Oxford County
Growing stronger together

Design Guidelines

and Supplemental Specifications for Municipal Services

January 2026

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1 INTRODUCTION TO STANDARDS

1.1 FOREWORD

This document is applicable to capital works projects completed by Oxford County (the County) and/or its Consulting Engineers, and private land development projects completed by Developers. This document is intended to provide information and define minimum acceptable standards to Consulting Engineers, Developers and their agents, municipal partners and stakeholders requiring knowledge of the principles governing the development of land and the engineering design and construction of public infrastructure within the County.

All infrastructure requirements for design and construction noted within these Design Guidelines only applies to infrastructure that is owned and/or operated by the County of Oxford. Any infrastructure that is owned and operated by the local Area Municipality will need to adhere to the local Area Municipality's standards accordingly.

It is the responsibility of Developers, Consulting Engineers, and Contractors to apply sound engineering principles and industry best practices to provide an end product that is practical, feasible, efficient, safe, and sustainable to operate and maintain by the County. Any deviation from these standards requires a written request to the County for acceptance prior to implementation.

This document is available on the County's website and will be reviewed and updated on an as-required basis to remain current with the County Development Plan and related strategic plans, industry best practices, and to remain in compliance with regulatory requirements. Revised documents will be uploaded to the County's website. These standards have been prepared based on municipal and provincial regulations and standards, as well as industry best practices. If any standards set forth in this document contradict other applicable industry standards, the more stringent standards shall take precedent. Where these standards refer to bylaws, policies, acts, regulations, or standards, this shall mean the most recent edition or amendments of the referenced document.

1.2 SCOPE

These standards and procedures apply to the preparation and submission of Design Briefs, Conceptual Development Plans, Area Structure Plans, Outline Plans, Preliminary and Detailed Engineering Drawings, and the construction of the proposed infrastructure within the County including, but not limited to:

- Roadways including traffic control devices, curb and gutter, sidewalks, and other active transportation facilities;
- Sanitary sewer and storm drainage collection systems and related appurtenances, lot grading, and lot service connections;
- Water distribution systems for potable water and fire protection and lot services;
- Shallow (franchised) utilities (i.e., gas, hydro, telecommunications, and others);

- Facilities including reservoirs, pumphouses, lift stations, and stormwater management facilities, and;
- Landscaping including hard and soft elements.

These standards apply to the design and construction of new infrastructure and the rehabilitation of existing infrastructure. Modifications to these guidelines may be required in older neighbourhoods (e.g., due to right-of-way restrictions) which the County acknowledges and typically does not consider as a deviation to these guidelines, but which will require acceptance by the County as noted above.

All works to be constructed within the County of Oxford shall be designed and executed in accordance with the most current standards and regulations set out under the Accessibility for Ontarians with Disabilities Act (AODA). Compliance with AODA requirements shall be integrated into all stages of project development, including planning, design, procurement, and construction, to ensure that accessibility is upheld throughout the lifecycle of the project.

1.3 DEFINITIONS

In this document, the following words shall have the meaning hereinafter assigned to them. Words with definitions provided are capitalized throughout this document.

Table 1-1 Defined terms

Term	Definition
Applicant	See definition for “Developer”.
Area Structure Plan (ASP)	ASPs provide the framework for developing and servicing new areas of the County. ASPs must include the sequence of development proposed for the area, proposed land uses, proposed population density, the general location of major transportation routes and public utilities, and all other matters considered necessary by Council. Refer to the County’s website for active ASPs.
Capital Works Project	A project led by Oxford County’s Engineering Services Division (within the Public Works Department) for upgrades, installations or improvements to County infrastructure.
Construction Completion Certificate (CCC)	A certificate in accordance with the Construction Act prepared by the Developer’s Consultant and executed by the County confirming that the work is complete and operational, that all deficiencies have been resolved to the

Term	Definition
	satisfaction of the County, and that the warranty period for the work can commence.
Consultant	An individual, firm, or corporation retained to provide expert professional advice, services, or technical support for County or development-related projects. May include engineers, planners, architects, environmental specialists, or other regulated professionals.
Consulting Engineer	A licensed Professional Engineer, in good standing with Professional Engineers Ontario (PEO), retained to provide engineering services related to public infrastructure or development projects within the County.
Contractor	Any qualified person, persons, or corporation which shall undertake the construction or installation of municipal infrastructure and services on behalf of either the Developer or the County.
County	The upper-tier municipal government, known as the County of Oxford, responsible for developing, administering, and enforcing policies, standards, and procedures within its jurisdiction.
Designer	A qualified individual or entity responsible for preparing design drawings, specifications, and related documentation for public infrastructure or development projects, in accordance with applicable legislation and professional standards.
Developer	An individual, corporation, or legal entity undertaking the planning, financing, and execution of land development projects, including the construction of public and private infrastructure.
Developer's Consultant	A Consulting Engineer, Landscape Consultant, or Ontario Land Surveyor, or other party hired by the Developer to assist with the design and to oversee construction of the proposed development.
Developer's Representative	A Consulting Engineer, Landscape Consultant, or Ontario Land Surveyor hired by the Developer to act on the Developer's behalf.

Term	Definition
Development Agreement	A legal contract for developments. It sets out the terms and conditions under which development of the lands are to take place within the County, including the responsibility to construct public facilities and associated financial obligations.
Development Brief	A document prepared by the Developer or Consulting Engineer providing a planning and development overview of a project.
Deviation	A departure or alternative to these standards. A request for Deviation must be made through a formal (written) request that must be submitted to the County prior to implementation. The request for Deviation must include a recommendation from the Consulting Engineer and must be approved by the Engineering Department.
Easement	An agreement, usually registered on the certificate of title for the property, that gives the County the right to use a landowner's property in some way (such as to access a utility). Easements can also partially restrict a landowner's use of the affected portions of land.
Engineering Department	The municipal department that represents the County for internal and external review and approval of various development applications.
Engineering Design Brief	A document containing all the technical documentation supporting the project as described in a Development Brief or Outline Plan.
Environmental Reserve	Land owned by the County to be preserved in its natural state. Environmental Reserve features including swamps, gullies, ravines, natural drainage courses, flood plains, and shorelines are defined in Section 6 of the Ontario Provincial Policy Statement.
Final Acceptance Certificate (FAC)	A certificate in accordance with the Construction Act prepared by the Developer's Consultant and accepted by the County confirming that the work is complete and acceptable to the County, that all deficiencies and Maintenance work have been resolved to the satisfaction of the County, and that the Warranty Period for the work has expired.
Form 1	MECP Document titled "Record of Watermains Authorized as a Future Alteration". It is used for municipal drinking water

Term	Definition
	systems to pre-authorize minor upgrades under a Drinking Water Works Permit.
Franchise(d) Utilities	Utilities that are provided by an independent service provider who pays franchise fees to the County for access to municipal land and the exclusive right to provide distribution through a Franchise Agreement. In the County, this includes gas, electrical power, telecommunications, and street lighting. As these utilities can be installed within the frost zone, the term is interchangeable with “Shallow Utilities”.
Geographic Information System	A tool for collecting, managing, analyzing, and presenting geographic data. GIS organizes layers of information into maps and analyzes spatial location. The County uses GIS data to keep a record of their assets.
Gross Developable Area	Gross Developable Area refers to the total land area of a development application, including developed and undeveloped land, less Environmental Reserve (ER). Gross Developable Area includes populated and occupied land, roadways, stormwater management facilities, parks, and school space.
Inspector	The person authorized and supplied by the County to see that the installation is executed according to the specifications and the approved plan(s) with good workmanship according to the latest applicable practices and standards
Issued for Tender Documents	The contract drawings and specifications which have been accepted by the County and issued by the Consulting Engineer for the purpose of competitive bidding by Contractors.
Issued for Construction Documents	The contract drawings and specifications which have been issued by the Consulting Engineer for construction of the work. IFC Documents incorporate any revisions to the IFT Documents which may have been made during the tendering process.
Landscape Consultant	A qualified landscape designer, in good standing with the Ontario Association of Landscape Architects (OALA), that is responsible for the design, layout, and supervision of installation of landscape and related work, recording as-constructed information, certifying the material and installation is in accordance with the standards, design drawings, and

Term	Definition
	design specifications, and performing those duties with the standard of care prescribed by OALA.
Letter of Credit	A letter issued by a bank or financial institution to the County to serve as a guarantee for the proper performance of a Developer as defined by a Development Agreement.
Maintenance	All repairs and/or replacements of any County Improvements which may, at the County's discretion, be necessary during the Warranty Period. The Developer is responsible for all maintenance during the Warranty Period.
Master Plan	A document that outlines existing and future trends for the County. Examples include utilities (Water, Sanitary, Stormwater) and Transportation Master Plans. These reports describe the status of the existing systems and plan for future expansion areas. Any required upgrades to the existing systems to support future expansion areas are also described.
Ministry of the Environment, Conservation and Parks	The provincial ministry responsible for environmental policy and sustainable resource development. Known as the Ministry of Environment, Conservation and Parks, (MECP). This general term is intended to encompass any future changes in department naming.
Ministry of Transportation, Ontario	The provincial ministry responsible for providing a safe and efficient transportation system. Known as the Ministry of Transportation, Ontario, (MTO). This general term is intended to encompass any future changes in department naming.
Municipal Development Plan	The Council-approved planning document that outlines a strategic path to manage regional, rural, and urban growth subject to Part 4 of the Provincial Policy Statement.
Municipal Drain	A drainage system built and maintained by Area Municipalities to remove excess water from private lands; typically in rural areas. The County of Oxford does not own, nor or they responsible for, any Municipal Drains.
Municipal Improvements	A proposed development (such as a new subdivision) or off-site upgrades required to support a proposed development. Municipal Improvements are the responsibility of the Developer. Examples of Municipal Improvements include deep utilities, shallow (franchise) utilities, roadways, active

Term	Definition
	transportation facilities, street lighting, landscaping, and earthworks.
Municipal Services	Services provided by the County upon construction completion acceptance; i.e., snow clearing and garbage collection.
Net Developable Area	Net Developable Area refers to the total land area of a development that can be populated or occupied. Net Developable Area excludes roadways, stormwater management facilities, parks, and school space.
Open Space/Public Open Space	Any parcel of land or body of water that is dedicated and reserved for public use, including Municipal and Environmental Reserves.
Owner	The individual, corporation, or legal entity that holds legal title to a parcel of land and is responsible for initiating or overseeing development or construction on that land.
Partial Construction Completion Certificate	A certificate prepared by the Developer's Consultant and executed by the County confirming that the work associated with an approved staged construction plan is substantially complete, noting all deficiencies and Maintenance work that need to be resolved to the satisfaction of the County.
Planning and Development Department	The municipal department that represents the County for internal and external review and approval of planning and development applications.
Prime Contractor	A company that, through a written, contractual agreement with the Owner (the Developer or the County as the case may be), is responsible for coordination of all activities conducted on a worksite and ensuring OHSA legislation is followed. Without written assignment of Prime Contractor, the person with the highest degree of control over a worksite is deemed the Prime Contractor.
Private Property Owner	An Owner of land not part of a subdivision or large-scale development project, who may undertake localized improvements or construction that interfaces with County property or infrastructure.
Public Utilities	Utilities owned and maintained by the County, including the water distribution system, sanitary collection system,

Term	Definition
	stormwater collection and management system, roadways, and open spaces.
Public Utility Lot	Land required to be given under Public Lands Act for roads and/or Public Utilities.
Record Drawings	A revised set of drawings submitted by the Developer to the County upon completion of construction. Record Drawings reflect all changes made to the specifications and drawings during construction and include updated dimensions, lengths, elevations, geometry, etc. of the work.
Transportation Division	The municipal department that represents the County for internal and external review and approval of roadway related improvements.
Rural Services	A level of service that entails individually owned and operated water and sewage systems, serviced from County owned trickle fill (or truck fill) water distribution systems and low-pressure sanitary sewer systems. Transportation level of service includes roadways, which may be gravel or paved, with ditches.
Seasonal Deficiency	A County Improvement which cannot be completed due to the time of year (for example: landscaping, concrete, paving, etc.) and which is deferred until the following construction season. Seasonal Deficiencies will not be included in the issuance of a CCC for completed work; Seasonal Deficiencies shall have a separate CCC, Warranty Period, and FAC.
Security	A financial assurance given by the Developer to the County, via a Letter of Credit, to ensure the due and proper performance of its obligations under the Development Agreement.
Shallow Utilities	See Franchise Utilities. In addition, this can include utilities that do not pay franchise fees to the County, such as communication services.
Site	A project work area, whether it is a Development, Capital Works Project, County Right-Of-Way, Public/Private Property, where construction work is taking place, planned to take place, or has recently taken place.

Term	Definition
Strategic Plan	A council-approved planning document that sets priorities, directions, and desired outcomes to meet the goals set out in the MDP.
Subdivider	An individual, corporation, or legal entity responsible for dividing land into multiple lots or parcels for development, in accordance with applicable planning and legislative requirements.
Substantial Completion Certificate	A certificate in accordance with the Construction Act prepared by the Developer's Consultant and executed by the County confirming that the work is substantially complete, noting all deficiencies and maintenance work that need to be resolved to the satisfaction of the County, and triggering the release of the major lien fund as defined by the Ontario Construction Lien Act.
Tangible Capital Assets	An economic resource managed by the County including roadways, buildings, equipment, land, utilities, stormwater management facilities, etc.
Traffic Impact Assessment	A report, prepared by the County's or Developer's Consultant, which investigates the impact a proposed improvement or development may have on traffic operations and recommends any mitigation measures that may be required as a result of the proposed improvement or development.
Underground Services, or Underground Services Department	The municipal department that represents the County for internal and external review and approval of underground infrastructure related improvements.
Urban Services	A level of service that includes a municipally owned water distribution system, sanitary collection system, and stormwater collection and management system. Transportation level of service includes paved roads with curb and gutter.
Warranty Period	A minimum two-year period of time commencing with the execution of a CCC and ending with the execution of a FAC.
Wastewater System	Referring to Sanitary Sewer System
Water Network Analysis	A report, prepared by the Developer's Consultant, which demonstrates that the proposed water system is capable of meeting these standards based on system pressures, flow

Term	Definition
	velocities, head losses, and flow rates and does not negatively impact adjacent areas or infrastructure.

1.4 LIST OF ABBREVIATIONS

In this document, the following abbreviations shall have the meaning hereinafter assigned to them. Abbreviations with definitions provided are capitalized throughout this document.

Table 1-2 List of Abbreviations

Term	Definition
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ADD	Average Day Demand
AES	Canada Atmospheric Environment Service
AHU	Air Handling Unit
ALD	Assistive Listening Device Systems
ANSI	American National Standards Institute
AODA	Accessibility for Ontarians with Disabilities Act
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASP	Area Structure Plan

Term	Definition
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
A/V	Audio/Video
AWG	American Wire Guage
AWWA	American Water Works Association
BACnet	Building Automation and Control Network
BAS	Building Automation System
BCIN	Building Code Identification Number
BMPs	Best Management Practices
BMS	Building Management System
BTU	British Thermal Unit
CB	Circuit Breaker
CCC	Construction Completion Certificate
CCTV	Closed Circuit Television
CEC	Canadian Electrical Code
CEU	Continuing Education Unit
CFD	Computational Fluid Dynamics
CLI-ECA	Linear Infrastructure Environmental Compliance Approval

Term	Definition
COV	Change of Value
CPTED	Crime Prevention through Environmental Design
CSA	Canadian Standards Association
CT	Current Transformers
Cx	Commissioning
DC	Direct Current
DCW	Domestic Cold Water
DDC	Distribution Digital Control
DFO	Department of Fisheries and Oceans Canada
EIS	Environmental Impact Study
EMT	Electrical Metallic Tubing
EMP	Energy Management Plan
EMIS	Energy Management Information System
ER	Environmental Reserve
ESC	Erosion and Sediment Control
EV	Electric Vehicle
F/A	Fire Alarm
FAC	Final Acceptance Certificate
FADS	Facility Accessibility Design Standards

Term	Definition
FAS	Fire Alarm System
FAT	Factory Acceptance Testing
FLA	Full Load Amperage
GHG	Green House Gas
GI	Green Infrastructure
GIS	Geographic Information System
HP	Horsepower
HHL	High High Level
HI	Hydraulic Institute
HMT	Harmonic Mitigating Transformer
H-O-A	Hand-Off-Auto
HVAC	Heating Ventilation and Air Conditioning
Hz	Hertz
ID	Identification
IDF	Intensity Duration Frequency
IEEE	Institute of Electrical and Electronics Engineers
IFC	Issued for Construction
IFT	Issued for Tender
I/O	Input/ Output

Term	Definition
IP	Internet Protocol
IPMVP	International Performance Measurement and Verification Protocol
IR	Infrared Radiation
ITHD	Current Total Harmonic Distortion
kAIC	Kilo Ampere Interrupting Capacity
kVAR	Kilovolt-Ampere Reactive
kVAd	Kilovolt-Ampere Demand
kWd	Kilowatt Demand
LAN	Local Area Network
LED	Light Emitting Diode
LID	Low Impact Development
MAC	Media Access Control
MCC	Motor Control Centre
MDD	Maximum Day Demand
MDP	Municipal Development Plan
MDrP	Master Drainage Plan
MECP	Ministry of the Environment, Conservation and Parks
MMA	Ministry of Municipal Affairs (Ontario)
MMAH	Ministry of Municipal Affairs and Housing (Ontario)

Term	Definition
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of the Environment
MTO	Ministry of Transportation, Ontario
MTS	Manual Transfer Switch
MV	Medium Voltage
NADCA	National Air Duct Cleaners Association
NAFS	North American Fenestration Standard
NBC	National Building Code of Canada
NEB	National Environmental Balancing Bureau
NECB	National Energy Code of Canada for Buildings
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code of Canada
NFPA	National Fire Protection Association
NIDS	Non-Invasive Detection System
NPC	National Plumbing Code of Canada
NSF	National Sanitation Foundation
OALA	Ontario Association of Landscape Architects
OBC	Ontario Building Code
OCP	Over Current Protection

Term	Definition
OEL	Occupational Exposure Limit
OESC	Ontario Electrical Safety Code
OFC	Ontario Fire Code
OGS	Oil Grit Separator
OHSA	Occupational Health and Safety Act
OH&S	Occupation Health and Safety
OPSD	Ontario Provincial Standard Drawings
OPSS	Ontario Provincial Standard Specifications
OS	Open Space
OTM	Ontario Traffic Manual
PAW	Permit of Approved Works
PCC	Point of Common Coupling
PDC	Private Drain Connection
PEO	Professional Engineers Ontario
PF	Power Factor
PFC	Power Factor Correction
PIR	Passive Infrared Sensor
PK HR	Peak Hour Demand
PLC	Programmable Logic Controller

Term	Definition
POE	Power over Ethernet
PUL	Public Utility Lot
PVC	Polyvinyl Chloride
REAP	Renewable Energy Action Plan
REX	Request to Exit
RF	Radio Frequency
RMS	Root Mean Square
RPU	Regional Public Utility
RYCB	Rear Yard Catch Basins
SAE	Society of Automotive Engineers
SB-1	Supplementary Standard SB-1: Climatic and Seismic Data
SB-10	Supplementary Standard SB-10: Energy Efficiency Requirements
SB-12	Supplementary Standard SB-12: Energy Efficiency for Housing
SCADA	Supervisory Control and Data Acquisition
SCC	Substantial Completion Certificate
SDWA	Safe Drinking Water Act
SLS	Street Lighting Service
SMACNA	Sheet Metal and Air Conditioning Contractors National Association

Term	Definition
SMT	Smart Metered Services
SPD	Surge Protective Device
SPMDD	Standard Proctor Maximum Dry Density
SWED	Stormwater Engineering Division
SWM	Stormwater Management
SWMF	Stormwater Management Facilities
SWS	Subwatershed Study
TAC	Transportation Association of Canada
TCA	Tangible Capital Assets
TCP	Traffic Control Plan
TCU	Terminal Control Unit
THHN	Thermoplastic High Heat-resistant Nylon
TIA	Traffic Impact Assessment
TIAC	Thermal Insulation Association of Canada
TMP	Traffic Management Plan
TRCA	Toronto and Region Conservation Authority
TSS	Total Suspended Solids
TSSA	Technical Standards and Safety Association
UGS	Underground Services, or Underground Services Department

Term	Definition
UPS	Uninterruptable Power Supply
VAV	Variable Air Volume
VFD	Variable Frequency Drive
VTHD	Voltage Total Harmonic Distortion
WDMA	Window & Door Manufacturers Association
WNA	Water Network Analysis

1.5 MUNICIPAL PLANNING DOCUMENTS

The following documents provide guidance on the planning of municipal growth and provide further requirements for public infrastructure.

- *Municipal Development Plan*
- *Outline Plans*
- *Strategic Plans*
- *Land Use Bylaw*
- *Area Structure Plans*
- *Regional Transportation Plan*
- *Area Redevelopment Plan*
- *Stormwater Master Plan*
- *Active Transportation Plan*
- *Transit Master Plan*
- *Transportation Master Plan Study*
- *Water and Wastewater Master Plan Study*
- *Oxford County Trails Master Plan*
- *Woodland Conservation By-Law*
- *Oxford County Community Improvement Plan*
- *Draft Oxford Natural Heritage Systems Study*

1.6 REFERENCE MATERIALS

Reference will be made throughout the standards to other regulatory agencies, standards, and documents. These may include the most recent versions of the following:

1. Government of Ontario's Design Guidelines for Sewage Works:
    - *Standards for Municipal Waterworks*

- *Guidelines for Municipal Waterworks*

2. Government of Ontario's Municipal drinking water systems, licensing, registration and permits:
   - *Wastewater Systems Standards for Performance and Design*
   - *Wastewater Systems Guidelines for Design, Operating, and Monitoring*
3. Ontario's Stormwater Management Planning and Design Manual:
   - *Stormwater Management Guidelines*
4. Ontario Building Code, Private Sewage Systems - Standard of Practice.
5. Grand River Conservation Authority:
   - *Grand River Source Protection Plan*
6. Ontario Occupational Health and Safety (OHS) Legislation, including the *OHSA Act, OHS Regulation*, and *OHS Code.*
7. Ontario Provincial Standards Specifications and Drawings (OPSS/OPSS.MUNI/OPSS.PROV/OPSD).
8. Transportation Association of Canada (TAC):
   - *Manual of Uniform Traffic Control Devices for Canada (MUTCDC)*
   - *Geometric Design Guide for Canadian Roads*
   - *Turning Vehicle Template*
   - *TAC/ITE Canadian Guide to Traffic Calming*
   - *Canadian Roundabout Design Guide*
9. Ministry Transportation Ontario (MTO):
   - *Highway Geometric Design Guidelines*
   - *Roadside Design Guidelines*
10. Institute of Transportation Engineers (ITE):
    - *Transportation Impact Analysis Guidelines for Site Development*
11. Transportation Research Board, National Cooperative Highway Research Program (NCHRP):
    - *NCHRP Report 672 – Roundabouts: An Informational Guide*
12. Ontario Traffic Manual, Book 12 - Guidelines for the Design and Installation of Traffic Signals, Book 5 Regulatory Signs, Book 6 Warning Signs
13. National Fire Protection Association
14. Canadian Standards Association
15. National Building Codes and Standards
16. Ontario Building Code, Barrier-Free Design Guidelines
17. NFPA 1141, Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural and Suburban Areas

Additional applicable standards and regulations, not noted above, may also be referenced in each section.

1.7 MUNICIPAL FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT

The Municipal Freedom of Information and Protection of Privacy Act is in effect for the County, and it gives any person a right of access to the records in municipal custody or control, subject to limited and specific exceptions. All documents and information, including correspondence, agreements, plans, and specifications that are written, photographed, recorded, or stored in any manner by the County may be subject to the access and privacy provisions of the Act.

Developers and their agents, consultants, and Contractors shall identify all information that they consider confidential, and the basis for confidentiality (including those parts of their submission that relate to trade secrets, commercial, financial, labour relations, scientific, and technical information).

While the County will endeavour to use Sections 10 and 11 of the *Municipal Freedom of Information and Protection of Privacy Act* to protect the confidentiality of the information identified by the Developer or their representatives as confidential, other sections of the Act may apply, and the information may have to be disclosed to members of the public who request access to records in the County's custody and control.

1.8 FEES AND CHARGES BY-LAW

The County enforces the Fees and Charges By-Law, and all subsequent amendments, to impose fees and charges for services provided by the County of Oxford that are not covered through direct taxation. Within these Design Guidelines and Appendices, wherever applicable, fees and charges noted in the Fees and Charges By-Law shall apply to the appropriate party.

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2. PROCEDURES FOR DEVELOPMENT

The engineering requirements and procedures for development related agreement compliance have been documented herein to assist industry, staff, consultants and associated stakeholders through inspection, compliance and assumption of new subdivisions, site plans, consents and external works within the municipal right-of-way.

2.1 GOALS AND OBJECTIVES

The goals of Development Agreement Compliance in the County are as follows:

a) Ensure all site works are constructed in general conformity to the approved Site Plan / Plan of Subdivision and consistent with the clauses of the applicable Development Agreement.

b) Ensure all infrastructure constructed within the municipal right-of-way, both assumed and unassumed, is constructed in accordance with approved plans, consistent with the County's standards and specifications as detailed in these guidelines, and in general compliance with all applicable regulations.

c) Ensure that materials, workmanship and all construction techniques and technologies used are inspected and certified by the Owner's Professional Engineering Consultant to be in accordance with County Standards.

d) Ensure all private works constructed under the Site Plan are completed in accordance with approved plans and to the satisfaction of the County prior to the release of securities.

e) Ensure downstream infrastructure is not adversely impacted by the construction activity associated with the development application.

f) Ensure works within existing municipal right-of-way which are necessary to accommodate private development have no adverse impacts to existing public infrastructure or unduly impede reliable services to the public.

g) Protect the interest of property owners and/or residents, both within and surrounding development application by responding to compliance matters identified prior to the assumption/final security release.

2.2 ENGINEERING SUBMISSIONS

The following details the submission requirements for developers concerning the technical review process of planning application files for plan of subdivision, site plan approval, and consent applications. All submission documents shall be provided in the form of an electronic file. Paper copies shall be provided upon request by the County.

Submissions, including reports and engineering drawings that are prepared by the developer's design engineer, are reviewed by County's Public Works Department specifically by the Development Review Team. Additional review agencies or authorities may include engineering and technologist staff employed by local area municipalities. The following sections describe the content of which the submissions to the County should contain. Incomplete submissions which do not attempt to address all aspects of the draft conditions or engineering criteria may be returned with a request for complete documentation unless acceptable arrangements have first been made with the County of Oxford Public Works Department.

2.3 INSPECTION

The Proponent's Consulting Engineer has full responsibility for the actions of the Contractor and the quality of the work. The Proponent's Engineer is responsible for providing full time inspection services during the construction of all municipal services in the project.

County staff shall only provide a part-time monitoring of the construction activities to ensure general conformance to the Subdivision Agreement or Site Plan Approval, and the County's policies and standards. Employees, contractors or agents of the County may, at any time and from time to time prior to assumption of the Works by the County, enter upon the Land without notice to the Owner to:

- Inspect any of the Works. Such inspection by the County shall in no way relieve or replace the County's requirement for the Owner's Engineering Consultant to provide full time inspection of the Works under this Agreement;
- Conduct any tests that in the opinion of the County of Oxford Public Works Department are necessary to confirm or verify quality of materials and construction; and,
- Make emergency repairs in the event the Works do not function or do not function properly, or in the opinion of the County of Oxford Public Works Department, require necessary immediate repairs to prevent damage or hardship to any persons or to any property. Such undertaking of repairs by the County shall in no way be deemed as acceptance or assumption of the Works by the County.

2.4 MEETINGS

The Owner's engineer shall co-ordinate a pre-construction meeting to be arranged and notify the County of Oxford Public Works Department 5 (five) working days prior to the meeting. It is expected that the owner's engineer, the site inspector and contractor will attend, as well as the owner or their direct representative. For the meeting the contractor will be required to provide an approximate schedule of construction, a list of subcontractors, and a list of materials, mix designs etc., to be used in the construction of the subdivision and / or site plan works (materials must conform to municipal specifications). Minutes of the meeting will be taken by the owner's engineer and circulated to all in attendance. The County of Oxford Public Works Department shall be invited to all subsequent progress meetings.

2.5 PROCEDURES FOR PROCESSING

The following details the submission requirements for developers concerning the technical review process of planning application files for plan of subdivision, site plan approval, and consent applications.

Submissions, including reports and engineering drawings that are prepared by the developer's design engineer, are reviewed by County's Public Works Department specifically by the Development Review Team. Additional review agencies or authorities may include engineering and technologist staff employed by local area municipalities. The following sections describe the content of which the submissions to the County should contain. Incomplete submissions which do not attempt to address all aspects of the draft conditions or engineering criteria may be returned with a request for complete documentation unless acceptable arrangements have first been made with the County of Oxford Public Works Department.

2.5.1 Subdivisions

Compliance for subdivision applications involves several stages of approval, from initial Conditional Approval, through to construction and final completion of all required works and services. The County uses inspections, certifications and ongoing communication with the Owner and their agents to ensure all aspects of the development complies with the conditions of approval and any relevant development agreement clauses.

The goal of Subdivision Compliance is to ensure the interests of the municipality and the public are protected throughout the development and ultimately reach the successful assumption of quality, sustainable municipal assets.

2.5.1.1 Initial Engineering (Detailed Design) Submission

Following Draft Plan Approval, the first Engineering submission shall consist of:

a) Transmittal letter outlining what is being proposed, submission date, contents of submission package and contact information on who is to review this submission.

b) One (1) complete set of drawings;

c) One (1) copy of the draft/final survey plan;

d) One (1) set of detailed Engineering drawings;

e) One (1) set of sanitary sewer and storm sewer calculation sheets;

f) One (1) set of an updated Stormwater management report and a digital copy of the model (if applicable);

g) One (1) copy of any other relevant reports or drawings (functional servicing report, traffic impact study, noise impact study, archaeological assessment, tree preservation, EIS, hydro-G, geotechnical report, etc.) that required updating (at County's discretion) since initial submission at time of draft plan application;

h) A checklist showing how the draft plan conditions have been addressed;

i) Payment of applicable Public Works Development Review Fees based on current cost indicated in County Fees and Charges By-Law No. 4889-2007 (or as amended) at the time of Engineering submission

j) Schedule in Gantt chart format outlining expected timelines for approval and servicing; and,

k) Other plans that may be required through the planning and development review process.

l) Contract documents (if requested)

The design of municipal services shall be based upon the specifications and standards in effect at the time the Engineering drawings are approved.

The County's Public Works Department, Development Review Team, shall approve all Engineering drawings but such approval shall in no way relieve the Owner's Engineer of the responsibility to design adequate and safe services. Along with any written comments. The original marked up first submission County copy of the Engineering drawings (as applicable) shall be returned to the proponent. All sanitary sewers, storm sewers, watermains and their appurtenances and all roadways being constructed within the County of Oxford, shall conform to the County's and/or area municipality's specifications, depending on ownership

2.5.1.2 Subsequent Engineering Submissions

Upon review of the first submission of Engineering drawings and reports by the County (and other review agencies), the Engineer shall amend the drawings and reports to incorporate the comments and shall submit:

a) One (1) complete sets of revised Engineering drawings as outlined in first (or previous) submission(s); Note: the revision block on all drawings is to be updated to include the revision number, comment about the revision and the revision date, Final approved drawings shall be signed and sealed by a Professional Engineer licensed by PEO;

b) Signed and sealed Engineering Cost Estimates (Schedule of Works) for inclusion in the development agreement. Actual contractor pricing may be used if deemed acceptable by the County and area municipality;

c) Signed copy of the Alteration to Drinking Water System Form I application and supporting documentation;

d) Signed copy of the Consolidated Linear Infrastructure (CLI) application packages plus a full digital submission of the CLI application that includes a copy of all required supporting drawings, information, and calculations;

e) Copies of all applicable approvals (MTO, Local Conservation Authority, MNRF, NECB, etc.);

f) A checklist showing how the draft plan conditions have been addressed;

g) Payment of applicable Public Works Development Review Fees based on current cost indicated in County Fees and Charges By-Law No. 4889-2007 (or as amended) at the time of Engineering submission;

h) Schedule in Gantt chart format outlining expected timelines for approval and servicing and;

i) Contract documents, as requested by County.

2.5.1.3 "As-Constructed" Submission

Upon completion of construction works, developers are required to submit as-constructed drawings to the County for approval:

a) As-constructed drawings must accurately reflect the final state of the constructed project, including any modifications or deviations from the original plans;

b) The submission of as-constructed drawings must be facilitated by the developer's consultant;

c) The consultant must ensure that the as-constructed drawings are updated to reflect any changes made during the construction process;

d) All as-constructed drawings must be stamped with the seal of a licensed engineer;

e) The stamped drawings must be submitted to the County within fifteen (15) working days of completion of construction works;

f) The Engineer shall also provide the drawings in electronic file format (.DWG or .DXF and as a native PDF) to the County's satisfaction;

g) Failure to submit accurate and stamped as-constructed drawings within the specified timeframe may result in penalties or delays in project approval processes.

2.5.1.4 Construction Inventory

The County is tracking quantities and costs of works constructed in residential subdivisions throughout the County in order to compile statistical information, establish average construction costs for municipal works and to collect data for County Asset Management. This information will assist in determining average rates for the County's share of servicing costs, forecasting to determine County contributions for future works as part of its Staging of Development Programming, keeping an up-to-date log of County assets and budgeting for future growth requirements under the County's Development Charge Studies. This information is required from the Applicant's Consulting Engineer at the time when the approved engineering drawing package is submitted to the County, prior to start of construction. The construction inventory sheet shall be in MS Excel file format. The inventory sheet shall contain the type, size and cost of municipal works to be inventoried by the County.

2.5.1.5 Agency Approvals

Municipal Consent Process for New Development

The Applicant, Consulting Engineer, and/or Utility shall be required to co-ordinate the municipal consent process for utility installation on new developments and / or development within County right-of-way. The utility companies shall forward their completed plant design in digital format (.DWG/.DXF) to the Consulting Engineer, who shall prepare a Composite Utility Plan as required for submission to the County.

A Road Occupancy/Excavation Permit will be required from the County for any works proposed within Oxford County Road allowance.

MECP Consolidated Linear Infrastructure (CLI) Approvals

The Engineer shall submit MECP application forms for CLI Approval for sanitary sewers and storm sewers (for the latter, when it is owned by the County). An additional set of Engineering drawings shall be provided to the County to accompany the application submission.

The Developer and their assigned Engineer will be responsible for conforming to conditions of the County's CLIs for the sanitary collection system and storm collection/management system. This includes requirements for design/approvals, inspection, and testing of sewers.

MECP Municipal Drinking Water License Program (Form 1)

Water servicing approvals are processed under the MECP Municipal Drinking Water Licensing Program. Under provincial license, the system provides the municipality with a Municipal Drinking Water Permit from which the municipality issues Drinking Water Works Permit Amendments for the works to be constructed by the Proponent.

The Engineer shall submit MECP application Form 1 – Record of watermain as a Future Alteration, for all new watermain to be connected to the water distribution system. Additional drawings and technical documentation (as required) shall be provided to the County to accompany the application submission.

Water System Construction Acknowledgement

The Engineer shall submit a completed and signed Water System Construction Acknowledgement form prior to beginning work on any Oxford County water system infrastructure. Submission of the completed form is acknowledgement that the company(ies) completing and overseeing the work, including employees of the company(ies), subcontractors, agents, and suppliers, will work in accordance with legislation and regulations and are accepting corporate responsibility for ensuring legislative compliance.

2.5.2 Site Plans

The County utilizes the Site Plan Control By-Law to ensure functional and high-quality developments are constructed throughout the County. At the time of site plan approval, a development agreement is registered on title with schedules including site plan and servicing drawings.

2.5.2.1 Definition of Stages

Agreement Compliance for Site Plans can be described in the following stages:

Construction Compliance and Site Management

Throughout the course of Site Plan construction, the Owner is responsible to maintain site construction activities in a manner that is acceptable to the County and ensure that all works are in conformity with the approved plans, policies, By-Laws and development agreement provisions.

Compliance issues during construction are typically flagged to the County on a complaint driven basis, at which point staff coordinate with the Owner to ensure issues are resolved promptly.

2.5.2.2 Initial Submission

Engineering submission requirements will vary between sites and projects depending on the scale and context of the proposal. The requirements will be determined in consultation with the County's Development Review Team. Complete submissions shall be accompanied by a covering letter prepared by a qualified professional indicating where deviations from County Standards or policies have occurred, and cause for the deviation (if applicable). Additional requirements may be determined by the Formal Consultation. Unconventional requirements should be discussed with Formal Consultation staff prior to submission.

Engineers Qualifications

Drawings and reports shall be prepared by a qualified professional engineer licensed in the province of Ontario.

Design Submissions

Design submissions are to be accompanied by any supporting documentation required for the completeness of the application. Such documentation may include, but may not be limited to, copies of the following reports:

a) Geotechnical (soils) Report;
b) Hydrogeological Report;
c) Traffic Impact Assessment Report;
d) Environmental Assessment;
e) Copies of reports submitted to the Conservation Authority;
f) Stormwater Management Report;
g) Noise Report;
h) Functional Servicing Report;
i) Vibration Report;
j) Archaeological Report.

Site Plan Drawings

A complete set of engineering and/or architectural drawings will be required for the site plan application submission. Engineering drawings typically required for site plan developments shall include, but not be limited to:

a) Site Plan Drawing (general layout with site data chart);
b) Site Grading and Drainage Plan (including erosion and sediment control);
c) Site Services Plan and Profile;
d) Landscaping Plan;
e) Electrical Services and Utilities Plan;
f) Lighting Layout and Distribution Plan;
g) Building Elevations Plans;
h) Any servicing external to the site that may be required for proposed connections; and
i) Any other Plans or Details required due to Study or Report recommendations.

2.5.2.3 Subsequent Engineering Submissions

Upon review of the first submission of Engineering drawings and reports by the County (and other review agencies), the Engineer shall amend the drawings and reports to incorporate the comments and shall submit:

a) One (1) complete set of revised Engineering drawings as outlined in first (or previous) submission(s); Note: the revision block on all drawings is to be updated to include the revision number, comment about the revision and the revision date, Final approved drawings shall be signed and sealed by a Professional Engineer licensed by PEO;
b) Signed and sealed Engineering Cost Estimates (Schedule of Works) for inclusion in the development agreement. Actual contractor pricing may be used if deemed acceptable by the County and area municipality;
c) Copies of all applicable approvals (MTO, Local Conservation Authority, MNRF, NECB, etc.);
d) A checklist showing how the site plan conditions have been addressed;
e) Payment of applicable Public Works Development Review Fees based on current cost indicated in County Fees and Charges By-Law No. 4889-2007 (or as amended) at the time of Engineering submission;
f) Schedule in Gantt chart format outlining expected timelines for approval and servicing and;
g) Contract documents, as requested by County.

2.5.2.4 Construction Compliance and Site Management

Throughout the course of site development and construction, the Owner will be responsible to undertake and maintain construction activity on the site in a manner acceptable to the County, ensuring that all works are carried out in conformity with the approved plans, By-Laws and provisions of the Development Agreement. Any public complaint as a result of the development shall be given due priority and addressed appropriately to the satisfaction of the County.

Site Management

In terms of good site management, the following are items to proactively consider during the construction phase of a development project:

a) Development Notification Signage indicating Owner/Consultant/Contractor contract information and the County's site plan application file number.

b) Maintain site in a neat and orderly condition, with regard to:
   - Debris and waste management;
   - Operation and storage of construction equipment and building materials;
   - Dust control;
   - Idling vehicles, generators and other equipment;
   - Public sidewalk and roadway maintenance including snow and tracked soil/mud removal to ensure these areas remain free of obstructions and damage is avoided;
   - Construction fencing to ensure the public is not exposed to undue risk;
   - Surface drainage and grading.

c) Protect public property within the right-of-way in accordance with the policies and By-Laws of the County;

d) Ensure work undertaken does not damage or create a hazard to adjacent private property or unduly impact the surrounding public;

e) Have regard for all applicable County and Area Municipality By-Laws, such as, but not limited to, the following: Noise Control, Road Occupancy, Encroachment, Sewer Use, Parking, Load Restrictions, etc.

f) Maintain adequate Erosion and Sediment Controls with continued inspection, monitoring and maintenance throughout construction and build-out.

2.6 ASSUMPTION OF SERVICES

Assumption of services will occur when the County of Oxford assumes responsibility for the maintenance, repair and liability of works and services installed as part of plan of a subdivision, site plan or consent process. Assumptions will be taken into consideration solely upon the Owner fulfilling the requisite conditions delineated within the relevant agreement (including but not limited to the plan of subdivision, site plan, and consent). All works and services must be constructed per the approved plans, appropriate certification provided, and the Owner must demonstrate how all requirements of the applicable agreement have been satisfied.

Assumption of infrastructure (and commencement of the warranty period) shall not be granted until the following deliverables, as applicable, have been submitted by the Developer (to satisfaction of County Public Works):

a) Engineer Certification Letter;
b) As-Built Drawings;
c) Service Record Sheets;
d) Daily Site Inspection Records;
e) Construction Photos;
f) Substantial Performance & Proof of Publication Certificate;
g) Quality Assurance Testing (e.g. Geotechnical Testing Reports);
h) Commissioning Records, Water Distribution System Testing (e.g. Water Pressure/Leakage testing, Fire Flow testing, tracer wire continuity testing, etc.);
i) Sewer CLI-ECA Testing (CCTV sewer videos, Deflection Testing, Leakage Testing);
j) Project Deficiency/Outstanding Work List;
k) Any other project specific item required by Oxford County Public Works.

Once the Developer has submitted all documents to the satisfaction of Public Works, the County will issue a Preliminary Acceptance Letter confirming that the warranty period commences.

