.4.2 Watercourse Erosion Control and Prevention

Increased runoff volumes, and increased durations of erosion causing flows, have the potential to have detrimental erosive impacts to downstream receiving watercourses, unless adequately controlled.

Similar to flood control requirements, owners are required to provide erosion control in accordance with the specified level of control outlined within a higher-level study (SWS, SMP, MESP or otherwise) that encompasses the owner's site. Where a higher-level study does not exist, the owner is required to consult with the County and Agencies (including the appropriate

Conservation Authority) regarding the acceptable level of runoff controls to be applied to the owner's site.

For erosion control, the owner is required to mitigate any potential erosion impacts in accordance with Provincial guidelines. At a minimum, the owner should provide extended detention control (detention of the 4-hour, 25mm storm event over at least 24 hours, with a preference for 48 hours). Alternatively, the owner should demonstrate the retention of the 90th percentile rainfall (27mm for the County) consistent with potential pending Provincial guidelines, and subject to review and discussion with the County. Erosion controls are credited towards overall on-site quantity control measures.

Existing drainage patterns should be maintained to the extent possible. Minor changes may be considered by the County (in consultation with Conservation Authority when appropriate), in its sole discretion, if the owner is able to justify the need for a diversion and is able to fully mitigate the impacts on both the receiving and the losing systems.

Oxford County may (in consultation with Conservation Authority where appropriate), in its sole discretion, consider reduced erosion control requirement if the owner is able to clearly demonstrate that the impacts of the proposed development would not result in any off-site impacts. This could potentially apply in locations out-letting to insensitive watercourse receivers (such as lined channels with no natural systems located downstream).

Storm sewer outfalls to natural channel systems shall incorporate proper protection against local erosion, including bank scour protection. Where storm sewer outfalls outlet to steep and/or deep valleys, drop structures shall be incorporated and designed to address these concerns. All erosion mitigation measures at outfalls should be designed to blend with the natural receiving watercourse system to the extent possible.

5.4.3 Field Testing and Monitoring

5.4.3.1 Field Testing

The contractor shall undertake a video inspection after cleaning and flushing as per OPSS.MUNI 409 for all sewers upon completion of installation. After completion if the 2-year maintenance period, the sewers shall be videoed again to ensure there are no defects in material or installation. One copy of the video inspection with a condition survey report from each survey shall be supplied to the County or the County of Oxford's service provider.

Contractors are not permitted to flush the new sewer lengths into existing sewers. Contractors shall provide and place temporary plugs where necessary to prevent silt and debris from entering existing sewers.

Where silt and debris has entered the existing sewers as a result of construction activities the existing sewer lengths and manhole structures shall be inspected by the **Oxford County Public Works.** Once the affected areas have been identified, the Contractor shall clean, flush and video those sections as directed by the **Oxford County Public Works** at their own expense.

5.4.4 End of Pipe Treatment

End of pipe Stormwater Management Facilities (SWMFs) refers to those systems with open ponding areas used for quantity, erosion, and/or quality control to mitigate the impacts of development. An end of pipe SWMF may refer to a dry pond, wet pond, wetland, or hybrid design. End of pipe SWMFs are typically only applicable for drainage areas of 5ha or greater in order to support a permanent pool component.

The County does not have design requirements for Stormwater Management Facilities. Where a SWMF is required and proposed by the owner, it shall be designed in accordance with the local Municipality's design guidelines and the Province of Ontario's (MOE's) 2003 Stormwater Management Planning and Design Manual, or any subsequent updated versions. The SWMF shall also meet guidelines and criteria set forth by the appropriate conservation authority (including its recommendations with respect to acceptable landscaping) and other agencies (i.e. MTO, MNRF, etc.), as applicable.

Siting of SWMFs shall be established in consultation with **Oxford County Public Works,** account for other Agency requirements, and be justified to the satisfaction of the County. Siting shall be based on site specific conditions and an appropriate analysis of environmental, technical (safety, maintenance, and operations), economic and social considerations.

Consideration shall be explicitly given in the supporting design materials to long term operations and maintenance requirements for the proposed SWMF, with particular attention to the required frequency of inspection and monitoring, as well as the design of operations and maintenance amenities (such as sediment decanting zones, access roadways and safety considerations), and the expected frequency of sediment removal in the case of wet ponds, wetlands, and hybrid systems.

5.5 EROSION AND SEDIMENT CONTROL

5.5.1 General

Erosion and sediment controls are required by the County for any proposed development, site alterations or Capital Works Project to ensure that sediment is kept on site, and that it does not negatively impact adjacent roadways, properties, infrastructure, watercourses, and waterbodies.