2.7 WARRANTY PERIOD

The duration of the warranty period will be determined and formalized within the agreement pertinent to the planning file (e.g., plan of subdivision, site plan, consent), as well as in accordance with the regulations set forth by the local municipality and County of Oxford. An End of Warranty Certificate will be issued upon successful completion of the warranty inspection and confirmation that any outstanding obligations of the pertinent agreement have been satisfied.

Following Assumption by the County, assumed infrastructure must complete the Council-mandated one-year Post-Assumption Warranty Period. During this period, the Owner remains responsible and liable for warranty defects related to poor materials or workmanship.

2.8 SECURITIES

As a condition of site plan/severance/subdivision approval, the County may request securities to ensure that site works comply with the approved plans and all obligations to the County are fulfilled. Securities are a monetary deposit collected by the County to ensure that works identified in the Development Agreement are carried out in accordance with the Development Agreement and approved design. Following the completion of a development and all required works, the developer may apply to the County to verify that all works are completed as required by the Development Agreement and all obligations to the County are fulfilled. Following this determination, securities will be released.

Note, all securities associated with the plan of subdivision approval process are to be submitted to, held by, and released by the Area Municipality (unless otherwise informed/required by Oxford County Public Works). Oxford County's consent/approval is required prior to the Area Municipality releasing any such securities.

Calculating Financial Securities

Financial security must be furnished to the County for all internal works or services that are to be designed, constructed, and ultimately transferred to the County for ownership. The estimated amount of financial security for such internal works shall be determined by a qualified professional engineer, and amount to 100% of the estimated cost, unless otherwise agreed to by the County in collaboration with the affected Area Municipality.

Similarly, financial security must also be provided to the County for all external works or services, including those within the County right-of-way, which are to be designed, constructed, and handed over to the County. The estimated amount of financial security for external works shall likewise be assessed by a professional engineer, and amount to 100% of the estimated cost.

Submission of Securities

The securities must be provided to the County by certified cheque, bank draft, debit, cash, or irrevocable Letter of Credit issued by a Canadian chartered bank or other financial security in the form satisfactory to the County. In addition, for development obligations under the *Planning Act*, a surety bond is an acceptable form of security. If a surety bond is provided as security, it must be in compliance with the County's Surety Bond template and the requirements under the *Planning Act* and Ontario Regulation 461/24. Securities shall be provided at the time the Site Plan Agreement is entered into and prior to the commencement of works on the property or issuance of a building permit.

Release of Securities

When a release of securities is requested, the applicant shall provide the required evidence the works have been completed in accordance with the approved site plan. A cover letter requesting inspections and security release shall be submitted with the required evidence. The County will coordinate the required inspections of the property with the appropriate person to confirm and the securities will be returned to the owner after the inspection and approval of the works.

2.9 CONSENT APPLICATION AND COMPLIANCE

Consent is a term used in provincial planning legislation (Ontario Planning Act) to describe the approval required to subdivide land without the requirement of a plan of subdivision. It is most commonly used to sever an existing lot or parcel into more than one lot.

Upon approval of application, the Consent Authority may impose conditions of consent as part of the provisional decision. Conditions can include, for example, the requirement for Site Plan Approval or for the Owner to enter into a consent agreement with the County.

Should consent conditions necessitate the construction of external works within County right of way, the Owner will be required to enter into Consent Agreement and provide adequate securities to ensure construction of the applicable works. Any external works required under a consent agreement will be subject to the same compliance requirements as if required through a development or Subdivision Agreement.

2.9.1 Consent Agreement Compliance Objectives

The Consent Authority may impose reasonable conditions through the provisional approval of consent applications which may include the requirement to enter into a Consent Agreement to ensure that:

1. All existing works and services for both retained and severed parcels are in general conformity to the current Oxford County Standards, specifications, all applicable By-Law requirements and fulfill obligations imposed through the provisional decision of Consent;
2. All materials, workmanship and construction techniques and technologies used are inspected and certified by the Owner's Professional Engineer to be in compliance to County's standards;
3. All works and services (both, surface and ground structures) constructed within the municipal limits, if required, are per approved plans, consistent with Oxford County standards and specifications;
4. Protect the interest of the public, property owners and occupants of the new development, neighbouring properties and to eliminate or reduce negative impacts to adjacent lands as a result of new creating new lots/parcels;
5. Stormwater drainage and erosion control management programs are in place to protect downstream property, infrastructure and natural features.

2.10 EXTERNAL WORKS

Works external to a site can be triggered by development related to subdivision, site plan or consent and, when required, the terms for external works compliance will be established through the associated agreement.

2.10.1 Definition of External Works

External works typically represent approved works constructed by the Owner outside the limits of their property such as extension of a sewer or minor road works as a result of proposed development. There are also circumstances where works internal to the site may be considered “external” if the proposed works benefit parties beyond the limits of the site such as a sewer servicing upstream lands that crosses the site through an easement.

External works may include items such as:

- Installation of municipal infrastructure (e.g., watermains, sanitary sewers, pump stations, storm sewers, outlet control devices, others);
- Traffic channelization and turning lanes;
- Sidewalks, trails, curbs, other similar physical features; and
- Traffic control devices (e.g., traffic signals).

2.10.2 Role of Professional Engineer in Delivering External Works

The Owner shall appoint a qualified Professional Engineer registered with Professional Engineers Ontario to design, supervise and certify the construction and installation of the external works, with the duties of the Professional Engineer to include, but not be limited to the following:

a) Prepare and certify the designs in accordance with the Oxford County Engineering Standards;

b) Obtain all necessary approvals from the MECP and coordinate with Conservation Authority, and any other external agencies, as required;

c) Act as the Owner's representative in all matters pertaining to the construction;

d) Assist and coordinate with Owner’s Contractor to obtain Municipal Consent prior to initiating work within the right-of-way. However, obtaining Municipal Consent remains the Owner’s Contractor responsibility;

e) Provide contract administration and inspections for all external works, including utilities;

f) Undertake any required testing and certify the quality of external works;

g) Maintain all records of construction and upon completion to advise the County of all construction changes;

h) Provide final "as constructed" drawings in a form acceptable to the County prior to acceptance of external works by the County; and

i) Monitor external works for completion and restoration within the timelines specified in on the Permit of Approved Works (PAW) with the intent to minimize traffic disruptions.

2.10.3 Key Process Steps for External Works

County Involvement During Construction

Process for monitoring progress and responding to complaints is as follows:

1. Construction Progress Meetings.
2. Site Visits During Construction.
3. Complaint Response.

Timed Requirements

Process for implementing construction timing identified in Agreement is as follows:

1. Confirm timed requirements operational for use.
2. Issue timed requirement deficiency letter
3. Reduce, Dissolve or Utilize Security.

Acceptant of External Works

Process for clearing external works as operational and release security is as follows:

1. Owner Submits request for acceptance of works
2. County issues acceptance of external works requirements letter.
3. Joint external works inspection.
4. Final acceptance of external works.
5. 1 year warranty period for external works.

2.10.3.1 County Involvement (CI) During Construction

County Staff will remain engaged throughout construction of external works as Owner-led work within the right-of-way has the potential to impact the public and will ultimately be accepted as municipal infrastructure.

CI1: Construction Progress Meetings

Where development projects involve external works, Oxford County may have staff from other Divisions (Transportation, Water and Wastewater and/or Engineering Services) attend pre-construction meetings as well as subsequent site construction meetings, in addition to Development staff. Development staff will serve as the single point of contact for issues that arise relating to unexpected design or scheduling changes, provide clarification and advice on interpretation and application of County policies, standards, methods and procedures and coordinate technical inquiries during construction with other Divisions. The Owner's Professional Engineer remains responsible for all contract administration and inspection during construction.

CI2: Site Visits During Construction

Development staff will perform general visits to ensure compliance and will coordinate with the Owner's Professional Engineer with regards to construction compliance, public complaints and design matters that may arise during construction. However, County will not be involved and responsible for contract administration and inspections during construction. The Owner's Professional Engineer will be responsible for inspections and contract administration.

CI3: Complaint Response

Development staff will investigate all complaints received relating to external works and coordinate with the Owner's Professional Engineer to determine any measures necessary to address the concern. Should a critical deficiency or maintenance issue arise which is considered to be a safety or operational risk to the County or general public, the County will provide immediate notification to the Owner identifying a clear deadline by which the matter must be remedied. If not corrected in a timely manner, the County may proceed to schedule the necessary remedial work and invoice the Owner or drawdown on held securities for the total cost incurred.

2.10.3.2 Acceptance of External Works

Infrastructure installed or altered within an existing municipal right-of-way must be accepted by the County as operational for use prior to the County assuming maintenance of the new or altered infrastructure.

External Works Acceptance (EWA) occurs when all works and services are constructed in accordance with accepted plans, appropriate certification provided, and the Owner demonstrates how all requirements of the Development Agreement have been satisfied.

EWA1: Owner Submits Request for Acceptance of External Works

Requests for acceptance of external works can be submitted via email through the Public Works Development email portal: PublicWorksDevelopment@oxfordcounty.ca .

EWA2: County issues Requirements Letter for Acceptance of External Works

All requirements for acceptance of external works shall be outlined in the clauses of the development or consent agreement. Upon receiving a request for acceptance inspection, the County will provide the Owner a requirements letter summarizing the agreement clauses to be satisfied prior to accepting and assuming maintenance of the external works. While not all works will be assumed by the County (some infrastructure, like sidewalks, streetlighting, stormwater infrastructure will be assumed by the Area Municipality), the County does require certain assurances in order to provide acceptance after completion. The following list outlines the minimum requirements to be satisfied prior to assumption:

a) Confirmation from the County inspector that all works, services, sewers, roads, sidewalks and other physical works have been constructed, certified and inspected to be in general conformity to the accepted plans and specifications;

b) As required, confirmation from applicable County Divisions that specialized external works are satisfactory;

c) Submission of all stamped "As-Constructed" drawings and digital files by the Owner's Professional Engineer; and

d) Confirmation or certification on any other specific requirements under the Development Agreement.

The Owner's Professional Engineer shall submit a complete external works acceptance package containing all required documentation and certifications together with a cover letter clearly referencing and responding to each item in the issued Requirements Letter. Development will review the package and coordinate with the Owner's Professional Engineer to confirm as requirements are cleared and identify those requirements that remain outstanding. An acceptance of external works will be issued once all items identified in the requirements letter have been cleared.

EWA3: Joint External Works Inspection

The External Works Acceptance Inspection shall be completed by Development staff with the Owner's Professional Engineer in attendance, once the site is well-prepared for review. A well-prepared site shall include fully uncovered surfaces that are free of debris; the Developer shall ensure extensive cleaning is completed by the time inspection is scheduled. This ensures the physical work requirements can be cleared with the initial inspection. Alternatively, staff will provide the Owner's Professional Engineer with a summary of deficiencies. The Owner's Professional Engineer shall ensure that all deficiencies are rectified to the County's satisfaction prior to requesting a follow-up inspection.

At the time of the joint inspection, all works and services are to be completed and the road returned to base asphalt. The joint walkthrough will identify all deficiencies to be repaired prior to acceptance of external works. If required, divisional inspections should be completed prior to the joint walkthrough so that deficiencies identified by other County divisions (Water and Wastewater Services, Transportation and Waste Management Services, Engineering Services, Facilities and Fleet, etc.) can also be discussed while both parties are on site. Development staff will compile a deficiency list and forward to the Owner and their Professional Engineer. Should the Owner disagree with any noted deficiency items, they shall raise those concerns prior to the list being finalized as the list will form an agreed upon summary of repairs to be completed.

EWA4: Final Acceptance of External Works Inspection

The Owner's Professional Engineer may request the Final Acceptance Inspection once all agreed upon deficiencies, have been rectified and topcoat asphalt is in place. Failure to complete all items identified on the deficiency list will result in the requirement for further follow up inspections. If the Final Assumption Inspection is not requested within twelve months of the finalized joint walkthrough, the County may require a follow up walkthrough prior to scheduling the final inspection.

EWA5: Issue Acceptance of External Works

Development staff shall prepare and issue an Acceptance of External Works letter, with a copy provided to the appropriate operations divisions, to acknowledge when the County, and the

Area Municipality, assumes maintenance of new or adjusted municipal infrastructure within an existing municipal right-of-way.

EWA6: 1-year Warranty Period for External Works

Following acceptance of external works, the infrastructure will remain under warranty for a one-year period or as indicated in the development agreement. During this period, the Owner remains responsible and liable for warranty defects related to poor materials or workmanship. Warranty defects shall be considered deficiencies that reasonably should not have occurred given the age of the infrastructure and are not related to maintenance damage or damage caused by a party or force other than the Contractor.

2.11 RIGHT-OF-WAY PERMIT

All development driven works within County right of way will require a Right-of-Way permit, which is contingent upon the following from the Developer's Professional Engineer:

- Permit applications that are deemed complete must be submitted a minimum of ten (10) business days prior to the start date;
- The applicant must provide a Traffic Management Plan (TMP) that meets all the requirements of the Ministry of Labour and the Ontario Traffic Manual (OTM) Book 7 – Temporary Conditions. A TMP sets out the general staging of the work that will ensure safe through traffic movement, utility services, pedestrian traffic and vehicular access to the areas and businesses adjacent to the construction site, while allowing for the safe construction of the desired works. It is a tool that effectively harmonizes the construction project's physical requirements with the operational requirements of Oxford County and the transportation needs of the road users within the County. The TMP must be reviewed and approved by the County's Transportation Division prior to the issuance of a Right-of-Way permit.
    - The applicant must provide a separate Traffic Control Plan (TCP) for the proposed occupancy/work that is in general conformity with the TMP. This should be added in the form of a note on the TMP;
- The County will require 100% securities for all works to be completed within the municipal right-of-way. This will be based on the Developer's Engineer's estimate for external works within the municipal right-of-way. This amount shall be deposited to the County, and will be released when the work has been completed to the satisfaction of the County. Payment can be made by calling customer service at 519-539-9500 ext. 3915, and making payment over the phone with either Visa or Mastercard. File number must be mentioned for reference;
- The applicant shall submit engineering drawings which include servicing and road restoration details;
- The applicant shall be required to have their Engineer undertake full time inspection of works within the right-of-way. The Engineer shall provide satisfactory field notes, material specifications, compaction results and construction photos;

- The Traffic Control Plan, Engineer's estimate, engineering drawings, and any other supporting documentation must be circulated to PublicWorksDevelopment@oxfordcounty.ca for review and approval prior to submission for Work in Right-of-Way Permit;
- The applicant's contractor must be approved by the County before work can commence in the right-of-way. The contractor shall give the County a minimum of 48 hours notice prior to water service connections. A licensed operator from the County shall be present for all connections and any other water operations (valve turning, testing, etc.).

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3 DRAWING STANDARDS

3.1 GENERAL REQUIREMENTS

a) A complete set of drawings shall consist of separate drawings of some or all of the following:

- Title Page
- Site plan
- Plan and profile for roads, drainage and storm sewers
- Plan and profile for sanitary sewers and watermains
- Plan and profile for sanitary and storm sewers for common trench designs
- Plan of proposed street lighting, hydro, telephone, cablevision and gas
- Plan of proposed signage and pavement markings
- Additional plans showing any special detail and cross-sections (i.e. removals, grading, temporary watermain plan, etc.)

b) Full sized drawings to be ANSI D 22" x 34" (559mm x864mm). Reduced drawings are to be 11" x 17" (279mm x 432mm).

c) The County of Oxford contract drawings and AutoCAD standards are based on the current versions of the industry standard software by Autodesk: AutoCAD and Civil 3D Design. All drawings submitted to the County of Oxford must be in DWG format using Autodesk AutoCAD support versions 2018 or higher .

d) Drawings scales and dimensions shall be shown on all drawings.

e) The drawings shall be neat and legible with adequate clearance margins between the drawing information and the title block border. Notes and text shall locate and describe the proposed work in sufficient detail to facilitate construction. Limits of construction and match lines shall be clearly marked on the drawing.

f) Plan and profile drawings shall be drawn with the profile on the bottom of the drawing sheet lined up under the plan if possible. Center line stations, utilities, inverts, material and grade information shall be located across the bottom of the profile.

g) North arrow shall be oriented in the two northerly quadrants, if possible.

h) Lettering shall be to Leroy metric heights and widths. Vertical upper case lettering is preferred. Lettering shall be unobstructed by linework and other drawing information. Conflicts between linework, symbols, dimensioning or text shall be removed.

i) Construction notes shall be located around the perimeter of the drawing, tagged to the drawing feature.

j) All elevations shown on the drawings shall be metric geodetic datum. The source and location of the datum shall be clearly noted on each drawing.

k) The drawing title block shall be the County of Oxford Standard Title Block and shall include the project name, project location, type of drawing (i.e. site Plan) and Engineer's name and/or company name and logo, Engineering File No. and the County of Oxford drawing number and key plan

l) Plan profile drawings shall conform to scales: 1:250 or 1:500 horizontal, 1:50 vertical.

m) Standard details such as manholes, catch basins, hydrants, etc., that are shown and described in the County of Oxford Design Guidelines and Supplemental Specifications for Municipal Services need not be shown in detail on the drawings; the standard Drawing No. shall be quoted on the plan for reference. Standard symbols, abbreviations, materials, and hatch patterns shall be used. Any additional symbols, abbreviations, materials, and hatch patterns shall be included in the County of Oxford standard legend.

n) All drawings shall bear the dated stamp/seal and signature of the professional engineer responsible for the design.

o) Provisions shall be made on all drawings for the insertion of the County of Oxford drawing number in the space provided labeled "Drawing No." The County of Oxford will provide the number for insertion on the drawing. Consultant drawing number will be placed immediately above in the space labeled for that purpose.

p) Numerical values on the construction drawings shall be shown to two (2) decimal places unless accuracy warrants otherwise.

q) Line work for all constructed works shown on the drawings shall retain the thicker line density (as for proposed works) for ease of determining the extent of works covered by the drawings. Existing elements shall be shown in grey line work.

3.2 SITE PLAN AND KEY PLANS

a) The site plan of the construction works shall be scaled as: 1:500.

b) The following existing and proposed information shall be shown on the Site Plan:

- Existing watercourse
- Pavement, curbs
- Ditches, culverts, storm sewers, manholes cleanouts, inlet/outlet structures and catch basins
- Sanitary sewers, manhole, cleanouts
- Watermains, valves, hydrants, chambers, blowoffs
- All pertinent property, right-of-way and easements
- Road allowance and easement dimensions
- Lot numbers and existing legal plan numbers
- One meter contour lines for slopes greater than 10% existing and proposed
- Power and telephone and street light poles
- Plan and profile drawing reference numbers

- Gas mains, underground hydro, telephone, street lights and cable and their related appurtenances
- Site Benchmarks
- Routing of all major storm flows including the 100-year storm

c) A Key Plan to a small scale, (e.g., 1:10000), showing the location of the works in relation to major streets, shall be provided in the upper right-hand section of the drawing sheet.

d) A drawing index shall be provided and include the drawing titles, sheet numbers, and the County drawing number.

3.3 PLAN AND PROFILE DRAWINGS - GENERAL

Each base plan and profile shall show but not be limited to the following information:

a) All cadastral information including property lines, right-of-ways, easement lines and dimensions in sufficient detail to relate design to surrounding and adjacent properties shall be included on all drawing submissions.

b) Legal description and civic addresses of existing properties.

c) Road allowance dimensions.

d) Existing pavement curbs, sidewalks, ditches, driveways, lanes, retaining walls, buildings, trees and shrubs within the right-of-way. Note significant trees on and within 5 metres of the right of way.

e) All existing underground and surface utilities and services (with offsets, elevations, size, age and material type and as-built references) including but not limited to the following:

- Sanitary sewers, storm sewers, watermains and appurtenances
- Street light poles, conduit and appurtenances
- Hydro poles and underground wiring ducts and appurtenances
- Telephone poles, underground wiring ducts and appurtenances and fibre optic cables
- Gas mains and appurtenances
- Cable television ducts and appurtenances
- Traffic control devices, poles, conduits, signs and painting
- Irrigation systems

f) All relevant topographic information. For slopes greater than 10 percent, one (1) meter contour lines are required.

g) Autodesk Project name, drawing and layout name in the bottom left hand corner of the title block.

h) Benchmark elevation, identification number and location shall be shown in the appropriate section of each title block.

i) Right-of-way and/or road centreline stationing shall be to metric standards (0+000) at 20 metre intervals and shall be related geometrically to legal property lines or survey monuments. Stationing shall run left to right where possible and upstream on gravity pipes.

j) Where possible, plan views shall be horizontal across the drawing sheet, and shall be aligned vertically by centre line stationing with the profile view below.

k) Profile elevations shall be placed at both sides of the profile. Split profiles must show elevations on both sides of the break.

3.4 ROADS

The following shall be shown in addition to the information required in Section 3. Plan and Profile Drawings – General:

a) All proposed roadworks, complete with offsets from road centerline, including: pavement, curbs, sidewalks and poles.

b) Stations of the BC & EC of road centreline and curb return horizontal curves together with the curve information including delta angle, radius, tangent length and arc length.

c) Details of intersections with spot elevations at all critical points including grades and elevations of curb returns.

d) Catchbasin rim elevations and stations related to road centerline chainage. To include lead locations to main, lead diameters and material in a table.

e) Existing ground profile and finished pavement profile along the pavement centerline with elevations at 20 metre intervals.

f) Crossfall or crown information with gutter elevations at change points.

g) Proposed road centreline grade.

h) Stations and elevations of BVC, EVC, and VPI.

i) Vertical curve information including the length of curve and sag or crest K value, where K equals the length of the vertical curve in metres divided by the algebraic difference in grades, percent.

j) Elevations along the vertical curve at ten (10) metre intervals.

k) Elevation and station of low and high spots of vertical curves.

l) Where the slope of existing ground is greater than 10% across the right-of-way, cross-sections shall be shown at intervals not exceeding twenty (20) metres.

m) Where there is an elevation difference of more than 1.2 m from the design road centre line to a suitable building site on the adjacent parcel, driveway grades and profiles shall be shown on the drawings.

n) Where only a half road is being constructed, full width design cross-sections shall be provided as required to ensure the design suits the future development of adjacent properties.

o) Typical road cross-section showing right-of-way width, proposed road design structure, pavement width, sidewalks, curbs, underground utilities, hydro, power and street light poles, hydrants and their related offsets.

p) Proposed and existing monument with label (note: no monuments shall be destroyed during construction).

q) Additional design details as required.

r) Refer to Figure 2.2 for a plan and profile sample drawing.

3.5 STORM AND SANITARY SEWERS

The following shall be shown in addition to the information required in Section 3. Plan and Profile Drawings – General:

a) Include common trench designs on the same construction drawing.

b) All proposed storm and sanitary works including manholes, drop pipes, cleanouts, catchbasins, inlet/outlet structures, pipe work, ditches, culverts, inspection chambers, services and wyes, complete with offsets, rim elevations, stations related to the road centreline, and pipe inverts at manholes and pipe grade breaks.

c) Existing ground profile and finished ground or pavement profile along the centerline of the proposed sewer.

d) Distance between manholes with proposed grade of pipe.

e) Stations and elevations of the BC, and EC of all horizontal curves with the curve information including delta angle, radius, tangent length and arc length.

f) Stations and elevations of BVC, EVC and VPI.

g) Vertical curve information including the length of vertical and maximum pipe deflection.

h) Elevations along vertical curves at ten (10) metre intervals.

i) Size, material type and class of pipe.

j) Existing or proposed pipe crossings to be shown in profile and to include pipe inverts.

k) Proposed inverts and offset locations to property line of service connections at property lines.

l) Location of existing buildings on properties served by storm and sanitary sewers.

m) Additional design details as required.

n) Refer to Figure 2.2 for plan and profile sample drawing.

o) Materials, types, size, inverts and flow direction to be shown for all proposed and existing culverts.

3.6 WATER

The following shall be shown in addition to the information required in Section 3. Plan and Profile Drawings – General:

a) All proposed waterworks including size, material type and class of pipe, hydrants, valves, joint restraints, fittings and all related appurtenances with offsets and stationing related to road centreline.

b) Locations of proposed service connections including an offset distance from a survey marker or lot corner.

c) Existing ground profile and finished ground or pavement profile, and invert profile along the centerline of the proposed watermain.

d) All other service crossings to be shown in profile (e.g., sewer mains, gas mains, etc.).

e) Extent of work required in making the connection to existing watermains.

f) If the proposed watermain alignment or profile varies from the road centreline, the following shall be provided:

- Stations of the BC and EC of horizontal curves together with curve information including delta angle, radius, tangent length and arc length
- Stations and elevations of the BVC, EVC and VPI of vertical curves together with curve information including curve length and maximum pipe deflection required

- Elevations along vertical curve at ten (10) metre intervals
- Proposed grades

g) Pipes requiring joint restraints shall be shaded, labeled and dimensioned from adjacent fitting showing the length of pipe requiring restraint.

h) Additional design details as required.

i) Refer to Figure 2.2 plan and profile sample drawing.

3.7 STREET LIGHTING AND TRAFFIC CONTROL SIGNALS

The following shall be shown in addition to the information required for plan view in Section 3. Plan and Profile Drawings – General.

Should traffic signals be required, a separate Signal Wiring Plan; and Signalized Intersection Plan showing location of all poles and mounted hardware, handholes, ducts/cables, the controller, and full turn lanes (storage and taper). The plans shall be submitted at a scale of 1:250. PHM-125 record drawings are required for all traffic signal drawings. The following is also required:

a) Pole, conduit and appurtenances locations with offsets and stationing related to road centreline

b) Size, type, class of conduits

c) Schematics of wiring details for street lights and traffic signals

d) Details of detector loops and all other wiring circuit on traffic signals

e) Street lights shall be numbered and pertinent information

3.8 SIGNAGE AND PAVEMENT MARKINGS

a) A separate plan shall be prepared in all cases for road surface works. This plan shall detail eradications, alterations, additions and new regulatory and advisory signage and line painting.

   The design shall conform to Ministry of Transportation Installation Guidelines.

   The following information shall be shown:

   - Dimensions, lengths and colour of proposed lane or curb markings, medians, and crosswalks
   - Lane widths, median radii and taper ratios

- Dimensioned location and type of new or relocated signs. Type of new, removed or relocated signs, including a sign inventory table
- A signs materials list indicating pavement markings shall be arranged in table format
- For drawing clarity show curb locations only. Do not show subsurface/overhead utilities, legal information or addresses

3.9 DETAIL SHEET AND CROSS-SECTIONS

a) Where there is not sufficient room on the plan and profile drawings, design details for the particular drawing may be provided on a separate sheet.

b) Scale shall be determined by the designer to suit the design detail, and shall be included on the detail drawing.

c) Where road cross-sections are required they may be provided on a separate sheet.

d) Cross-sections shall be to a scale of 1:250 (H) to 1:100 (V) unless otherwise approved.

e) Starting at the lower left hand corner of the drawing sheet, cross-sections shall be placed up the sheet in order of increasing stationing. Grid elevations shall be shown at the left hand side of each cross-section and stationing shall be shown above each cross-section. Adequate space shall be left between cross-sections so as to ensure clarity.

f) Cross-sections shall include:

- Design road cross-section within the right-of-way
- Existing ground cross-section extending into the adjacent properties as required
- Existing and proposed sub-surface utilities
- Significant objects/structures located within existing and proposed right-of-way

3.10 AS-BUILT SUBMISSIONS

a) Drawings shall include all information as specified elsewhere for the construction drawings, but shall be corrected upon completion of construction to note all works removed during construction.

b) All dimensions shown shall reflect the As-Built conditions of the construction and all references to “Proposed” ,”Install”, etc. shall be removed. As-Built drawings shall be to scale in accordance with the As-Built dimensions shown. The revision table shall be completed indicating the drawings are As-Built.

c) All As-Built features shall be surveyed and survey points imported into the digital drawing. The As-Built drawing shall reflect the true elevation and location of all constructed features, in both the plan and profile views. Tolerance for moving features in drawings will be >0.5m (e.g. manholes installed less than 0.5m from design location do not need to be shifted on the digital as-builts/drawings).

d) The As-Built drawings shall be submitted in the following digital formats:

- Supported Acrobat PDF
- "AutoCAD Etransmit" Autodesk: AutoCAD Supported format or equivalent method to ensure transfer of all reference files, pen tables (ctb files) and text and dimension styles.

e) Line work for all constructed works shown on the drawings shall retain the thicker line density (as for proposed works) for ease of determining the extent of works covered by the drawings.
Proposed construction for future phases of the project shall not be shown on the As-Built drawings.

f) All As-Built drawings shall include the following information as well as the required asset information as listed below:

- The location and elevation of all existing utilities and services encountered in the construction operation
- The location and invert elevation at property line of all individual service connections, and the wye Chainage, at the main for all constructed and existing works
- A note on each drawing describing the type of trench material (sand, gravel, clay, hard pan, etc.) encountered during construction and the location and profile of all rock
- Complete Sanitary and Water Service Record Sheets for each lot
- Complete Storm Service Record Sheet for lots where a Storm Service exists. Newly developed areas do not have Storm Services, and Oxford County will investigate existing storm services and remove them if feasible. In areas where it is better to maintain an existing storm service rather than have it removed, a Record Sheet shall be filled out and kept within the As-Built drawings.

Fig 3.01

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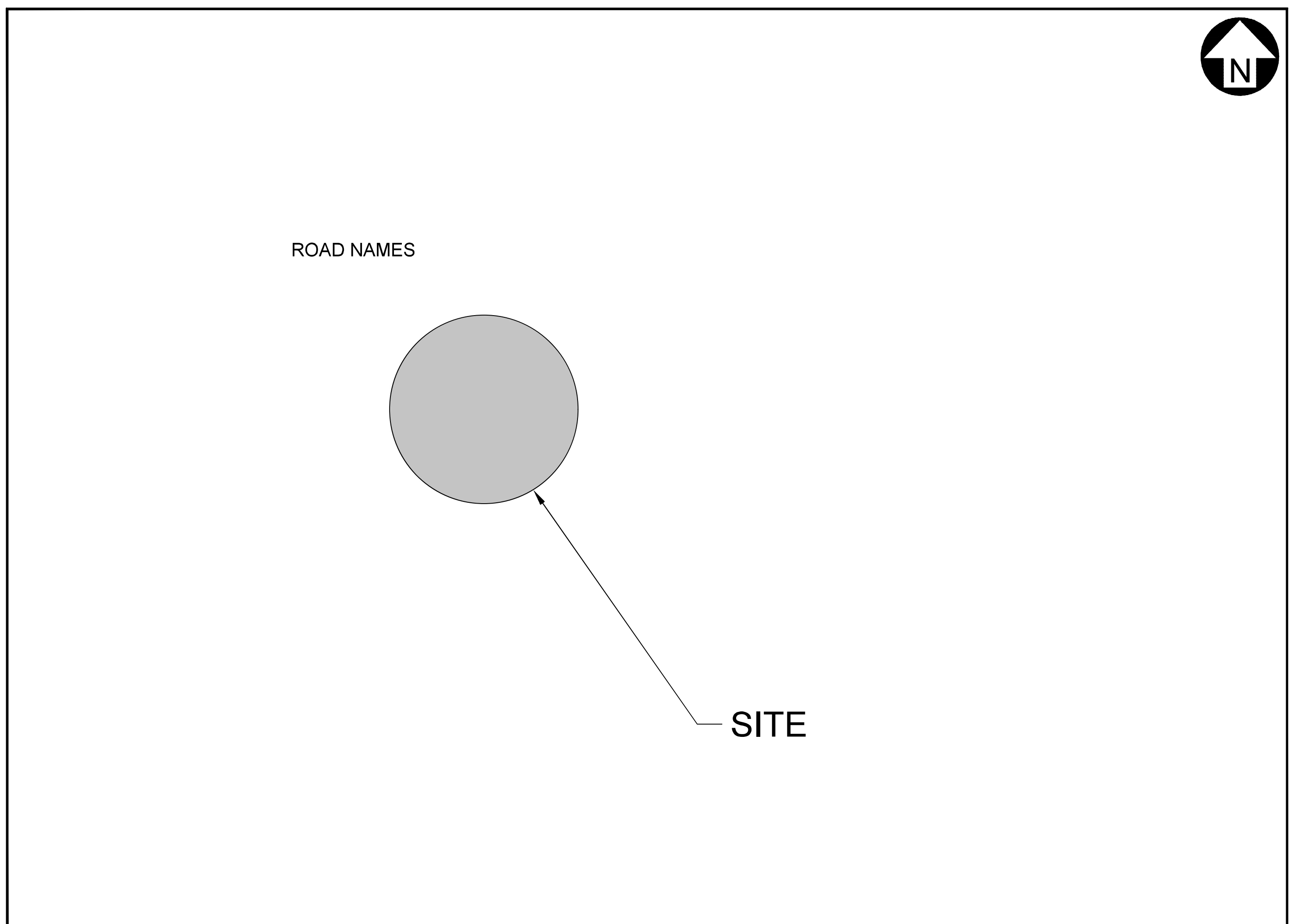
OXFORD ROAD/STREET RECONSTRUCTION

ROAD NAME TO ROAD NAME

CITY/TOWN/MUNICIPALITY, ONTARIO

CONTRACT NO. 9300##-2024

ISSUED FOR REVIEW/TENDER



KEY PLAN
SCALE: N.T.S.

DRAWING NUMBER	DRAWING INFORMATION
00	COVER SHEET
CIVIL DRAWINGS	
C01	NOTES, LEGEND, AND DETAILS
C02	TRAFFIC DETOUR PLAN
C02	REMOVALS - STATION 1+000 TO 1+220
C02	PLAN AND PROFILE - STATION 1+000 TO 1+220
C02	RESTORATION, LINE MARKINGS, AND GRADING - STATION 1+000 TO 1+220
C02	TYPICAL CROSS SECTIONS
TRAFFIC SIGNALS AND STREET LIGHTING	
E00	REMOVALS - STATION 1+000 TO 1+220
STRUCTURAL	
SS00	REMOVALS - STATION 1+000 TO 1+220

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Layout: COVER 22x34 date: Oct 06, 2025 09:11 user: smclaren

COUNTY DRAWING INDEX NO: RSW-####-00-YYYY

DWG NO. 00

Fig. 3.02

MAJOR ROAD NAMES

MINOR ROAD NAMES

N

FOR CONTINUATION - SEE DRAWING XX

FOR CONTINUATION - SEE DRAWING XX

298		298
297		297
296		296
295		295
294		294
293		293
292		292
291		291
290		290
STATION		STATION
ROAD PROFILE		ROAD PROFILE
TOP OF WATERMAIN		TOP OF WATERMAIN
STORM SEWER INVERT		STORM SEWER INVERT
SANITARY SEWER INVERT		SANITARY SEWER INVERT

file: C:\Users\smclaren\AppData\Local\Temp\AcPublish_31104\ Unsaved Drawing.dwg
Layout: V-PLAN & PROFILE 22x34 date: Oct 06, 2025 09:11 user: smclaren

Oxford County
Growing stronger together

KEY MAP:

N

SITE

DRAWING LEGEND:

AREA MUNICIPALITY:

NAME

CONSULTANT:

NAME

SEAL(S):

01	ISSUED FOR XXXXXX	00/00/2000	X.X.X
NO.	DESCRIPTION	DD/MM/YYYY	BY:

DESIGN BY: X.X.X. DRAWN BY: X.X.X. APPROVED BY: X.X.X.

OXFORD COUNTY RD./ST.
RECONSTRUCTION PROJECT

DRAWING TYPE
PLAN AND PROFILE
REMOVALS

STATION: XX+XXX TO STATION: XX+XXX

HOR. SCALE: 1:250 VERT. SCALE: 1:50

DWG NO.

CONTRACT NO:

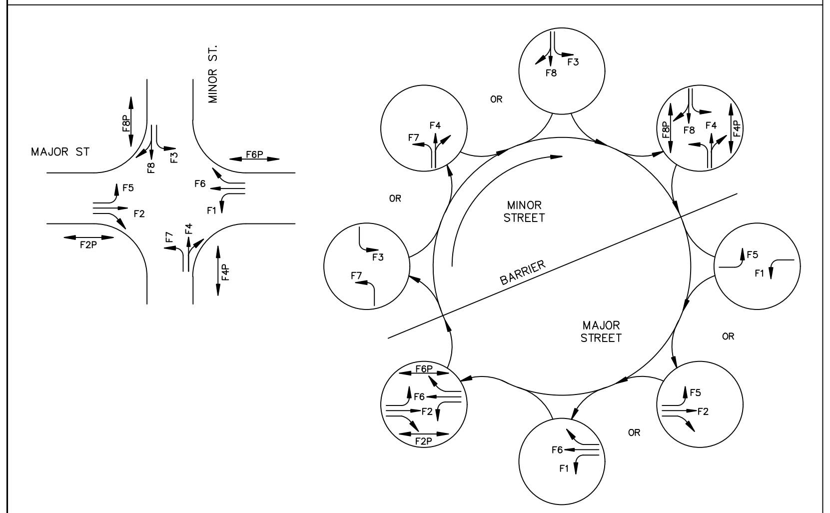
COUNTY DRAWING INDEX NO: RSW-####-01-YYYY

01

LEGEND

- HIGHWAY SIGNAL HEAD (30 cm RED) WITH BACKBOARD AND MAST ARM
- HIGHWAY SIGNAL HEAD (30 cm RED) WITH BACKBOARD AND OVERHEAD CABLE
- OVERSIZE HIGHWAY SIGNAL HEAD WITH BACKBOARD AND MAST ARM (ALL 30 cm LENSES)
- SPECIAL HEAD WITH ARROW INDICATION AND BACKBOARD (EXAMPLE SHOWS TYPE 2 HEAD)
- SPECIAL HEAD WITH BACKBOARD AND ONE OR MORE PROGRAMMABLE LENSES (EXAMPLE SHOWS TYPE 2 HEAD)
- STANDARD SIGNAL HEAD WITH BACKBOARD AND MAST ARM (ALL 20 cm LENSES)
- STANDARD SIGNAL HEAD WITH MAST ARM, WITHOUT BACKBOARD
- BICYCLE SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD WITH COUNT DOWN
- PEDESTRIAN PUSH BUTTON
- ACCESSIBLE PEDESTRIAN SHORT POLE
- TRAFFIC SIGNAL POLE
- CURB RAMP (1.22 m WIDTH) PROVIDING ACCESS TO SINGLE CROSSWALK
- ACCESSIBLE PEDESTRIAN PUSH BUTTON WITH AUDIBLE TONE
- VEHICLE PASSAGE LOOP &/OR COUNT LOOP DETECTOR
- DIAMOND LOOP DETECTOR
- VEHICLE LOOP DETECTOR
- DUPLEX LOOP DETECTOR
- NON-INTRUSIVE DETECTION ZONE
- EMERGENCY VEHICLE PRE-EMPTION DETECTOR
- TACTILE PLATES
- TRAFFIC CONTROLLER CABINET
- UPS TRAFFIC CONTROLLER CABINET WITH UNINTERRUPTIBLE POWER SUPPLY
- UNINTERRUPTIBLE POWER SUPPLY CABINET
- TRAFFIC SIGN
- TRAFFIC SIGN WITH FLASHING BEACON
- ILLUMINATED TRAFFIC SIGN
- TC-54
- TEMPORARY CONCRETE BARRIER

PHASE SEQUENCE DIAGRAM



REVISIONS	DATE	ANALYST	DESCRIPTION OF REVISIONS	RECOMMENDED BY
CONTRACT NO. INFORMATION				

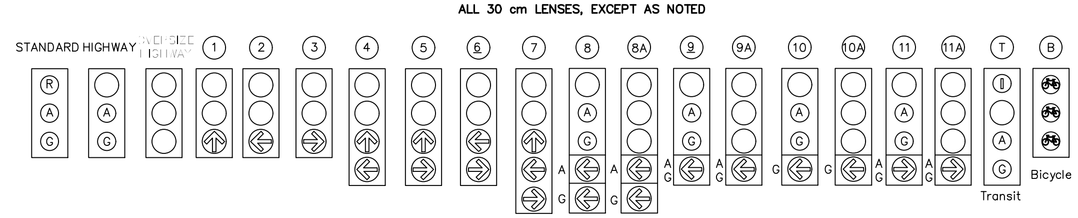
Fig. 3.03

5m 0 10m

CLASSIFICATION OF ROADWAY	TRAFFIC SIGNAL HEADS				LOCATION	
		TYPE	SIZE	BACKBOARD	MOUNTING HT.	OFFSET FROM POLE
MAJOR ROADWAY		PRIMARY				
		SECONDARY				
		AUXILIARY				
	SEPARATE LT.TURN ARROWS	PRIMARY				
		SECONDARY				
MINOR ROADWAY		PRIMARY				
		SECONDARY				
		AUXILIARY				
	SEPARATE LT.TURN ARROWS	PRIMARY				
		SECONDARY				

TRAFFIC CONTROL SIGNAL HEADS

ALL 30 cm LENSES, EXCEPT AS NOTED



8 9 AMBER ARROW MUST BE USED IN A PROTECTED/PERMISSIVE SIMULTANEOUS LEFT TURN OPERATION.

NOTE: -FOR SPECIAL ARROW HEADS 8, 9, 10 AND 11, 20 cm AMBER BALL AND 20 cm GREEN BALL LENSES SHOULD BE USED.
-BICYCLE SYMBOL IN ACCORDANCE TO O. REG. 626 H.T.A.

Oxford County
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P.O. Box 1614, 21 Reeve Street
Woodstock, Ontario N4S 7Y3
Phone: 519-539-9800
Fax: 519-421-4711
www.oxfordcounty.ca

MUNICIPALITY ______________________________

INTERSECTION ______________________________

____

DATE ____________________ SCALE ____________________

RECOMMENDED BY ______________________________

MUNICIPAL OFFICIAL (MUNICIPAL INSTALLATION)
REGIONAL TRAFFIC REPRESENTATIVE (MINISTRY INSTALLATION)

SIGNALS WARRANTED:

SIGNAL DESIGN RECOMMENDED FOR APPROVAL:

SIGNAL INSTALLATION APPROVED AS PER SECTION 144 (31) H.T.A.:

APPROVAL DATE:

DRAWING NAME:

MODIFIED:

Oxford County Design Guidelines | 4 | Transportation

TABLE OF CONTENTS

LIST OF FIGURES

4. TRANSPORTATION

4.1 GENERAL

Infrastructure projects including development projects shall conform to the applicable standards and guidelines as stipulated in each section below for national, provincial and County standards. All construction specifications and standard drawings shall be in accordance with the applicable Municipal Ontario Standard Specification and any Ontario Provincial Standard Drawing or as replaced by the specified **County Standard Drawings**, local lower tier municipal specifications or standard drawings or as directed by the **County of Oxford Public Works**.

4.2 TRAFFIC AND TRANSPORTATION PLANNING AND ENGINEERING

4.2.1 Oxford County Official Plan

Refer to the most recent version of the County's Official Plan to obtain and review the guiding principles for infrastructure improvements to the County Road system including connectivity, network improvements and road widenings, road classifications, active transportation infrastructure including pedestrian and cycling facilities, public transit and railway lines.

4.2.2 Transportation Master Plan

Refer to the most recent version of the County's Transportation Master Plan identifying specific transportation needs, road network improvements, intersection improvements, grade separations, and specific road projects in accordance with Phase 1 and 2 of the Municipal Class Environmental Assessment process.

4.2.3 Cycling Master Plan

Refer to the most recent version of the County's Cycling Master Plan for the location and type of cycling facility identified.

4.2.4 Traffic Impact Study

Refer to the most recent version of the Oxford County Traffic Impact Study Guidelines for requirements around Traffic Impact Studies, and when/where they are required.

4.3 ROAD GEOMETRIC DESIGN STANDARDS

4.3.1 General Requirements

Geometric road design shall generally conform to the current Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads.

4.3.2 Roads Design

4.3.2.1 Design Speed

Design speed shall be based on the following chart:

Table 4-1 Road Design Speed

Posted Speed (km/h)	Design Speed (km/h)
50 and below	60
60	70
70	80
80	90

4.3.2.2 Centreline Radii

This chart is a summary of typical design speeds versus standard super elevation grades taken from Table 3.2.4 of the TAC Geometric Design Guide for Canadian Roads

Table 4-2 Typical Design Speeds Vs. Super Elevation Grades

Design Speed (km/h)	Minimum Radius (m)			
	Normal Crown	Reverse Crown 2%	Superelevation 4%	Superelevation 6%
40	660	65	45	40
50	950	115	80	75
60	1290	185	130	120
70	1680	290	200	190
80	2130	400	280	250
90	2620	530	380	340

1. *Source: Geometric Design Guide for Canadian Roads – Tables 3.2.4 and 3.2.8.*

4.3.2.3 Radii for Curb & Gutter

All curb and gutter radii must allow for adequate turning in accordance with a WB-20 truck template. Compound curves to be used when appropriate, and at the discretion of the County Engineer.

4.3.2.4 Lane Widths

For multi-lane roads or channelized intersections, minimum lane widths shall be based on the following chart:

Table 4-3 Minimum Lane Widths

Description	Width (m)
Right Turn Lane	3.0
Left Turn Lane	3.0
Through Lane*	3.35
Curb Lane (single lane per direction)	3.5
2-way Left Turn Lane	4.0

*For Rural Roads a paved 1.15m wide and 1.5m wide gravel shoulder is required adjacent to the travel lane.

NOTE: In situations with higher design speeds or higher road classifications, wider lane widths may be required.

4.3.2.5 Right-of-Way, Pavement and Boulevard Widths

Pavement widths, right-of-way widths and boulevard widths shall be based on the following chart (edge of pavement to edge of pavement):

Table 4-4 R.O.W., Pavement, and Boulevard Widths

Usage	R.O.W. (m)	Pavement (m)	Boulevard (m) Both Sides
County Road - Rural	30	Varies	Varies
County Road - Urban	26	Varies	Varies

Refer to **Figures 4.04, 4.05, 4.06** and **4.07** for the various Oxford County Typical Road Sections. For Reconstruction projects, cross-sections may be modified to address constraint areas. To be determined at detailed design and verified with **County of Oxford Public Works**.

4.3.3 Vertical Alignment

Refer to the most recent version of the TAC Geometric Design Guide for Canadian Roads Chapters 2 (Design Controls, Classification and Consistency) and 3 (Alignment and Lane Configuration).

4.3.3.1 Vertical Curves

When the numerical difference between two road grades exceeds 1%, a vertical curve must be incorporated using the following criteria:

- Vertical curve length shall be numerically greater than or equal to the design speed
- When matching new vertical curves into existing ones, match the K values to provide continuity.

Table 4-5 Vertical Curve K Values

Design Speed (km/h)	60	70	80	90
Crest Vertical Curve Minimum K[1]	11	17	26	39
Sag Vertical Curve Minimum K[2]	18	23	30	38

Source: Geometric Design Guide for Canadian Roads, Tables 3.3.2 and 3.3.4.

For more information on design speed, refer to **Section 4.3.2.1 of this manual**.

4.3.3.2 Maximum and Minimum Road Grades

a) The maximum grades of roads shall be derived from the following table:

Table 4-6 Maximum and Minimum Road Grades

Road Type	Minimum Grade (%)	Maximum Grade (%)
County Road - Urban	0.5	6
County Road - Rural	0.5	6

b) Flat see-saw profiles (identical high and low points) will not be allowed in road profile designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or to an acceptable Overland Flow Outlet.

c) In reconstruction projects within existing developed areas of the County, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to **County of Oxford Public Works**.

4.3.3.3 Drainage Issues

a) Overland Flow Routes

i. The design of all road profiles for New Development Projects are required to accommodate and direct major overland flow routes (OLFR) to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the **County's Development Engineering Staff** for information, assistance, review and acceptance, all to the satisfaction of the **County of Oxford Public Works**.

ii. The design of all major road profiles for Capital Works Projects (including Municipal Class Environmental Assessments) are required to consider major overland flow routes (OLFR) and where possible, accommodate and direct the OLFs to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the **County of Oxford Public Works** for information, assistance, review and acceptance, all to the satisfaction of the **County**.

iii. In reconstruction projects within existing developed areas of the County, where the existing profile and driveway conditions cannot accommodate an outlet to a formalized OLF Route, the proposed profile must provide for adequate road drainage and be acceptable to **County of Oxford Public Works**.

iv. In order of preference, OLFR should be directed along:

a. Urban Thoroughfare;
b. Civic Boulevard;
c. Main Street;
d. Area Municipality Connector;
e. Area Municipality Street;
f. Parks, open spaces;
g. Dedicated municipal easement

b) Culverts Under Roads

i. 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.

ii. County practice requires that culverts must convey the minimum storm events as specified below:

Table 4-7 Culvert Sizing by Storm Event

Classification of Road	Minimum Storm Event To Be Conveyed By Culvert
Urban and Rural	50-year storm event
Bridges	100-year storm event or Regional storm event (250-year), subject to the local Conservation Authority conditions

4.3.4 Horizontal Alignment

Refer to the most recent version of the TAC Geometric Design Guide for Canadian Roads Chapters 2 (Design Controls, Classification and Consistency) and 3 (Alignment and Lane Configuration).

4.3.4.1 Access and Sight Distance

As determined from Figure 9.10.1 of the TAC Geometric Design Guide for Canadian Roads, the following stopping sight distances shall be provided at intersections and accesses:

a) On new intersections and major accesses such as large commercial or industrial development, the desirable decision sight distance shall be provided.
b) On all other new accesses, the minimum decision sight distance shall be provided.
c) For existing accesses and single-family residences, the minimum stopping sight distance shall be provided.

This figure assumes a line of sight from the driver of a vehicle entering the intersection (1.05m above the pavement surface) to the headlights of an approaching vehicle (at a height of 0.38m). Design speeds for the intersecting roadways are listed in **Section 4.3.2.1** of this manual.

4.3.4.2 Transition Between Road Types

Transition from two lanes to four should be made using the taper dimensions noted in the table in **Section 4.3.2.1** in relation to design speed. The transition from four lanes to two lanes should be clearly signed with a Wa-23R and Wa-23Rtas per the Ontario Traffic Manual – Book 6. Transition from hard surface to loose surface should be signed with a Wa-25 and a Wa-25T.

4.3.5 Rural Asphalt Lift Edge Taper

On rural roads, asphalt in all lifts shall be laid so that the edge of pavement is inclined at a 45-degree angle. Base lifts of asphalt shall be laid wider than surface lifts, so that a consistent slope is maintained.

4.4 INTERSECTIONS

4.4.1 Road Safety Audit

Consultant/Developer must complete a Road Safety Audit, as per the Oxford County Road Safety Audit Guidelines, when considering potential impacts to an intersection or roadway that is within the jurisdiction of the County.

4.4.2 Road/Road Approach Grades

Refer to TAC Geometric Design Guide for Canadian Roads – Figure 2.3.2.2.

4.4.3 Road Layouts

When two (2) streets connect at an intersection they shall connect at 90 degrees with 10 metre straight sections measured back from the street line.

4.4.4 Traffic Calming

Refer to the most recent version of the TAC Canadian Guide to Traffic Calming.

Refer to **Figure 4.03** for the typical Milled Rumble Strips layout approaching a stop-controlled intersection.

4.4.5 Roundabouts

A roundabout is a raised island located in the centre of an intersection, which requires vehicles to travel through the intersection in a counterclockwise direction around the island. Where a roundabout is being considered, the Consultant shall complete the County's **Roundabout Feasibility Initial Screening Tool** (2024 Oxford County Transportation Master Plan – Appendix G) to support the design.

All approaches to the circle shall be protected by a Yield sign, so that vehicles already traveling on the roundabout have right-of-way over vehicles entering it. A One-Way sign Rb-21, indicating a counterclockwise direction of travel, shall be installed on the centre island opposite each approach.

For maintenance purposes, sanitary maintenance holes are not permitted to be located within the raised centre island of the roundabout. The sanitary maintenance hole is to be located within the apron of the island. Storm maintenance holes may be located within the centre island of the roundabout, provided the proposed landscaping does not hinder access to the maintenance hole.

Location of mainline water valves shall be coordinated with Oxford County Public Works to determine the most suitable location, on a project-by-project basis.

4.4.6 Traffic Control Signal Warrants

Traffic signals shall be considered warranted if:

a) Intersection conditions meet or exceed the warrant requirements of Section 4.3 of the Ontario Traffic Manual – Book 12

4.4.7 Intersection Pedestrian Signal (I.P.S.) Warrants

Intersection pedestrian signals shall be considered warranted if:

a) Conditions meet or exceed the warrant requirements of Section 4.8 of the Ontario Traffic Control Manual – Book 12

All aspects of the pedestrian signal design, including crosswalks and pedestrian access equipment, shall be AODA compliant.

4.4.8 Materials

Materials used for traffic signals shall be in conformance with the requirements of the appropriate subsection of this Section.

4.4.9 Right-Turn Lanes

Right-turn lanes should be designed according to the following table:

Table 4-8 Right-Turn Lanes Design Standards

Design Speed (km/h)	Taper Ratio Design Domain	Lane Length Design Domain (m)
50	11:1 – 17:1	35 – 75
60	14:1 – 17:1	40 – 90
70	17:1 – 20:1	50 – 110
80	17:1 – 24:1	60 – 130

The taper ratio is the ratio of the taper length to the lane width. The design domain is the range of the deceleration length to the deceleration length plus the storage length. The appropriate storage length can be calculated using the following equation where S is the storage length (m), N is the design volume of turning cars (v/h), and L is the length occupied by each vehicle (m).

$$S = \frac{NL}{30}$$

Further details on the design of right-turn lanes can be found in Chapter 9.14 of the TAC Geometric Design Guide for Canadian Roads.

Right-turn channelizations with a yield design can either use a 60m taper or an auxiliary lane designed with the same parameters as a normal right-turn lane. A sufficient turning radius should be used to include room for a pedestrian island. Further details on right-turn channelizations can be found in Chapter 9.15 of the TAC Geometric Design Guide for Canadian Roads.

4.4.10 Left Turn Lanes

Left-turn lanes should be designed according to the following table:

Table 4-9 Left-Turn Lanes Design Standards

Design Speed (km/h)	Design Domain for Taper Ratio
50	8:1 – 30:1
60	15:1 – 36:1

70	15:1 – 42:1
80	15:1 – 48:1

The lower end of the design domain is appropriate for more constrained urban areas while the upper end is appropriate for less constrained rural areas. The storage length can be calculated using the same equation that is applicable for right-turn lanes. Details on the appropriate deceleration length can be found in Chapter 2 of the TAC Geometric Design Guide for Canadian Roads. Further details on left-turn lanes can be found in Chapter 9.17 of the TAC Geometric Design Guide for Canadian Roads.

4.4.11 Intersection Control Drawings

Any alterations to an existing Oxford County intersection, or the creation of a new intersection within Oxford County, shall require the Designer to create a legal PHM-125 (intersection control) drawing for the intersection and submit to County of Oxford Public Works department for record keeping.

4.5 PAVEMENT STRUCTURES

4.5.1 Geotechnical Report

A geotechnical report shall be completed unless otherwise noted by the County's Project Manager. The report shall include borehole data, groundwater level, and recommendations for pavement structure and need for a hydrogeological study to potentially dewater during construction. The geotechnical engineer licensed as a Professional Engineer (P.Eng.) with the Professional Engineer's of Ontario shall prepare and seal the report including recommendations for pavement structure including depth of granular base material, asphaltic concrete pavement and tack coat recommendations. Where retaining walls are identified, the geotechnical report shall include discussions and recommendations for the design and construction of a retaining wall. Sufficient borehole locations and depth shall be completed to support the retaining wall design recommendations. For development projects, completing a geotechnical report is the responsibility of the developer. For Capital Work projects, it is the responsibility of the **County of Oxford Public Works** department.

4.5.2 Base Component Depths

Municipal Projects: The pavement structure of all roads being constructed or repaired under a Municipal Project, and in New Subdivisions, shall be based on the following table, at a minimum:

Table 4-10 Base Component Depths for County Roads

Subgrade Type	Component	County Road (Min. Depth in mm)
	Asphalt	150[a]
	Gran. A	150

	Gran. B	450[b]
	Equivalent Granular Thickness	711.5

a) 2 lifts x 50mm HL-8 plus 1 lift x 50mm HL-4. Thicker asphalt depth should be considered for urban areas.
b) 450mm of Granular B is the minimum standard that is required on all County Roads. Granular B thickness may be increased where warranted based on the Geotechnical Report recommendation and Pavement Design Analysis

If the geotechnical investigation determines the native material is stronger & free draining, a reduction in the Granular B thickness could be considered, at the discretion of **County of Oxford Public Works** department.

Table 4-11 Equivalent Granular Thickness Factors

Component	Factor
Asphalt (New or Recycled)	2.00
Granular A	1.00
Granular B	0.67

- Top-coat asphalt shall be placed over existing or freshly laid hot mix asphalt, cold in-place recycled, or milled asphalt, and shall have a minimum lift thickness of 50mm.
- Granular A shall be placed at a minimum thickness of 150mm.
- A tack coat shall be applied on all milled surfaces and between each asphalt lift.

4.5.3 Granular Base

County preference is given for granular base using full-depth Granular "A" to minimize excavation depth and minimize conflicts with existing shallow utilities. However, the Oxford County Engineer, and/or geotechnical report, may identify the need for using both granular 'B' and granular 'A' to address specific road structure needs based on the underlying soil conditions. Refer to the current version the Ontario Provincial Standards and Specifications OPSS.MUNI 206 Grading, OPSS.MUNI 1001 Aggregates - General and OPSS.MUNI 1010 Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

4.5.4 Asphaltic Concrete Pavement

Table 4-12 Asphalt Selection by Road Classification

Classification of Road	PGAC	Binder Asphalt	Surface Asphalt
Rural County Road	58-28	HL 8	HL 4
Urban County Road	58-28	HL 8	HL 4

County requires the use of a Material Transfer Vehicle (Shuttle Buggy) for base, binder and surface courses of asphalt on all rural and urban roads.

Refer to the current version of the Ontario Provincial Standards and Specifications OPSS.MUNI 310 Hot Mix Asphalt and OPSS.MUNI 311 Asphalt Sidewalk, Driveway, Boulevard, and Sidewalk Resurfacing. Tack coating of the granular base and between lifts of hot mix asphalt shall be included as stipulated in OPSS.MUNI 310 as recommended by the geotechnical report or required by the **County of Oxford Public Works**.

Refer to the current version of the Ontario Provincial Standards and Specifications OPSS.MUNI 331 Full-Depth Reclamation with Expanded Asphalt Stabilization and OPSS.MUNI 333 Cold In-Place Recycled (CIR) Mix and OPSS.MUNI 335 Cold In-Place Recycled (CIR) Expanded Asphalt Mix.

Surface course asphalt (HL-4) shall be virgin (no recycled products or recycled/reclaimed asphalt pavement [RAP] shall be allowed in hot mix asphalt HL-4) and shall be mixed with 5.3% to 5.5% of 58-28 Performance Graded Asphalt Cement (PGAC).

Binder/Base course asphalt (HL-8) may contain RAP as per OPSS.MUNI 1150 (up to maximum of 15%) and shall be mixed with 5.0% to 5.2% of 58-28 PGAC

Driveways and levelling/padding courses (HL-3F and HL-3 respectively) may contain RAP as per OPSS.MUNI 1150 (up to a maximum of 15%) and shall be mixed with 5.3% to 5.5% of 58-28 PGAC.

In cases where high rutting issues and concerns are present or anticipated, different pavement structure may be required by the County Public Works Department. Designer to consult with the County Public Works Department to determine if improved/premium asphalt mix, higher/lower PGAC grade, increased pavement thickness, and/or addition of geogrid on granular base is required.

4.6 PAVEMENT MARKINGS

Permanent pavement markings shall be designed in accordance with the Ontario Traffic Manual – Book 11. Proposed designs shall be submitted to the **County of Oxford Transportation Division** for approval, prior to application.

4.6.1 Materials

For rural roads, traffic paint shall be used.

For urban roads, Field Reacted Polymeric material shall be used.

For high traffic rural intersections, Field Reacted Polymeric material shall be used within the intersection and 30m of each approach. **County of Oxford Public Works** to determine if a rural intersection is a high traffic rural intersection or not.

4.6.2 Pavement Marking Removals

Any Pavement marking removals that are required shall be specified to be removed by abrasive blasting equipment (with materials in accordance with MTO DSM) or grinding. Determination of which method shall be used shall consider project-specific variables mentioned with this section. The Design Engineer shall coordinate with Oxford County Public Works for final decision between the two methods.

Table 4-13 Comparison of Pavement Marking Removal Methods

Criteria	Grinding	Abrasive Blasting
Pavement Damage	High	Low
Removal Effectiveness	Excellent (All Types)	Best for Thing Markings
Ghosting	Moderate – High	Low
Cost	Lower	Higher
Speed	Fast	Slower
Urban / Residential Suitability	Fair	Good
Long-Term Pavement Impact	Negative	Minimal

Grinding shall be considered when:
- Removing thick thermoplastic or MMA pavement markings;
- Speed and cost are primary concerns; and/or
- Pavement condition is already poor or due for resurfacing.

Abrasive Blasting shall be considered when:
- Preserving pavement condition is critical;
- Working in urban or residential areas;
- Removing paint or thin epoxy markings; and/or
- Aesthetics and long-term performance matter.

4.7 CONCRETE FLATWORK

Refer to the current version of the Ontario Provincial Standards OPSS.MUNI 351 Concrete Sidewalk.

4.7.1 Tactile Plates

Tactile plates at intersection radii should be custom made to the correct radius, arc and chord for the approaches. Tactile plates should be installed at all pedestrian crossings as per the A.O.D.A.

4.8 CURB AND GUTTER

Refer to the current version of the Ontario Provincial Standards OPSS.MUNI 353 Concrete Curb and Gutter Systems.

a) Types and Applications

   i. For all road classifications, Concrete Barrier Curb with Standard Gutter as per OPSD 600.04 shall be used.

b) Transition/Termination

   i. A transition of 3.0m is required between curb types. Curb transitions must occur on the road with the lower classification, minimum 1.0m away from the end of the radius.
   ii. Curb termination shall be as per OPSD 608.01

c) New Access

   i. Any new accesses to existing roads are required to attain approval from the **Oxford County Transportation Division** as per the Oxford County Entrance Guidelines and By-Law 5222-2010

4.9 RETAINING WALLS

Retaining walls shall be designed according to the following specifications:

a) The supplier shall be Permacon Grande Walle or an approved equivalent.
b) The minimum block size shall be 200mm x 375mm x 1000mm
c) A grey color shall be used for the blocks.
d) The retaining wall must have drainage including a drainage sock behind the wall and adequately spaced outlets that do not drain to a sidewalk or road. Drainage outlets should drain to a catch basin when possible.
e) All Grande Walle style retaining walls shall include approved shop drawings stamped by a professional engineer registered with the P.E.O.
f) Fencing is required if the height of the wall exceeds 1m.

4.10 ROADSIDE PROTECTION

Refer to the current version of the TAC Geometric Design Guide for Canadian Roads Chapter 7 (Roadside Design) for guide rails and other roadside protection measures.

Where guiderails are present or required, shoulder shall be paved with a minimum depth of 50mm HMA, and a minimum distance of 12m from the end of the Sequential Kinking Terminal (SKT) End Treatment shall be paved.

4.11 TRAFFIC CONTROL DEVICES, PXO, STREETS SIGN AND PAVEMENT MARKINGS

At a minimum, refer to Ontario Traffic Manual:

- Book 5 (Regulatory Signs)
- Book 6 (Warning Signs)
- Book 7 (Temporary Conditions)
- Book 11 (Pavement, Hazard and Delineation Markings)
- Book 12 (Traffic Signals)
- Book 15 (Pedestrian Crossing Treatments)
- Book 18 (Cycling Facilities)

4.11.1 Construction Signage

Advance warning road closure signage (TC-65, TC-67, etc.), including detour signage, must be erected and in place a minimum of two weeks (14 calendar days) prior to road closures

4.11.2 Pavement Markings

Centre line pavement markings will be required on all Street classifications. All pavement markings are to be designed in accordance with the Ontario Traffic Manual Standards. All final pavement markings on urban roads shall be of a durable material (field reacted polymeric) as defined in OPSS. All final pavement markings on rural roads shall be traffic paint. Green surface treatment for cycling facilities, longitudinal crosswalk markings and stop bars to have an anti-skid resistance of 50 BPN to 65 BPN (British Pendulum Number).

Pre-marking of top and base asphalt shall be completed a minimum of 24 hours before final application. The application of the pavement markings shall be within 24 hours after acceptance of the pre-markings by **County of Oxford Public Works**. Temporary pavement markings will be required if the topcoat of asphalt is scheduled more than 2 weeks after the base asphalt is complete.

Traffic signage shall be designed in accordance with the applicable Ontario Traffic Manual Standards. Cycling Facility Signs to be installed with the appropriate lane divider lines.

Pavement markings and traffic signs shall be shown on the same drawing. Traffic signs shall include the OTM reference number, a graphic of the sign and station/offset.

4.12 INTERSECTION TRAFFIC CONTROL SIGNALS

4.12.1 Drawing Requirements

Drawings shall identify the following:

a) Poles
b) Anchor Assemblies
c) Power Supply Assemblies
d) Traffic Controller Cabinet Assembly

4.12.2 Precast Concrete Handholes

Precast concrete handholes shall be designed in accordance with OPSD 2117.020.

4.12.3 Prefabricated Service Boxes

Prefabricated services boxes shall be designed in accordance with OPSD 2117.020.

Where a ground rod or plate is required in or adjacent to the maintenance / handhole or prefabricated service box, the system #6 AWG copper ground wire shall exit out of the maintenance / handhole or prefabricated service box to enable ground rod connection.

4.12.4 Ducts and Fittings

The following minimum size conduit shall be identified in the design drawings:

a)	Road Crossings – Handhole to handhole	- 3/75mm
b)	Boulevard – Handhole to Controller Pad	- 4/75mm + 1/50mm
c)	Boulevard – Handhole to Pole Footing	- 2/75mm
d)	Boulevard – Handhole/Controller Pad to Power Supply	- 2/50mm
e)	Boulevard – Controller Pad to Communication Pedestal	- 50mm
f)	Boulevard – Handhole to Flasher	- 50mm

The type of conduit shall be rigid polyvinyl chloride (RPVC) unplasticized conduit conforming to CSA Standards C22.2 No. 211.2.

Open Cut Installation

Rigid ducts installed by open cut, direct buried and subsurface installation shall be rigid polyvinyl chloride (RPVC) unplasticized conduit conforming to CSA Standards C22.2 No. 211.2, except where otherwise indicated. All rigid ducts in roadway shall be installed utilizing unshrinkable backfill material.

Directional Boring

Rigid ducts installed by directional boring shall be rigid polyvinyl chloride (RPVC) unplasticized conduit conforming to CSA Standards C22.2 No. 211.2 except as otherwise indicated.

4.12.5 Cable Installation

This specification is intended to govern the supply, delivery and installation of the following cables including splicing and termination:

a) Low voltage Cable
b) Low Voltage 5, 7, 12 and 19 conductor solid copper-traffic signal cables, and
c) Extra-low voltage,

i. 4, 6, 12 and 25 pair interconnect communication cable
ii. 2 conductor loop / pedestrian pushbutton lead-in cable
iii. 4 conductor pedestrian pushbutton lead-in cable

Fibre optic cable

All traffic signal, loop, and communication cable used must meet the Operating Authority Specification.

General

Low-voltage multi-conductor cables shall be according to CAN/CSA C22.2 No. 239.

Low-voltage single conductor cables for Underground Installations shall be standard copper type RWU90 cross-linked polyethylene according to CSA C22.2 No. 38.

Low-voltage single conductor cables for aerial installations on messenger cable shall be type RW90 stranded aluminum cross-linked polyethylene according to CSA C22.2.

Low-voltage neutral supported cables with one, two, or three insulated aluminum conductors and ACSR neutral shall be 300 V type NS-90 or 600 V type NSF-2 and shall be according to CSA C22.2 No. 129.

Low-voltage multi-conductor traffic signal cable shall be according to OPSS 2409.

All traffic signal cables shall meet or exceed OPSS.MUNI 2409. The Contractor shall use MTO type of traffic signal cable throughout the installation. Mixing of MTO and IMSA cable types at an installation shall not be permitted.

Extra Low-Voltage Cables

Extra low-voltage cables for use of traffic signal interconnection systems shall meet or exceed IMSA Specification No. 19-2.

Extra low-voltage cables for use of traffic signal actuation devices shall meet or exceed OPSS.MUNI 2410 and “3M” Traffic Control Systems for Model # 30003 cable. Radar detector cables shall conform to manufacturer requirements.

Loop Lead-in and Pushbutton Cable

The following types of cable are approved for use:

2/C #14 AWG, Shielded

i. Belden #8720, or
ii. Impulse #211441S

4.12.6 Power Supply

Supply Control Cabinet Assembly

Supply control cabinets shall be designed to include a Smart Metered Service (SMT) for Traffic Signals and an unmetered Street Lighting Service (SLS) for Street Lighting. Power supplies will be 120/240V, 100 Amp, 1Ø, 3 wire power supply pedestal assembly complete with powder coated green steel enclosure and pre-fabricated concrete base. Control cabinets shall be designed to provide additional space for future UPS on the concrete base including conduit integration.

4.12.7 Poles

Aluminum Poles, Base Mounted

Designers shall note whether a pole base needs to be Light Duty or Heavy Duty, based on the equipment installed on the pole.

Any length of aluminum pole mounted on a bridge deck shall be complete with a vibration dampening device.

Aluminum base mounted poles shall be per OPSD 2200.010 Concrete Footing for Base Mounted Lighting Poles.

Pole Erection

Base mounted lighting poles shall be installed as per OPSD 2414.010 3.3 m Aluminum Pole, Base Mounted and OPSD 2415.011 Steel Pole, Base Mounted.

4.12.8 Footings And Pads for Electrical Equipment

Concrete

Concrete shall conform to OPSS.MUNI 1350, be 32 Mpa 28-day strength and supplied by an approved Ready-Mix Concrete supplier with a Ready Mixed Concrete Operation.

Anchorage Assemblies and Hardware

All steel components shall be hot dip galvanized conforming to CSA G164M.

The complete anchorage assembly shall be as shown in OPSD 2215.020 Anchorage Assembly for Lighting Poles and Signal Poles. A wood template shall be provided with each assembly.

Studs shall be factory inserted and held in place with a pre-applied threaded locking compound. The nuts on studs shall be installed finger-tight only by the fabricator. Any threads of the studs and bolts exposed above the ferrule shall be coated with factory applied white lithium grease. A minimum of three exposed bolt threads shall be visible above the top of the adjusting nut when a pole is installed and connected.

Concrete Pads

The concrete pad for the controller cabinet and UPS foundation shall be constructed as shown in OPSD 2126.010 Distribution Assembly, Concrete Pad and Ducts and OPSD 2126.020 Distribution Assembly, Concrete Pad and Ducts.

Concrete shall be placed, vibrated, cured, protected and finished conforming to OPSS.MUNI 904 and shall be formed as one monolithic slab. The alignment of the sleeves and/or duct entry points shall be scribed marked on the top of the concrete slab.

Anchorage Assemblies

The anchorage assembly shall be in the size and configuration shown in OPSD 2215.020 Anchorage Assembly for Lighting and Signal Poles...

4.12.9 Traffic Control Signals

Traffic Signal Poles are to be mounted to buried concrete pole bases with circular or round poles. Design shall include:

a) Conduit and appurtenances locations with offsets and stationing related to road centreline;
b) Size, type, class of conduits for buried power service supply;
c) Schematics of wiring details for traffic signals (including poles with streetlights attached to directly to signal poles);
d) Details of Non-Invasive Detection System (NIDS), detector loops, buried conduit, controller cabinet assembly, hand wells, pole height, arms, brackets, signal heads and all other wiring circuits for traffic signals;
    a. **County of Oxford Public Works** to determine which of NIDS or detector loops are required at each intersection in question.
e) Streetlights mounted to traffic signal poles shall be numbered and pertinent information, (i.e. wattage, lamp type, pole height and location, arranged in table format)

4.12.10 Traffic Signal Equipment and Electrical Traffic Control Devices

Mast Arms

Mast arms shall be aluminum with steel pole plate.

Double Arm Brackets

Double arm brackets for signal heads shall be aluminum. These brackets shall be used to mount signal heads and using a two-point application.

Signal Heads

Signal heads shall be designed for use in all directions facing the direction of approaching traffic according to the “legal drawing” Form PHM-125, approved for the intersection. Any alterations to an Oxford County intersection shall require an updated PHM-125 drawing from the Designer.

The signal heads shall be securely covered with a durable coated nylon signal head bag and shall remain in place until all tests have been completed and the signal heads are put into operation. Pedestrian heads shall be turned to face the pole prior to operation.

Traffic signal head bags shall be a durable nylon bag with nylon straps and shock cords designed for traffic signal heads. All bags shall be equipped with a nylon mesh window for signal testing.

Signal heads shall be adjusted for maximum visibility and focusing prior to final tightening or sealing of hardware. Unused hubs in signal heads shall be plugged with sealing caps, without a gasket.

Pedestrian Pushbuttons

Pedestrian pushbuttons shall be audible and shall be located on the pole face. The pushbutton/sign assembly mounting height shall be measured from the centre of the pushbutton to the adjacent sidewalk/boulevard grade. This height shall be 1.10m. The pedestrian pushbutton/sign assembly shall be Polara INS2-2 Wire Navigator Pushbutton Station (PBS) complete with control unit or approved equivalent (Audible).

Fibre Optic Cable

The installation of cables shall be carried out in the following manner:

- Materials used to facilitate the pulling of cables in conduit. Cable shall not be pulled at temperatures below -6 degrees C.
- Cable runs shall be continuous between poles. Signal cable splices shall only be made within a steel / aluminum pole handhole or junction boxes on a wooden pole. No signal cable splices are permitted below ground level.
- Sufficient length of free cable shall be left in pole handholes or junction boxes to permit proper connection to be made with cable coming from signal and/or pedestrian heads.
- Cable from signal and/or pedestrian heads on steel/aluminum poles shall run inside the mast arms and carry down inside the pole to the handhole.
- Cable from signal and/or pedestrian heads on wood poles shall run inside the mast arms and carry on up or down the outside of the pole to a 200mm x 200mm x 100mm PVC watertight junction box. The junction box shall be mounted between 4m and 5m above the finished grade.
- Detector lead in cable from the vehicle detector loops shall be brought to the controller pad through the designated conduit and 1.5m coiled up on the pad. These cables shall be one continuous piece with no splices and shall run from the curbside junction box to the controller pad.

- All signal cables shall terminate in the controller cabinet.

Prefabricated Service Boxes

The following prefabricated service boxes are approved for us:

- Type I
  - Quazite – Model # PT2436BA18 with cover – Model # PT2436HA0046, or
  - Synertech – Model # S2436B18FA with cover – Model # S2436HBBOA.
  - Quazite – Model # PT1730BA18 with cover – Model # PT1730HA0046, or
  - Synertech – Model # S1730B18FA with cover – Model # S1730HBBOA.
  - Quazite – Model # PT1324BA18 with cover Model # PT1324HA0046,or
  - Quazite – Model # PT2436BA18 with cover Model # PT2436HA0046

Power Supply Pedestal Assembly

Power Pedestal Assemblies shall be from the following manufacturer: Pedestal Solutions Inc.

4.12.11 Non-Intrusive Detection System (Camera Detection)

The camera detection system for Oxford County intersections within the City of Woodstock shall be the following:

a) Miovision detection solution, supplied by Innovative Traffic Solutions Inc, to include the following hardware and software components:

   i. Miovision Core DCM
   ii. Miovision SmartView 360 cameras c/w mounting hardware
   iii. Cat5e - 300ft to be supplied
   iv. Miovision Detection Software (perpetual)
   v. Miovision Intersection monitoring license (1 year term)
   vi. Miovision Managed Connectivity license, 1GB (1 year term)

4.13 SOUND ABATEMENT

Refer to the most recent version of the Ministry of the Environment, Conservation and Parks publication “Environmental Noise Guideline Stationery and Transportation Sources – Approval and Planning” Publication NPC-300.

4.14 MAILBOXES – COMMUNITY / RURAL

The most recent version of the Transportation Association of Canada Design Guide for Canadian Roads Chapter 7 (Roadside Design) references the most recent version of the American Association of State Highway and Transportation Officials (AASHTO) Guide for Erecting Mailboxes on Highways. Canada Post shall be consulted for replacements, consolidation or planned new mailbox locations including community mailbox specifications and drawings, as well as temporary mailboxes during construction.

4.15 SERVICE ROADS

Refer to the most recent version of the TAC Design Guide for Canadian Roads Chapter 8 (Access).

4.16 GUIDELINES FOR ENTRANCES

Refer to the current version of the County's Guidelines for Entrances to the County Road System - Tiered Access Control Standards" and Oxford County Entrance By-Law No. 5222-2010.

4.17 SITE FURNITURE

Refer to the most recent version of the Oxford County Official Plan, TAC Design Guidelines (TAC), O.P.S.S. and A.O.D.A.

4.18 ACTIVE TRANSPORTATION

4.18.1 Pedestrian Walkways

The Oxford County Transportation Master Plan strategy is to provide for pedestrian connectivity with the local pedestrian walkway network. Please refer to most current version of the Oxford County approved Transportation Master Plan, O.P.S.S., A.O.D.A. and the Ontario Traffic Manual.

4.18.2 Cycling Infrastructure

Refer to the current version of the County approved Cycling Master Plan, A.O.D.A., the Ontario Traffic Manual and **County Standard Drawings** for widths of cycling lanes or paved shoulder, painted buffers and rumble strip locations as applicable. Typically, rural Oxford County roads consist of a 1.5 metre wide shoulder complete with a rumble strip and line striping providing a buffer width of 0.5 to 1.0 metres.

4.18.3 Trails

Refer to current version of the Oxford Trails Master Plan including Appendix C – Trail Designers' Toolbox for guidelines for trail design.

4.19 SEDIMENT & EROSION CONTROL

The County requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected. The relative Conservation Authority will be required to provide review, comment and approval for each ESCP.

For resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area, an ESCP is not required, unless otherwise directed by **County of Oxford Public Works**. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring. In all other cases, an ESCP is required from the Designer.

4.19.1 Bird and Wildlife Protection

Contractors shall not destroy active nests or harm birds and other protected species under the Migratory Birds Convention Act (MBCA), 1994. Clearing and grubbing of trees, shrubs, and vegetation should not occur between April 1 and August 30 to avoid interfering with the nesting activity of migration birds. If clearing needs to occur during this period, an environmental condition evaluation in accordance with the MBCA acceptable to the County must be completed prior to any clearing.

4.20 ROADSIDE & BOULEVARD RESTORATION

4.20.1 Rural Road Restoration

All rural roadside restoration shall include a minimum of 150mm depth of screened topsoil complete with hydroseed and mulch.

4.20.2 Urban Road Restoration

All urban roads and street restoration shall include a minimum of 150mm depth of screened topsoil and sod. Sod shall not be placed before June 30th or after October 31st in any year. All placed sod shall receive a continuous application of water for a minimum of 24 hours during dry weather above 23 degrees Celsius. All sod placement for road construction projects shall be sufficiently watered and maintained by the contractor until Substantial Completion is achieved and will be subject to a 30-day maintenance period. The 30-day sod maintenance period shall begin at the completion of sod installation. At the end of the 30 days, the County shall inspect all placed sod to confirm the following conditions:

- No surface soil is visible;
- No sign of dry or dead grass;
- Grass height shall be 30mm minimum, and 70mm maximum; and
- Each sod piece shall show evidence of rooting into the underlying soil.

Any sod installations that do not meet the criteria above shall be replaced by the Contractor immediately and be subject to another 30-day maintenance period. Additional maintenance periods shall be added until all sod meets the criteria above. Inspections shall not be made during the winter dormant period for Southwestern Ontario (November 15th to April 15th inclusive). Timing between inspections shall be suspended during the winter dormant period and continue once they have ended.

4.20.3 Topsoil Testing

All topsoil proposed for placement for restoration in any subdivision or County Road construction project shall be tested by a certified laboratory that the quality of topsoil will support the germination and establishment of the sod and/or hydroseed. A report by the laboratory shall be provided certifying the topsoil to be placed is satisfactory for supporting grass cover. All activities related to topsoil testing, requirements, and quality shall be in accordance with OPSS 802.

4.21 CONSTRUCTION SIGNAGE

4.21.1 General

Use the Ontario Traffic Manual - Book 7 - Temporary Conditions for all construction signage applications.

4.21.2 Traffic Management Plans

A TMP is required whenever the **Oxford County Project Manager** determines the Capital Works or Development Works facilitate the need.

4.21.3 Detour Plans

Detour plans must be authorized through the Transportation Division, two weeks prior to the tender being posted. Signs are to be placed by the Contractor's own forces. Detour Routes shall only utilize County Roads. Any detour routes that are proposed to include an Area Municipality road must be circulated to the applicable Area Municipality for their review and comment.

4.21.4 Pedestrian Safety

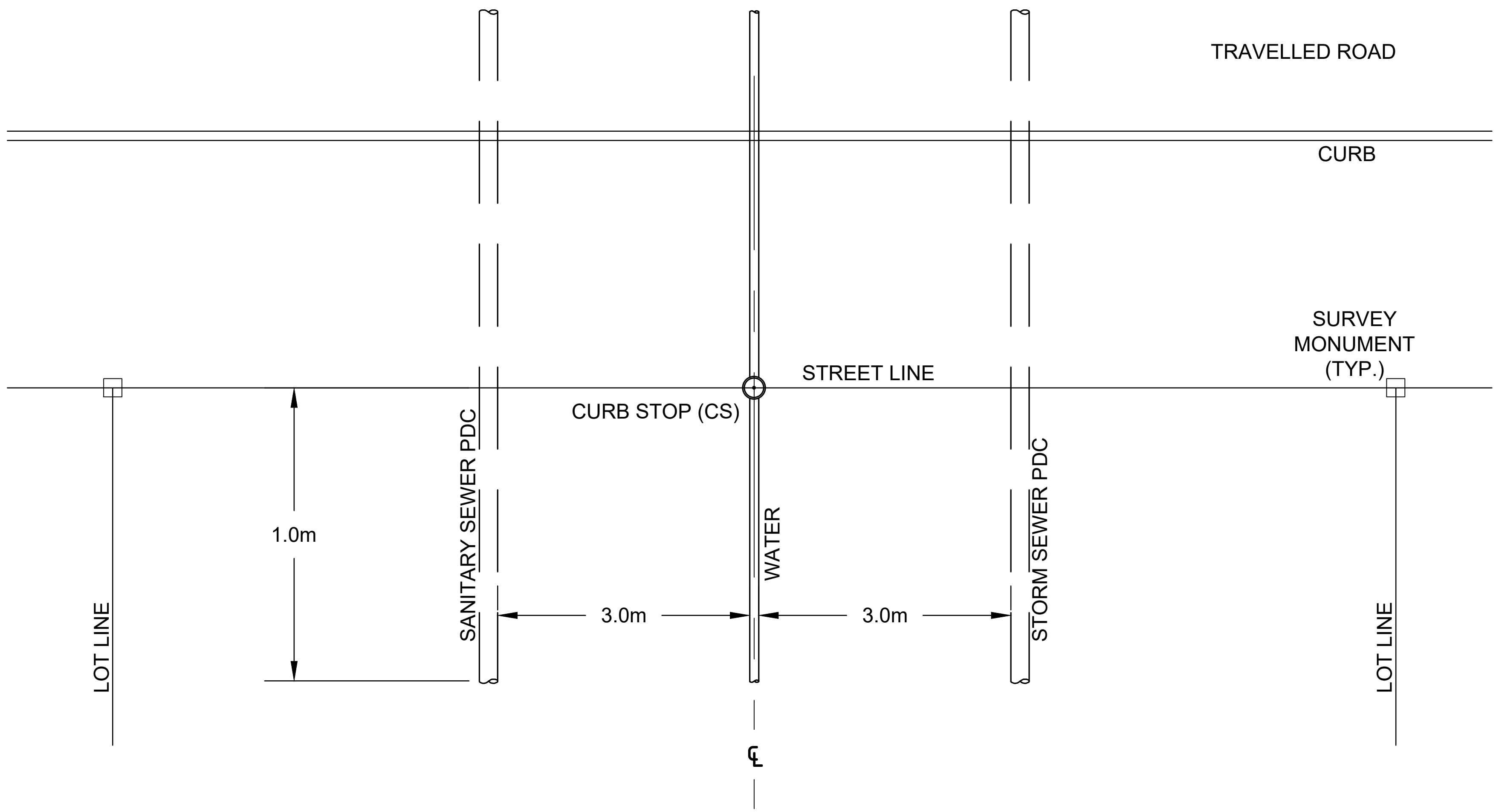
Construction Projects in proximity to high pedestrian areas, including schools, commercial areas and any other source of high pedestrian volumes should take extra precaution to separate construction activity from pedestrian movements.