Prior to the commencement of any on-site work activities, owners must implement an Erosion and Sediment Control (ESC) Plan that includes ESC measures designed to effectively reduce on-site erosion and minimize off-site transport of sediment, either through overland flows, municipal sewer systems or via wind transport. ESC measures shall conform to the erosion and sediment control methods as outlined by the appropriate Conservation Authority, in addition to the County requirements. Reference is also made to CN/CSA-W202-18 (Erosion and Sediment Control Inspection and Monitoring) and OPSS.

Details of the ESC Plan/drawings shall be prepared by a licensed professional engineer and be included with the appropriate submission(s) for approval by the County, and other relevant agencies (i.e. appropriate Conservation Authority, MNRF, etc.), as required. Preference is given to those professionals with the Certified Practitioner/Inspector in Erosion and Sediment Control (CPESC/CIESC) designation from the Erosion Sediment Control Association of Canada.

ESC Plans shall be prepared to show a plan view of the construction site and/or construction phase. Plans must be drawn at a minimum scale of 1:500. Lines and symbols shall be used to represent ESC measures.

ESC Plans shall include details demonstrating/indicating how ESC measures are to be constructed and maintained. Details shall be enough so the ESC measure can be properly installed. Plan enlargements may be required to show additional details in sensitive and/or special site areas.

Notes shall be included to outline site monitoring/remediation requirements for ESC measures, construction staging procedures, construction timing windows and restrictions, and any other key information.

Disturbance to site areas should be minimized, where possible, to reduce the potential for erosion and sediment transport. Owners should consider a staged approach to construction works, such that disturbance to site areas occurs only as necessary for construction activities.

ESCs may require modification throughout the construction phase to address current site conditions. ESC controls (and all accumulated sediment) should be removed off-site once site conditions have suitably stabilized.

5.5.2 Construction Phase

ESC Plans shall be prepared to address all phases of construction. Phases of construction are dependent on the nature of the construction activity; however typical phases of construction are as follows:

- Topsoil Stripping/Site Clearing.
- Earthworks/Rough grading.
- Site Servicing and Road Construction.
- House/Building Construction.
- Demolition.

Owners are required to tailor the ESC measures to their construction site, based on the requirements of the site characteristics and anticipated staging. Depending on the complexity of the construction activities, multiple ESC Plans may be required to address the various construction phases.

All ESC measures are to be inspected by the Design Engineer or a CISEC (Certified Inspector of Sediment and Erosion Controls) Certified Inspector a minimum of twice per week during the active construction period and after significant rainfall events (>10mm) to ensure ESC measures remain in good working condition. An inspection report is to be prepared by the site inspector immediately following each inspection. Inspection reports must outline the conditions of the ESC measures, including any deficiencies noted and a timeline to address such deficiencies. Erosion and Sediment Control Guide for Urban Construction (CVC, 2019) (ESC Guide for Urban Construction). The County is to be provided a copy of each inspection report in a timely manner following each inspection (i.e. within 1 week).

Independent inspections may be completed by **Oxford County Public Works** order to verify that the ESC measures implemented on the site follow the approved plan and in working order.

Written notice will be provided as required, outlining any deficiencies noted and providing a timeline to address.

The owner is responsible for addressing any deficiencies noted in the erosion and sediment controls implemented on the site. If the deficiencies are not addressed within the specified timeframe, the County may use the Letter of Credit to finance any required remedial works.

5.5.3 Permissible ESC Measures

Permissible erosion controls for site alterations include, but are not limited to, the following practices.

5.5.3.1 Surface Roughening (Scarification)

Scarification is a process of roughening exposed slopes perpendicular to the slope/drainage direction. Typically, scarification can be useful for sites with steep slopes up to 2H:1V. Scarification reduces drainage velocity, quantity, and erosion potential.

.1 Seeding

Vegetative cover is established by seeding a disturbed area. Typically, seeding of disturbed areas is conducted following final grading or for site areas where no further construction is scheduled for 30 days. Seed application typically occurs with straw mulching, hydraulic mulching, and erosion control blankets. Seeding using hydroseeding or terra seeding techniques is encouraged to support the more rapid growth of vegetation. Sodding may be required in site areas where instant ground cover is required or where seed is difficult to establish (e.g. swale inverts due to concentrated flows).

.2 Mulching

Freshly seeded soils can be protected by applying man-made or natural materials such as mulching. Mulching reduces drainage velocity and therefore the erosion potential of seeded soils. Manufacturer's specifications should be followed for mulch application.

.3 Polymers and Tackifiers

Polymers and tackifiers are substances which can be used in conjunction with seeding and mulching activities to bind material together (increase cohesion) to limit erosion. Such materials must be confirmed to be environmentally benign. Supporting material is required where such substances are proposed prior to approval and application.

.4 Erosion Control Blankets, Netting and Matting

Erosion control blankets, netting and matting should be fully biodegradable materials which are placed on relatively steep surfaces to prevent erosion and promote seed growth. This type of mechanical stabilization is also required in areas of exposed soils if construction is proceeding outside the growing season (i.e. late October to early April). Manufacturer's guidelines should be followed in the use of erosion control blankets.

.5 Vegetative Buffer Strips

Erosion control can be provided through the use of existing or proposed vegetation adjacent to the feature to be protected.

5.5.3.2 Sediment Controls

Permissible sediment controls for proposed developments or site alterations include but are not limited to the following practices. In all cases, the County encourages re-vegetation of exposed surfaces as quickly as possible following grading works.

.1 Vehicle Tracking Control Mat

The County requires that a vehicle tracking control mat (i.e. “mud mat”) be implemented where vehicles access and leave a construction site via a county road. A mud mat is comprised of both 150mm diameter aggregate (first 10m) and 50mm diameter aggregate (last 10m) placed on a geotextile, 300mm deep, with a minimum width of 5m and a minimum total length of 20 m. Mud mats should be located at each site entrance/exit. Mud mats require regular maintenance to ensure sustained performance. Where the mud mats fail to perform, and where sediment is conveyed to the road, the owner will be required to clean the road at its sole expense. Should the County inspect the road and determine that maintenance is not adequate, the owner shall be responsible to address the identified deficiencies. Other less common forms of vehicle tracking control, such as wash-pads, are also acceptable for use. There may be instances where the County requires owners to implement multiple forms of vehicle tracking control.

.2 Dust Management

Dust management is a key consideration during dryer periods (summer, etc.) and is most notable whilst soils are not yet stabilized on site. Efforts must be made to ensure appropriate mitigation measures are available and in place on site, such that concerns can be avoided and/or otherwise managed within a timely manner should they arise.

Sediment transport via wind can be reduced by implementing dust control measures on site. Dust control measures can include but are not limited to: soil wetting via water truck, placement of calcium chloride, anionic polymers, and vegetation of disturbed areas.

.3 Temporary Grading Diversions

Diversion of drainage from steep slopes and disturbed areas through the use of diversion swales should be considered depending on site conditions. Drainage should be directed to appropriate sediment control measures.

.4 Check Dams

Check dams (most typically rock check dams, however other types of materials are available) involve the placement of granular material either in a swale, ditch, or watercourse to facilitate settling of sediment. Site specific design of check dams shall consider the depth of the swale (i.e. the height of check dams shall be smaller than the depth of the swale). Check dams shall be constructed such that flows do not by-pass the check dam.

.5 Temporary Slope Drains

To prevent slope erosion, concentrated drainage may be conveyed down a slope via a temporary slope drain comprising a flexible conduit or ditch liner. Slope drains should employ adequate inlet and outlet protection and should not discharge directly to creeks.

.6 Sediment Control Fences

Sediment control fences function as a barrier to sediment migration and drainage, creating ponding and therefore settling of sediment, rather than relying on filtering of the runoff. In order to function properly and effectively, sediment control fence must be properly installed and

maintained, including ensuring an appropriate depth of burying/anchoring. In areas of environmental concerns, or sensitive discharge locations, a double row of silt fence may be required. Sediment Control fence should not be used in areas of concentrated flows; other more appropriate measures should be used in those areas, including check dams and compost berms.

.7 Compost Berms

Compost berms may in some locations be used in place of sediment control fences. The Compost berms should be designed according to manufacturer's guidelines. Unlike sediment control fence, compost berms are able to filter sediment from drainage and do not obstruct flow paths. Compost berms are easily spread out on-site after construction completion instead of being required to be removed like sediment control fence.

.8 Compost Socks

Compost socks provide a similar function to compost berms, however on steep or paved surfaces, manufacturer's guidelines should be used in both design and placement of the compost sock. Compost socks can also be used in place of rock check dams and catch basin sediment traps.