Sidewalks that are closed or removed should have signed alternate detour routes. Pedestrian paths of travel impacts must be addressed in accordance with AODA. If it is not possible to retain a smooth hard-surface sidewalk, appropriate closure and pedestrian detour signage is required identifying an AODA compliant path of travel.

Impactful closures where reasonable detours are not available require informational signage placed for a 2-week period prior to the event.

Any material deliveries or construction vehicle movements crossing pedestrian areas should be carefully monitored by a traffic control person.

Schools in close proximity to projects should be notified in the preconstruction letters and kept informed of progress.



NOTE:

1. LOCATION OF SANITARY AND STORM SERVICES ON LOTS IN WOODSTOCK AND TILLSONBURG MAY VARY FROM THIS FIGURE. CHECK WITH LOCAL MUNICIPALITY.
2. STORM PDC REQUIREMENT AND LOCATION SHALL BE AT THE DISCRETION OF THE LOCAL MUNICIPALITY.
3. SANITARY AND STORM PDC TO BE INSTALLED TO 1.0m PAST PROPERTY LINE.
4. CURB STOP TO BE LOCATED ON PROPERTY LINE.
5. ALL SERVICE WIRES TO BE PLACED A MINIMUM OF 2m AWAY FROM MUNICIPAL SERVICES.

OXFORD COUNTY STANDARD DRAWING	REV#: 2
SERVICE LOCATIONS SINGLE FAMILY RESIDENTIAL	08/2025
	FIG. 4.01

Oxford County
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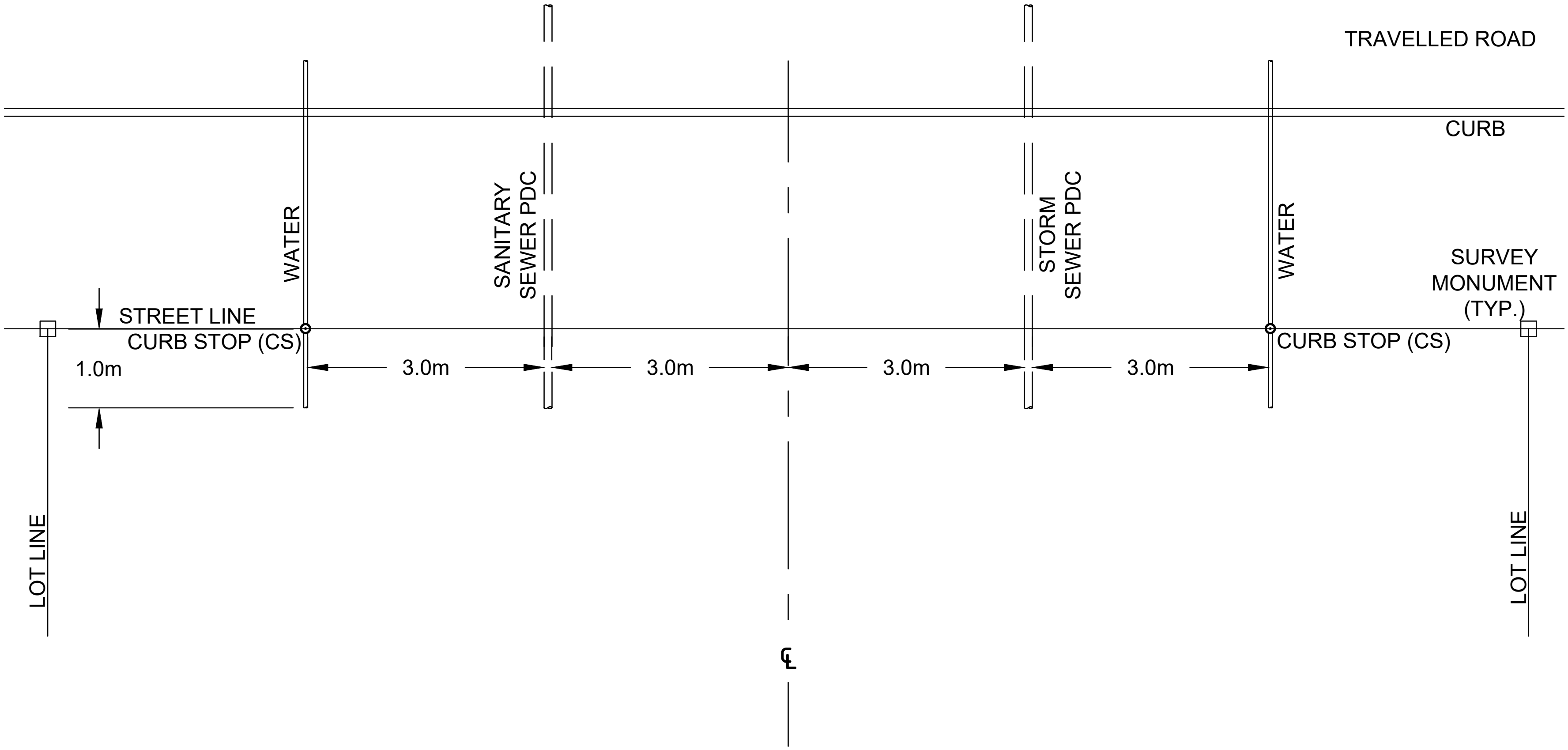
PREVIOUSLY: FIG 1.1.1



NOTE:

1. LOCATION OF SANITARY AND STORM SERVICES ON LOTS IN WOODSTOCK AND TILLSONBURG MAY VARY FROM THIS FIGURE. CHECK WITH LOCAL MUNICIPALITY.
2. STORM PDC REQUIREMENT AND LOCATION SHALL BE AT THE DISCRETION OF THE LOCAL MUNICIPALITY.
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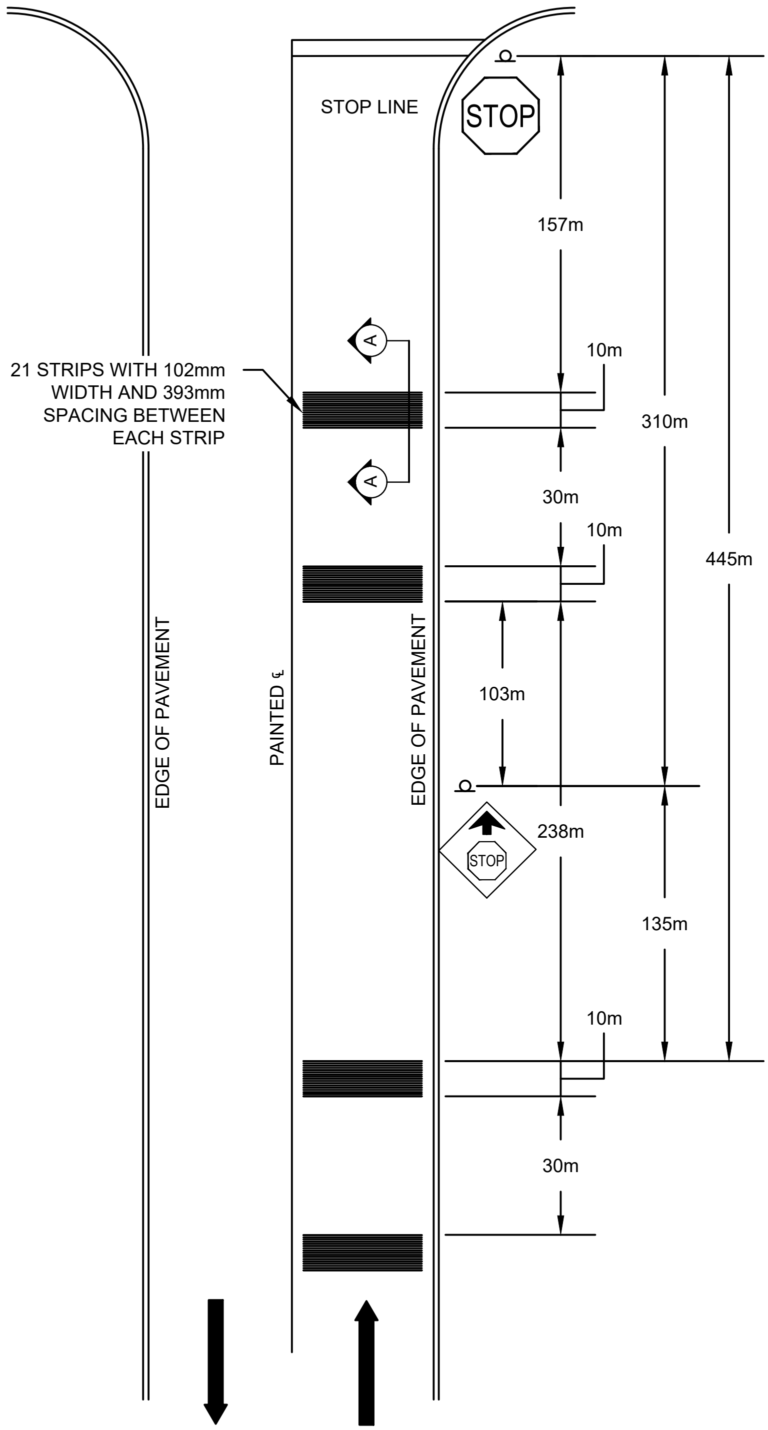
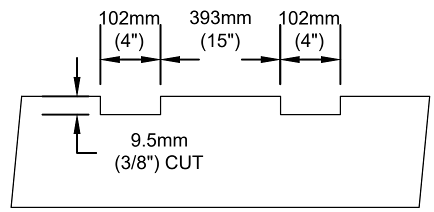
4. CURB STOP TO BE LOCATED ON PROPERTY LINE.
5. ALL SERVICE WIRES TO BE PLACED A MINIMUM OF 2m AWAY FROM MUNICIPAL SERVICES.

OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County Growing stronger together
SERVICE LOCATIONS SEMI DETACHED RESIDENTIAL	08/2025	
	FIG. 4.02	

PREVIOUSLY: FIG 1.1.2





1 A-A SECTION
Scale: N.T.S.

OXFORD COUNTY STANDARD DRAWING

REV#: 1

TYPICAL LAYOUT FOR MILLED RUMBLE STRIPS

08/2025

Oxford County
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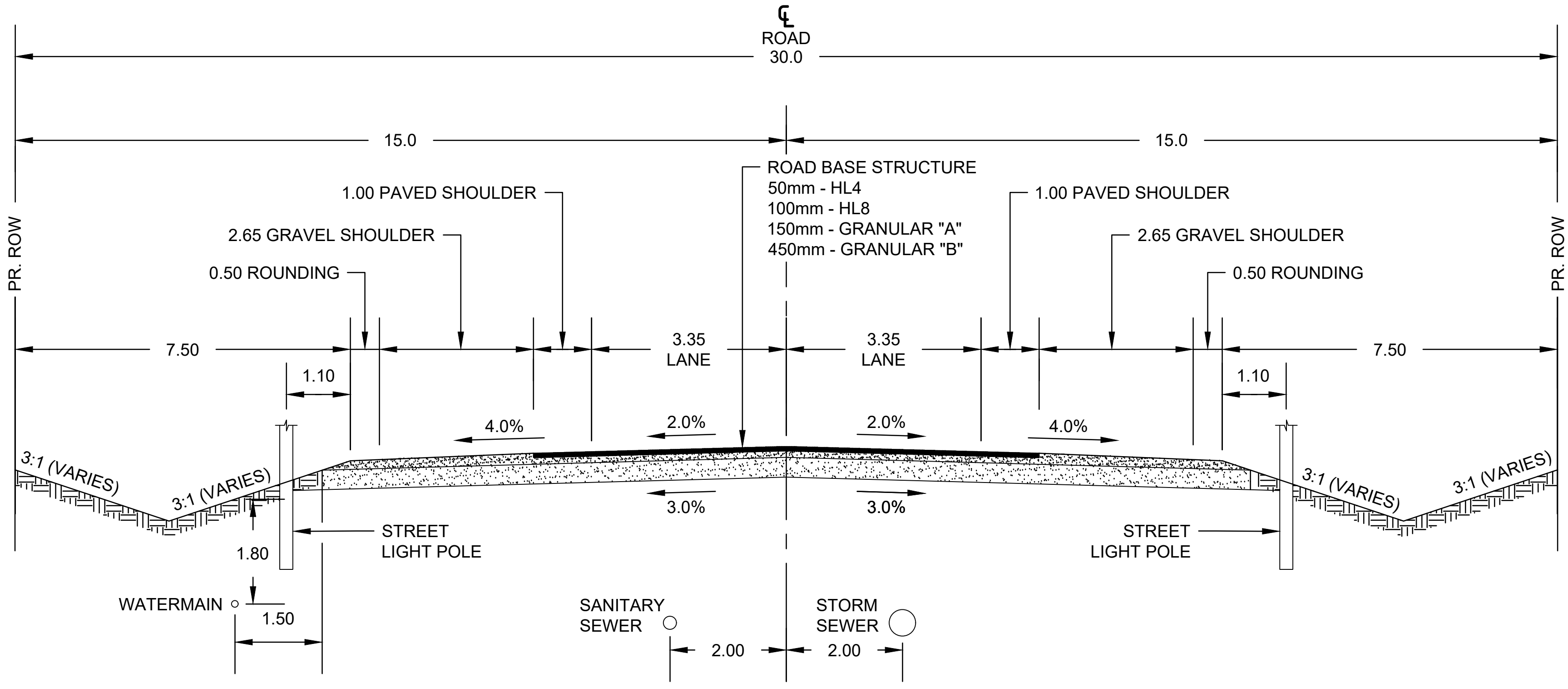
FIG. 4.03

PREVIOUSLY: D1800-1-2004



RURAL TYPICAL SECTION - 30m ROAD ALLOWANCE

N.T.S.

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN.
2. STREET LIGHT STANDARDS ON ALTERNATE SIDES OF THE ROAD.
3. UTILITY RELOCATION MAY BE REQUIRED TO SUIT PROPOSED CROSS SECTION.
4. CROSS SECTION MAY BE MODIFIED TO ADDRESS CONSTRAINT AREAS, TO BE DETERMINED AT DETAILED DESIGN.
5. PARTIALLY PAVED SHOULDER PROVIDES: REDUCED SHOULDER MAINTENANCE; IMPROVED SAFETY FOR SLOW MOVING AGRICULTURAL VEHICLES ALONG SHOULDERS, LIMITED BICYCLE ACCESSIBLE SHOULDER.
6. ANY CONSTRAINED AREAS SHOULD BE DISCUSSED WITH THE COUNTY ENGINEER.

OXFORD COUNTY STANDARD DRAWING	REV#: 0
30m RURAL TYPICAL ROAD SECTION	08/2025
	FIG. 4.04

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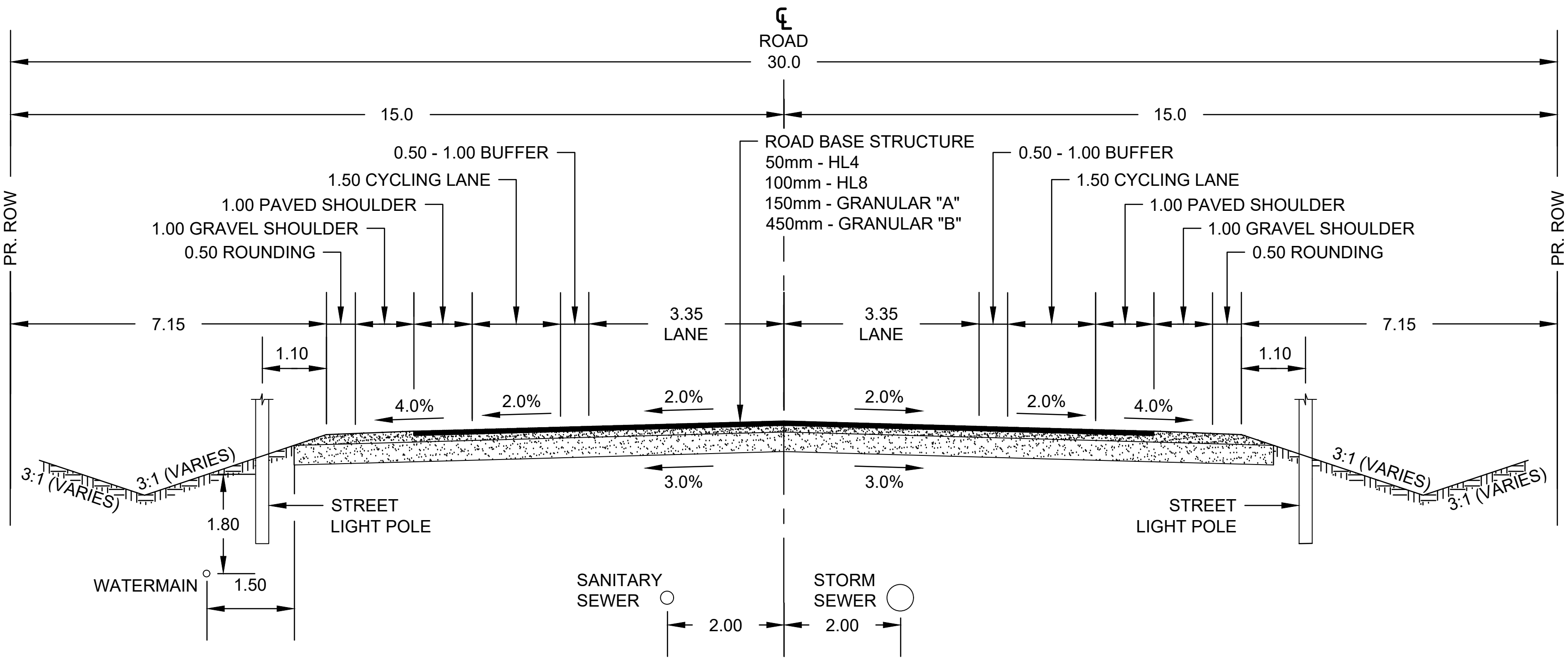
PREVIOUSLY: N/A



RURAL TYPICAL SECTION w/ CYCLING - 30m ROAD ALLOWANCE

N.T.S.

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN.
2. STREET LIGHT STANDARDS ON ALTERNATE SIDES OF THE ROAD.
3. UTILITY RELOCATION MAY BE REQUIRED TO SUIT PROPOSED CROSS SECTION.
4. CROSS SECTION MAY BE MODIFIED TO ADDRESS CONSTRAINT AREAS, TO BE DETERMINED AT DETAILED DESIGN.
5. PARTIALLY PAVED SHOULDER PROVIDES: REDUCED SHOULDER MAINTENANCE; IMPROVED SAFETY FOR SLOW MOVING AGRICULTURAL VEHICLES ALONG SHOULDERS, LIMITED BICYCLE ACCESSIBLE SHOULDER.
6. ANY CONSTRAINED AREAS SHOULD BE DISCUSSED WITH THE COUNTY ENGINEER.

OXFORD COUNTY STANDARD DRAWING

30m RURAL TYPICAL w/ CYCLING ROAD SECTION

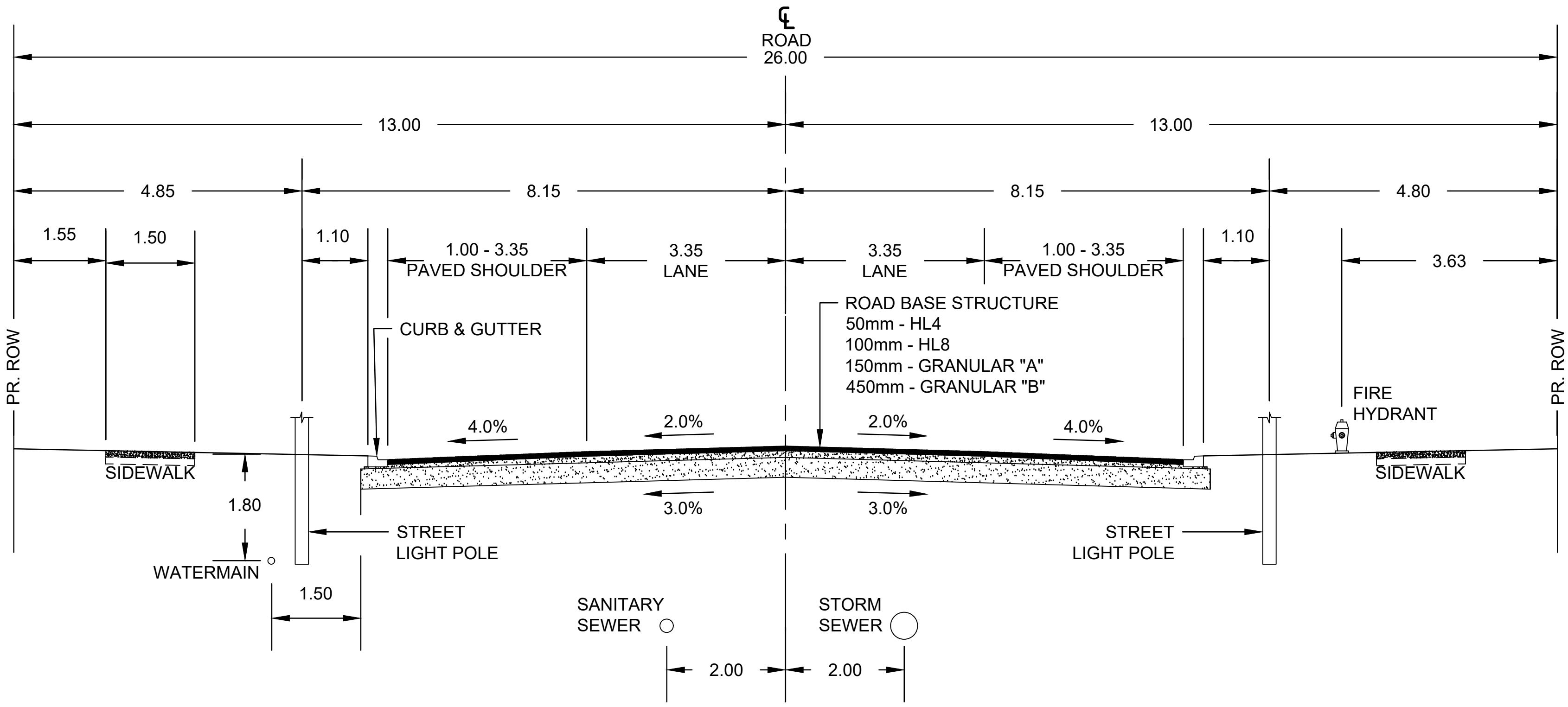
REV#: 0

08/2025

Oxford County
Growing stronger together

FIG. 4.05

PREVIOUSLY: N/A



URBAN TYPICAL SECTION - 26m ROAD ALLOWANCE

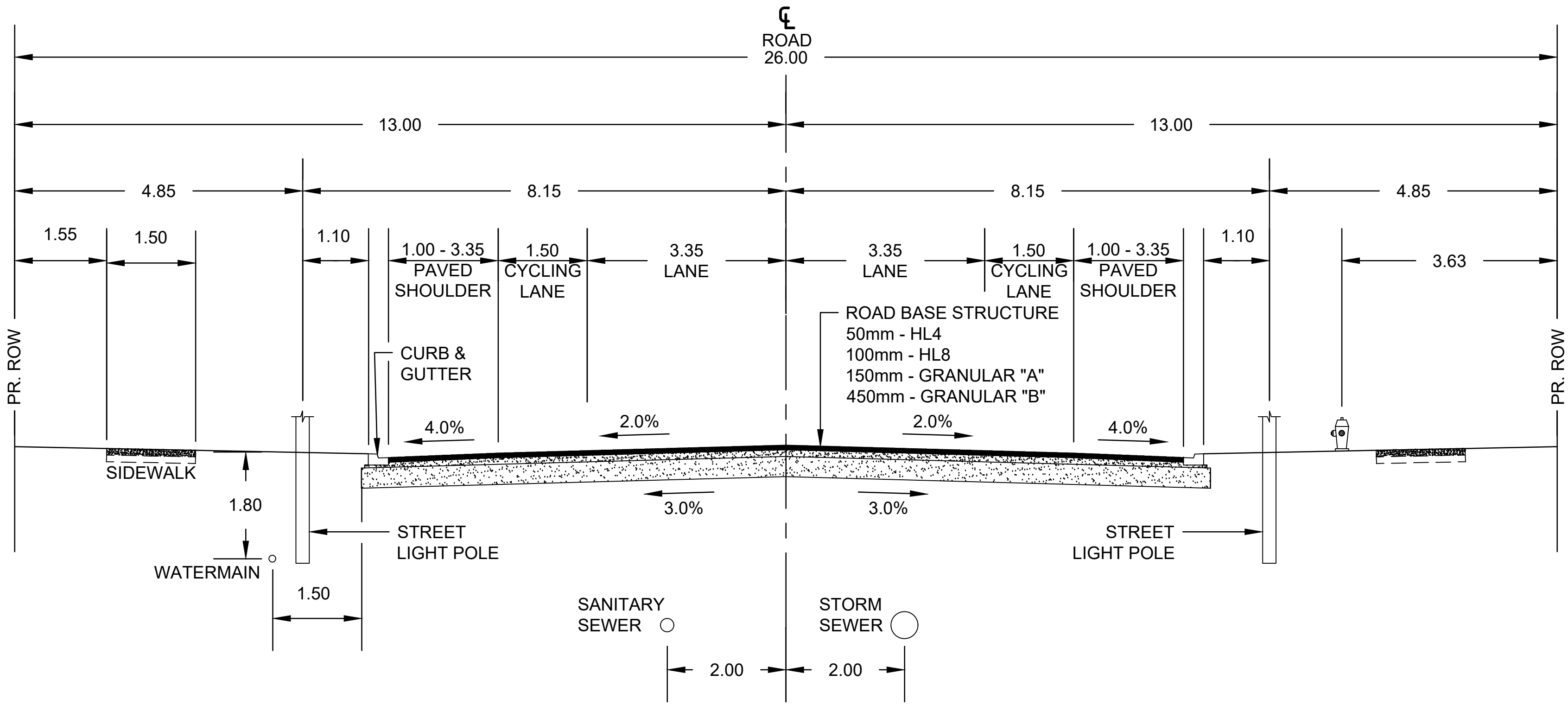
N.T.S.

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN.
2. CURB AND GUTTER AS PER OPSD.
3. STREET LIGHT STANDARDS ON ALTERNATE SIDES OF THE ROAD.
4. STREET LIGHT POLES TO BE LOCATED NOT LESS THAN 3.0m EITHER SIDE OF HYDRANT LATERALS.
5. UTILITY RELOCATION MAY BE REQUIRED TO SUIT PROPOSED CROSS SECTION.
6. CROSS SECTION MAY BE MODIFIED TO ADDRESS CONSTRAINT AREAS. TO BE DETERMINED AT DETAILED DESIGN.
7. ANY CONSTRAINED AREAS SHOULD BE DISCUSSED WITH THE COUNTY ENGINEER.
8. FOR 3 - LANE TYPICAL CROSS SECTION WITH 2 LANES AND A SHARED CENTER LEFT TURNING LANE, THE SHARED LEFT TURNING LANE SHALL BE 3.5m WIDE AND EACH THROUGH LANE SHALL BE 3.35m WIDE.

OXFORD COUNTY STANDARD DRAWING	REV#: 0	Oxford County Growing stronger together
26m URBAN TYPICAL ROAD SECTION	08/2025	
	FIG. 4.06	

PREVIOUSLY: N/A



URBAN TYPICAL SECTION w/ CYCLING - 26m ROAD ALLOWANCE

N.T.S.

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN.
2. CURB AND GUTTER AS PER OPSD.
3. STREET LIGHT STANDARDS ON ALTERNATE SIDES OF THE ROAD.
4. STREET LIGHT POLES TO BE LOCATED NOT LESS THAN 3.0m EITHER SIDE OF HYDRANT LATERALS.
5. UTILITY RELOCATION MAY BE REQUIRED TO SUIT PROPOSED CROSS SECTION.
6. CROSS SECTION MAY BE MODIFIED TO ADDRESS CONSTRAINT AREAS. TO BE DETERMINED AT DETAILED DESIGN.
7. ANY CONSTRAINED AREAS SHOULD BE DISCUSSED WITH THE COUNTY ENGINEER.
8. FOR 3 - LANE TYPICAL CROSS SECTION WITH 2 LANES AND A SHARED CENTER LEFT TURNING LANE, THE SHARED LEFT TURNING LANE SHALL BE 3.5m WIDE AND EACH THROUGH LANE SHALL BE 3.35m WIDE.

OXFORD COUNTY STANDARD DRAWING

26m URBAN TYPICAL w/ CYCLING ROAD SECTION

REV#: 0

08/2025

Oxford County
Growing stronger together

FIG. 4.07

PREVIOUSLY: N/A

Oxford County Design Guidelines | 5 | Stormwater

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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 <u>Seeding</u>

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 <u>Mulching</u>

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 <u>Polymers and Tackifiers</u>

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 <u>Erosion Control Blankets, Netting and Matting</u>

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 <u>Vegetative Buffer Strips</u>

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: ____________

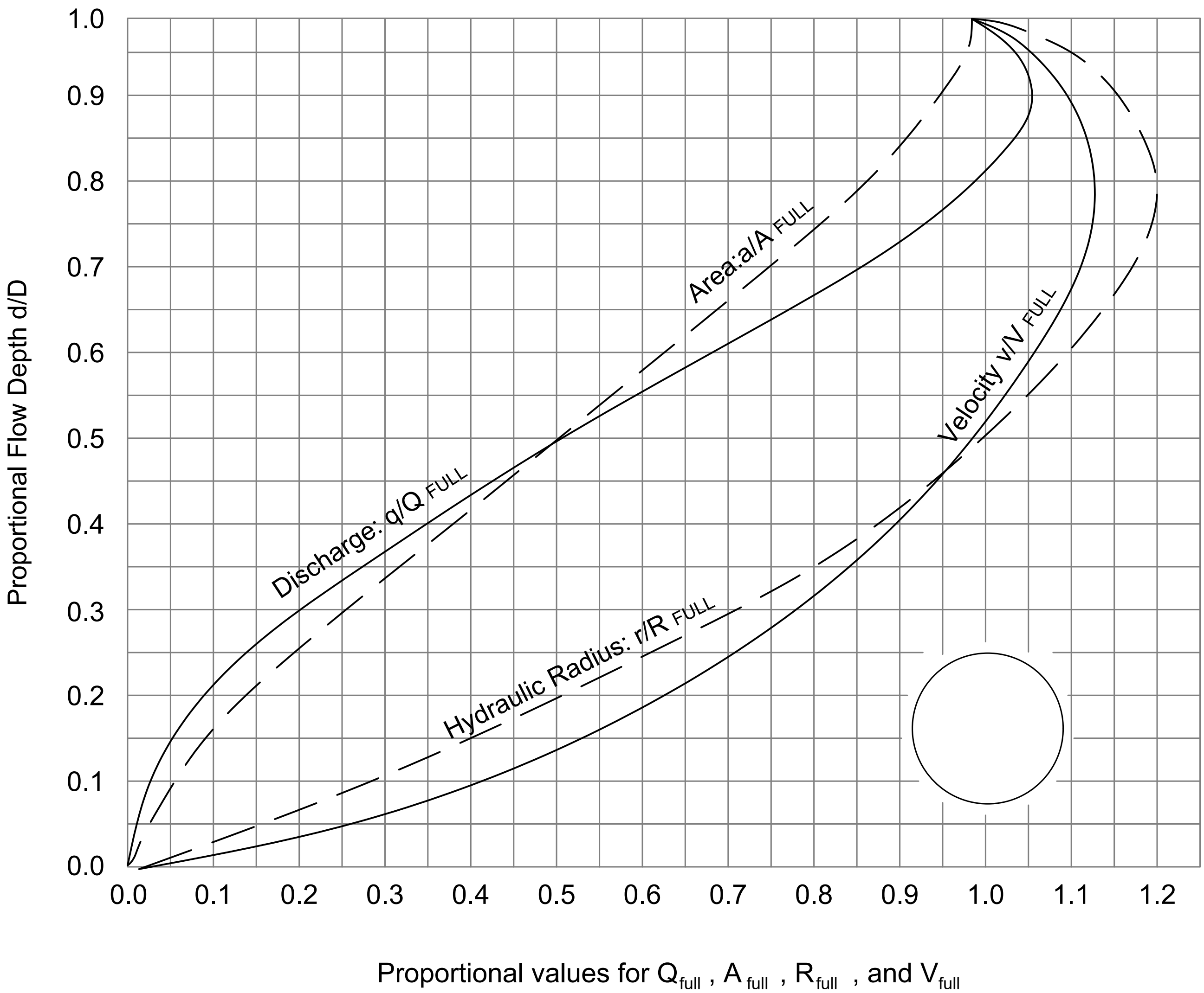
PROJECT FOLE No: ____________

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)		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	
												SEC TION	ACCUML													U.S.	D.S.

OXFORD COUNTY STANDARD DRAWING	REV#: 1
STORM DESIGN SHEET	12/2025
	FIG. 5.01

Oxford County
Growing stronger together

PREVIOUSLY FIG 5.1



OXFORD COUNTY STANDARD DRAWING

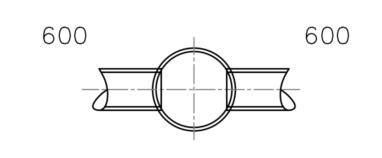
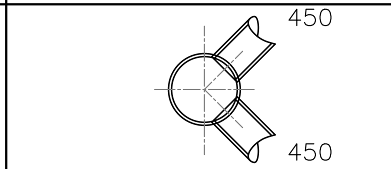
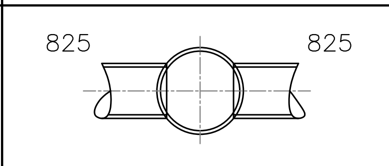
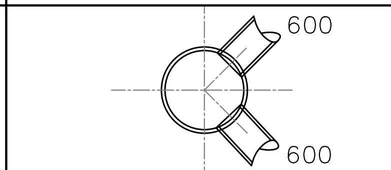
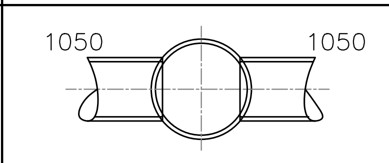
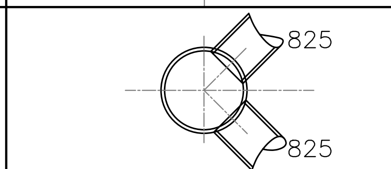
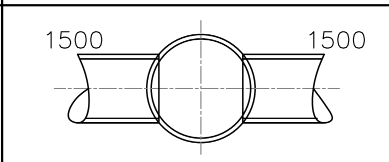
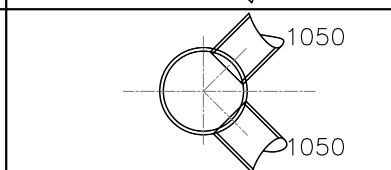
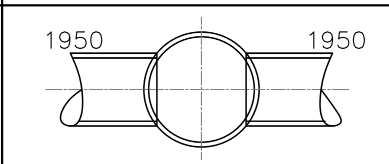
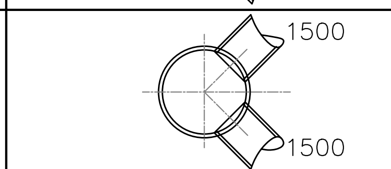
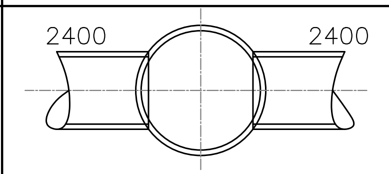
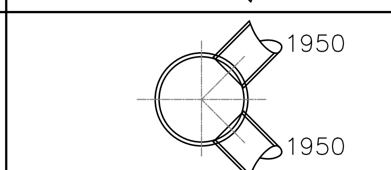
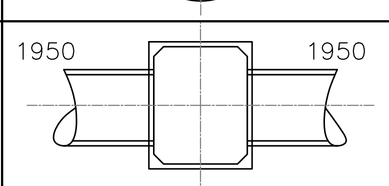
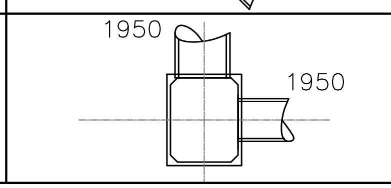
REV#: 1

12/2025

HYDAULIC ELEMENTS
OF CIRCULAR PIPE

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	 600 600	 450 450
1500	 825 825	 600 600
1800	 1050 1050	 825 825
2400	 1500 1500	 1050 1050
3000	 1950 1950	 1500 1500
3600	 2400 2400	 1950 1950
3000 x 2400	 1950 1950	 1950 1950

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	Oxford County Growing stronger together
MAXIMUM PIPE SIZES FOR PRECAST MAINTENANCE HOLES	12/2025	
	FIG. 5.03	

PREVIOUSLY FIG 5.3

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Oxford County
Growing stronger together

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6 WATER

6.1 GENERAL

The current Ontario Provincial Standards, American Water Works Association Standards, Canadian Standards Association, and Ministry of the Environment, Conservation, and Parks (MECP) Guidelines for Drinking Water Systems provide the minimum requirements that must be met. In addition, the following criteria must be included in the Design presented for approval to the **County of Oxford Public Works**. If there is a discrepancy between the County Specifications and the MECP Guidelines, then the **County of Oxford Public Works** shall be contacted to resolve the issue. Any deviation from these specifications must be submitted in writing to the **County of Oxford Public Works** for approval.

In areas of suspected soil contamination or high groundwater, a geotechnical investigation will be required. 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. The report shall be completed by the Developer's Geotechnical Engineer during the design of the project and the appropriate measures including for corrosion protection are to be incorporated in the contract. The soils investigation report is to be made available to the County for review and comment prior to finalization.

The City of Woodstock and Town of Tillsonburg are Service Providers for The County. Oxford County Design Guidelines are to be followed for all 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. The County and its Service Providers shall inspect all commissioning of watermains and service installations on both public and private property in their respective locations. 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.

6.1.1 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 watermain 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 watermain 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 watermain 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 wastewater 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 watermain 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.

6.2 WATER DISTRIBUTION SYSTEM DESIGN

These standards cover the requirements for the design of water distribution systems.

6.2.1 Watermain Design

All watermains shall be designed in accordance with these standards as well as the other standards referenced in **Section 6**.

The County's water distribution system exists for the purpose of distributing potable water. Private supplies of potable or non-potable water may not be cross connected to the County's water distribution system. The Developer must adhere to By-Law No. 6544-2023 for Cross Connection Control and Backflow Prevention.

All proposed developments shall provide the County with a Functional Servicing Report complete with proposed water and fire flow demands. The report shall include a watermain layout as a PDF, as well as CAD and/or Shapefiles. The Functional Servicing Report will review the development's proposed demands to ensure the proposed layout can meet the criteria noted below. Oxford County will complete a review of the development within the County's water distribution system model to verify the proposed layout, pipe sizing, and identified results is sufficient to service the development within the overall system. All new subdivisions and large-scale developments will require a hydraulic water model developed for their distribution system. Refer to **Section 6.2.2** for more details.

The County's Water Services Division will review and provide commentary on all new development, including water systems on private property as part of the site plan review process.

6.2.1.1 Watermain Classifications

Watermains within the County are classified as follows:

- Distribution Main: Watermain with a nominal diameter of 300mm and smaller.
- Transmission Main: Watermain with a nominal diameter larger than 300mm.

6.2.2 Hydraulic Modeling

6.2.2.1 General

The County has adopted InfoWater Pro as its standard for hydraulic modelling. Other software packages may be used for analysis and reporting, but all model input files provided to the County must be directly readable by InfoWater Pro without modification. The accuracy and readability of the input files are the sole responsibility of the Developer.

The model shall include all watermains 50mm diameter and larger, hydrants, centerline road elevations at nodes, control valves (pressure reducing valves, flow regulating valves, check valves), reservoirs and booster pumping stations.

For phased developments, a hydraulic model incorporating the distribution system for each phase shall be submitted during the application for the first phase of the development. It should be noted that phases will need to match with anticipated requests for conditional approval to be made. Where a submission is made at a later date for a phase which doesn't match a phase considered during the design studies approval process, additional hydraulic modelling will be required at the cost of the Developer and may be subject to additional review fees by the County. The County may require hydraulic modeling analyses beyond the development boundaries in situations where the operation of existing water system facilities such as control valves, reservoirs and pumping stations, are influenced by changing demands in the new development.

The model report shall also include calculations to ensure water quality in the subdivision during each of the phases and ultimate buildout as well as in any temporary or permanent dead-end watermains and specify the installation of automatic flushing devices as required.

As a minimum, the model submission to the County must include a steady state hydraulic analysis for each proposed development phase under the following demand conditions:

- Average day
- Max Day
- Peak hour
- Maximum day plus fire flow

All Hydraulic reports shall include detailed maps/layouts of the watermain system (valves, hydrants, etc.) and shall clearly show the pipe and node numbering.

Extended period simulations are not required unless specifically requested by the **County of Oxford Public Works**.