.9 Sediment Traps

The design and construction of sediment traps should incorporate guidelines outlined in the 2019 ESC Guide for Urban Construction unless otherwise specified by the County or appropriate Conservation Authorities. Typically, drainage areas to sediment traps are less than 2ha. The location of sediment traps should be outside of regulated floodplain limits whenever possible.

.10 Sediment Control Ponds/Basins

Similar to sediment traps, sediment control ponds/basins should incorporate guidelines outlined in the ESC Guide for Urban Construction Guidelines, unless otherwise specified. Typically, sediment control ponds/basins are sized to provide a permanent pool volume, as well as an active storage volume with a minimum drawdown time for drainage areas of 2ha or greater. Sediment control ponds/basins should be located outside of areas regulated by the area Conservation Authority unless approved through their permitting process.

.11 Catch basin Sediment Traps

Catch basin sediment traps are devices positioned inside catch basins and are intended to prevent sediment build-up and clogging of the storm sewers by trapping sediment laden runoff. Catch basin sediment traps are required on all catch basins potentially subject to sediment laden runoff, including those outside of the construction site. Catch basin sediment traps should be cleaned as per manufacturers specifications.

.12 Polymer Flocculation

Anionic polymers can be used in combination with many of the sediment control measures noted previously to create larger particles which more easily settle out. Polymers can be used for dewatering and bypass applications, including creating treatment ditches or pipes that contain polymer blocks or contact surfaces to promote flocculation and minimize sediment loading to downstream receivers.

5.5.3.3 Drainage Protection

Permissible drainage protection for site alterations includes, but are not limited to, the following practices.

.1 Temporary Creek Crossings

Temporary creek crossings typically span a watercourse feature for the purpose of construction access. For regulated watercourses, appropriate Conservation Authority, MNRF, and possibly DFO will have individual requirements that should be fulfilled related to location, capacity, and form.

Where watercourses are not regulated by other agencies, concrete or corrugated metal pipes may be used to provide temporary crossings during construction. Notionally, the crossings would be required to convey a frequent event (i.e. 2-year storm event +/-) design flow, depending upon the duration of crossing, time of year, and any site-specific constraint; the capacity is to be established in consultation with the County.

.2 Temporary Drainage Diversions

Temporary diversions of non-regulated drainage features should be conducted only when necessary to reduce impacts on the social or natural environment and are supported by a comprehensive evaluation of potential impacts. Diversions should be designed according to drainage function and form and may require natural channel design principles. Watercourse diversions must account for other Agency requirements.

.3 Temporary Storm Drain Inlet Protection

Storm drain inlet protection may consist of a sediment control barrier, granular material, geotextile, and/or ponding area. Specific applications will require different inlet protection designs.

.4 Temporary Storm Drain Outfall Protection

Outfall protection should be designed according to both the outfall flow velocities and the receiving watercourse flow dynamics.

.5 Temporary Flow Bypass and Dewatering

Temporary cofferdams are used to allow dewatering of a construction area to permit work in dry conditions. Sediment laden water should be pumped to a sediment bag (or equivalent) within a vegetated area a minimum of 30m away from features to be protected. Design considerations and installation and maintenance considerations are provided within the ESC Guide for Urban Construction, unless otherwise specified by the County or appropriate Conservation Authority.

5.5.3.4 Soil and Fill Management

.1 General References

Fill management and excess soil management should follow applicable guidelines, including the Province of Ontario's "Management of Excess Soil – a Guide for Best Management Practices."

.2 Fill and Topsoil Stockpiles

Fill and Topsoil stockpiles shall be limited to a height of 3m and must have side slopes not exceeding 3H:1V. Sediment fences are to be installed around the perimeter of the stockpile to control sediment laden runoff. For larger material stockpiles (>100m^3) an additional setback at the toe of the stockpile (not less than 2m) shall be included. Stockpiles to be undisturbed for 30 days or more must be vegetated to prevent sediment transport, typically by seeding.

RUNOFF COEFFICENT 'C' VALUES

THE FOLLOWING 'C' VALUES WILL APPLY WHEN DESIGNING STORM SEWERS

PARKS, OPEN SPACE	0.20
SINGLE FAMILY/SEMI DETACHED	0.50–0.55
TOWNHOUSE/ROWHOUSE	0.65
APARTMENTS	0.65–.070
COMMERCIAL, INSTUTUTIONAL & INDUSTRIAL	0.70–0.90
DENSELY BUILT, PAVED	0.90

STORM SEWER DESIGN SHEET
OXFORD COUNTY

FLOW Q=2.78 x C x A x I

WHERE:
Q= PEAK FLOW IN LITRES PER SECOND(L/S)
A= AREA IN HECTARES (Ha)
C= RUNOFF COEFFICIENT
I= RAINFALL INTENSITY (mm/hr)
RETURN PEROID= 2 YEARS

DATE: ____________

DESIGNED BY: ____________

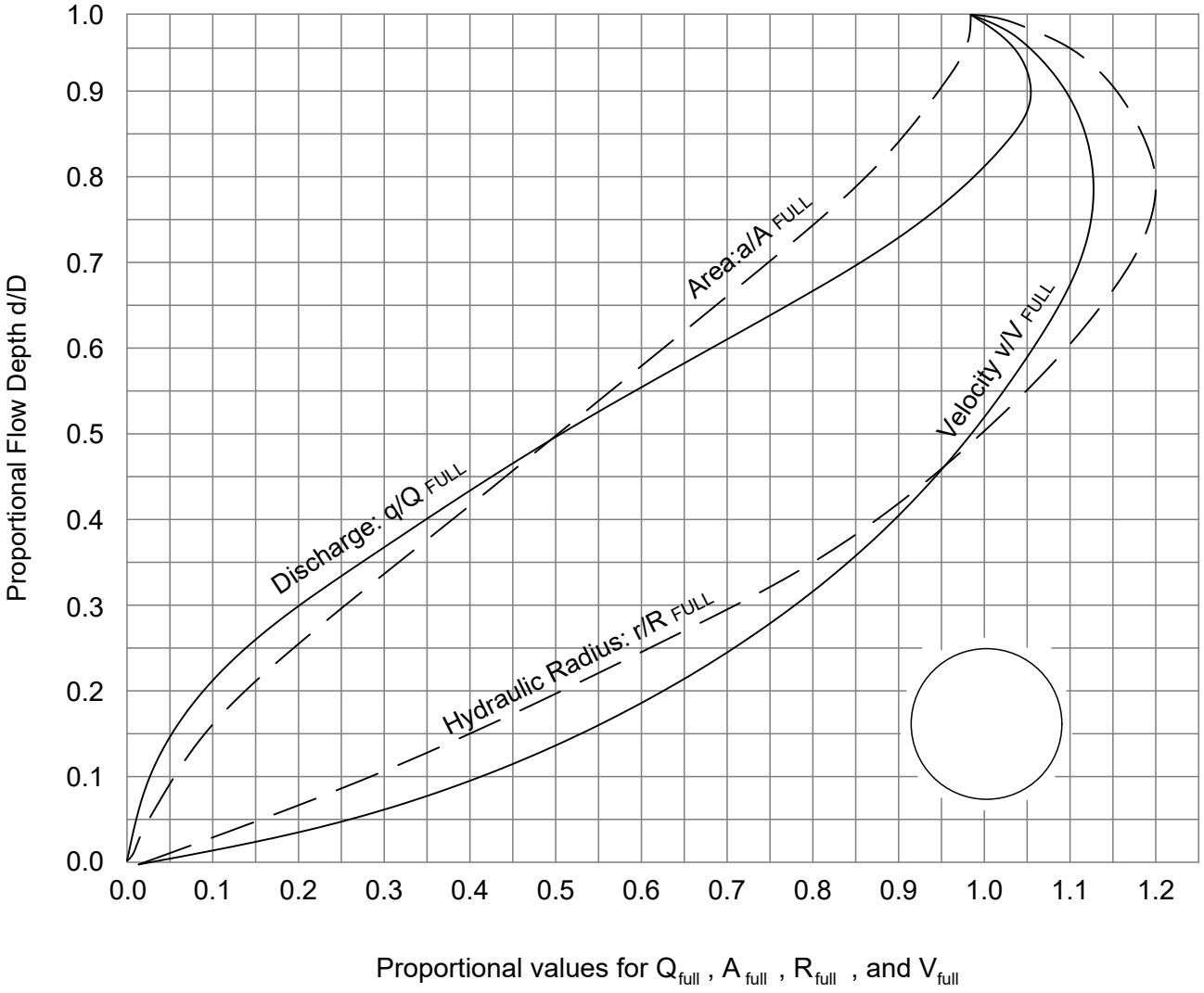
PROJECT NAME: ____________

PROJECT FOLE No: ____________

LOCATION				AREA		TOTAL (A X C)						RAIN FALL DENSITY				SEWER DESIGN							PROFILE				
AREA No.	STREET	FROM MANHOLE	TO MANHOLE	DELTA HECTARES	TOTAL HECTARES	C	A X C	TOTAL SECTION	TOTAL LATERAL	TOTAL SEWER	TOTAL 2.78 AxC	TIME ENTRY (mm) SEC TION	TIME ENTRY (mm) ACCUML	INTENSITY mm/hr	Q L / s	n	PIPE SIZE (mm)	SLOPE %	CAP L/S	VELOCITY m/s	LENGTH M	TIME OF FLOW	FALL IN SEWER	HEADLOSS	DROP IN MANHOLE	INVERT ELEVATIONS U.S.	INVERT ELEVATIONS D.S.