6.2.2.2 Information Provided by the County

County of Oxford Public Works will provide minimum steady-state pressures at the connection node(s). The designer is cautioned that only the pressures provided by the County will be acceptable for the model. Use of fire flow tests are permitted when requested **by The County's Water Services Division**. These tests may only be used as a reference as they are not representative of design flow conditions. Fire flow tests are not to be older than 2 years. **The County's Water Services Division** may require new fire flow tests to be completed if the area has seen growth since the last tests.

6.2.2.3 Hydraulic Model Input Standards

.1 Units

When inputting data into the model, the following units shall be used with the required accuracy.

Table 6-1 Units and Accuracy

Parameter	Units	Accuracy
Elevation	Metres	x.xx
Length	Metres	x.x
Diameter	Millimetres	X (hard conversion)
Demand	Litres per second	x.xxxx
Tank Diameter	Metres	x.
Tank Volume	Cubic Metres	x.xx
Pressure	Metres (of water)	x.xx
Power	Kilowatts	x.xx
Time	Hours	x.xx

.2 Node Elevations

In meters to geodetic datum. Finished centerline road elevations and / or estimated final grading contours are required.

.3 Node and Link Identification

Nodes and links are to be graphically identified on a map.

.4 Demands

Use average day demands and global demand multipliers for demand patterns.

6.2.2.4 Submission Requirements

Submit electronic versions of the following files in InfoWater Pro or EPANET format:

- The model input file for each design scenario (ADD, MDD, PK HR, Max Day + Fire Flow).
- The map or shape file of the modelled system.

- Submit a report, sealed by a Professional Engineer licensed to practice Engineering in the Province of Ontario, including:
- A summary of the demand scenarios and points of connection to the County system.
- A network map (in colour) for each scenario which identifies node and link numbers.
- Node tables for all scenarios listing node numbers, elevation, demands, and pressures.
- Link tables for all scenarios listing link numbers (with up and downstream nodes indicated), diameters, lengths, roughness, velocities, flows, head losses, and age of water calculations.
- For multi-phase developments, provide model data and summaries for all phases as part of the first phase submission.

Reports containing results that indicate operating parameters outside the acceptable Design Criteria will be automatically rejected without further review and returned to the Owner for correction.

6.2.2.5 Review by the County of Oxford Public Works

County of Oxford Public Works will review the report and advise on the need for any further analysis to be carried out at the Developer’s cost. Subsequent submissions with alterations to the original (i.e. changes to street layout, pipe sizes, pumps, elevations, demands, type of development, etc.) will be subject to additional Water/Wastewater System Capacity Assessment/Hydraulic Modelling. Additional fees will apply.

6.2.2.6 Request to Change Settings of Automatic Flushing Devices

The Developer based on partial buildout of a subdivision. This request should be submitted to the **County of Oxford Public Works,** who upon approval will forward it to **Water Operations** for the purpose of making the change to the automatic flushing device settings.

The water distribution system shall have been modelled fully, including for this stage or phase of subdivision buildout, demonstrating the required settings to achieve the necessary water quality.

6.2.3 Design Criteria

6.2.3.1 Design Water Demands

.1 Definitions

Average Day: The total amount of water demanded within one year divided by the number of days within that year.

Maximum Day: The average water demand over the day (midnight to midnight) of highest water demand within one year.

Peak Hour: The highest short-term (1 hour) demand within a system not including fire flow. The peak hour is normally the highest hourly demand on the maximum day.

Domestic: Any non-fire water use.

.2 Domestic Water Demands

Average day domestic residential demand and peaking factors for design shall be as per the MECP Design Guidelines for Drinking-Water Systems.

For Design purposes, the following densities shall be used:

Table 6-2 Design Population Densities

Type of Use	People/ Unit
Low density residential	3 people per unit
Medium density residential	2.4 people per unit
High density residential	1.6 people per unit

.3 Commercial, Institutional and Industrial Water Demands

Non-residential demands and peaking factors can be referenced from the MECP Design Guidelines for Drinking-Water Systems. Institutional and commercial flows should be determined by using historical records, where available. For industrial, when the type of industry is known, discussions should be held with representatives of the industry to determine water requirements. These demands vary greatly with the type of water-using facilities or processes present in the development. For industrial demands the designer shall discuss water requirements with the **County of Oxford Public Works**.

.4 Friction Factors

The following Hazen-Williams "C" values, which include an allowance for age, shall be used for the following materials:

Table 6-3 C-Factor for Materials

Pipe Diameter	C- Factor
PVC/PVCO	150
DI	130
CPP	140
HDPE	140

If the watermain material has not been determined at the time of watermain sizing, a "C" factor of 130 shall be used.

6.2.3.2 Fire Flow Requirements

The Fire Underwriters Survey (FUS) and National Fire Protection Association (NFPA) publishes the most common methods for the calculation of the required fire flow in Ontario. The FUS method is also endorsed by reference in the Ontario Building Code and the Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Drinking Water Systems.

Oxford County water systems vary in size, capacity, and complexity. In some cases, systems have not been designed for fire protection.

In systems that are not fire rated, the Developer may require onsite storage for fire protection such as a standpipe or cistern for site plan development to proceed. In this instance the local Fire Department will require input in consultation with Oxford County. All costs associated with this will be the responsibility of the Developer.

In systems designed for fire protection that are unable to achieve the required fire flows for the development, additional onsite storage such as a standpipe or cistern to augment fire flow shall be required for site plan development to proceed. In areas where pressures are below requirements to support fire suppression such as sprinklers, onsite storage and fire pumps to augment these pressures shall be required for site plan development to proceed. All costs associated with these measures will be the responsibility of the Developer. For subdivision developments, booster pump stations may be required to achieve the required fire flows while maintaining optimal pressures. In all instances listed, consultation with Oxford County will be required.

Justification and rationale should be provided on whether the subject site meets or does not meet the required fire flow based on both calculation methods.

.1 Non-Sprinkler Buildings

The applicant must provide:

- NFPA 1 and FUS Calculations (complete with exposure charges) for the Required Fire Flow (RFF) of the proposed building. The Available Fire Flow (AFF) to the subject property, considering hydrant coverage, must be greater than the calculated RFF; or,
- Ontario Building Code (OBC) Method for Fire Flow Calculations

Q = Required water supply in litres

$Q = KVS_{Total}$

.2 Sprinkler Buildings

An applicant must provide:

- an NFPA 13 calculation for the sprinkler demand and hose stream allowance; the calculation must clearly delineate the sprinkler demand from the hose stream allowance; and
- an NFPA 1 and FUS Calculation (complete with flow credits for the sprinkler system and exposure charges) for the Required Fire Flow (RFF) of the proposed building; the calculation must clearly delineate the flow credits for the Sprinkler System and Exposure Adjustment Charge component within the total RFF. As per NFPA1, for a building with an approved fire sprinkler system the fire flow demand (NFPA1) and fire sprinkler demand (NFPA13) shall not be required to be added together.
- The Available Fire Flow (AFF) to a subject property is allocated on a priority basis first for public fire department use for exposure control and secondly for private use for on-site suppression systems. The flow required for Exposure Control must be available from nearby hydrants for public use prior to and independent of any hydrants being made available for private use in accordance with Ontario Building Code requirements; or
- Ontario Building Code (OBC) Method for Fire Flow Calculations

Q = Required water supply in litres

$Q = KVS_{Total}$

In addition to the above, these are the minimum fire flow requirements for development:

- 75 L/s Single Family Dwelling - Detached
- 133 L/s Semi-detached / Townhouse / Row house (based on 2 storeys)
- 159 L/s for Design of new Booster Pump Stations and new pressure zone

Industrial, Commercial, Institutional Development, and multi-residential shall be calculated as required on a case-by-case basis according to requirements of the Ontario Building Code (OBC) and in accordance with the specifications in Oxford County's Engineering Design Guidelines. In the event of a discrepancy between these documents, the more stringent requirements shall apply.

6.2.3.3 Pressure and Flow Requirements

Watermains shall be sized to maintain the greater of:

- Maximum hourly demand at a pressure not less than 275 KPa (40 psi).
- Average day demand at a pressure not less than 310 KPa (45 psi).
- For systems designed for fire flow, maximum day demand plus fire flow at a pressure not less than 140 Kpa (20 psi) at any hydrant lateral or potential fire service connection. Pressure to be taken at the most critical locations. In the urban centers, design must consider the possibility of two simultaneous major fires.
- Maximum residual pressure should not exceed 550 KPa (80 psi) and a minimum residual pressure should not be below 275 kPa (40 psi).

All pressures shall be calculated/determined assuming minimum hydraulic grade line conditions apply. Refer to **Section 6.2.3.7** of this document and confirm with the **County of Oxford Public Works**.

6.2.3.4 Minimum Pipe Sizes/Acceptable Pipe Sizes

The minimum size for watermains shall be 150mm diameter except beyond the last hydrant on cul-de-sacs where smaller diameter pipe shall be used which is designed for domestic and maximum hour demands only. Refer to **Oxford County Standard Drawings**.

In distribution systems where no fire protection exists, pipe sizes of 50mm to 100mm may be acceptable, upon approval from the **County of Oxford Public Works**.

Accepted pipe sizes are 50mm and 100mm (see above), 150mm, 200mm, 250mm, 300mm, 400mm, 450mm, 600mm. For larger pipe sizes (450mm and larger), the designer should consult with the **County of Oxford Public Works**.

HDPE pipe larger than 50mm in diameter is to be used for directional drilling only.

6.2.3.5 Water Quality

Watermains and watermain networks shall be designed so that water shall not remain unused in the watermain for more than three days (72 hours) under average day demand. For phased developments, water quality shall be reviewed under all phasing conditions.

To demonstrate a three-day turnover, the designer shall provide a hydraulic analysis as outlined in **Section 6.2.2** of this document. The hydraulic analysis shall also provide calculations to determine if and where automatic flushing devices are required and determine the appropriate size of the automatic flushing device.

Oxford County and its Service Providers have a primary responsibility to ensure that the minimum chlorine residuals are maintained in the distribution system and therefore reserves the right to require watermain looping and/or automatic flushing devices and/or blow-offs to facilitate the maintenance of the required chlorine residual under the Safe Drinking Water Act.

On private property, where there is a concern that there may be degradation of the water quality (when a three (3) day water turnover cannot be achieved), the County reserves the right to require perimeter isolation (See **Section 6.2.13**). This shall consist of a testable device (DCVA) on the water service and shall be installed at the property line and at the Owner's expense. In situations where there is a concern with respect to water quality and perimeter isolation is required, designers shall also address water quality on private property. The designer is encouraged to consult with the **County of Oxford Public Works**.

6.2.3.6 Maximum Velocities

The watermain shall be sized so that the maximum velocity in the pipe shall not exceed 1.5 metres per second during maximum hour domestic flow conditions or 4.0 metres per second during fire flow conditions unless otherwise approved by the **County of Oxford Public Works**.

6.2.3.7 Boundary Conditions

For the purposes of hydraulic analysis, the designer shall contact **County of Oxford Public Works** for appropriate boundary conditions. The minimum hydraulic grade lines (HGL) for the various service areas shall be provided.

Hydrant flow testing may be used as a guideline to assist in establishing boundary conditions for new development. These tests must be 3rd party verified from a certified flow testing firm. The use of municipally conducted fire flow testing as a sole reference for design purposes is not permitted

The designer shall assume a reservoir with the appropriate HGL for water supply to the area being designed.

6.2.4 Layout of Watermain

The objective when designing and installing watermain is to have as few fittings or joint deflections as possible while meeting the requirements of the following sections.

6.2.4.1 Watermain Location within Road Allowance

Watermains are to be located in the standard location indicated on the appropriate typical road cross-section in the applicable **Oxford County Standard Drawing**, unless otherwise approved.

On watermain bends, the watermain may deviate from the standard location by up to 1.0m, provided that the deviation is towards, or closer to the street line.

Watermains shall not be located within 3m horizontally of hydro transformers, hydro poles, and light standards, or more as required by applicable Health and Safety Legislation.

Watermains installed in rural areas, easements or trail systems may require ground-mounted signage to indicate the location of a watermain. Designer shall coordinate with Oxford County Public Works to determine if signage is required on a project-by-project basis.

6.2.4.2 Watermain Pipe Depth

On curb and gutter roads, the designer should have an objective depth 1.8m when designing watermain. However, variations to depths of up to 2.2m will be permitted to address variations in topography and to avoid conflicts with other utilities. Reasoning should be provided for any areas where depth is in excess of 2.2m and such deviations shall be approved in accordance with **Section 6.1**.

On open ditch and rural roads, the minimum depth of watermains shall be the greatest of:

- 2.1m below the road centerline;
- 1.8m below the bottom of the ditch; or
- 1.8m below grade if there is no ditch

On rural roads within the County, the designer should also review the vertical alignment of the road so that, where possible, future road improvements will not result in an unacceptable watermain depth, as defined in this specification.

.1 Pipe Insulation

Thermal Insulation requirements shall be as per **Section 6.3** and **County Standard Drawings**.

Where watermain is required to be laid with less than 1.8m of cover thermal insulation shall be placed to prevent freezing. Material used to insulate mains shall have a minimum compressive strength of 690 kPa. All thermal insulation joints shall be tightly butted together and secured by tape or other means to prevent movement during backfill. Manufacturer specifications shall be provided prior to installation.

Where 600mm diameter or larger storm sewers or culverts cross over or under a watermain, insulation is required unless there is a minimum 1.8m vertical clear separation between the sewer and watermain.

Watermains and services located 500mm or less horizontally from a maintenance hole or catch basin shall also be insulated for a distance of 1m beyond each edge of the structure.

.2 Pre-Insulated Pipe

Pre-insulated watermain pipe may be used as an alternative to the slab-type insulation. This option should be presented in the initial design phase prior to construction for the approval of the **County of Oxford Public Works**. Refer to **Section 6.3** for material requirements.

6.2.4.3 Pipe Offsets/Bends/Deflection

Offsets must be made according to **Oxford County Standard Drawings**. Use of offsets must be indicated on the approved plans or in the case of unforeseen obstructions found after approval by the watermain design, written approval of the designer must be obtained.

If using joint deflection, full lengths of pipe must be used. The maximum joint deflection for various pipe materials shall be half of the pipe manufacturer’s specifications. Where it is not possible to lay pipe to the required radius utilizing joint deflection, manufactured pipe bends must be used.

Axial deflection (i.e. Bending of the pipe barrels) is prohibited for PVC pipe. Any change in the direction of the watermain in excess of the pipe joint deflection tolerance shall be made using an appropriate fitting. Thrust or joint restraint shall be provided as in **Section 6.2.4.7**.

6.2.4.4 Casings and Spacers

Where casings are required for watermain crossing bridges, roadways, railways, rivers, streams, or creeks, casing specifications shall be as set out by the governing authority.

In general, casings shall be steel plate ASTM A139 Grade B welded joint. Casing materials other than steel must be approved by the **County of Oxford Public Works** prior to installation.

Steel casings shall use the following inside diameters and wall thicknesses as listed below. The designer shall ensure that the minimum requirements noted will suit the project-specific parameters.

Table 6-4 Steel Casing I.D. and Wall Thickness

Nominal Pipe Size (mm)	Minimum Casing ID (mm) (I.D.)	Minimum Casing Wall Thickness (mm)
100	315	6.35
150	356	7.94
200	454	7.94
250	546	7.94
300	584	9.53
350	686	9.53
400	762	12.70
450	787	12.70
500	838	12.70
600	991	12.70

Casings shall be filled with clean sand. The use of Cellular Grout is not permitted.

Where watermain is located between proposed residential dwellings, it shall require fusible watermain pipe placed inside a casing. The casing shall extend the entire length of the property with valves placed on the watermain at each end of the casing for isolation purposes. Valves should be located a minimum of 3.0m from each end of the end of the casing. Where casings containing watermain are located within easements between residences, the casing shall be offset a minimum of 1.0m from the property line to avoid fence posts.

If the watermain material used inside the casing is PVC or Ductile Iron bell and spigot, all pipe bell joints inside the casing shall be restrained using approved restraints. All restraints shall be wrapped with a Petrolatum Coating System. Mechanical joints inside the casing are not permitted. Both ends of the casing shall be covered using an approved wrap-around or pull-on rubber end seal to prevent backfill from entering the casing.

When watermain is placed inside a casing, the watermain shall be supported by spacers using the centered configuration. The size, location, and number of spacers will be as per the manufacturer's recommendation.

6.2.4.5 Termination of Watermains

Watermains shall be terminated opposite street lines or property lines. All watermain terminations to have a 50mm blowoff with a control valve to surface. The 50mm watermain stop shall be tapped into the watermain no further than 0.5m from the cap or plug to release trapped air/pressure from the watermain prior to removal of the cap or plug.

6.2.4.6 Blow-Offs / Automatic Flushing Devices/Addressing Water Quality

The Design of the watermain shall be undertaken to ensure adequate water quality requirements are met. Refer to **Section 6.2.2** for requirements relating to Hydraulic Modelling.

Dead end watermains which are part of an interim phase of a subdivision build-out shall meet water quality requirements by:

- Demonstrating adequate turnover by use; or
- Installing an automatic flushing device.

Where an automatic flushing device is used to maintain water quality, a water meter and pit shall be installed to measure the volume of water discharge. The Owner will be charged for the water used. The designer shall provide calculations which indicate the volume of water to be discharged by the automatic flushing device and the sizing of the automatic flushing device as well as indicate the timer settings to be used. This information shall be clearly indicated on the drawing. The Owner's Contractor shall initially set up the automatic flushing device to the indicated settings. (Prior to Conditional Approval). Subsequent adjustments to the automatic flushing device when the system is operated by the County or its Service Provider shall be made by Water Operations, based on approval of information submitted by the designer.

Where an automatic flushing device is not required to maintain water quality a standard 50mm blow-off as per **Oxford Standard Drawings** will be required to allow flushing to take place.

On a cul-de-sac or similar streets, blow-offs, when required, shall terminate in the boulevard. Blow-offs must be operable without the necessity of excavating. The Developer shall provide calculations during the design phase to **County of Oxford Public Works**, which indicate the volume of water to be discharged by the automatic flushing device and the sizing of the automatic flushing device as well as indicate the timer settings to be used.

Where automatic flushing devices are intended to be used, the following limitations shall apply:

- Automatic flushing devices may not be used to discharge directly to a ditch or to the natural environment as municipal water contains chlorine.
- Devices shall be discharged to a storm sewer which in turn discharges to a storm water management pond where the remaining chlorine can be dissipated before being released or discharged to the natural environment. In any situation where there are large volumes of water potentially being discharged from an automatic flushing device, or where the receiving storm system is a sensitive system, further consultation with the County of Oxford Public Works must take place to confirm if the use of an automatic flushing device is appropriate in the situation.
- Any water discharged from an automatic flushing device must have a free chlorine residual of 0.0 mg/L (i.e. no detectable level of chlorine). Acceptable means of disposal is by discharge into a storm sewer or open environment (drainage ditch). All discharge shall be in accordance with the Sewer Use By-law which governs the discharge to County owned Storm Sewers. Storm sewer discharge limits specified in Area Municipalities' storm sewer Bylaw must also be adhered to. Use of dichlorination basket with sodium thiosulphate pucks is an acceptable solution for dichlorination.
- Temporary connections for automatic flushing devices (150mm) may be made directly to a storm maintenance hole or to a storm catch basin. If into a maintenance hole, the drainage pipe must outlet just above the benching, at the bottom of the structure. To remove the flushing device, the drainage pipe to the storm sewer should be fully grouted and properly bricked and mortared at the catch basin, maintenance hole or storm sewer.
- The last water service on a dead end watermain which is a permanent dead end or a temporary dead end as part of an interim phase or stage of subdivision; shall be located as close as possible to the Termination of Watermain (within 0.5m of the end or tapped into the end cap) regardless of whether there is a manual blow-off or automatic flushing device installed.

6.2.4.7 Thrust Restraint

All watermain repairs and installations shall require mechanical restraints as listed below. A mechanical thrust restraint is required on all fittings, bends, tees, hydrant tees, valves, hydrants, crosses, reducers and plugged or capped dead-ends. Thrust restraint shall be in accordance with **Oxford County Standard Drawings** and meet the material requirements in **Section 6.3**.

Mechanical thrust restraint is required in areas of Engineered fill. In areas of Engineered fill an additional restrained length of pipe shall apply to the requirements listed below.

Prior to construction all thrust restraint design shall be submitted to the **County of Oxford Public Works** for review. The results should be shown on the contract drawings along with the type of restraint to be used.

The following are minimum requirements with respect to thrust restraint:

- All fittings, bends, tees, hydrant tees, valves, crosses, reducers 100mm up to and including 250mm shall be restrained to the pipe along with a minimum of 3 full pipe length joints (18m) measured from each side of appurtenance.

- All 300mm up to and including 400mm fittings, bends, tees, hydrant tees, valves, crosses, reducers shall be restrained to the pipe along with a minimum of 4 full pipe length joints (24m) measured from each side of appurtenance.
- Plugged or capped dead ends 100mm up to and including 250mm shall be restrained to the pipe along with a minimum of 3 full pipe length joints (18m) measured from the end of pipe.
- Plugged or capped dead ends 300mm up to 400mm shall be restrained to the pipe along with a minimum of 4 full pipe length joints (24m) measured from the end of pipe.
- All 400mm plugged or capped dead ends shall be restrained to the pipe along with a minimum of 5 full pipe length joints (30m) measured from the end of pipe.

In addition to manufacturer's specifications and where possible full lengths of pipe shall be placed each way from all fittings to the lengths listed above. Any joints encountered in the restrained lengths listed above from fittings, bends, tees, hydrant tees, valves, hydrants, crosses, reducers and plugged or capped ends shall be restrained.

Where fittings, bends, tees, hydrant tees, valves, crosses, or reducers are connected or adjacent to existing infrastructure, joints on the existing system shall also be restrained to the lengths listed above.

Pipe larger than 400mm shall be restrained as per the pipe manufacturer's recommendations, but shall also include the requirements above at a minimum. Shop Drawings submitted by the pipe manufacturer shall include:

- Letter of Compliance
- Pipe design calculations
- Summary of fittings and method of restraint
- Installation Guide
- Tabulated Layout Drawings indicating restrained lengths for fittings and valves stamped and signed by a Professional Engineer licensed to practice Engineering in the Province of Ontario

On vertical offsets due to conflicting utilities such as sewers, the pipe shall be backfilled before the watermain is pressurized. **County of Oxford Public Works** reserves the right to specify the use of mechanical restraint and/or concrete thrust blocks.

6.2.4.8 Watermain and Other Utilities Separation

Designers should refer to Ontario Ministry of the Environment, Conservation, and Parks (MECP) Guidelines for the Design of Water Distribution Systems (latest revision) and the Ontario Plumbing Code (latest revision) regarding the location of watermains and water services relative to sewers and to the Public Utilities Act of Ontario regarding the location of watermains relative to other utilities.

A Subsurface Utility Engineering (SUE) investigation shall be completed and paid for by the Developer for the complete project area including test pits at critical crossing locations or as requested by the **County of Oxford Public Works**. SUE investigations shall be provided based on **ASCE 38-02** Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data.

Encroachment of utilities, structures, sewers and/or any utility appurtenances, which may impact the watermain, the integrity of its bedding, and/or structural capabilities, shall have design considerations applied to adequately protect the watermain and the utilities.

It is preferable that utility crossings be at a 90-degree angle to reduce the supporting lengths required during construction.

.1 Parallel Installations of Watermains and Sewers

Sewers and watermains located parallel to each other should be constructed in separate trenches maintaining the maximum practical horizontal separation. Separation of watermains and sewers shall be in accordance with **MECP F-6-1** Procedure to Govern Separation of Sewers and Watermains.

.2 Crossings of Watermains and Sewers

Separation of crossing watermains and sewers shall be in accordance with **MECP F-6-1** Procedure to Govern Separation of Sewers and Watermains.

If the watermain is less than 1.8 metres below grade at the crossing, the watermain shall be insulated in accordance with **Oxford Standard Drawings**.

6.2.4.9 Looping of Watermain/Supply Redundancy

Water distribution systems shall be designed to avoid dead end pipes wherever practical. Dead end pipes shall meet the requirements in **Section 6.2.4.6**.

Watermains on dead end streets where the watermain length would exceed 150m shall be looped, where possible. Water distribution systems shall be designed so that no more than 40 units with individual water services and meters shall be serviced without looped connections to existing or proposed streets. If the looped watermain is connected to a dead-end watermain, a line valve must be installed on the dead-end watermain at the connection point to permit isolation of supplies.

On new streets where lots are serviced without looping, the watermain design shall provide a minimum fire flow based on the type of buildings (i.e. residential, industrial, commercial, or institutional).

Where looping or supply redundancy is proposed to be achieved from two watermains/supply sources, the hydraulic modelling must include scenarios whereby each water supply source would be a single source of supply, and the watermains shall be sized accordingly.

For requirements for looping for private property, see **Section 6.2.7.5**.

6.2.5 Line Valves

6.2.5.1 Location and Spacing of Watermain Valves

.1 Residential Developments

For watermains servicing residential developments, valves shall be located so that any section of watermain serving up to a maximum of 60 residential water services can be isolated by operating not more than four valves. The phasing of development should be considered, and valving should be logical (i.e. at intersections). In residential areas, valves shall be spaced no more than 250m apart.

.2 High Density Residential, Commercial and Industrial Developments

For watermains servicing high density residential, industrial, and commercial areas, valves shall be located to be no more than 150m apart.

.3 Transmission and Sub-Transmission Watermains

Watermains larger than 400mm should have valves at 400m intervals and at all road crossings. Tracer wire test stations for locating purposes shall be installed a maximum 500m after each valve. Tracer wire test stations to be located a maximum of 500m apart.

The **County of Oxford Public Works** may permit larger spacings on a project-specific basis.

Valves on 400mm diameter watermains do not require chambers unless valves are placed in locations where check valves with bypasses are installed, or butterfly valves are used. Valves on watermains larger than 400mm require chambers complete with bypass piping, and chambers shall be sized accordingly. Valve chambers shall have a 300mm deep sump pit for drainage purposes.

.4 Intersections of Watermains

Valves shall be located at all intersections. At cross intersections a minimum of 3 valves shall be installed and a minimum of 2 valves shall be installed at tee intersections. The valve locations shall be on the extension of the street line. If necessary, adjustments in the field can be made to avoid curbs or other obstructions that may interfere with valve placement.

At intersections where smaller watermains connect to larger transmission or sub-transmission watermains, each smaller watermain shall be valved with an isolation valve whereas the larger watermain shall be valved as required above.

.5 Valves for Looped Services/ Private Watermains

Valves shall be installed on looped services or private watermains to isolate buildings or groups of buildings so that no more than 80 individual water services or apartment complex containing 300 dwelling units, or more are on any one valved section. The Developer shall install a valve on the street watermain between connections to a looped private watermain if there is not an existing valve, at no expense to the County.

.6 Crossings of Watermain, Rivers, Railways, Controlled Access Highways, Bridges

Watermains crossing rivers, railways, controlled access highways and between residential dwellings shall be valved on each side of the crossing.

.7 Hydrant Laterals

Valves shall be located on all hydrant laterals according to **Oxford County Standard Drawings**.

.8 Location of Valves at Intersections with Roundabouts

Water valves may be placed within the raised roundabout island where possible. However, if placement of the valves creates a potential conflict with the curb & gutter of the island, then the valves are to be placed in the boulevard clear of the curb and gutter of the approaching streets.

.9 Valve Boxes and Extensions Rods Required

All valves shall be provided with valve boxes. Valve extension rods shall be as detailed in the **Oxford County Standard Drawings**.

6.2.5.2 Valve Locations - Phasing of Subdivision Developments

Valves shall be located to meet the requirements of **Section 6.2.5.1**. The location and quantity of valves shall be taken into consideration to reduce shutdowns and inconvenience to customers during the construction of additional phases. Valves may be installed on a temporary basis and relocated to accomplish this.

6.2.5.3 Sizing of Valves

Valves shall be sized to be the same size as the watermain on which the valve is installed. Downsizing valves to one size smaller than the main is not permitted.

6.2.6 Fire Hydrants and Fire Department Connections

All fire hydrants situated within the road allowance are the sole property of Oxford County and shall be operated only by Oxford County and its Service Providers. The operation, connection and use of hydrants are regulated under By-Law No. 6544-2023.

Fire hydrants and valves shall be installed in accordance with **Oxford County Standard Drawings**.

For more information on required fire flows refer to **Section 6.2.3.2**.

6.2.6.1 Fire Hydrants and Fire Department Connections

All new public hydrants shall be flow tested and colour coded in accordance with the requirements of NFPA 61. Colour coding is for the purpose of indicating available fire flows at 20psi residual pressure. Colour coding shall be by means of placing reflective markers on each of the two 65mm hydrant outlets. In new subdivisions and site plans, the designer shall create a table on the drawings for fire hydrants and their colour coding marker.

Fire hydrant extensions as required for deeper bury are to be obtained from the fire hydrant manufacturers. A maximum of one 300mm extension is permitted per hydrant.

Hydrants shall be plugged when installed in areas of high groundwater. Plugs to be installed by manufacturer. Hydrants with plugged drains must be clearly marked and pumped dry after each use.

Upon completion of each phase of development, the County of Oxford requires that all fire hydrants be flow tested. Records of field test data must be submitted prior to commencement of the maintenance period. Testing will be completed in the presence of a licensed operator from the County or the County of Oxford’s service provider. It is understood that as phasing of developments progress, hydrant flow rates may change (i.e. dead ends to looped connections). These locations shall be re-evaluated in the presence of the County or its Service Provider.

It is the responsibility of the Contractor or Developer to confirm hydrant flow rates of all hydrants in the development prior to final acceptance. All costs associated with testing will be the responsibility of the Contractor or Developer.

Table 6-5 Hydrant Class Specifications

Class	Rated Capacity	Colour (NFPA 61)
Class AA	5700 L/min or greater	Light Blue
Class A	3800-5699 L/min	Green
Class B	1900-3799 L/min	Orange
Class C	1900 L/min or less	Red

6.2.6.2 Location/Spacing of Hydrants on Public Streets

The maximum allowable hydrant spacing is 180m in single family residential areas and 90m in commercial, industrial, institutional, and multi-family residential areas.

A hydrant shall be located at all intersections, where possible. Hydrants shall be installed at a minimum of 1.5m from the edge of driveways in residential areas, and 2.5m away from driveways in industrial, commercial, and institutional areas. Minimum clearance from sidewalks to hydrants is 0.6m. Hydrants located in residential areas shall be located on a common lot line.

Hydrants shall be placed in the road boulevard in accordance with the applicable typical cross-section provided in the applicable **Oxford County Standard Drawing**. Hydrants shall be a minimum of 1.5m away from other underground utilities.

Where possible, hydrants should be located at the high point of the watermain. The County reserves the right to request additional hydrants if necessary.

The location of hydrants on private property is subject to the requirements and approval of the **Area Municipality Fire Department** in accordance with the Ontario Building Code.

6.2.6.3 Location of Hydrants to Sprinkler or Standpipe Systems

For use with sprinkler or standpipe systems the hydrant must be located not more than 45m from the Fire Department connection.

6.2.6.4 Hydrants on Dead-end Streets

Hydrants shall be located on dead end streets in accordance with **Oxford Standard Drawings**.

6.2.6.5 Addition or Relocation of Hydrants

Regardless of hydrant location shown on accepted subdivision plans, additional hydrants may be required, or existing hydrants may have to be relocated due to circumstances unknown at the time of plan acceptance such as the position of a structure, Fire Department connection, driveway or landscaping feature.

Such an addition and/or relocation shall be requested when the County approves the service plan and must be done at the expense of the Developer or, if the subdivision has been assumed, at the expense of the Owner of the property for which the additional or relocated hydrant is required.

6.2.6.6 Hydrants on Private Property

Hydrants shall be located on private property where required to meet spacing requirements in accordance with the Ontario Building Code, subject to the approval of the **County of Oxford Public Works**.

Fire hydrants shall be installed such that they are readily accessible to the fire department. For average conditions, fire hydrants shall be placed at least 12.2m from the buildings being protected, in accordance with NFPA 24.

Fire hydrants shall be located at a minimum distance of 3.0m from a fence or other such obstruction.

Fire hydrants shall not be placed near retaining walls where there is danger of frost through the wall, in accordance with NFPA 24.

Where municipal water is not available, and an on-site water supply is utilized for firefighting purposes, a fire hydrant shall not be installed, but instead a standpipe connection shall be provided.

The cost for the supply and installation of hydrants located on private property must be paid by the property Owner.

All private hydrants should be painted red and are the responsibility of the Owner.

6.2.6.7 Hydrants for Fire Department Connections

Follow the requirements set out in the Ontario Building Code.

6.2.6.8 Protection of Hydrants

If the placement of a hydrant on public or private property is such that it will be susceptible to damage by vehicular traffic, bollards are to be installed, at the Owner's cost, in sufficient number to protect the hydrant. Minimum spacing between any bollard and a hydrant shall be 1.0 metre, and bollards shall be a minimum of 1.0 metre in height. Bollards shall be painted hydrant yellow. Bollard construction to be steel with concrete fill.

6.2.6.9 Illegal Connection and Operation of Hydrants

The illegal connection and/or operation of any municipal fire hydrant will result in fines as set out in the **Oxford County By-Laws**.

6.2.7 Water Services, Fire Services and Private Watermains

For the design and materials requirements for all water service pipe and fire service mains on private property, the Ontario Building Code shall apply. It should be noted that water quality requirements are not addressed in the Ontario Building Code. Where there is a concern that there may be a degradation of water quality in the private servicing that has the potential to enter the municipal water supply system, the **County of Oxford Public Works** reserves the right to require premises isolation. Premises isolation shall consist of appropriate backflow prevention measures (Refer to **Section 6.2.13**) and shall be installed at the property line at the Owner's expense. The Developer must adhere to By-Law No. 6544-2023 for Cross Connection Control and Backflow Prevention.

The Owner will be responsible for water service sizing. The **County of Oxford Public Works** shall be consulted for available pressures and flows at the watermain under design conditions given in **Section 6.2.3.3**. If the results of hydrant flow tests are to be used, **County of Oxford Public Works** shall be consulted for necessary adjustments since flow tests are not usually done at design conditions.

On private property, adequate water required for fire protection shall be determined in accordance with the Ontario Building Code. Fire flow and hydraulic calculations shall be reviewed by the **County of Oxford Public Works**.

It is a requirement to provide fire flow information (i.e. hydrants on private property and fire sprinkler requirements) in conjunction with site plan submissions for water servicing to determine the correct water service sizing.

Both the main stop and curb stop shall be shown on site plan submissions and service record sheets.

6.2.7.1 Service Size for Single Family Residential Homes

The minimum service size for single family residential homes shall be 25mm. It is recommended that the Owner adjust the water service sizing based on flow requirements for water services to single family homes which are estate lots, larger homes, have deep setbacks, are at the ends of cul-de-sacs, are in areas of lower pressure, or where automatic lawn sprinkler systems or fire sprinkler systems are to be used.

As required by the Ontario Building Code on private property, the minimum size for fire service mains and water service pipes, combined with fire service mains, shall be 150mm, in accordance with NFPA 24. For mains that do not supply hydrants, sizes smaller than 150mm may be used, subject to:

- The main supplies only automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems or Class II standpipe systems.
- Hydraulic calculations show that the main will supply the total demand at the appropriate pressure. Systems that are not hydraulically calculated shall have a main at least as large as the riser.

.1 <u>Accepted Water Services Sizes</u>

Acceptable water service sizes are 25mm, 32mm, 38mm, 50mm, 100mm, 150mm, 200mm, 250mm, and 300mm diameter.

6.2.7.2 Individual Booster Pumps

In some areas of the County, pressures within the existing system may be less than the minimum pressures under **Section 6.2.3.3** or due to the height of building**.** In these cases, the use of an internal booster pump and/or pressure tanks may be required, see section 6.5.1 for residential pump model recommendations. The sizing, design and installation of an individual booster pump would be the responsibility of the Owner. Any private booster pump would be the responsibility of the Owner upon completion. Information on system pressures at points of supply should be obtained from the **County of Oxford Public Works**.

6.2.7.3 Individual Pressure Reducing Valves

In some areas of the County, pressures within the existing system may be more than the maximum pressures under **Section 6.2.3.3**. In these cases, the use of an internal pressure reducing valve (PRV) may be required. This would be the responsibility of the Owner upon completion. Information on system pressures at points of supply should be obtained from the **County of Oxford Public Works.**

6.2.7.4 General Requirements - Water Services

Water service shall mean the pipe, fittings and shut off valve that convey potable water from a connection on a watermain or private watermain to the meter location.

Water services larger than 25 mm diameter must be hydraulically modelled for sizing based on required demand as supplied by the Owner, Developer, or Contractor.

.1 <u>Water Services to Residential Dwelling Units (Detached, Semi-detached, Townhouses, Row-housing)</u>

Each dwelling unit in a detached, semi-detached, townhouse or row house block, must be serviced with a separate water service connected to a watermain or private watermain with shutoffs placed on the property line.

- Water Services must front the dwelling unit including on private sites connecting to a private watermain
- No trees, shrubs, landscaping, garbage containers, compost devices, or other obstructions shall be located on top of or near the water services
- The curb stop shall remain clearly visible and unobstructed.
- The development agreement and condo declaration shall specify: All defects to the private watermain, or beyond the curbstop, shall be repaired by the Owner of the premises. Should the County become aware of any such defect, and upon written notification to the Owner, the said defect is not repaired, within seven days of the date of the notification, then the County may turn off the water supply to the Premises. If the County is ordered under statutory authority to restore the water supply, then the County may repair the defective service extension, private main and meter pit and charge the cost to the Owner and collect such cost according to law, and until paid, such cost shall remain a lien on such Premises, and may also be collected in the like manner as taxes. The Owner shall be held responsible for the cost of restoration.

.2 <u>Water Services to Commercial/Industrial Malls</u>

Each structure in a commercial or industrial mall shall have one water service connected to a watermain or private watermain. Units in such a mall may have an individual water service connected to a watermain or private watermain outside the unit.

.3 Water Services to Swimming Pools/ Lawn Sprinkler Systems

Swimming pool facilities and lawn sprinkler systems must be serviced by connecting to the metered side of a water service that is within a heated structure.

Connections to lawn sprinkler systems are to have backflow prevention devices in accordance with CAN CSA B64 and are subject to the approval of **the County of Oxford Public Works.** Direct Pool Makeup Water Connections are to have backflow prevention devices in accordance with CAN CSA B64 and are subject to the approval of **the County of Oxford Public Works.**

All fixtures are required adhere to By-Law No. 6544-2023 for Cross Connection Control and Backflow Prevention.

.4 Water Services to Other Structures

Unless otherwise approved in writing by **the County of Oxford Public Works**, all structures not covered in the sections above, including commercial, industrial and institutional facilities, shall have one water service connected to a watermain or private watermain.

.5 Water Services to Ancillary Buildings:

Where a secondary dwelling unit is added in an ancillary building on the same property and where the municipal water service is adequately sized to provide water servicing to the single-family home and the ancillary unit, the water servicing to the ancillary secondary dwelling unit may be branching from the water line as above downstream of the water meter, complete with a shut of valve.

Where a secondary dwelling unit is added in an ancillary building on the same property and where the municipal water service is not adequately sized to provide water servicing or the single-family home and the ancillary unit, or where the water service material is lead, a new water service from the municipal water main to the ancillary unit will be required, at the Developer's cost. The new water service shall have a shut off valve and meter pit installed, located 300mm from the property line on the City right-of-way.

.6 County to Designate Watermain to Provide Service

When there are two watermains on a road allowance, the water service shall be laid from the structure to the watermain which, in the opinion of the **County of Oxford Public Works**, provides adequate flow and/or pressure.

Water services shall not be tapped off transmission watermains 600mm and larger where an alternate source is available.

.7 Water Services to Residential Apartment Buildings (5 dwelling units or more)

Apartment buildings (5 dwelling units or more) shall have one metered water service connected to a watermain or private watermain.

.8 Water Services to Residential Dwelling Units in Townhouse/Condominium Blocks

Each dwelling unit in a private block must be serviced with a separate water service connected to a watermain or private watermain. Water services must front the dwelling unit they service unless otherwise approved in writing by the **County of Oxford Public Works** (refer to **Section 6.2.7.4.2**.

Where it is proposed that servicing of individual dwelling units is not in accordance with the standard above, bulk metering of the site at the point(s) where the water service enters the property will be required. Individual metering of dwelling units by Oxford County will not be provided in this circumstance.

.9 Water Services to Multi-Family Residential Buildings

This section will describe the requirements for individually servicing/metering new or converted multi-family (4 residential units or less) residential buildings. This may include but is not limited to the following configurations:

1. An existing single-family home that has been converted to a multi-family residence such as a duplex, triplex or fourplex. The newly created units may have several different layouts such as side by side, upstairs/downstairs units, front/back, etc.
   - In this case, the building must be supplied by a water service pipe from the municipal watermain in the street to the property line that is adequately sized for the intended use of the building. The minimum water service size is 25mm for the building.
   - Oxford County allows one water service pipe from the municipal watermain to the property line with a shut off valve located on the property line of the County right-of-way. Once the water service pipe crosses the property line it can be branched off into 2-4 separate water services, one for each new customer. A meter chamber will have to be installed which will house a single Oxford County water meter. Individual metering of dwelling units by Oxford County will not be provided in this circumstance. Each branch shall have a shut-off valve located after the meter chamber on private property. From this point the water service pipes will enter the building and be connected to the building plumbing system.
2. Newly constructed building purpose built as a multi- family residence (duplex, triplex, or fourplex).
   - As described above, a single meter will be monitored by Oxford County, individual metering will not be provided in this circumstance.
3. Other multi-family (that may or not be stacked) residential condominium or rental units that cannot be serviced as described in the previous sections (**Sections 6.2.7.4.1 to 6.2.7.4.7**).
   - As described above, a single meter will be monitored by Oxford County, individual metering will not be provided in this circumstance. Regardless of the configuration of the building, it is important to understand that each metered water service consists of a water service pipe, an isolation valve and a water meter. The meter chamber is to be located in the front of the residential units being serviced and it must be accessible for maintenance.