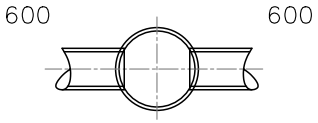
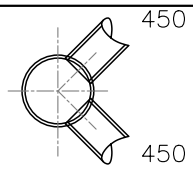
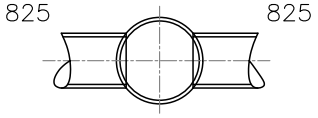
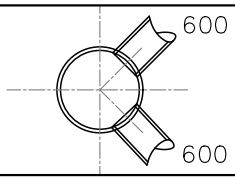
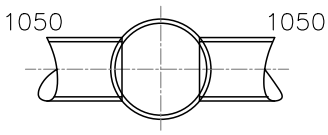
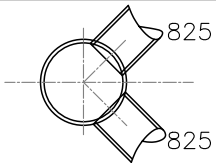
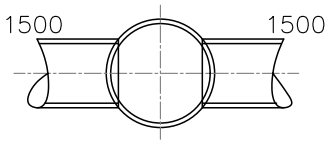
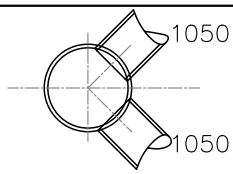
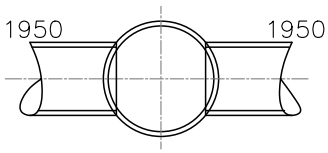
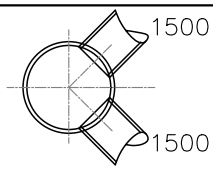
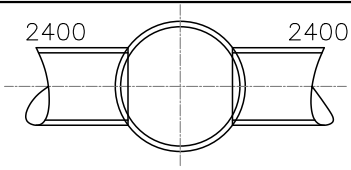
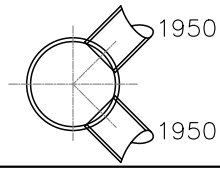
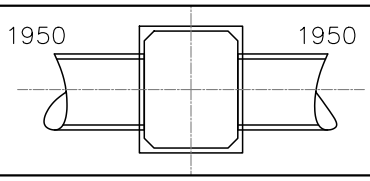
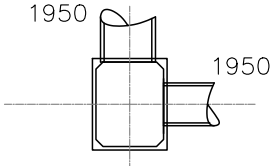
OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County — Growing stronger together
STORM DESIGN SHEET	12/2025	
	FIG. 5.01	

PREVIOUSLY FIG 5.1



OXFORD COUNTY STANDARD DRAWING	REV#: 1	OxfordCounty Growing stronger together
HYDAULIC ELEMENTS OF CIRCULAR PIPE	12/2025	
	FIG. 5.02	

PREVIOUSLY FIG 5.2

MAINTENANCE HOLE INSIDE DIAMETER (mm)	MAX. PIPE SIZE FOR STRAIGHT THROUGH INSTALLATION (mm)	MAX. PIPE SIZE FOR RIGHT ANGLE INSTALLATION (mm)
1200		
1500		
1800		
2400		
3000		
3600		
3000 x 2400		

1. ALL DEMINSIONS ARE FOR CONCRETE PIPE.
2. ALL DIMENSIONS ARE IN MILLIMETRES
3. KNOCKOUTS FOR SMALL DIAMETER CATCH BASINS LEAD SIZES 300mm OR LESS COLUD BE PROVIDED IN ADDITION TO WHAT IS SHOWN
4. INFORMATION TAKEN FROM ONTARIO CONCRETE PIPE ASSOCIATION (O.C.P.A.)

OXFORD COUNTY STANDARD DRAWING	REV#: 1	OxfordCounty Growing stronger together
MAXIMUM PIPE SIZES FOR PRECAST MAINTENANCE HOLES	12/2025	
	FIG. 5.03	

PREVIOUSLY FIG 5.3