.10 Decommissioning of Existing Water Services

Disconnection of existing water services of any size shall include removal of the valve box and valve rod and capping of any pipe to be abandoned at the watermain unless an alternate location is approved by **The County of Oxford Public Works** or its Service Providers. Where the watermain that the service was connected to remains in service, a 20mm main stop shall be added at the connection location for pressure relief. The cost of this will be the responsibility of the Developer / Owner.

6.2.7.5 Looped Water Servicing Requirements

A looped water service connected to a public or private watermain or watermains must be installed for the following scenarios:

- When one water service will not supply the required flow for domestic use and fire protection.
- For an apartment complex containing one or more structures and more than 300 dwelling units.
- For a townhouse, condominium or similar complex having more than 80 units with individual water services and meters.
- For buildings over 84m in height, two water service connections will be required in accordance with the OBC. These two water services shall be able to be isolated from each other by a valve in the municipal water distribution system.

The looped water servicing must be installed to service the private development from two sources. If the looped watermain is connected to one public watermain, an isolating splitter valve must be installed in the public watermain to permit isolation of supplies, at no cost to the County.

Where a private water system is connected to the municipal water system by two or more connections, the municipal water system shall be protected by perimeter isolation of the private system. This shall mean the installation of a testable device at the property line in accordance with **Section 6.2.13**. These devices shall be owned and maintained by the Owner.

6.2.7.6 Material Type

Material type shall be an approved material type as indicated in **Section 6.3** to the property line. On private property, material for water service pipes and fire service mains shall comply with Part 7 of the Ontario Building Code.

6.2.7.7 Location and Layout of Water Services

Water services connected to a private watermain are subject to the same requirements as water services connected to a public watermain.

.1 Single Family and Semi-Detached Lots:

The standard residential water service will be located as per **Figure 4.01** and **4.02** in the **Oxford County Standard Drawings**.

Please see **Section 6.3** for more details.

.2 Street Townhouse Blocks.

Figure 4.01 in the **Oxford County Standard Drawings** shall apply where space permits. Approval for deviations will be given on a case-by-case basis.

The water service pipe must be installed at right angles to the watermain and in a straight line from the watermain to the water meter.

.3 Water Service Pipe Depth

Water services shall have no less than 1.8m and no more than 1.9m of cover from final surface grade. Variations from this cover may be made only if approved by the **County of Oxford Public Works**. If a minimum cover of 1.8m cannot be achieved due to underground obstructions or changes in surface grade, thermal insulation must be used. Refer to **Section 6.3** and **Oxford County Standard Drawings**. No water service shall have a ground cover less than 1.0m deep from ground surface to the top of pipe.

The Owner must ensure that water services and private watermains are located so that "berm" or "mound" type landscaping will not cause excessive cover over water services.

In areas of reconstruction new watermain and services shall be installed at a minimum depth of 1.8m to the Property Line. It may be necessary to transition from the new depth to the existing depth beyond the property line, which shall be taken into consideration during design.

.4 Crossings of Existing Utilities

Water services crossing sewers or utility obstructions require a minimum of 500mm of clearance under and a minimum of 150mm over an obstruction. Insulation may be required at crossings as noted in **Section 6.2.4.2.1**.

Water services passing under Etobicoke style storm sewers wrapped in clear stone and geotextile shall require a casing or carrier pipe minimum 0.5m below storm sewer outside of the geotextile wrapping. Conduit will be centered under the storm sewer and extend a minimum of 1.2m beyond the extents of the sewer. Conduit shall be minimum 50mm ID. Length will vary depending on size of storm sewer. Material shall be HDPE or PVC. Ends of pipe shall be sealed to prevent backfill from entering the casing / conduit. Conduits placed under storm sewer shall be indicated on plan / profile drawings and as-built drawings.

6.2.7.8 Approved Deviations in Location of Water Services

Deviations from the requirements of the previous section may be approved by the **County of Oxford Public Works** for the following conditions:

.1 Cul-de-sacs, Street Curves and Bends

On cul-de-sac streets and on street curves and bends the water service stubs may be installed at angles other than 90 degrees to the watermain and will not necessarily go through the midpoint of the lot frontage. The water service must be in a straight line from the watermain to the meter.

.2 Water Service Cannot be Located in the Typical Location

Where the water service cannot be located in line with the center of the lot, the water service stub may be installed at any point on the front of the lot. It must still be installed at a right angle to the watermain and in a straight line from the watermain to the meter and must maintain the appropriate separation distances from other utilities.

.3 Water Service Cannot Extend in a Straight Line from the Watermain to the Water Meter

Under the scenarios provided above, if the water service stub has been installed on the lot frontage but the water service cannot be in a straight line from watermain to water meter then the water service extension may be installed in a straight line from the curb stop to the meter provided the meter is inside the front wall of the structure.

.4 Water Meter to be Located at the Side of a Structure

Where the water service entrance must be located at the side of a structure, the water service stub must be located on the front of the lot such that the water service extension can be installed in a straight line from the watermain to a point outside the structure adjacent to the meter. Such a water service shall be a minimum of 1.5m from the structure and centered within a minimum 3.0m wide clear space.

.5 Cold Cellar on Front of Building

Where there exists a cold cellar on the front of the building and the water service stub has been installed in the standard location on the lot frontage, the water service extension may be installed under the porch or cold cellar in a straight line from the watermain to inside the first heated wall. A maximum distance of 2 metres of water service pipe may be located under the porch or cold cellar floor slab. The water service shall be continuous between the curb stop and the water meter, with no coupling permitted. The water meter shall not be located within the cold cellar as this is subject to freezing.

6.2.7.9 Nonconforming Installation of Water Service or Private Watermain

.1 Water Service does not Conform with Location Requirements

If the water service stub is to be extended and it is found that the water service will not conform to the above location requirements in **Sections 6.2.7.7 and 6.2.7.8**, the water service stub shall be disconnected from the watermain and a new stub installed which will conform to the requirements, at no cost to the County.

.2 Water Service or Private Watermain not in Accordance with Specifications or with Approved Service Drawing

If a water service stub, a water service or a private watermain is installed that is not in accordance with these design guidelines or with the service drawing approved by the County, such installation will be required to be removed and relocated to conform with the design guidelines or approved drawings.

.3 Existing Water Service to Relocated, Rebuilt or Replaced Structures

If an existing water service cannot conform to the above location requirements, or is of lead or other unsuitable material, a new water service must be installed which will conform to the requirements of this Section. If a Demolition Permit was issued for an existing structure on the lot, then the existing water service must be abandoned at the watermain and a new water service installed to service the structure.

.4 Relocation to be at Owner or Contractor’s Expense

All relocation work required in the above Sections shall be at the expense of the Owner or Contractor. The Owner will be responsible, upon approval of the demolition permit, to cut and cap the existing water service(s) at the watermain to Oxford County standards and at no cost to Oxford County.

6.2.7.10 Fire Service Design

The determination of fire service requirements and the sizing of supply piping shall be the responsibility of the Owner. If a domestic water service is combined with a fire supply service, the Owner is responsible to ensure that the supply pipe is large enough to carry the combined demand. Design and installation of sprinkler and standpipe systems and their supply services shall conform to the requirements of the Ontario Building Code and the Fire Code. The design of the Fire Services must be approved by the County.

The Owner should obtain flow and pressure information in surrounding areas of the water distribution system from the **County of Oxford Public Works**. If the flows and pressures required are in excess of the minimum design standards given in **Section 6.2.3.3** and in excess of the actual capacity of the system the Owner shall install booster pumps and/or storage to satisfy the required demand.

Where there is a concern that there may be a degradation of water quality in the private servicing that has the potential to enter the municipal water supply system, **Oxford County Public Works** reserves the right to require premise isolation. Premise isolation shall consist of appropriate backflow prevention measures to the risk posed (i.e. check valve) and shall be installed at the property line at the Owner’s expense. The Owner shall consult with **Oxford County Public Works** to ascertain the necessary requirements for the site.

Minimum Requirements:

- If the distance from the property line to any fire hydrant results in more than one cubic meter of stagnated water volume, a single check valve must be installed 1.0m inside of property line.
- If the distance from the property line to the building’s fire suppression system results in one (1) cubic meters of stagnated water volume, a single check valve must be installed 1.0m inside of property line. This is in addition to the requirements inside the building as per the Ontario Building Code and the County’s Backflow Prevention By-Law 6544-2023.

.1 Separated Water and Fire Services

Only one service shall be taken from the watermain. Domestic service must be tapped off the fire service outside the building with separate shut-off valves, in accordance with **Oxford County Standard Drawing**.

Sprinkler and standpipe services may be combined. The Owner is advised to consult with the Insurance Underwriter before combining these services.

.2 Combined Water and Fire Services

A domestic water service may be combined with a sprinkler or standpipe service or with a combined sprinkler/standpipe service. The Owner is advised to consult with the Insurance Underwriter before combining these services. The Owner/designer is advised that water quality should be considered; domestic water demands may not achieve a sufficient turnover rate (see 7.3.5) to prevent poor water quality.

6.2.7.11 Water Service Size or Location Not Determined

Where water service stub size and/or location for any block cannot be determined prior to street construction, the **County of Oxford Public Works** will not approve installation of the water service stub.

6.2.7.12 Water Service Valves

All new water services, including replacements, shall be equipped with a new main stop and a curb stop in accordance with **Oxford County Standard Drawings** unless otherwise directed by the County or its Service Provider. The curb stop shall be provided with a service box and operating rod.

.1 Location of Water Service Valves up to 50mm Diameter

On water services of 50mm diameter and smaller, a main stop shall be installed at the watermain, and a curb stop shall be installed at the property line in accordance with **Figure 4.01** and **4.02** in the **Oxford County Standard Drawings**.

.2 Location of Valves for Water Services 100mm Diameter and Larger

For water services of 100mm diameter and larger, water service valves shall be placed in the location approved by the **County of Oxford Public Works** and in accordance with **Oxford County Standard Drawing.**

Where the watermain cannot be closed off for the water service connection, a tapping sleeve and valve will be required at the watermain. It should be noted that size on size taps (e.g. 150mm x 150mm tap) is not permitted and a tee will have to be cut in.

Where the watermain can be closed and a tee cut into it, or where a new watermain is being installed, a valve shall be installed 0.3m from and on the street side of the property line.

The requirement to use a tapping sleeve and valve or to cut in a tee to make the service connection will be made at the discretion of the **County of Oxford Public Works**.

.3 Valves for Building Complexes

In building complexes such as town housing developments or shopping plazas, where individual services are connected to a larger common service, a valve shall be placed on each individual service where it joins the common service. Valves must be easily accessible for operation and must be in accordance with drawings approved by the **County of Oxford Public Works**. Sectionalizing valves on the common service may also be required.

.4 Valves for Water Services to be Connected to a Private Watermain

Water services to structures in a complex that are to be connected to a private watermain shall have the curb stop or valve placed 3 metres from the face of the structure. If this distance locates the curb stop in the paved portion of the complex, a deviation in the curb box location may be approved by the **County of Oxford Public Works**.

.5 Locates for Curb Stops or Valves

The layout for water services must be such that the curb stop, or valve can be easily found by referring to two directional dimensions to locate the curb stop or valve at 90 degrees to the building or structure face.

.6 Water Service Control Valves Not to be Covered

The Owner shall ensure that water service control valves are not obstructed in any way, including by structures or by "mound" or "berm" type landscaping.

6.2.7.13 Water Service Entrances

Water services of all sizes shall enter through the building wall or under the wall footing into a heated area, leaving sufficient pipe and working space for meter installation.

A length of between 0.3 and 0.45 metres shall be exposed above the finished floor. The pipe shall enter the building not less than 0.15m and not more than 0.3m from the wall.

6.2.7.14 Protection from Contamination

Connections to the municipal potable water system shall be designed and installed so that non-potable water or substances that may render the water non-potable cannot enter the system. This shall be in accordance with the requirements of the Ontario Building Code, Part 7 Plumbing.

.1 Backflow Prevention Devices Required on Water Services in High Elevation Areas of the County

In some high elevation areas of the County, the Owner may be required to install a check valve on the water service to prevent backflow into the watermain in the event of a loss of pressure in the system.

The Owner will be responsible for the supply, installation and maintenance of all check valves and protective devices, at no cost to the County. Refer to **Section 6.2.13** for additional information on Backflow Prevention.

6.2.7.15 Electrical Grounding

.1 New Installations

Electrical systems of all new developments shall not be grounded to the water system. Refer to Ontario Hydro Electrical Safety Code (Section 10) for grounding requirements.

.2 Upgrade of Existing Plant

Where an existing watermain is replaced or upgraded, the grounding of electrical systems to the water service may not be adequate. It will be the Owner's responsibility to ensure grounding is adequate after the watermain is installed.

6.2.8 Water Meters

6.2.8.1 General Requirements

The costs of water servicing in Oxford County shall be in accordance with the County Water/Wastewater Schedule of Rates and Charges currently in effect.

Refer to **Sections 6.2.7.7 and 6.2.7.8** for acceptable servicing configurations. All domestic services shall be metered.

Fire services are not metered except for sprinkler systems located in individually metered dwelling units.

6.2.8.2 Supply of Water Meters and Water Meter Remote Read Registers and Meter Strainers for Services 150mm and Larger

The County or its Service Provider will supply all water consumption meters that are used for billing. The Developer shall install the meter, and the County will maintain the meter post installation.

One County Meter will be placed in each single family residential, multi-family residential, commercial, industrial and institutional building. Generally, this means one meter per individual property except for apartment condominiums which will only have one meter. Water meters up to 20mm in size will be supplied by the County and subject to the fees and charges outlined in By-Law No. 4889-2007 for each property. Accompanying all water meters will be an Electronic Radio Transmitter (ERT) device used for collecting water usage data. The ERT Device will be installed as per **Oxford County Standard Drawings.**

Secondary meters may be purchased from the County for the convenience of the Owner, as in apartment houses or multiplex units, at the Owner's request and expense. All secondary meters will be installed in a manner so that all water supplied passes through the County meter prior to passing through the secondary meter. Secondary meters will not be read, billed separately, or maintained by the County.

Strainers for 75mm and larger installations where required shall be supplied by the Developer/Owner.

The installation of the water meter shall be completed by a licensed plumber at the Owner's expense. The ERT device will be installed by the County or its Service Provider.

6.2.8.3 Location of Water Meter

The water meter shall be installed on the water service immediately inside the point of entry of the water service into the building (see **Section 6.2.7.13**). Any variation from this location must be approved in writing by the **County of Oxford Public Works**.

The Owner shall provide sufficient space for installation and maintenance of the meter. The water meter must be accessible for reading and maintenance and must be protected from freezing and other damage. In accordance with **Section 6.2.7.8.5,** water meters shall not be installed within a cold cellar. The use of meter pits or chambers for meters at property line shall be at the direction of **Oxford County Public Works**.

The meter or piping shall be no closer than 1 metre to any electrical panel or above or below any electrical panel unless provided with a meter enclosure as outlined in **Section 6.2.8.3.1**.

.1 Water Meter Enclosures

Water meters may be installed in electrical rooms provided a shield is installed between the water meter and any electrical panel located within one metre. The shield must be of metal construction (or approved alternative) and affixed securely to the wall and must be of sufficient width to isolate the water meter from the electrical panel. It must not impede the maintenance of the water meter.

.2 Meter Pits

Meter pits will be allowed only with the approval of the **County of Oxford Public Works** when no other suitable location is feasible. Meter pit design and installation must be submitted for approval as per **Section 6.2.7.4**. All costs associated with the supply and installation of the meter pit will be the responsibility of the Owner. Water meters in pits shall be in accordance with **Oxford County Standard Drawing**.

6.2.8.4 Installation of Water Meters

Water meters up to 50mm in size shall be installed in accordance with **Oxford County Standard Drawings**.

Water meters larger than 50mm in size shall be installed in accordance with AWWA C700, C701 or C702.

.1 Water Meter Valving

All new and replacement installations shall require a valve on each side of the meter for isolation purposes. The Owner must supply and install the outlet and inlet valving and any bypass valve (when required) for all sizes of meters. The Owner will be responsible for maintaining and keeping the meter inlet and outlet valving operational and in good working order.

Meter setting valves are currently only in meter pits. Valves must open counterclockwise.

.2 Meter Strainers

Should the Owner wish to install a meter they shall consult with the designer regarding the dimensions of supports required for the meter and strainer. Strainers are not supplied by the County or their service providers; this would be at the Developer/Owners expense.

.3 Water Meter-by-pass Required

For Industrial, Commercial, and Institutional properties where the meter is 75mm or larger, a lockable bypass for this meter must be installed. For Industrial, Commercial, and Institutional properties with meters smaller than 75mm, a lockable by-pass will be installed where the customer cannot tolerate a shut-down of the water service during business hours. Bypass valves shall be closed and sealed for use by the County only.

Meter bypasses shall be installed according to **Oxford County Standard Drawing**.

6.2.8.5 Meter Sizing

The size of meters will generally be one size smaller than the water service. The size of the meter must be negotiated with the **County of Oxford Public Works** in accordance with the flow requirements. Developer/Owner to consult with **County of Oxford Public Works** with proposed flow requirements to size meter.

6.2.8.6 Water Meter Purchasing

Contact your local municipality to purchase the water meter and ERT device

6.2.9 Blow-Offs and Swab Launches

When dead end mains are encountered, a fire hydrant or blow-off is required near this dead end. The blow-off must be designed in such a manner as to convey the water to a suitable drain and must be operable without the need for excavating. Stop and Drain type valves are permitted. Blow offs or Swab launches shall be installed with 150mm thick 19mm clear stone bedding.

Blow-offs or swab launches installed in “hard surface” (asphalt or concrete) areas will require 300mm thick granular “A” bedding compacted mechanically in two 150mm thick lifts.

Blow-offs will be 50mm diameter for mains up to and including 200mm diameter. Blow-offs will be 100mm diameter and use the swab launch detail for 250mm and 300mm mains.

In areas that do not have fire hydrants, permanent swab launches will be installed for swabbing and flushing. Blow-offs and swab launches to be installed as per **Oxford County Standard Drawings**.

6.2.10 Corrosion Protection

.1 Petrolatum Coating System

All surfaces of fittings, flanged connections, nuts, bolts, tie rods, clamps, valves, sleeves, Victaulic-style couplings, joint restraints, etc., shall be protected using petrolatum materials. For application requirements refer to **Section 6.3**.

.2 Cathodic Protection for PVC Watermain

The size and type of anodes shall be determined through the Geotechnical report. Refer to **Section 6.3** for applications and minimum anode sizing requirements. Anode locations shall be clearly shown on the Construction and as-built drawings. In addition, a tabular listing of the stations at which the anodes are to be installed shall be provided.

Valves or appurtenances that are epoxy coated do not require this procedure.

Refer to **Section 6.3** for requirements.

6.2.11 Easements

Easements are required for any County owned watermain which is located on privately-owned property. An easement is required to ensure that the municipal services and utilities crossing the site can be properly installed and maintained by the County or the County of Oxford's service provider.

The minimum width of easement shall be 6.0m for a single watermain only buried at a standard depth. When the easement is 6.0m, the watermain will be installed 2.0m from one side of the easement to provide an adequate working area to access and repair infrastructure placed within the easement. Where there is more than one utility, adequate width of easement and separation of utilities for both construction and future access and maintenance shall be provided.

Where a watermain is installed on an easement which is located on private property or between private properties which have or may have building(s) located on them presently or in the future, the watermain shall be installed in a casing. Refer to **Section 6.2.4.4 Casings and Spacers**.

6.2.12 Instrumentation

Instrumentation and control equipment which will become the property of or be under the operation of the County must meet all design and installation standards outlined in the County's SCADA Standard's, including the following: PLC Programming Standards, SCADA Alarm Standards, Control Panel Standards, HMI Standards, and Process Control Narratives (PCNs). All PCNs shall be approved by the **County SCADA Technician**.

6.2.13 Backflow Prevention

A backflow prevention device shall be required for all industrial, commercial, and institutional developments as well as select multi-residential developments. Such a device will be installed by the Developer, Contractor, or property Owner at their expense. These devices shall be as per AWWA standards and approved by the **County of Oxford Public Works**. The property Owner shall comply with the requirements of **By-Law No. 6544-2023**. Refer to www.oxfordcounty.ca/backflow for additional information.

In the City of Woodstock all residential services shall require the installation of a dual-check backflow preventor. Installation shall be as per **Oxford County Standard Drawings**.

6.3 WATER DISTRIBUTION SYSTEM CONSTRUCTION

Supply and installation of water systems shall be in accordance with the current Ontario Provincial Standard Specifications (Municipal) and Ontario Provincial Standard Drawings as amended herein.

6.3.1 Approved Products and Product Approval Process

All products proposed for use on water system construction projects in Oxford County shall be submitted to the **County of Oxford Public Works** in writing and approved prior to use.

The County and its Service Providers reserve the right to select any product or material they deem suitable for the application and may provide an AWWA standard and/or other specifications and conditions for the use of such products or materials. Products or materials installed without the approval shall be removed and replaced with an approved replacement at no expense to the County.

Manufacturers, distributers, Contractors, designers, and other parties may request that products be considered as an approved equivalent to the products listed herein. A typical product approval submission shall include but not be limited to the following:

- Detailed product data sheet including materials and material properties, performance specifications, and any relevant standards (AWWA, ASTM, ISO, CSA, etc.)
- A list of sizes, classes, etc. with detailed dimension information
- Detailed installation guide
- Safety Data Sheet
- Material warranty information
- References for use on past projects
- Other information as may be requested by **County of Oxford Public Works** or to demonstrate equivalency to the products specified herein

Review and acceptance of an equivalent product is at the sole discretion of **County of Oxford Public Works**.

The Designer reserves the right to exclude the use of one or more of the acceptable products noted herein within their design where the use of these the approved materials listed herein is not acceptable due to project-specific constraints. Modifications may be listed in the Contract Drawings and/or Specifications.

6.3.2 Watermain Materials & Installation Notes

6.3.2.1 General Requirements and Reference Specifications

All waterworks materials used in the construction, repair, and operation of the drinking water system that come into contact with water shall meet all current applicable standards set by the American Water Works Association ("AWWA"), Canadian Standards Association ("CSA"), the American National Standards Institute ("ANSI") safety criteria standards, American Society for Testing and Materials (ASTM), NSF/14, NSF/60 and NSF/61.

The Contractor will get approval for all materials selection from the **County of Oxford Public Works** prior to delivery to the site.

6.3.2.2 Transition in Pipe Material

Materials shall remain consistent throughout a project unless approved by the **County of Oxford Public Works**. Approval will only be provided under abnormal special circumstances.

Transition from one pipe material to another must be made at a valve or branch. Where PVC pipe is used, a tracer wire must be provided along the entire pipe and terminated within the valve box.

6.3.2.3 Pipe, Fittings, Tracer Wire and Spacers

Acceptable watermain pipe, fittings, tracer wire, and spacer materials shall be as outlined below. Joint lubricants shall be as supplied by the pipe manufacturer and approved by the County of Oxford Public Works.

.1 Ductile Iron (DI)

Piping shall be Ductile Iron Cement Mortar Lined CL 52 as per AWWA C104, C150 and C151.

Fittings shall be mechanical joint only per AWWA C110, C111, C150 and C153.

Fittings shall have the pressure rating, nominal diameter, manufacturer name, and AWWA standard cast on them.

Fittings shall be either fusion bonded epoxy coated (inside and out) to NSF-61 or Ductile Iron mechanical joint with cement lining. All Ductile Iron fittings, mechanical joints, and restraints are to be protected using a petrolatum corrosion protection system. Refer to **Section 6.3.8**.

All pipe and fittings shall come capped from the factory to prevent contaminants. Any damage to the epoxy coating shall be repaired using epoxy paint suitable to the application (NSF-61, buried application).

Self-restrained fittings (RCT Flex-Tite or approved alternate) are permissible in place of mechanical joints provided they are rated for at least 350 psi.

Copper strips, wedges, or other devices to provide electrical continuity shall be provided by the pipe manufacturer.

Installation of ductile iron pipe and mechanical joint fittings shall conform strictly to the manufacturer's instructions.

.2 Polyvinyl Chloride (PVC) and Molecularly Oriented PVC (PVCO)

Joints shall be SBR rubber gasket push-on type. For PVC water main and fittings located within petroleum hydrocarbon and/or chlorinated solvent contaminated soils, gaskets shall be made of oil-resistant Buna-N (Nitrile) rubber. If the Contractor suspects there may be contaminated soil in the field, the Contractor shall immediately notify the Contract Administrator and Project Manager.

All PVC pipe and PVC fittings shall be blue in colour.

Molecular Oriented PVC pipe (PVCO) is an accepted material however this material may only be used in new subdivisions and new development areas. This material is not permitted for use in the reconstruction of existing areas. The use of this material will be reviewed on a case-by-case basis. For construction of watermain 400mm and greater, Submittals by the pipe manufacturer in the form of a Construction Report will include the following:

- Letter of Compliance including date of manufacture (pipe manufactured more than 24 months prior to delivery to the project site at no expense to Oxford County)
- Summary of fittings and specials
- Restrained length calculations and drawings signed and stamped by a Professional Engineer licensed to practice Engineering in the Province of Ontario.
- Installation Manual
- Copy of CSA Certification and NSF 61 Certification

The following PVC and PVCO pipes are permitted for use on County projects:

- AWWA C900, CSA B137.3 – Class 235 DR 18 (complete with tracer wire) 100mm through 1500mm diameter colour coded blue.
- PVCO AWWA C909, CSA B137.3 – Class 235 C.I.O.D. (complete with tracer wire) 100mm through 300mm diameter colour coded blue.

PVC push-on fittings are permitted with the exception of service tees and main valves. All PVC fittings less than or equal to 300mm shall be injection-molded as per AWWA C907 and CSA B137.2, colour coded blue. Larger fittings utilizing AWWA C900 pipe standards are also permitted. All push-on fittings shall require mechanical restraint. Refer to **Section 6.3.8** for corrosion protection requirements.

The use of fabricated fittings will not be permitted unless approved in writing by the **County of Oxford Public Works.**

Ductile Iron fittings used in PVC watermain systems shall be cement mortar lined mechanical joint only as per AWWA C110, C150 and C153. All fittings, mechanical joints, and restraints are to be protected using a petrolatum corrosion protection system. Refer to **Section 6.3.8**.

All Ductile Iron fittings in PVC watermain systems shall require cathodic protection as listed in **Section 6.3.8.2**.

.3 <u>High Density Polyethylene (HDPE)</u>

HDPE pipe is to be used for directional drilling or casing pipe only unless approved in writing by the **County of Oxford Public Works**. HDPE pipe shall be used for all directional drilling in the County.

All HDPE pipes shall be Ductile Iron Pipe Size (DIPS) unless approved in writing by the **County of Oxford Public Works**. In the design phase, inside diameters must be considered to ensure flow characteristics are similar to the design nominal pipe size. HDPE watermain less than 100mm dia. shall be copper tubing size (C.T.S.).

HDPE shall be as per AWWA C901 and C906, DR 11, PE 3408/3608 DIPS with a blue stripe on side (complete with tracer wire).

Fittings shall be butt fusion or mechanical joint only as per AWWA Specifications C110, C153 and C906. Class 304 Stainless steel stiffeners are required at all mechanical joints. Push-on fittings are not permitted.

.4 <u>Concrete Pressure Pipe (CPP)</u>

Concrete Pressure Pipe and fittings 600mm and greater as per AWWA C301 (L) (min. Class 16) or C303 (min. Class 150). Pipe design to be completed by the manufacturer. Shop Drawings and design calculations for the watermain shall be stamped by a Professional Engineer licensed to practice Engineering in the Province of Ontario, working for the manufacturer.

The Contractor shall submit the following:

- Certified Shop Drawings
- Affidavit of Compliance
- Design calculations
- Details of specials and fittings
- Details of materials and methods of welding
- Rubber Gasket Material Test Reports
- Steel Test Reports
- Restraint Length Calculations Stamped by a Professional Engineer licensed to practice Engineering in the Province of Ontario (for watermains greater than 300mm diameter)
- Aggregate samples
- Tabulated Layout Schedule

.5 Pre-Insulated Pipe

The watermain pipe shall consist of a factory-applied rigid polyurethane foam minimum 50mm thick and an outer protective jacket. The outer protective jacket shall consist of a tape wrap polyethylene with UV inhibitor, or a factory applied extruded black HDPE copolymer with UV inhibitor. Pre-insulated pipe shall be Urecon or approved equal and shall be installed in strict conformity with the manufacturer’s recommendations.

.6 Tracer Wire and Connectors

Tracer wire is required for all watermain and water service installations. The use of thermoplastic High Heat-resistant Nylon coated wire (THHN) in place of tracer wire is not permitted.

Tracer wire for direct bury shall be Solid #12 AWG (0.0808” diameter), 21% conductivity, high strength (HS), copper-clad hard drawn high carbon steel (CCS) tracer wire, 30 mil. HDPE insulation jacket complying with ASTM-D-1248, minimum break load 452 lbs, 30-volt rating, blue in colour.

Tracer wire for directional boring shall be four Solid #12 AWG (0.0808” diameter), 21% conductivity, extra high strength (EHS), copper-clad hard drawn high carbon steel (CCS) tracer wire, 45 mil. HDPE insulation jacket complying with ASTM-D-1248, minimum break load 1150 lbs, 30-volt rating, blue in colour. Tracer wire connected to existing cast iron or ductile iron pipe shall be properly connected with a thermite weld or approved equivalent. Welds will be completely sealed with a mastic type sealer. The mastic shall be TC mastic or approved equal.

At each inline valve a single tracer wire must be brought up outside the valve box to the top of the box and inside the box through a drilled hole complete with rubber grommet. Tracer wire will attach to the mainline wire with approved connectors only. Splices of any other nature will not be permitted and will result in the total replacement of the mainline tracer wire. The length of tracer wire inside the valve box shall be +/-500mm and coiled to not interfere with valve operation. Tracer wire to be installed as per the **Oxford County Standard Drawings**.

Tracer wires on water services shall extend from the main to the curb stop. Where metallic curb stops and main stops are used, thaw nut connectors shall be provided on the curb stop and main stop. Where a thaw nut connector is not provided at the curb stop or main stop, the tracer wire shall attach to the mainline wire with approved connectors only and at the curb stop be brought up to 150mm below grade and secured to the valve box with Denso Petrolatum tape or approved equal. A 5.5 kg zinc anode shall be provided at the curb stop.

Test stations shall be Copperhead Snakepit CD14*TP or approved equal. The maximum distance between stations shall be 500m.

Tracer wire at hydrant locations shall be installed to each hydrant valve. The tracer wire shall attach to the mainline tracer wire by means of an approved connector. Tracer wire shall be placed along the hydrant lead, up the outside of the hydrant valve box where it will enter the inside of the valve box through a rubber grommet. A coil of 0.6m of tracer wire shall be left inside the valve box.

All connections or repairs in the tracer wire system shall be made using a copper split-bolt connector with DRYCONN Direct Bury Waterproof Split-Bolt Housing (Aqua), DRYCONN 3-Way Direct Bury Waterproof connector (DB Lug Aqua), Pro-Line TracerLock (TL-LUG-SS) Connector, SnakeBite Locking Connector (LSC1230), or approved equal. Tracer wires at ends of rolls, repairs, or water services 100mm diameter or larger shall have sufficient slack to be knotted together prior to placement of connector. All connections shall be wrapped with petrolatum tape and compressed tightly by hand around wire and connector.

At the end of non-metallic services and mains a 5.5 kg zinc anode must be installed at the end of the tracer wire or the wire brought up to a test station. Non-metallic curbstops will require an approved connector to attach to the mainline tracer wire. No splices of the mainline tracer wire are permitted. Tracer wire connections to be installed as per **Oxford County Standard Drawings**.

At the ends of capped watermain, a minimum of 2 m of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connection. The end of the tracer wire shall be spliced to a 5.5kg zinc anode and is to be buried at the same elevation as the watermain.

Tracer wire continuity testing shall be conducted following installation and prior to final restoration demonstrating the conductivity/traceability to the satisfaction of the County or its Service Provider.

.7 Casing Spacers

When watermain is placed inside a casing, the watermain shall be supported by spacers using the centered configuration. The size, location, and number of spacers will be as per the manufacturer's recommendation.

Approved Casing Spacers are as follows:

- CCI #304 Stainless Steel (CSS8 and CSS12 models)
- PSI Ranger II
- Cascade #304 Stainless Steel (CCS, CCS-ER, CCS-JR, CCS-ES models)

6.3.2.4 Pre-Cast Valve Chambers

All chambers are to be precast, complying in all respects with the design requirements of OPSS 441 and OPSD 1101 chambers, including concrete materials and joint waterproofing. Manufacturer’s design drawings, calculations, and certification shall be submitted at least 10 working days prior to commencing work. Certification shall be marked on units.

Shop drawings for precast chambers will include all details and be reviewed and stamped by a Professional Engineer licensed to practice Engineering in the Province of Ontario retained by the Contractor.

All chambers are to be designed to counteract full buoyancy forces as if the groundwater level is at the ground surface. All buried external surfaces of the chambers are to be waterproofed as specified herein.

All chambers are to be fitted with frost straps in accordance with OPSD 701.100. Each strap shall run continuously from the bottom slab to the top section.

Pipe supports are to be adequately sized to support the valves, pipes and appurtenances that will be supplied by the Contractor. The supports will be reinforced concrete or manufactured stainless steel supports (minimum grade 304) and tied to the base with properly sized dowels.

Units shall be constructed in accordance with details indicated, plumb and true to alignment and grade. Complete units as pipe laying progresses.

Precast concrete base shall be set on a minimum of 75mm granular bedding compacted to 95 % Standard Proctor Maximum Dry Density (SPMDD) or as indicated on Contract Drawings.

Each joint shall be watertight with approved rubber ring gaskets. Clean surplus mortar and joint compounds from interior surfaces of unit.

All lifting holes shall be filled with non-shrink grout. Floor of chamber will be sloped to sump pit at 1 in 20. Depth of sump to be 300mm.

The Contractor will get approval for chamber selection from the **County of Oxford Public Works** prior to supplying the material to the site.

6.3.2.5 Chamber Piping and Fittings

The piping, valves and fittings to be incorporated into the chambers will comply in general with all requirements of the buried watermain, with the additional requirements below.

1. The Contractor shall submit shop drawings for review of all chamber piping, fittings, and valves, clearly showing all proposed materials, dimensions, and details of thrust restraint (thrust blocks not permitted). Piping and fittings of all diameters shall meet the applicable AWWA standards.

2. All chamber piping and fittings 400mm or larger shall be Ductile Iron, Class 52 pipe, or approved equivalent, of the same rating as the main. All exposed metal surfaces not otherwise coated with approved AWWA epoxy coatings will receive corrosion protection as described in **Section 6.3.8**.
3. Vent piping and fittings shall be stainless steel, manufactured from type 304L stainless steel produced from parent metal conforming to ASTM A240 and AWWA Manual M11 (pressure limit 1035 kPa). All vents shall have a minimum of two bands of 50mm wide high reflective yellow tape.
4. Tracer wire within the chambers shall be secured to the inside wall and shall be accessible from the surface.
5. All other materials which are not specifically described herein or noted on the Contract Drawings but required for the completion of the work (such as couplings, gaskets, jointing materials, fasteners, other accessories) shall be as selected by the Contractor, subject to approval of the **County of Oxford Public Works**.

6.3.2.6 Gate Valves and Rods

Gate valves shall be manufactured to AWWA C509 or C515 Specifications. Valves shall be ductile iron. Tapping valves and sleeves must be approved by the **County of Oxford Public Works**.

The number of turns to operate the valve shall be 3 times the valve diameter in inches plus 2 to 3 turns. Valves with number of turns in excess of this will not be permitted.

All gate valves and tapping valves must be Ductile Iron, resilient seat, epoxy coated gate valves with non-rising stem (NRS).

400mm gate valves do not require chambers unless valves are placed in locations where bypasses are installed.

Valve boxes as supplied by Canada Valve, Mueller Ltd. or approved equal will be acceptable. All boxes shall be screw type.

Valve rods shall be manufactured as per **Oxford County Standard Drawings**.

Valves must be mechanical joint and must open Counter-Clockwise.

<u>**Notwithstanding the above, all valves, including hydrant valves connected to the City of Woodstock water system, shall open Clockwise.**</u>

6.3.2.7 Combination Air / Vacuum Valves

Air release/vacuum relief valves should be installed at high points on distribution and transmission watermains where air can accumulate. Automatic air release valves should not be used in situations where flooding of the access hole or chamber may occur. Air release/vacuum valves shall conform to AWWA C512.

Air valves shall be combination air valve with cast iron or plastic boot and cover, stainless steel internal parts, class 125 flange inlet boot rated to 1378kPa W06, 0 to 1034kPa working pressure. Seat to be bronze with Buna-N seat. Under Ground Air Valve Systems must be approved by the **County of Oxford Public Works**. Air / Vacuum valves for direct bury to be installed as per **County Standard Drawings 6.18** and **6.19**. The Contractor shall submit shop drawings for review of all piping, fittings, and valves, clearly showing all proposed materials, dimensions and locations. The final number and location of these valves will be reviewed by the **County of Oxford Public Works** prior to construction. Piping and fittings of all diameters shall meet the applicable AWWA standards.

The exterior surface of valve body shall be epoxy coated. Adequate support shall be provided for the valve. Valves shall be Valmatic, Apco, ARI, or approved equal.

6.3.2.8 Waterproofing of Chambers and Maintenance Holes

Waterproofing membrane shall be supplied and installed on all exterior concrete surfaces of the watermain chambers, 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. 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.

6.3.2.9 Service Material

The County will accept cross-linked polyethylene (PEX) or raised temperature polyethylene (PE-RT) potable water service tubing. PEX and PE-RT water service tubing may not be installed within petroleum hydrocarbon and/or chlorinated solvent contaminated soils.

Polyethylene (HDPE) plastic pressure pipe is approved for use on a site-specific basis only as directed by **Oxford County Public Works**.

Polyethylene plastic pressure pipe shall be according to OPSS.MUNI 1842, AWWA C906, CSA B137.1 and supplied from a plant approved by an organization accredited by the Standards Council of Canada. The pipe shall be manufactured with blue colour stripes indicating potable water. Pipe connecting to AWWA C800 compression joint valves and fittings shall be installed using stainless steel support liners inside pipe at each joint according to manufacturer's specifications.

PEX, PE-RT, and HDPE service material shall be colour coded in solid blue or blue striped.

Copper service material is not permitted in new construction. Services larger than 50mm shall be designed in accordance with the applicable standards for watermains.

All existing copper service material connected to PVC watermain that has been exposed and not replaced during construction shall require cathodic protection as per **Section 6.3.8.2**. All services shall be a minimum of 25mm diameter and require a tracer wire. All service material shall conform to NSF 61.

PEX service material 25mm to 50mm shall be pressure rated to a minimum of 1103 kPa (160 psi). Pipe shall be manufactured using the high-pressure peroxide (Engel) method of cross linking in accordance with AWWA C904, ASTM D3350 and a minimum degree of cross-linking of 80% in accordance with ASTM D2765, Method B. Pipe to have a co-extruded UV Shield made from UV resistant high-density polyethylene, colour blue. Pipe to be certified to standards ASTM F876, F877, F2023, CSA B137.5, and NSF 14 and 61. Pipe connecting to AWWA C800 compression joint valves and fittings shall be installed using stainless steel support liners inside pipe at each joint according to manufacturer's specifications.

PE-RT service material 25mm to 50mm shall be pressure rated to a minimum of 1379 kPa (200 psi). The pipe shall be in accordance with CTS cNSFus-pw CSA B137.12 AWWA C-901 CL5 ASTM F2769, NSF 14, and NSF 61. The pipe shall be blue. Pipe connecting to AWWA C800 compression joint valves and fittings shall be installed using stainless steel support liners inside pipe at each joint according to manufacturer's specifications.

All main stops shall be Lead-Free Brass, full port style, and conform to AWWA C800 and NSF 61.

Acceptable fittings shall be Ball Valve style. All fittings used on non-metallic service lines shall be manufactured to accommodate tracer wire. Acceptable fittings for tracer wire are Mueller 110 compression for electrical thaw connection or approved equal.

Service Saddle Bands shall be double bolt type 304 Stainless Steel of minimum 20-gauge thickness. Approved service saddles for PVC watermain are, Smith-Blair 372, Romac 304, 305 and 306, Robar 2600 or approved equal.

6.3.2.10 Curb Stops

All curb stops shall be Lead-Free Brass, full port style, and conform to AWWA C800 and NSF 61. Curb stops shall operate at 150 psi. Megatite composite style curb stops or approved equal may also be used.

Table 4-6 Curb Stops

Size	Curb Stops	
	General Description	Copper Connections
25mm	Ball Valve	Compression
38mm	Ball Valve	Compression
50mm	Ball Valve	Compression

All fittings used on non-metallic service lines shall be manufactured to accommodate tracer wire. Acceptable fittings for tracer wire are Mueller 110 compression for electrical thaw connection or approved equal.

Curb stops shall be installed with electrical thaw nuts on the private side facing away from the watermain. Inverted Key type curb stops and "Stop and Drain" types are not permitted.

6.3.2.11 Curb Boxes

All curb boxes shall be manufactured with metallic composition. All curb boxes must be able to be located using a magnetic locating device. Curb box length to be manufactured to accommodate the service's depth of bury. Operating rod to have modified top to enable use of same key as used on the A726 box with stainless steel operation rods and connecting pins.

Table 4-7 Curb Boxes

Curb Boxes	
25mm to 50mm services	20mm hexagon head plugs

6.3.2.12 Fittings

All fittings shall be Lead-Free Brass and conform to AWWA C800 and NSF 61. All fittings used on non-metallic service lines shall be manufactured to accommodate tracer wire where required.

6.3.2.13 Mechanical Restraint

All restraint devices shall be approved by the County or its Service Provider prior to installation.

Restraint devices for PVC, Ductile Iron, and HDPE pressure pipe of all sizes shall be manufactured of high strength ductile iron, ASTM A536, grade 65-45-12, and shall incorporate a series of machined serrations on the inside diameter to provide contact to the pipe and support the pipe wall.

Tie rods and clamp assemblies shall be wrapped in Denso paste and tape (to manufacturer specifications). Tie rods, washers and connecting bolts are to be a minimum of 19mm (3/4"). Connecting bolts shall be of high strength, stainless steel type 304, AWWA C111/A21.11. All mechanical restraints shall have corrosion protection as per **Section 6.3.8**.

Restraint devices shall meet or exceed the requirements of ASTM 1674 and Uni-B-13-92 recommended performance specification for joint restraint devices for use on PVC pipe and shall be FM approved. Notarized original certification shall be included with submittal documents.

.1 <u>Restraint devices for PVC/PVCO</u>

Joint restraints for PVC pipe and fittings shall be either serrated ring or wedge action type as manufactured by Uniflange, EBAA, Star, Sigma, Romac or approved equal. Restraints for Molecular Oriented PVC pipe (PVCO) shall be as per the pipe manufacturer's recommendation. It should be noted that Romac "grip ring" restraints are not permitted for use with PVCO pipe.

.2 <u>Restraint devices for Ductile Iron</u>

Joint restraints for Ductile Iron pipe and fittings shall be either serrated ring or wedge action type as manufactured by Uniflange, EBAA, Star, Sigma, Romac or approved equal.

.3 <u>Restraint devices for HDPE</u>

Restraint devices shall be designed to resist pull out forces based on the maximum working pressure rating of the pipe. Forces experienced due to expansion and contraction of the pipe require special consideration.

Internal pipe wall stiffeners must be used when restraining HDPE. The stiffeners must be sized to encompass the entire bearing length of the restraint device. Pipe systems must be Engineered to prevent movement causing the fitting to slide or rotate on the pipe.

Joint restraints for HDPE pipe and fittings shall be either serrated ring or wedge action type as manufactured by EBAA, Star, Sigma, or approved equal.

6.3.2.14 Hydrants

Fire hydrants shall be Canada Valve (Darling), Century, MacIvity M67, East Jordan Iron Works Watermaster 5CD250, AVK Series 2780 or approved equal.

Fire hydrant extensions as required for deeper bury are to be obtained from the fire hydrant manufacturers. A maximum of one 300mm extension is permitted per hydrant.

Fire hydrants shall have a chrome yellow high gloss exterior paint over quick dry red oxide primer.

Hydrants shall be installed a minimum of 1.5m from the edge of a driveway and from any other physical obstruction which could interfere with the operation of the fire hydrant.

Public hydrants shall have the body and bonnet painted yellow with colour coded reflector rings in accordance with the National Fire Protection Association (NFPA) 291 colour coding based on flow testing.

Private hydrants shall have the body and bonnet painted red with bonnet and caps painted in accordance with the National Fire Protection Association (NFPA) 291 colour coding based on flow testing.

All hydrants shall have a brass-to-brass seat and open Counter-clockwise. All hydrants shall be equipped with a 100mm STORZ pumper connection (cap painted black) and two (2) 63.5mm hose connections 180° apart.

Hydrants shall be plugged when installed in areas of high groundwater. Plugs to be installed by manufacturer. Hydrants with plugged drains must be clearly marked and pumped dry after each use.

<u>**All hydrants attached to the City of Woodstock Water System shall be plugged and open Clockwise.**</u>

6.3.2.15 Automatic Flushing Devices

An Eclipse 9800 Automatic Flusher or approved equal shall be used for all Automatic Flushing Devices. Contractor to ensure the automatic flushing device size as well as timer settings follow the design specifications.

6.3.2.16 Granular Material

As per OPSS.MUNI 1010.

6.3.2.17 Testing

Supply test certificates in accordance with the appropriate specification, for the following materials:

- Pipe
- Valves
- Fittings
- Hydrants

6.3.2.18 Delivery

Materials found to be defective in manufacture or damaged in handling after delivery, shall be replaced. Materials found to be damaged upon installation shall be replaced, which will include the costs of furnishing of material and labour required for the replacement.

All pipes up to and including 600mm diameter shall be delivered to the Work Area with end covers. End covers shall be factory installed on both ends with a tamper evident seal. Components shall adhere sufficiently to withstand the stresses caused during shipment.

6.3.2.19 Handling

Load and unload materials so as to avoid shock or damage. The lining and coating of pipes shall not be damaged.

Extra precautions and care must be taken at temperatures below freezing to eliminate the possibility of impact damage to the pipe.

6.3.2.20 Storage

Place materials in a safe storage area. Keep interiors of pipes and fittings clean.

6.3.2.21 Non-Shrinkable Concrete Fill

Non-shrinkable concrete fill shall be produced using 25kg/m^3 portland cement and aggregates in accordance with CSA A23.1. The following requirements shall also apply:

- Slump 150mm to 200mm
- 28-day strength of 0.4MPa
- 24-hour strength - at least 0.07MPa

6.3.3 Installation of Watermains by Open Cut

6.3.3.1 General

The Contractor shall, unless specified otherwise furnish all material, equipment, tools, and labour necessary to complete the installations. The installation of watermain shall be as per AWWA Standards and Specifications and OPSS 401, 404, 441, 517, 1010, and Ontario Health and Safety Association OHSA Reg. 213/91 with the following exceptions/amendments.

Contractors shall give the County or its Service Provider a minimum of 48 hours notice prior to commencing construction. A licensed operator or inspector from the County or its Service Provider shall be present for all watermain construction.

In areas of reconstruction where existing metallic watermain is being replaced with PVC or HDPE, the property Owner should be advised that the grounding of electrical systems to the water service may not be adequate. It will be the property Owner's responsibility to ensure adequate grounding after reconstruction is complete.

In areas of construction where watermain or services are to be located in existing road surfaces or through driveways and entrances, the existing pavement, curbs, sidewalks and driveways shall be saw-cut in clean straight lines to minimize over-break prior to construction. All concrete and asphalt driveways, curbs, and sidewalks shall be restored to existing or better conditions within construction limits. Interlocking brick driveways shall be carefully disassembled to proposed construction limits and reassembled to existing or better conditions. If the property Owner cannot agree to the methods and materials required to reinstate all concrete, asphalt, and interlocking brick driveways, curbs, and sidewalks to existing or better conditions the County or its service provider will undertake a quotation for reinstatement to the construction limits according to existing materials. Based on the quotation the property Owner may receive monetary compensation to pursue other alternatives. Prior to receiving compensation, the property Owner will sign an agreement with the County or its Service Provider acknowledging acceptance.

6.3.3.2 Tracer Wire

All non-metallic direct bury watermain and services shall require tracer wire. Verification of conductivity of the tracer wire shall be performed upon completion of rough grading and prior to placement of base coat asphalt on all streets before substantial completion of the project. An additional locate shall be performed prior to expiration of the warranty period before final acceptance.

A locate or conductivity test with the new tracer wire shall be performed by the Contractor and completed in the presence of a licensed water operator from the County or its Service Provider. The tracer wire shall be installed in such a manner as to be able to trace all components without loss or deterioration of signal or without the signal migrating off of the tracer wire. This test shall be conducted using the industry standard low frequency (512 Hz) line tracing equipment. If it is not continuous from valve to valve, the Contractor shall at his own expense replace or repair the wire. If a dispute arises as to the ability to trace all components, an independent 3rd party may be required to resolve the dispute and will be done at the Contractor's expense. Continuity testing in lieu of actual line tracing shall not be accepted.

6.3.3.3 Line and Grade

Contractors shall provide stakes to indicate the line and grade of the watermain as well as the location of fittings, bends, tees, valves, hydrants, crosses, reducers and plugged or capped dead-ends in accordance with the approved drawings before beginning any work. Line and grade stakes shall be marked and placed a minimum of 20 metres to a maximum of 50 metres apart.

Mains shall be laid and maintained to the required grades and locations with all valves, fittings, hydrants, etc. to be plumb and in accordance with the drawing locations. Deviations will not be permitted unless approved by the County or its Service Provider.

The Contractor shall be considered an "Excavator" and comply with the Ontario Underground Infrastructure Notification System Act. Contractors shall obtain locates prior to excavation and carry out exploratory excavations where necessary to establish or discover the location and elevation of existing pipes, conduits or other buried objects.

6.3.3.4 Frozen Ground

Do not place material on frozen ground. Should the bottom of the trench become frozen remove and replace the frozen material with bedding material compacted to 100 percent Standard Proctor Density.

6.3.3.5 Excavation and Trench Preparation

All excavations and trenching operations shall comply with the associated provisions of the Construction Projects Regulation (O. Reg 213/91).

Trenches shall be provided so that pipe can be laid with the proper alignment and depth so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at all points.

Where trench excavations are not kept within the design limits of the pipe, the **County of Oxford Public Works** may order sheathing and shoring, and/or a heavier class of pipe, and/or use of a higher class of bedding.

Where the subgrade in its natural state is inadequate to support the pipe and a means of addressing this is not provided in the Contract, the Contractor shall immediately notify the Designer and the **County of Oxford Public Works** to confirm what design modifications may be required.

The subgrade shall be removed where it has been adversely changed by construction operations or cannot adequately support the pipe. Where poor soil conditions exist, the excavated material will be replaced with crushed stone or other approved material as directed by the **County of Oxford Public Works**.

6.3.3.6 Dewatering

Always maintain the excavation free of water. The discharge of water from excavations into sanitary sewers is strictly prohibited unless a permit is obtained from the County and discharge is in accordance with the Sewer Use Bylaw currently in effect. The cost for cleanup of the sewer or other affected areas will be the responsibility of the Contractor or Developer.

6.3.3.7 Lowering & Laying

Before lowering and while suspended, the pipe shall be inspected for defects. Proper implements, tools and facilities as required by the **County of Oxford Public Works** shall be provided by the Contractor. All materials shall be lowered into the trenches by suitable means.

The interior of the pipe shall be inspected and completely cleaned of all sand or foreign materials before placing in the line. No foreign materials are to be placed in the pipe during its laying.

The inside of the bell and the outside of the spigot shall be brushed and free from all oil, grease or dirt before jointing. Precautions must be taken to prevent dirt from entering the joint space. At all times when pipe laying is not in progress, the open ends of the pipe shall be closed by water-tight plugs or other means approved by the Inspector. This must be adhered to during the noon hour as well as overnight. The trench shall be kept dry and free from water.

No pipe shall be laid in water except by permission of the Designer. No water shall be allowed to run through installations during construction. If trench flooding occurs that enters the main, contact the Inspector and/ or the Designer to determine the course of action for disinfection.

Cutting of the pipe for inserting valves, fittings or closure pieces shall be done in a neat manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe.

Pipe shall be laid with the bell ends facing in the direction of laying. Deviation from this shall only be permitted with the approval of the **County of Oxford Public Works**.

At grades above 10 percent, laying shall start at the bottom with the bell ends facing upward. Where deflection in the line laying is required, either in the vertical or horizontal plane, the deflection may be made at the joints with the maximum deflections not exceeding half of the pipe manufacturer’s specifications. Axial deflection (i.e. Bending of the pipe barrels) is prohibited for PVC pipe. If the opinion of the Inspector, the deflection is excessive they will order the job stopped. The **County of Oxford Public Works** or its Service Provider, if deemed necessary, will direct the Contractor to install special fittings in order to provide the necessary deflection.

Thrust restraints shall be installed as noted in **Section 6.2.4.7** of the Design Guidelines and as indicated by the manufacturer. Offset locations and details shall be shown on Construction and As-Constructed Plans.

When the new main shall cross existing utilities, or where an existing watermain will be undermined during laying operations, the **County of Oxford Public Works** may order the installation of support beams. Support beams shall be approved by the **County of Oxford Public Works** prior to placement. The removal or replacement of an undermined section of the existing watermain or sewer may also be required. The Contractor shall submit proposed methodology for the support and/or replacement for the approval of the **County of Oxford Public Works**.

In all cases where pipe is laid on backfilled material, the backfill shall consist of granular material compacted in maximum 150mm layers to a minimum of 95 percent Standard Proctor density. Pipe must not be laid on blocks.

No pipe shall be laid until the preceding pipe joint has been compacted and the pipe carefully embedded and secured in place.

All pipe and fittings shall be installed strictly in accordance with the manufacturer's instructions. At least two copies of the manufacturer's manual of instructions shall be kept on the job site; one copy in the possession of the foreman, the other with the pipe layers.

Installations shall be kept thoroughly clean during the progress of the work and until the completion and final acceptance thereof.

The Contractor shall supply all fittings to complete the installation to the lines and grades shown on the Contract Drawings.

Where vertical or horizontal curves are shown, the pipeline shall not deviate more than 300mm from line, or more than 75mm from grade.

6.3.3.8 Bedding

For the purpose of this specification all materials placed between the trench bottom and 300mm over the top of the pipe shall be considered as bedding. Bedding around the watermain and services may be granular material or clean screened sand. The use of native material for bedding is not permitted.

Granular materials greater than 19mm in size shall not be used for pipe bedding. Granular material shall be compacted to a minimum of 95 percent Standard Proctor Density.

Bedding material shall be placed full width of trench. Compact material around the pipe with hand tampers properly shaped to ensure full compaction below the haunches. Do not use mechanical tampers over the top of pipe where cover is less than 300mm.

The depth of trench excavations shall be sufficient to allow for the bedding required below the pipe invert.

6.3.3.9 Backfilling

Backfill shall be considered as starting from 300mm over top of the pipe. All materials below this point shall be considered as bedding.

If the **County of Oxford Public Works** decides that the site selected excavation material either wholly or partially, is not suitable for backfill, then suitable imported material shall be provided of a type approved by the **County of Oxford Public Works**.

Backfill trenches from the top of the pipe bedding to the underside of surface restoration with site selected excavated material. Provide backfill free of roots, organic material and stone larger than 250mm.

Backfill material shall be placed in lifts not exceeding 300mm and compacted to a minimum 95 percent Standard Proctor Density.

Backfilling on a public road allowance, or in an area that is to be designated as a public road allowance, shall be done in accordance with the requirements of the **County of Oxford Public Works** or other road authority.

Backfill on all County Road allowances in the travelled portion of the roadway shall be granular material as set out in the Ontario Provincial Standards.

Installation of material will be as directed by the **County of Oxford Public Works** or other road authority.

The Inspector may order the trench to be bedded by hand from the bottom of the trench to the centre line of the pipe with sand, placed in layers of 75mm and compacted by vibratory equipment. Bedding material shall be deposited on each side of the pipe simultaneously.

From the centre line of the pipe, fittings, and appurtenances to a depth of 300mm above the top of the pipe, trenches shall be backfilled by machine or by methods approved by the Inspector. The type of backfill material used shall be sand, gravel or approved excavated material.

The Contractor shall use special care in placing and compacting this portion of the backfill so as to avoid damaging or moving the pipe.

No frozen material shall be used for backfilling nor shall backfilling be carried out where material in the trench is frozen.

The surface shall be restored so that all pavement, sidewalks, curbs, gutters, shrubbery, fences, poles, sod and other property and surface structures removed or disturbed during the work shall be restored to a condition at least equal to that before the work began.

6.3.3.10 Compaction Test

The **County of Oxford Public Works** may order compaction tests by an independent testing company. Tests will be arranged for by the County or its Service Provider.

When tests show that the compaction does not meet the specified requirement, the Contractor will carry out further compaction in a manner directed by the **County of Oxford Public Works** and pay for further testing to establish proof of the specified compaction.

For backfill compaction, tests will be performed in accordance with the testing company’s recommendations.

Co-operate with the **County of Oxford Public Works** and testing company by scheduling the placing and compaction of backfill so that tests can be progressively taken.

6.3.4 Installation of Watermains by Directional Drilling

6.3.4.1 General

The Contractor shall, unless specified otherwise, furnish all material, equipment, tools, and labour necessary to complete the installations. The installation of watermain shall be as per AWWA Standards and Specifications and OPSS.MUNI 401, 404, 450, 517, 1010, and Ontario Health and Safety Association OHSA Reg. 213/91 with the following exceptions/amendments.

Contractors shall give the County or its Service Provider a minimum of 48 hours notice prior to commencing construction. A licensed operator from the County or its Service Provider shall be present for all watermain commissioning. Full-time inspection within the public right-of-ways shall be required by Developers consultants in consultation with the County and its Service Providers.

In areas of reconstruction where existing metallic watermain is being replaced with HDPE, the property Owner should be advised that the grounding of electrical systems to the water service may not be adequate. It will be the property Owner responsibility to ensure adequate grounding after reconstruction is complete.

In areas of construction where watermain or services are located in existing road surfaces or through driveways and entrances, the existing pavement, curbs, sidewalks and driveways shall be saw-cut in clean straight lines to minimize over-break prior to construction. All concrete and asphalt driveways, curbs, and sidewalks shall be restored to existing or better conditions within construction limits. Interlocking brick driveways shall be carefully disassembled to proposed construction limits and reassembled to existing or better conditions. If the property Owner cannot agree to the methods and materials required to reinstate all concrete and asphalt driveways, curbs, and sidewalks to existing or better conditions the County or its service provider will undertake a quotation for reinstatement to the construction limits according to existing materials. Based on the quotation the property Owner may receive monetary compensation to pursue other alternatives. Prior to receiving compensation, the property Owner will sign an agreement with the County or its Service Provider acknowledging acceptance.

6.3.4.2 Definitions

Directional drilling is defined as trenchless installation of pipes pulled through a drilled and reamed hole.

A pilot hole is drilled under and across the surface area that cannot be disturbed along a predetermined horizontal and vertical design profile. Direction and elevation are controlled by a steering mechanism in the drill string just behind the cutting head.

Reaming is enlargement of pilot hole to a suitable size to allow for the installation of the pipe.

6.3.4.3 Submission and Design Requirements Submissions

Submit shop drawings showing all equipment and plans required to complete the pipe installation by direction boring. This information shall include:

- Directional boring equipment and specifications;
- Sequence of operation;
- Location of entry and exit points;
- Location and positioning of the working area and individual plant items such as drilling equipment, slurry holding tanks, power generation units, slurry recovery units, pumps, pipe fabrication areas, etc;
- Location and disposal site for cuttings;
- Diameter of pilot hole, and number and size of pre-reams/back-reams’
- Pulling force and method to continuously monitor it;
- Dewatering plan;
- Slurry management plan; and
- Contingency plan for emergency situations including frac-out.

.1 <u>Design Requirements</u>

Procedures, materials and water management plan to be acceptable to the Ministry of the Environment, Conservation, and Parks (MECP), Ministry of Natural Resources and Forestry (MNRF), local Conservation Authority, and the other public agencies having jurisdiction over the project.

All plant, personnel, and construction activity must be contained within working areas or easement limits shown on the Contract Drawings.

.2 Record Drawing Requirements

Record drawings shall be provided following pipe installation. Record drawings shall include the following details:

- Horizontal (plan) location of installed pipe tied to known reference points.
- Profile of the installed pipe with elevations.
- Location of all joints and flanged connections tied to known reference.
- Subsurface ground conditions encountered (soil, clay, rock, etc.)

Record drawings shall be provided in both a PDF and 3D CAD format compatible with the latest version of Autodesk Civil3D.

6.3.4.4 Equipment

The drilling equipment shall be suitable for installation of the pipe size and length required. The boring equipment shall consist of, at minimum: the drilling rig, cutting and steering head, drill stems, power and control equipment, mixing tanks for drilling fluids and a slurry recovery system.

The steering system shall include a probe situated behind the cutting head that can interface with an above ground portable computer control console. The probe shall be able to indicate the orientation of the steering and cutting tool.

The cutting tool shall be steerable from the above ground computer control console so that any deviation from the design alignment can be corrected as boring progresses.

The drilling equipment shall be capable of being retractable and reset to a different horizontal alignment should obstacles such as boulders, tree roots, etc. be encountered. The Contractor shall not change the vertical alignment without the approval of the **County of Oxford Public Works**.

A surface probe shall be provided that can detect the location and depth of the cutting tool/steering system. The surface probe shall be used to confirm that the pipe alignment is within the easement and at the location identified.

6.3.4.5 Construction

.1 General

The Contractor shall provide all necessary equipment, drilling fluids, and power to perform the work specified.

.2 Utility Locating

The Contractor shall be considered an “Excavator” and comply with the Ontario Underground Infrastructure Notification System Act. Contractors shall obtain locates prior to excavation and carry out exploratory excavations where necessary to establish or discover the location and elevation of existing pipes, conduits or other buried objects.

.3 Dewatering

The proposed dewatering method for the entry and exit pits and all excavations shall not be modified without written consent from the **County of Oxford Public Works**.

All water extracted during any dewatering process shall be diverted through a filter system or settling ponds/basins to ensure minimum sediment transport (as per OPSS 518). The filter system or ponds/basins shall be located so as not to interfere with normal construction activity and the public use of such areas.

The discharge of water from excavations into sanitary sewers is strictly prohibited unless a permit is obtained from the County and discharge is in accordance with the Sewer Use Bylaw currently in effect. The cost for cleanup of the sewer or other affected areas will be the responsibility of the Contractor or Developer.

.4 Line and Grade

Line and grade control will be maintained to the locations and elevations on the Contract Drawings. Variations in grade will not be acceptable.

The control system must be capable of maintaining line and grade to ± 100mm over the total distance between the ground entry and exit points.

.5 Soil Transportation System

The directional boring system shall have a slurry system designed to enable excavated soil removal. The slurry system shall have a system of screens and desilting/sedimentation tanks to separate the soil from the slurry.

The drilling fluids may be transported to the drill rig for reuse. Disposal of the slurry onsite or into drainage systems will not be permitted.

.6 Entry and Exit Points

The Contractor shall review site conditions and assess entry and exit points. Assessment shall take the following items into consideration:

- Entry and exit angles to facilitate boring equipment and allow for pulling pipe into reamed hole.
- Setbacks or open cut excavation requirements at entry and exit points to provide the pipe profile and construction of appurtenances as indicated on the Contract Drawings.
- Location of other surface features (e.g. adjacent structures, walkways, fences, poles, trees, etc.)
- Location of other underground features (e.g. utilities, foundations, etc.)
- Protection of water courses against the transport of excavated or other materials into receiving waters.

.7 Pipe Installation

Only High-density Polyethylene (HDPE) pipe shall be used for HDD. The pipe shall not be laid to a radius greater than that recommended by the pipe manufacturer.

Once the pilot bore has been completed, the successfully tested pipe shall then be installed in the reamed hole.

The Contractor shall ensure by use of shear couplings or other means that the amount of tension applied does not exceed the tensile capacity of the pipe during the pipe installation process.

The Contractor shall allow sufficient time for the longitudinal stresses in the HDPE to dissipate before the pipe is cut for connection.

The installed pipe shall be cut to the length and at elevations detailed in the Contract Drawings. The ends of HDPE pipe shall be prepared for butt fused flanged connections. All joints shall be restrained. Use of concrete thrust blocks for restraint shall not be permitted.

.8 Tracer Wire

When Directional Drilling is used for watermain installation, four (4) tracer wires will be installed simultaneously. The subsequent wires will be used as a backup if the other tracer wire is broken during installation. Refer to **Section 6.3.2.3** for material requirements. Tracer wire shall be installed along the top of the pipe and bound at 6-metre intervals. The wire must be installed between each valve and/or the end of the watermain.

.9 Testing and Commissioning

Refer to **Section 6.3.9**.

.10 Disposal of Materials

Surplus excavated material and slurry shall be disposed off-site. The Contractor shall make his own arrangements for off-site disposal and for carrying out soil tests to ensure that disposal is consistent with MOE guidelines, policies and regulations.

6.3.5 Temporary Watermain and Services

Temporary watermain and services shall be in accordance with OPSS.MUNI 493 with the following exceptions/amendments.

When service interruption is likely to be greater than 24 hours for 2 or more residential units and/or buildings, temporary watermain must be installed. Each home or business shall have its own temporary water service connection. Shared services shall not be permitted. An approved back-flow preventer device shall be installed at the point of connection. The backflow preventer shall be placed above ground level with the excavation backfilled.

Prior to construction the Contractor shall submit a written detailed procedure outlining methods, materials, connection points to existing mains, connections to supply customers, and disinfection process for approval by the **County of Oxford Public Works**. A drawing showing the proposed layout of the temporary water supply system indicating connection points to the existing watermain must also accompany the submission. Contractors shall notify the County or its Service Provider in writing a minimum of 48 hours in advance of their intention to connect to existing watermain. It will be the responsibility of the Contractor to maintain temporary watermain and services in a safe operating condition at all times.

All open excavations shall be partially backfilled and fenced off.

When a hydrant is removed from service, a temporary hydrant may be required. Temporary hydrants will be installed with the necessary valves and fittings and shall be installed where existing hydrants have been removed or where spacing permits. Hydrants out of service will be bagged and clearly marked with a “HYDRANT OUT OF SERVICE” tag.

Closed loop temporary systems (i.e. hydrant to hydrant) will not be permitted. Each dead-end branch shall have either a blowoff or service connection to facilitate flushing and sampling of the temporary watermain.

Temporary watermain shall be a minimum of 50mm diameter Aquamine high impact, ASTM PVC 1120, D 2241, DR 17, 1720 kPa, or approved equal. The diameter of the temporary watermain shall be based on the number of services in the affected area. This main shall be certified for potable water use as per NSF 14 and 61.

Service piping shall be a minimum of 19mm inside diameter KuriTec Series K6136 reinforced PVC flexible connection or approved equal. Service piping shall be certified for potable water use as per NSF 61. Customer connections to external hose bibs shall require a brass wye fitting with dual shut-offs.

Prior to customer connection, all temporary watermain and temporary service piping shall be tested and disinfected. Testing of the temporary watermain and services will be at system pressure. Once testing of the temporary watermain is complete with no leakage, service piping shall be connected to the temporary watermain. There shall be no leakage in service piping.

Services shall be plugged, capped, or valved off at the end of the service pipe once flushing has been completed. Temporary watermain and services shall then be disinfected by removing plugs, caps, or opening valves to flow super-chlorinated water for the disinfection process. Plugs and caps shall be replaced, and valves closed once the disinfection process has begun. Taping ends of service piping is not permitted. All piping, hoses, valves, plugs, caps, and fittings for all connections shall be the responsibility of the Contractor. Flushing, swabbing, disinfecting and commissioning of the temporary system shall meet the requirements of **Section 6.3.9**.

All temporary services connected to external hose bibs shall be made using a brass wye connector for sampling and to ensure external water use by the customer. Connection via existing curbstop or external hose bib. Control valve handles for individual services to be removed once commissioned. Handles to be retained by Contractor and County for operation and maintenance issues.

When a replaced section of watermain is restored to service, the Contractor shall remove any corresponding temporary pipe and house service connection and shall leave the street, sidewalk and adjacent property in a neat and orderly condition.

6.3.6 Watermain Connections

6.3.6.1 Connections to Existing Mains & Jointing Watermain & Fittings

All chemicals and materials used in the operation of the drinking water system that come into contact with water within the system shall meet all applicable standards set by AWWA, ANSI, as well as the safety criteria standards under NSF60 and NSF61.

Contractors shall notify the County or its Service Provider in writing a minimum of 48 hours in advance of their intention to connect to existing watermain. Contractors shall locate and make connections to existing watermain as shown on the Contract Drawings in the presence of a licensed operator from the County or its Service Provider.

The method of connecting shall be determined by the **County of Oxford Public Works**. Where connections are to be made to concrete or steel mains, the installation will be such as to bare all coatings and materials in a proper manner. The Contractor shall submit a program for this work which shall be approved by the **County of Oxford Public Works** before work commences.

Contractors shall not operate existing valves. Contractors shall notify any existing customers of shutdowns at least 48 hours in advance of the disruption. Notices and customer lists of the affected area will be supplied by the County or its Service Provider.

The jointing of pipe shall be made in accordance with the manufacturer's instructions and the applicable AWWA standards.

No substitution of accessories will be permitted and only lubricants as supplied by the manufacturer will be permitted.

Extreme care shall be taken to prevent contamination of the existing watermain and new closure fittings. All new piping and appurtenances placed in the connection of the new main and existing waterworks system must be disinfected with a 1% solution of sodium hypochlorite or equivalent method, conforming with AWWA C651. All connections to existing watermain shall be 6 m in length or less. Connection requirements longer than 6 m shall be flushed, pressure tested and disinfected as per **Section 6.3.9**.

On straight lengths, no lateral deviation in excess of 150mm will be tolerated and on straight grades no grade deviation in excess of 75mm will be tolerated.

6.3.6.2 Valves, Hydrants & Fittings

Valves, valve boxes and hydrants shall be installed plumb at all locations. The valve box will be installed on every valve in such a manner that no shock or stress shall be transmitted to the valve. The box shall be centered and plumb over the operating nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.

Valve extension rods shall be installed according to **Oxford County Standard Drawings.**

Bends, crosses, tees and other fittings shall be installed where shown. Mechanical thrust restraint is required. Mechanical restraints to be installed as per **Section 6.2.4.7** of the Design Guidelines and in accordance with the Manufacturer’s specifications.

Prior to installation hydrants should be cycled to full open and full closed positions to ensure no internal damage or breakage has occurred during shipping and handling.

Hydrants shall be installed according to D1828-1-1993. Hydrants shall be set with the barrel vertical, outlets parallel to the roadway and at a depth suitable for the finished grade at the hydrant location. Temporary extension pieces may be necessary. Hydrants shall be installed using mechanical restraints.

Hydrants shall be set on concrete blocking, as shown on OPSD 1105.010. The excavation around the hydrant shall be filled to a minimum of 150mm above the hydrant drain, with at least 0.50 cubic metres of 19mm clean crushed stone, free from fine material, which shall be covered with filter cloth before backfilling. Hydrants shall not be backfilled before being inspected by the **County of Oxford Public Works or Service Provider**.

Cast iron plugs or caps shall be installed on all dead-ends with the dead-end being equipped with a suitable blow-off.

Hydrants installed in areas of high-water table may require drain outlets to be plugged to prevent contamination. Hydrants with plugged drains must be clearly marked and pumped dry after each use.

The illegal connection and operation of any municipal fire hydrant will result in fines as set out in the most recent version of Oxford County's Water/Wastewater Bylaw.

6.3.7 Service Installation

6.3.7.1 Connecting Services to Mains

Contractors shall give the County or its Service Provider a minimum of 48 hours notice prior to connecting services. A licensed Operator from the County or its Service Provider shall be present for all connections.

All new water services 100mm diameter and larger on private property must be tested and disinfected in accordance with **Section 6.3.9**. Private services will not be connected unless testing and sampling has been completed. A licensed operator from the County or its Service Provider shall be present for the testing and sampling procedure. The installation of services shall be as per applicable OPSS, OPSD and AWWA standards with the following exceptions/amendments.

Direct tapping of services to PVC watermain is not permitted. Water service connection main stops connected to Ductile Iron is permitted with an approved saddle only. Main stops shall be tapped into the main at a 10 to 20-degree angle. All service connections shall be tapped in with the main under working pressure.

One continuous piece of service pipe shall run from the watermain to the curb stop and service box at the street line. Splicing of service lines is not permitted.

Curb stops shall be installed with electrical thaw nuts on the private side facing away from the watermain.

Services of 25mm shall be installed as per **Oxford County Standard Drawings**. Services of 32mm, 38mm and 50mm in diameter shall be installed as per **Oxford County Standard Drawings**. The use of Copper for service material is not permitted. No couplings are permitted between the main stop and curb stop.

Services of 100mm diameter and larger shall be connected by either cutting out a section of the main and installing a tee with a cut-in sleeve or by using a tapping sleeve and valve. The type of connection will be determined by the County or its Service Provider.

Stainless Steel Double bolt saddles shall be used on all services for Ductile Iron pipe from 25mm to 50mm diameter. Saddles shall be full circumference wide band with stainless steel band, nuts, bolts.

Stainless Steel Double bolt saddles shall be used on all services for PVC watermain from 25mm to 50mm diameter. Saddles for PVC pipe shall be full circumference wide band with stainless steel band, nuts, bolts, and outlet.

The County or its Service Provider will inspect all connections unless otherwise agreed in writing. The Contractor will install service connections in subdivisions or new developments.

All tapping machines and other required equipment to be used onsite shall be satisfactory to the County or its Service Provider.

When connections are to be made to mains other than cast iron or ductile iron, they shall be done under special instructions from the **County of Oxford Public Works**.

Curb boxes shall be installed vertically, flush with finished grade, and located on the property lines. If extensions are required only threaded couplers shall be used. Set-screw type extensions are not permitted.

Cathodic Protection for services shall be installed in accordance with **Section 6.3.8.2**.

Services located 500mm or less horizontally from a MH or CB requires minimum 50mm thick insulation to 1.0m each side of structure.

The County or its Service Provider shall require a minimum of 48 hours notice prior to placement of finished grade materials surrounding the curb stop. Curb stops shall be inspected and raised to the level of finished grade. All service boxes located in concrete, asphalt, or interlocking brick surfaces shall have a 100mm inside diameter PVC pipe 300mm in length placed around the cap and flush with the surface. After placement of final grade material, the curb stop shall be flush with the surface and in a fully accessible and operable state.

Blue painted stakes 50mm x 100mm shall be placed during trench restoration to mark the termination of the water service. These stakes shall extend from service invert to a minimum of 600mm above finished grade.

Landscaping Trees are not permitted to be planted in a public right of way where the tree's trunk will interfere with the operation of the curbstop. The trees drip line at maturity shall not extend over the water service of a residence.

A record of service location must be produced for the As-Constructed drawings and provided digitally to the County.

Water services are to be located on these drawings by showing proper plan view locations which includes any bends and sweeps between the connection at the watermain, and the right-of-way, tie-in or curb stop. Depth below existing ground and invert elevation shall be indicated on the service locate sheet drawing.

All services shall require extensions from the curb stop to a minimum of 600mm above finished grade. These tail pieces will be used for testing and air relief purposes only. Material used for tail pieces shall be PEX, PE 3408/3608 Series 200 CTS, or approved equal and shall conform to AWWA C901.

Upon completion of testing, service tails will be capped and fastened to marker posts.

The illegal connection and operation of any municipal water service will result in fines as set out in the most recent version of Oxford County's Water/Wastewater Bylaw.

6.3.8 Corrosion Protection and Insulation

6.3.8.1 Petrolatum Coating System

Material requirements shall be as per AWWA C217, CSA Z245.30-14, and be ISO 9001 and ISO 14001 compliant. The installation of the petrolatum coating system shall be in strict conformity with AWWA C217 with the following exceptions/ amendments.

- All surfaces of fittings, flanged connections, nuts, bolts, tie rods, clamps, valves, sleeves, Victaulic couplings, joint restraints, etc., shall be protected using petrolatum materials. Prior to application all surfaces shall be free of dirt, grease, oil, paint, or foreign materials. The minimum acceptable application of a petrolatum coating system is a two-step process consisting of a primer and petrolatum tape. Where voids or other surface irregularities are encountered, filler material is required where the tape will not come into full contact with surfaces. Placement of petrolatum tape only is not acceptable.
- All surfaces of pipes, valves, fittings, and appurtenances in valve chambers shall be coated using petrolatum materials. Valves or appurtenances that are epoxy coated do not require this procedure.
- Petrolatum coatings shall be Denso or approved equivalent. After final inspection of the applied coating system any defects in the application process shall be repaired at the Contractor's expense.

6.3.8.2 Cathodic Protection for PVC Watermain

The size and type of anodes shall be determined through the Geotechnical report. The list below indicates the minimum anode requirements. Anode locations shall be clearly shown on the Construction and as-built drawings. In addition, a tabular listing of the stations at which the anodes are to be installed shall be provided.

Sacrificial anodes shall be installed at all ductile iron, cast iron pipe fittings, joint restraints, copper water service lines, and attached to tracer wire at the ends of watermain. At the ends of watermain the tracer wire shall be spliced to the wire of a 5.5 kg zinc anode and is to be buried at the same elevation as the watermain.

In areas of reconstruction where new non-metallic services are connected to existing metallic services at property line, anodes shall be connected to the existing metallic service pipe behind the curb stop on private property. Where existing metallic water service materials other than copper are encountered on private property, the Owner should be advised of replacement.

In subdivisions that have undeveloped lots with existing copper service lines on municipal property, an anode shall be installed on the copper service line during the connection inspection.

Anodes shall be installed as per OPSS.MUNI 442, OPSD 1109.010, OPSD 1109.011, and OPSD 1109.012. Attaching anodes to restraint nuts or gland pack nuts is not permitted. Anode wires shall be TWU or RWU-90 insulation with AWG#1/0 – 19 strand copper wire rated for underground direct bury applications.

Valves or appurtenances that are epoxy coated do not require this procedure. Connections to fittings, and joint restraints will be done using a thermite weld and coated with mastic. Anodes attached to copper services will be done using a silicon bronze ground clamp attached to the service pipe. The clamped connection shall be wrapped with petrolatum tape and compressed by hand around the connection. Installation shall be as per the manufacturer's specifications and recommendations.

.1 Minimum Anode Sizing

The Minimum anode sizes used shall be in accordance with the table below.

Table 4-8 Minimum Anode Sizing

New Installations of Fittings, Joint Restraints, and Services	Zinc – ASTM B418 Type II
Fittings and joint restraints	11kg Z-24-48
Water Services 38mm and larger	11kg Z-24-48
Water Services under 38mm	5.5kg Z-12-24

Existing metallic watermain, services, or connection between cast iron / ductile iron	Magnesium – ASTM B843 Type M-1C

watermains and PVC Pipe	
Fittings and joint restraints	14kg M-32-22
Water Services 38mm and larger	14kg M-32-22
Water Services under 38mm	7.7kg M-17-20

6.3.8.3 Thermal Insulation

Material used to thermally insulate mains and services shall have a minimum compressive strength of 690kPa. Approved material is STYROFOAM HI 100 BRAND by Dow Chemical or approved equal. Installation as per **Oxford County Standard Drawings**.

6.3.9 Swabbing, Flushing, Disinfecting and Bacteriological Testing of Watermains

6.3.9.1 Testing General

The Contractor shall give the County or its Service Provider a minimum of 48 hours' notice prior to testing. A licensed operator from the County or its Service Provider shall be present for the testing procedure and is required to fill out and submit the Watermain Inspection Report. Submission of Form F035 Watermain Inspection Report is required as final acceptance of the testing procedure. Testing shall be conducted as per OPSS and AWWA requirements with the following exceptions/amendments.

- The Contractor shall test all watermain, in such lengths or sections as directed by the **County of Oxford Public Works**. The Contractor shall provide all labour, water, pumps, gauges, caps, stoppers, air release cocks, pipe work and other apparatus required to complete the tests.
- The Contractor shall supply the **County of Oxford Public Works** with the pressure gauges intended to be used prior to the first test in order that they may be checked for accuracy. All equipment used by the Contractor in carrying out the testing shall be approved by the **County of Oxford Public Works**.
- Under no circumstances will the test lengths be permitted to exceed 600 m unless approved by the **County of Oxford Public Works**.
- Pipe crossings on bridges, under rivers, creeks, railway tracks, Provincial roads, and other right-of-ways shall be tested separately.

6.3.9.2 Commissioning Plan

The Contractor shall be responsible for submitting a Testing and Commissioning Plan for the work. The plan shall include:

- A detailed overview of their approach to each phase of the testing and commissioning process.
- A drawing showing the proposed sampling points.
- A schedule showing the phasing of testing and commissioning, separated by section if the new watermain will be commissioned in parts.
- A complete list of parts and materials to be used in commissioning indicating manufacturer, material type, certifications, etc.
- The SDS for all chemicals being used.
- Proof of NSF 60 compliance for all chemicals coming into contact with potable water.
- A copy of the County's standard form for watermain commissioning (template to be provided by **County of Oxford Public Works**.

6.3.9.3 Initial Flushing and Swabbing

Prior to testing and disinfection, and under the supervision of the County or its Service Provider, all dirt and foreign matter in the system shall be removed. Pipelines shall be cleaned by flushing and swabbing.

.1 Flushing

After watermain construction is complete initial flushing will be conducted on all branches of watermain until all visible foreign matter has been removed. All new and rehabilitated watermains shall be flushed and swabbed after the water services have been tapped.

.2 Swabbing

Once flushing is complete swabs may be inserted into all branches of watermain, or, as directed by the County or its Service Providers. The placement of swabs during construction is not permitted unless authorized by the County or its Service Providers. Swabbing will be completed prior to pressure and leakage testing.

The swab diameter shall be 1.25 times the outside diameter for pipes up to and including 300mm and 1.50 times the outside pipe diameters for pipes greater than 300mm. Each branch of the new mains will be swabbed using three sequentially numbered swabs. The velocity of the swabs shall not be less than 0.76 m/sec.

Swabbing shall be repeated until 2 consecutive clean swabs (no discolouration of swab) and the discharge water is clear and approved by Water Operations representatives. Any potential changes to swabbing process shall be at the discretion of the Water Operations Representatives.

6.3.9.4 Test Pressure

Test pressure shall be 1035 kpa (150 psi). This will be measured at the highest elevation in the test section. The test section shall be filled slowly with water and all air shall be removed from the pipeline. A period of 24 hours for absorption should be allowed before starting the test. The test section shall be subjected to the specified continuous test pressure for 2 hours. Hydrostatic pressure and hydrostatic leakage tests may be conducted either simultaneously or separately.

Hydrostatic testing of new watermain and appurtenances (fire hydrants and laterals, etc.) including water services to the curb box shall be done on new subdivision watermain infrastructure. Services can be dry tapped and included in testing. All other hydrostatic testing of new watermain replacements shall include the testing of all appurtenances including the installed service saddle 25mm main stops only. All services over 25mm shall be tested to the curb box.

Hydrostatic testing of reconstructed watermain and appurtenances (fire hydrants and laterals, etc.) shall be conducted in the same manner as new watermain. New services, including main stops and curb boxes shall also be tested provided they are not connected to existing services.

In areas where watermain has been rehabilitated with structural or cement mortar lining, pressure testing to 1035 kPa (150 psi) is not required. Rehabilitated watermain shall be tested at system pressure.

A visual inspection is required for all fittings, valves, and connection points where entry into the piping has occurred, prior to backfilling, to verify there is no leakage.

Testing and inspection will be completed to the satisfaction of the County or its Service Provider.

6.3.9.5 Blocking & Blanking

Once the Contractor is ready to test a section of the pipeline, the Contractor shall check that all relevant open ends are capped off and that all bends, tees, crosses, etc. are adequately restrained to safely withstand the test pressure.

6.3.9.6 Air Release Taps

The Contractor may be directed by the **County of Oxford Public Works** to excavate certain portions of the pipeline in order to provide taps for the release of air without additional payment. New water services may be used to release air provided they have temporary service material connected to the curbstop and placed to the surface of the ground

Air release taps shall be installed at all high points to accomplish this before the test pressure is applied.

6.3.9.7 Filling Pipe

The section of the pipeline to be tested shall be slowly filled with water obtained by the Contractor at his own expense from a source approved by the **County of Oxford Public Works**. The Contractor shall ensure that all air has been removed from the section of the pipeline to be tested.

6.3.9.8 Leakage Test

The test section shall be subjected to the specified continuous test pressure for two hours. The Contractor shall provide the **County of Oxford Public Works** with the necessary equipment for measuring the exact quantity of water added in order to maintain the test pressure throughout the duration of the test.

The County or its Service Provider shall calculate the allowable leakage for testing purposes. Allowable leakage for Polyethylene shall be as per OPSS 441.07.24.

If any section under test discloses a leakage greater than that allowed, the Contractor shall locate and repair the defective area or areas at their own expense.

6.3.9.9 Disinfection

.1 General

After the conclusion of flushing, swabbing, pressure and leakage tests to the complete satisfaction of the **County of Oxford Public Works**, the Contractor shall disinfect the newly constructed or rehabilitated water system including all sumps and chambers that are intended to hold potable water as per the MECP Watermain Disinfection Procedure, AWWA C651 Disinfecting Water Mains, NSF 60, and NSF 61.

All watermain shall be disinfected according to Ontario's "Watermain Disinfection Procedure". All water services 100mm and greater shall be disinfected according to Ontario's "Watermain Disinfection Procedure". The "Procedure for Disinfection of Drinking Water in Ontario" as adopted by reference by Ontario Regulation 170/03 under the Safe Drinking Water Act.

The two acceptable methods for disinfection are:

- A known quantity of water and a known quantity of Chlorine mixed in an approved tanker truck to achieve the required concentration of chlorine. This mixture will then be used to fill the new water main.
- A modified continuous feed method. This will be a known flow of water in the new water main injected with a known flow of chlorine to achieve the required concentration of chlorine.

The method, materials, quantities, and equipment to be used will be submitted to the **County of Oxford Public Works** for approval before the construction starts. Equipment used should be specific to testing and disinfecting and not used for any other purposes.

The Contractor shall complete the disinfection within ten days of being directed to do so. The Contractor shall give the County or its Service Provider a minimum of 48 hours written notice prior to disinfecting. A licensed operator from the County or its Service Provider shall be present for the disinfecting procedure.

.2 Contractor Supplied Materials

The Contractor shall supply all labour, water, materials, chemicals, flushing taps, disinfecting agents, etc. necessary to complete the disinfection and final flushing of the system to the satisfaction of the **County of Oxford Public Works**.

.3 Point of Application

The new watermain shall be kept isolated from the existing waterworks system using a physical separation until satisfactory bacteriological testing has been completed and accepted by the County or its Service Provider. Water required to fill the new main for hydrostatic pressure testing, disinfection and flushing may be supplied through a temporary connection between the existing water system and the new main. Temporary connections shall be as per **Oxford County Standard Drawings**.

The temporary connection shall include an appropriate testable reduced pressure zone (RPZ) check valve assembly used only above ground along with isolation valves located on each side of the device.

The County or its Service Provider will require the Contractor to provide written certification of the backflow prevention device's operation in accordance with CAN/Canadian Standards Association-B64 Series Manual each time the device is installed. See also **Bylaw 6544-2023**. The backflow prevention device shall be isolated from the new main during the hydrostatic pressure test by placing the isolation valves in the "closed" position.

It will be necessary to re-establish the connection after completion of the hydrostatic pressure test to disinfect and flush out the chlorinated water prior to the final connection of the new or rehabilitated main to the existing system.

.4 Disinfection Procedure

Chlorination methods for disinfecting newly constructed watermains shall be as per AWWA C651. Minimum contact times, initial chlorine concentrations, and maximum allowable decreases in chlorine concentration shall be as per the MECP Watermain Disinfection Procedure, as amended below.

Water entering the system shall be controlled to flow slowly during the application of the chlorine solution. The use of Dole valves may be required.

The County or its Service Provider shall record the duration of disinfection, as well as the initial dose and remaining residual at the end of the contact time.

6.3.9.10 Final Flushing

After disinfection, heavily chlorinated water should not remain in prolonged contact with the pipe.

In order to prevent damage to the pipelining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main, fittings, valves, hydrants, blow-offs, branches and all service tails.

It is unacceptable to allow heavily chlorinated water to remain in a main over a weekend or a 48-hour period.

Dechlorination of water shall be as per AWWA C655. The environment to which the chlorinated water is to be discharged shall be inspected prior to final flushing. All chlorinated water used for testing, flushing, and disinfecting watermains shall be disposed of safely. Any discharge of chlorinated water that will cause damage to the environment, including aquatic and terrestrial species, shall require a neutralizing chemical to be applied to thoroughly neutralize the residual chlorine.

When necessary, Federal, Provincial, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water. Chlorinated water may not be discharged to any water body.

Discharge of heavily chlorinated water into sanitary sewers is not permitted. Acceptable means of disposal is by discharge into a storm sewer or open environment (drainage ditch) with a free chlorine residual of 0.0 mg/L (i.e. no detectable level of chlorine). The concentration of chlorine in the water leaving the main will be approved by a certified operator from the County or its Service Provider on site. When discharging into the open environment or storm sewer, it will be the responsibility of the Contractor to ensure the effectiveness of the dechlorinating process.

The Contractor shall provide a written plan for the dechlorinating process which will be submitted to the County or its Service Provider for final approval prior to discharge.

6.3.9.11 Sampling Requirements

After final flushing and before the new watermain is approved for connection to the existing water system, two sets of water samples shall be taken at least 24 hours apart. Samples shall be collected every 350 metres, from the end of the line, and from each branch. For watermains less than 350 metres, two sets of samples shall be collected at a minimum of two locations.

The free chlorine residual must be between 0.50 mg/L to 1.50 mg/L.

Only a certified municipal operator or person designated by the Municipality (OWRA Reg. 128/04) shall collect bacteriological samples. Testing of initial samples as described above will be paid for by the County. Contractors shall contact the County for information regarding current approved laboratory services.

All water samples are to be analyzed at a laboratory that is accredited and licensed to perform microbiology tests on regulated municipal drinking water. If additional samples are required, they will be done at the Contractor's expense.

The results should be emailed to water_analytical@oxfordcounty.ca directly from the laboratory or may also be faxed directly to the County at 519-421-4711. For sampling performed in the City of Woodstock or the Town of Tillsonburg results should be forwarded to the Water Operations Manager at these locations.

Samples will be taken by an operator employed by the County or its Service Provider who will also provide the sample container, complete the appropriate paperwork (chain of custody) for samples going to the laboratory and seal the container or sample bottles.

The requested tests, free chlorine residual, time the sample was taken, location and the operator's name must be on the chain of custody. Samples submitted without appropriate paperwork (i.e. chain of custody) will be rejected by the testing laboratory and not analyzed.

Contractors will arrange for delivery of samples to the lab if a pick-up cannot be conveniently arranged.

Samples should be transported in a container with ice or cold packs to maintain a temperature between 4 °C and 10 °C, until delivered to the laboratory. Samples must be received at the laboratory within the holding time required for the type of sample. Samples taken from water mains isolated from the municipal consumers are identified as NR (not regulated under Reg. 170/03).

The minimum acceptable requirements for bacteriological tests are:

- E. coli 0 colonies per 100 ml
- Total coliform 0 colonies per 100 ml

If background bacteria are reported, the result shall not be accepted above 200 colonies per 100 ml. If an HPC (heterotrophic plate count) is analyzed, the result shall not be accepted above 500 colonies per 1 ml.

6.3.9.12 Commissioning of New Main

Contractors shall complete a New Watermain Inspection Report and submit to **Oxford County Public Works**.

Contractors must provide a method of dewatering to protect the new and existing watermain from contamination with foreign material or groundwater during the final connection. Should contamination occur, the entire cost of disinfecting the mains will be at the Contractor's expense.

One method of dewatering is to provide a crushed stone sump in the trench and sufficient pumps to control the water being drained from the main, assuring no backflow into the pipes from the trench.

All new piping and appurtenances placed in the connection of the new main and existing waterworks system must be disinfected with a 1% solution of sodium hypochlorite or equivalent method.

When all of the initial tests, including the bacteriological samples are satisfactory, approval from the County or its Service Provider must be obtained prior to connecting the main to the existing water system. Contractors shall give the County or its Service Provider a minimum of 48 hours' notice prior to connecting.

A licensed operator from the County or its Service Provider must be present on site during the removal of the temporary connection and until the connection to the existing waterworks has been completed.

6.3.9.13 Testing and Commissioning of Relined Watermains

In general, Swabbing, Flushing, Disinfecting and Bacteriological Testing of Relined Watermains shall follow the same procedures as listed above for new watermains, with some modifications. All relined segments of watermain shall remain isolated from the distribution system until testing and disinfection is complete.

The test pressure for relined watermains shall be at the existing system static pressure for a duration of 1 hour. Pressure testing shall not take place against existing "in place" valves.

The locations of any joints, fittings, repairs, and connection points in the relined system shall remain open for visual inspection for leakage until the pressure test is complete. This shall include any repairs to existing water services where they were necessary as a result of the relining process. Failure to do so will result in the excavation of any or all of these areas for visual inspection at the Contractor's expense.

6.3.9.14 Contractor's Liability

The Contractor shall be liable for all damage to equipment, property, persons, etc. caused by or as a result of the pressure and leakage tests performed and the flushing, disinfection, and cleansing of the system, pipeline, and accessories.

6.3.9.15 Removal of Equipment

Upon completion of the testing and disinfection of each section, the Contractor shall remove all ancillary equipment and plug all holes left by the air release taps in a manner satisfactory to the **County of Oxford Public Works**.

6.3.9.16 Defects in Pipework

The Contractor shall, at their own expense, carry out all remedial work necessary to rectify any defects revealed in watermain, pipelines and pipe work.

6.4 BULK WATER FILL STATIONS

Bulk water fill stations are intended to provide a reliable means of supplying water in large quantities for construction or commercial activities.

6.4.1 Site Layout

A bulk water facility shall be equipped with a minimum 3.0m wide paved asphalt apron around the bulk loading panel.

6.4.2 Process Design

Bulk water stations are part of the County's water distribution system and must be designed to prevent freezing of water lines and avoid the possibility of cross-contamination with the County's water system.

Provide an electrical/control panel complete with an automatic card reader system to control and monitor the operation of the bulk water system. The card reader and control system shall be utilized to quantify water takings for billing purposes. The card reader and control system must be designed in complete consultation with County staff to ensure compatibility and integration with the County's billing system.

Provide a flow meter, online pressure indicator transmitter and testable reduced pressure principle backflow preventer assembly on the main line. Design should consider adequate sampling ports and means for draining water.

Provide positive drainage around the bulk loading station to direct spillage and stormwater away from the station. Site design shall include provision for drive-through tanker circulation with no requirement to reverse direction or backup. Sufficient space should be provided for queuing of at least one tanker truck waiting to fill without impacting local traffic or blocking the street.

Site selection for new bulk loading stations shall be in consultation with the County and local community stakeholders to ensure public acceptance prior to design.

6.5 WATER CISTERNS BACKFLOW/METERING

On site water cisterns connected to municipal water are discouraged, however should one be permissible by **Oxford County Public Works** they are to be designed and constructed with a backflow protective device and a flow meter to account for water within the cistern. The Owner will be responsible for the supply, installation and maintenance of all check valves and protective devices and water metering, at no cost to the County.

Refer to **Section 6.2.13** for additional information on Backflow Prevention. Refer to **Section 6.2.8** for additional information on Water Metering.

6.6 WATER BOOSTER PUMPING STATIONS

Booster Pumping Stations refer to pumping stations in which intake lines are directly connected to the pressurized water main and are designed to increase pressure and maintain water transmission within a distribution system. Booster Pumping Stations shall be designed where pressures are below 310 kPa (45 psi) to provide pressure augmentation within a zone of the system. Refer to **Section 6.2.7.2** for Individual Booster Pumps to augment pressures for a small number of individual residences.

Refer to **Section 8** for general facility design requirements.

6.6.1 Design Criteria

The design criteria for the booster pumping station shall consider analysis of the following conditions:

- Peak flows – Required flowrates when water demand is at its highest.
- Night/low flows – Required flowrates when water demand is at its lowest.
- Fire flows – Sporadic occurrences and therefore must be added to the maximum daily flowrate, if applicable.

The Proponent shall provide the required domestic and fire flow demands and submit the data to the County. The County will review the submission using the approved water model which integrates the County's specified pressure bands. The County will reaffirm the booster station size and pumping requirements which must form the basis of facility design by the Proponent.

6.6.2 Pump System Design

The pumping station shall be designed such that the maximum daily demand can be met with the largest pump out of service. For pumping stations without adequate floating storage, additional pumping capacity should be considered for situations in which the largest unit is out of service.

The pumping station shall be designed with consideration for future capacity expansion. Adequate spacing and connections should be provided for installation of additional pumps, while still allowing for sufficient spacing for equipment servicing. Evaluate the anticipated range of flows and evaluate alternative pump types and sizes to achieve an efficient system design. Provide VFD-operated pumps for all booster pumping stations. Pump start and stop ramp times shall be confirmed through transient analysis.

6.6.3 Considerations for Low Flow Operation

During low flow periods, consider use of jockey pumps and/or pressure tanks to minimize pump cycling.

6.6.4 Piping, Valving, and Instrumentation

All piping shall be provided with isolations valve(s) to permit isolation/removal of pump(s) or major equipment for maintenance work without impacting the integrity or operational capacity of the pumping station itself.

All valves shall be located with ease of access considerations to allow for operation and future maintenance.

All pipes shall be colour coded to comply with the latest edition of the MECP Standards for Pipe Identification in Water and Wastewater Treatment Plants in Ontario. Arrows labeling the direction of flow within the pipe shall be provided.

6.6.5 Surge Relief

Surge relief devices shall be used to prevent equipment damage from water hammer/pressure surge events. Surge relief valves shall discharge water to a safe, controlled location that can accommodate high pressure and sudden flow events without causing flooding, contamination, or operational hazards. Recycling of surge water can be implemented to minimize water losses and in environmentally sensitive areas but should consider water age limits within the system. Wasting of surge water can be implemented where recycling is not viable, but the discharge water must comply with local environmental and stormwater regulations.

The surge relief system should be integrated with SCADA for alarms and monitoring.

6.6.6 Standby Power

Standby power is required to ensure uninterrupted water service during power outages. The pumping station design shall include full standby power capable of covering the station’s capacity including essential auxiliaries. The requirement and sizing of standby power should be assessed for each facility based on service criticality and other system factors. The criteria for assessing the need for standby power at a booster pumping station includes:

- If the booster pumping station is the sole source of supply for a pressure zone without adequate reserve storage.
- If the booster pumping station is critical for fire protection or public health and safety.
- If no alternative water supply or storage is available to meet water demands during potential outages.

Refer to **Section 8.11.7** of the facility guidelines for further requirements.

6.6.7 Equipment Servicing

The pumping station should be designed with spacing around pumps, piping, and equipment in compliance with O. Reg 332/12: Building Code (or latest version). Lifting devices, including crane-ways, hoist beams, eyebolts or other appropriate devices should be considered in the design to allow for maintenance or removal of pumps, motors, valves or other heavy equipment. The lifting devices should have a rated capacity greater than the heaviest equipment unit, including an appropriate safety margin. The station should be designed with floor, roof and door opening considerations to accommodate removal of large equipment.

6.7 WATER STORAGE

The design guidelines as provided herein are for the design of new or rehabilitation of existing reservoirs and tanks. All materials used in the design, alteration and operation of the drinking water system that come into contact with water within the system shall meet all applicable standards set by both the American Water Works Association ("AWWA") and the American National Standards Institute ("ANSI") safety criteria standards NSF International (NSF) NSF 61 and NSF 372.

Refer to **Section 8** for general facility design requirements.

6.7.1 Design

For new reservoirs, provide a minimum of two cells with the ability to isolate any one of the reservoir's cells. Isolation of one cell shall not impact the minimum required contact time (CT) value at the maximum flow rate. For expansion of existing reservoirs, design new cell(s) capable of being isolated from existing cell(s) for repair and or cleaning, or, to float independently on the water supply distribution system.

All inlet, outlet and piping within the storage tanks or reservoir cells shall be designed to allow the circulation of fresh potable water within the reservoir cells. All necessary piping and valving shall be provided to allow for the bypassing of any storage to be taken off-line for maintenance work. All valves should have ease of access for future maintenance.

To ensure an adequate chlorine level in the storage tank the design of static mixing system may be required. Static mixing system is preferred over baffling system.

All pipes inside the valve house shall be colour coded to comply with the latest edition of the MECP Standard for Pipe Identification in Water and Wastewater Treatment Plants in Ontario. Provide arrows indicating the direction of flow.

Reservoirs and storage tanks shall be designed to meet the following criteria:

- Construct with 316 Stainless Steel Piping, Schedule 10S at minimum.
- Position inlet/outlet pipes to promote fresh water circulation and minimize dead spots.
- Ensure full depth is available for operation.
- Install butterfly valves and piping to isolate reservoir cells for maintenance or construction without shutting down the entire reservoir.
- Provide isolation valves and piping for pumps.
- Reservoir and piping are to be designed to allow future expansions with minimal disruptions to continued use of the existing storage volume.
- Equip the reservoir's inlet valve chamber with a sump pump, in addition to a standby sump pump, each with check valves for drainage where gravity drain is not possible.

- Connect pumps and washdown pump to the reservoir's fill line.
- Install 40mm Stainless Steel washdown piping up the concrete pedestal, complete with valves and camlocks at each end, and a 50mm FIP x FIP valve with a 40mm camlock on inlet piping.
- Provide vents for each cell, protecting them from dust, dirt, insects, and vandalism. Ensure vents remain open at all times to allow air flow in and out of the reservoir cells.
- Ensure free air passage between cells using wall cutouts or pipe inserts above the maximum top water level and overflow line.

The water storage systems design shall follow additional criteria outlined in MECP Design Guidelines for Drinking-Water Systems.

- Valves: Piping diameter shall be considered when selecting valve types. For piping with a diameter of 100mm or greater, gate valves are the preferred selection. For piping with a diameter under 100mm, ball valves are the preferred selection. AWWA C504 butterfly valves (short body flanged with handwheel) may be used at non-critical locations.
- Spare piping shall be provided for future well connections/expansions.
- Install separate inlet and outlet lines to the tank with Swingflex check valves on each.
- Include a removable flared silt stop.
- Install a stainless steel ladder inside the bowl (submerged) with a landing.
- Provide GFCI receptacles, with enclosures suitable for wet/damp environments, at each landing in the access tube and at the roof hatch landing, mounted clear of the ladder travel way. Arrange receptacles to support confined space ventilation and temporary lighting for maintenance purposes.
- Install obstruction lights at the highest point on the exterior of the elevated tank. Where icing is likely to occur, install metal grating or protective ice shields over each light in a manner to ensure unobstructed view of at least one light approaching from any direction. Backup bulbs and a fail indicator shall be provided at the tank base, inside the pedestal or adjacent to electrical/SCADA panel.
- The elevated tank shall have one (1) access hatch framed at least 100mm above the surface of the roof at the opening. The access hatch shall have a watertight cover overlapping the framed opening and extending down around the frame at least 50mm, hinged on one side with a locking device. All other access ways shall be bolted and gasketed.
- Construct a concrete pad (1.5m x 2.0m) at exterior doorways exiting the valvehouse at the base of the tower, sloped away from the tower.
- Provide an isolation valve for the elevated tank located in an accessible valve chamber. Install a tee on the distribution main side of the isolation valve with a 150mm AWWA C502 dry barrel hydrant and a dedicated gate valve on the hydrant lead.
- Provide dual grounding wires to the bowl.
- Install kick-plates around all safety railings.
- Include DBI-Sala anchors and mounting bases for rescue equipment (SRLs, Rolgliss, etc.) on top of the bowl and at the landing.
- Extend the catwalk across the entire pedestal.
- Install six (6) LED lights at least 30m away from the pedestal.
- Install LED lights outside of doors (entrance ways) with switches located inside.
- Provide a genset hookup and ATS for power outages (distribution panel with manual 120/240V transfer may be used, e.g., Federal Pioneer - Service Entrance Generator Panel).

- Install separate low and high-level alarms from the pressure switch.
- Include RPU power source fail and RPU watchdog alarm.
- Install Damar DMP and FMC Keyscan security system.
- Include a temperature transducer on the tower outlet.
- Install a magmeter on inlet/outlet piping.
- Provide heat trace on inlet/outlet riser piping with a fail indicator.
- Include a recirculation pump if required.
- Install a 12mm boss for rechlorination on inlet piping and a 12mm boss for dechlorination on discharge piping.

A separate instrumentation and control system shall be provided exclusively for this function to alarm and warn of an overflow. When the water level reaches the high-high level (HHL) condition, the instrumentation and control system shall activate the reservoir high-high level (HHL) overflow alarm condition to the operator through the SCADA system.

Provide one ultrasonic level sensor in each reservoir cell or storage tank. Control of the inlet valve and monitoring of the reservoir water level shall be through duty ultrasonic level sensor. The selection of the duty transmitter shall be done by the Operator through the SCADA system.

Provide reservoir with overflow piping capable of discharging the designed maximum inflow of water to the reservoir. Design overflow capacity from each cell shall be designed for the firm capacity of the upstream station. Design drain to permit discharge of water in a controlled manner to the site drainage system and/or storage lagoons sized for a two (2) hour pumping duration from the largest upstream pump. Provide perimeter drainage system.

Where available, information on required capacity will be provided by the County for the design and construction of the reservoir.

6.7.2 Re-Chlorination system

Where specified, design and provide the required chlorination system at the reservoir with the following operating characteristics:

- The rechlorination system shall be based on the application of sodium hypochlorite for disinfection.
- Provide a minimum of two metering pumps sized for maximum day requirement if the system is pumping from the reservoir into an open system and sized for peak hourly demand if the system is pumping from the reservoir into a closed system.
- The rechlorination system shall be sized to provide an increase to the total chlorine residual of up to 1.0mg/L at the maximum outflow of water out of the reservoir.
- The liquid sodium hypochlorite shall be injected into the common outlet pipe through an injection quill by a metering pump and shall be controlled by station PLC via the chlorine residual analyzer. Isolation valves shall be provided so that the analyzer can sample water from the reservoir outlet pipe only. The chlorination system shall only operate when the water is flowing out of the reservoir.
- Isolate sodium hypochlorite tank(s) in a separate containment area. Volume of containment area is to be 110% of the total volume of hypochlorite tank(s). A sump complete with on-grade fiber grate cover must be installed to accommodate the storage tank and at least one 205L drum delivery. Double wall chemical containment is an

acceptable alternative for small chlorination facilities. Separate ventilation should also be supplied to keep sodium hypochlorite fumes out of the rest of the facility.

- Flood alarm field instrumentation detection system within the containment area to be provided to detect leakage of sodium hypochlorite from tank(s). Connect flood alarm instrumentation to SCADA system.
- The sealed sodium hypochlorite tank(s) shall be vented to the exterior of the building

Separate ventilation should also be supplied to keep sodium hypochlorite fumes out of the rest of the facility.

6.7.3 Emergency Eyewash, Facewash and/or Safety Shower

Emergency eye/ facewash and/or safety shower stations to be provide as per the requirements of ANSI Z 358.1-2014 (or latest edition) in the vicinity of any chemicals that would irritate the eyes/skin and close to the metering pump(s) and analyzers room. An appropriate emergency Eyewash, Facewash and and/or Safety Shower where a worker is required to work with, or is likely to be exposed to, a hazardous biological or chemical agent that could cause injury to the eye or skin. Provide tempered water to the eye/ facewash and safety shower stations as per the ANSI Z 358.1 requirements. If the length between the safety stations and the hot water heater is more than 30m, the water temperature shall be maintained by either recirculation, or a self-regulating heat tracing system.

Eye / face was stations to be equipped with dust covers. Connect the safety showers to the sanitary drainage system based on section 7 of the Ontario building code.

6.7.4 Site Access Road and Security

The access road shall be fenced off with 1.8m high galvanized steel chain link fence and as per OPSD 972.130 and OPSD 972.132. Secure and lockable gates should be provided at all access points.

Exposed surfaces such as access hatches, doors, etc. shall be designed to be vandal resistant. Ensure that all ventilation louvers to the reservoir are properly secured to prevent entry of foreign material. All hatches to be lockable and keyed to the County's lock system.

The exterior of the facility shall be provided with Light-Emitting Diode (LED) lighting and lamps suitable for horizontal, base up or base down operation. Lights shall be automatically turned on or off by motion sensors or light sensors and shall be capable of being manually turned on or off from a designated central location.

All exterior access such as the facility doors and reservoir roof access shall be provided with intrusion alarm detection device in consultation with The County of Oxford Public Works.

Internal valve boxes shall be cast in place concrete with a lockable stainless-steel cover. Ensure that the stainless-steel cover is designed to prevent water from entering into the reservoir from the valve box.

Refer **Section 8.6** for further building security requirements.

6.7.5 Architectural

Design reservoir with Valve House in front with access door and retaining walls.

The reservoir shall be architecturally designed to ensure that the exterior complements with its surrounding environment. The exterior material and or finishes shall be designed to require minimal maintenance (i.e. steel roof). It shall be provided with sufficient entrances as per Ontario Building Code and to be without any windows. All openings in the exterior walls shall be equipped with insect screens and vandal-proof louvers.

All roof drains shall have a dome protection. Drains inside the valve house shall have easily accessible traps.

Raised roof access hatches shall be fabricated of aluminum frame with insulated cover and watertight. It shall be provided with a snap lock with a retractable handle for topside hardware, and padlock eyelets.

Floor layout shall allow for an easy access to all equipment inside the Valve House. Floor areas shall be sealed with a waterproofing coating and shall have a slip resistant finish. Interior finish shall require minimum maintenance. Walls above the grade shall be weatherproofed and walls below the grade shall be waterproofed. Do not use unbreathable painting for interior surfaces of Valve House.

All electrical equipment including control panel shall be located on the main floor. Interior lighting shall be wall-mounted LED light fixtures, and readily accessible for replacement and maintenance purposes.

An internal access port from the valve chamber to the reservoir shall be provided and shall be Type 316L stainless steel. Rescue davit to County specifications should be located adjacent to the access port as per County specifications.

Landscaping shall complement the surrounding environment. Where possible select plant species that are native to the project site. Consideration shall be made to select species that require minimal maintenance or watering.

Facility doors shall open in the direction of egress travel, especially for rooms containing high-hazard contents. The doors for high hazard containing rooms shall be equipped with panic bars or other suitable exiting devices.

6.7.6 Structural

The design of the reservoir roof shall be based on a cast-in-place concrete structure with a membrane overlay. The roof to be covered by earth for insulation to sufficient depth to sustain growth of grass and landscape planting, consistent with minimizing structural needs to carry the load. Where necessary, supplement earth insulation with additional insulating material to prevent freezing of reservoir’s ceiling during the wintertime.

Provide access and ventilation shafts, two for each cell.

All water retaining structures to be designed to ACI 350 (R).

Concrete housekeeping pads, elevating the electrical equipment above the level of the floor, shall be provided to help prevent water damage. The housekeeping pads shall be sized appropriately for the equipment footprint to ensure a stable surface.

6.7.7 Mechanical

Provide valve boxes on top of the reservoir for all isolation valves.

The overflow pipe shall be terminated with a duckbill type backflow preventor.

Hardware inside the reservoir, ladders, handrails, etc. shall be stainless steel Type316L or FRP.

All piping shall be 316 stainless steel schedule 10S.

6.7.8 Heating, Ventilation and Dehumidification

Provide heating system for Valve House to maintain the temperature at minimum 15°C.

Dehumidification should be provided where excess moisture may cause safety hazards or damage to equipment.

6.7.9 Instrumentation and Control

Instrumentation and Control processes and devices shall be installed in compliance with the County's SCADA Standards. The County's SCADA standards include the following: PLC Programming, HMI, Control Pannel, PCN, and SCADA Alarm Standards. Process Control Narratives (PCNs) shall be reviewed and approved by the **County SCADA Technician**.

Provide a backup level sensing probe which will detect the water level at the overflow water level condition and activate the high high level (HHL) overflow alarm condition on the applicable SCADA system.

As a minimum the following should be connected to the SCADA system for monitoring and control:

- Reservoir cell duty selection
- Water level transmitter
- Flow direction (filling or discharging) detection
- Chlorine residual
- Chlorine metering pumps running status
- Chlorine metering pumps speed
- Chlorine metering pumps duty selection, manual or automatic mode (where required)
- Chlorine residual set point, manually set by operator
- Reservoir inlet/outlet control valve
- Inlet flowmeter
- Inlet pressure transmitter
- Discharge flowmeter
- Discharge pressure transmitter

- Pump status
- Power monitoring of MCC
- Standby generator status (where applicable)

6.7.10 Alarms

The following alarm points shall be monitored at the reservoir by the SCADA System:

- Fire Alarms
- Smoke Alarm
- Low ambient air temperature in sodium hypochlorite metering and analyzer room
- Flooding of containment area
- Flooding of the building
- Security intrusion Alarms
- Generator and ATS Alarming

6.8 WATER TREATMENT PLANTS

The design of the Water Treatment Plant and its components shall be in accordance with the Safe Drinking Water Act, associated regulations, and the latest version of the MECP Design Guidelines for Drinking-Water Systems. Consultation with Oxford County Public Works shall be required during the entire design phase for any water treatment plant.

Refer to **Section 8** for general facility design requirements.

6.8.1 Alternative Technologies

Where a change in the treatment technology is suggested/required, a Life Cycle Cost analysis and efficiency comparison between the existing and proposed technology must be completed to determine if it is an applicable replacement.

6.8.2 Site Security

Water treatment facilities shall be designed to deter vandalism and inhibit unauthorized access. A multi-layered approach should be utilized that integrates physical barriers, electronic surveillance, access-control technologies, and lighting.

A physical barrier consisting of a 1.8m (minimum) high chain-link fence, with specifications aligning with OPSD 972.130 and OPSD 972.132, shall enclose the perimeter of the facility. For vehicle access a swing or sliding gate, rated to withstand a low-speed vehicular impact shall be used. All exterior doors, hatches, and roof openings shall be designed with consideration of NFPA 730: Guide for Premises Security. Exterior doors shall be lockable and tamper-proof with ANSI Grade 1 hardware.

The facility exterior shall be provided with high pressure sodium vapour light fixtures (vandal and tamper resistant) or suitable LED alternatives. The lighting shall be equipped with high power factor ballast and lamps suitable for horizontal, base up or base down operation. Lights shall be automatically turned on or off by motion sensors or light sensors and shall be capable of being manually turned on or off from a designated central location.

Refer to **Section 8.6** for further security requirements.

6.8.3 Plant Layout

Maximize the site's ultimate capacity in planning the layout. Design of expansion works should be carried out to permit the orderly and economical construction of the facility with minimal disruption of the existing facility. Space for any future expansion shall be considered in determining the overall layout.

6.8.4 UV Disinfection

The UV disinfection train (if required) shall include a minimum of one standby unit at the peak hydraulic loading rate and be sized for seasonal flow rates. Selection of the UV system shall consider the total life cycle cost of the unit.

6.8.5 Primary Disinfection

The disinfection process shall be designed and operated to achieve the target log removal/inactivation credits stipulated in the Municipal Drinking Water License (MDWL) and incorporate a multi-barrier disinfection approach. The chosen method for primary disinfection shall include appropriate on-line detection and monitoring systems, complete with appropriate chemical handling and storage.

Provisions for continuous monitoring of primary disinfection must be provided under the current regulations. On-line free chlorine residual analyzers must include a minimum of one standby (spare) analyzer.

Additional requirements for water treatment plant as follows:

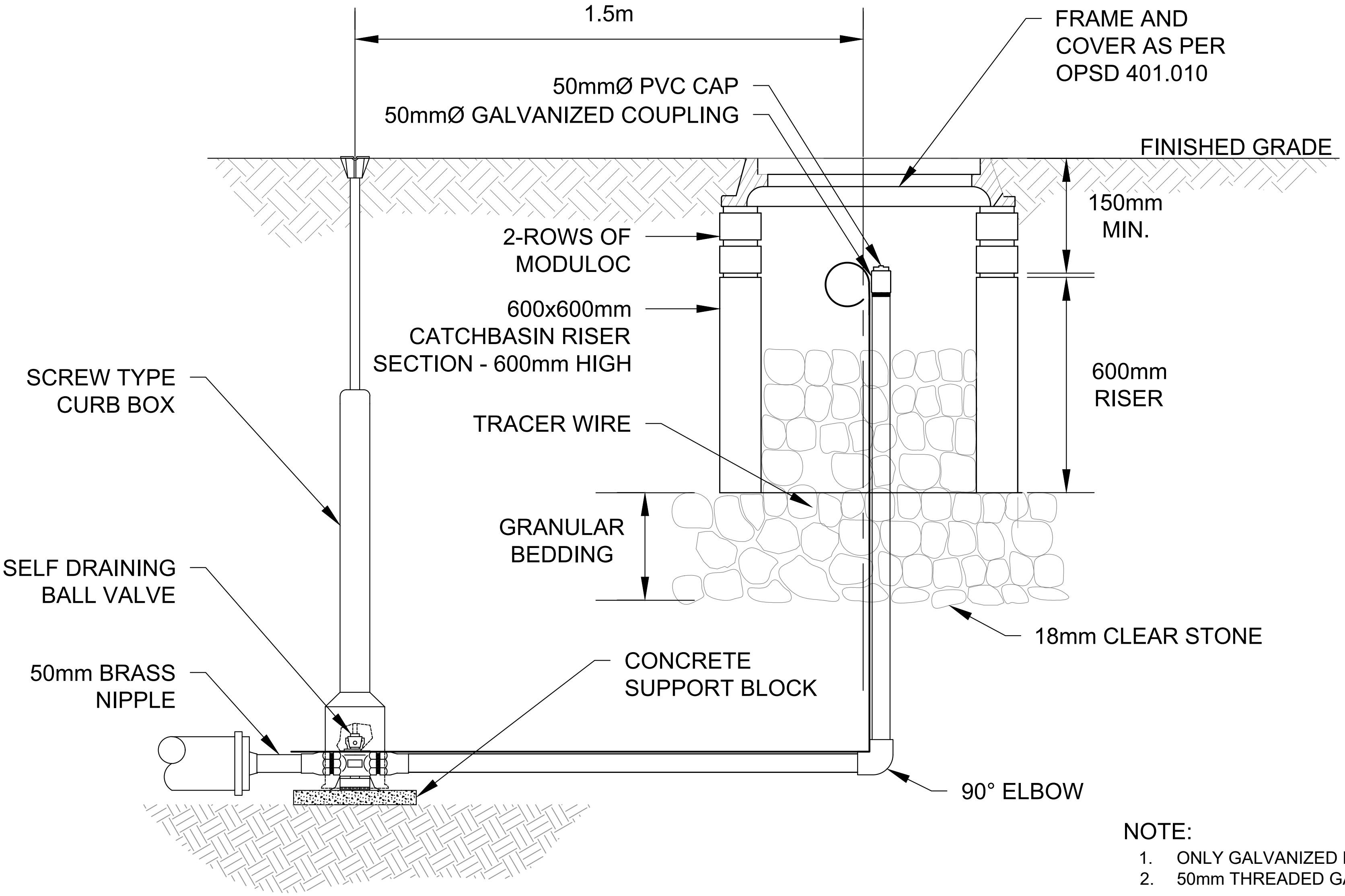
- Insulation: Install R30 roofing insulation and R20 wall insulation to ensure energy efficiency.
- Piping: Utilize 316 stainless steel, Schedule 10 piping for durability and corrosion resistance.
- Valves: Use gate valves for piping with a diameter of 100mm or greater. Use ball valves for piping under 100mm in diameter. AWWA C504 butterfly valves (short body flanged with handwheel) may be used at non-critical locations.
- Spare Piping: Provide piping to facilitate future wells and potential expansions.
- Isolation Valve: Install an outside station isolation valve with a tee'd off hydrant and valve for emergency access.
- Rescue Equipment: Include DBI-Sala anchors and mounting bases for rescue equipment.
- Power Backup: Provide a permanent genset and automatic transfer switch (ATS) for power outages.

- Alarms: Install separate low and high-level float alarms for the reservoir.
- Include RPU power source fail and RPU watchdog alarm for system reliability.
- Security: Implement a Damar DMP and FMC Keyscan security system for enhanced security.
- Flow Measurement: Install magnetic flow meters for all process control needs and on well and distribution piping for accurate flow measurement.
- Natural Lighting: Incorporate glass blocks or skylights in the roof to provide natural lighting.
- Roofing: Use steel roofing exclusively for durability.
- Aesthetics: Add different architectural block lines around the building to enhance its appearance.

6.8.6 Pressure Filters for Iron, Manganese and/or Arsenic Removal

For pressure filters and UV systems, install dual or triple filters for most sites. Equip all automated valves with Rotork actuators, avoiding the use of rate of flow valves on filter inlets. Design the system with dual-celled treated water reservoirs and include a backwash holding tank with redundant waste pumps. Additionally, provide a large garage door or a removable wall section to facilitate the replacement of filter tanks.

Residual Management is required for pressure filters for iron, manganese and/or arsenic removal. The waste sludge from the pre-treatment process and wastewater from the filter backwash drain are directed to the backwash equalization tank. Overflow piping is required to direct excess flow to the sanitary collection system or emergency storage (lined tank or pond).



NOTE:
1. ONLY GALVANIZED PIPE TO BE USED.
2. 50mm THREADED GALVANIZED RISER

OXFORD COUNTY STANDARD DRAWING

50mm BLOW OFF MAINTENANCE HOLE COVER

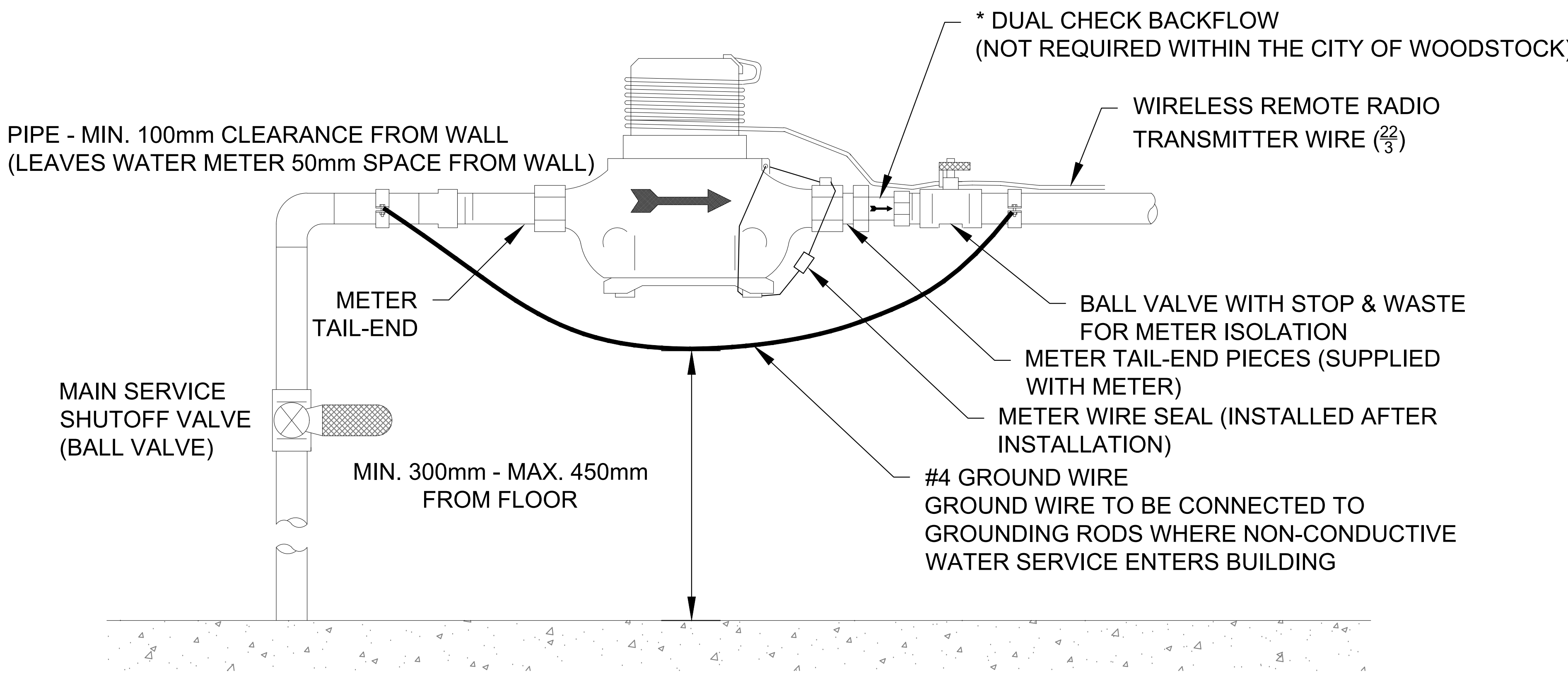
REV#: 3

08/2025

Oxford County
Growing stronger together

FIG. 6.01

PREVIOUSLY: D1803-1-2013



* CITY OF WOODSTOCK REQUIREMENT

OXFORD COUNTY STANDARD DRAWING

5/8" - 1" WATERMETER w/ VALVES ON BOTH SIDES - RESIDENTIAL & COMMERCIAL

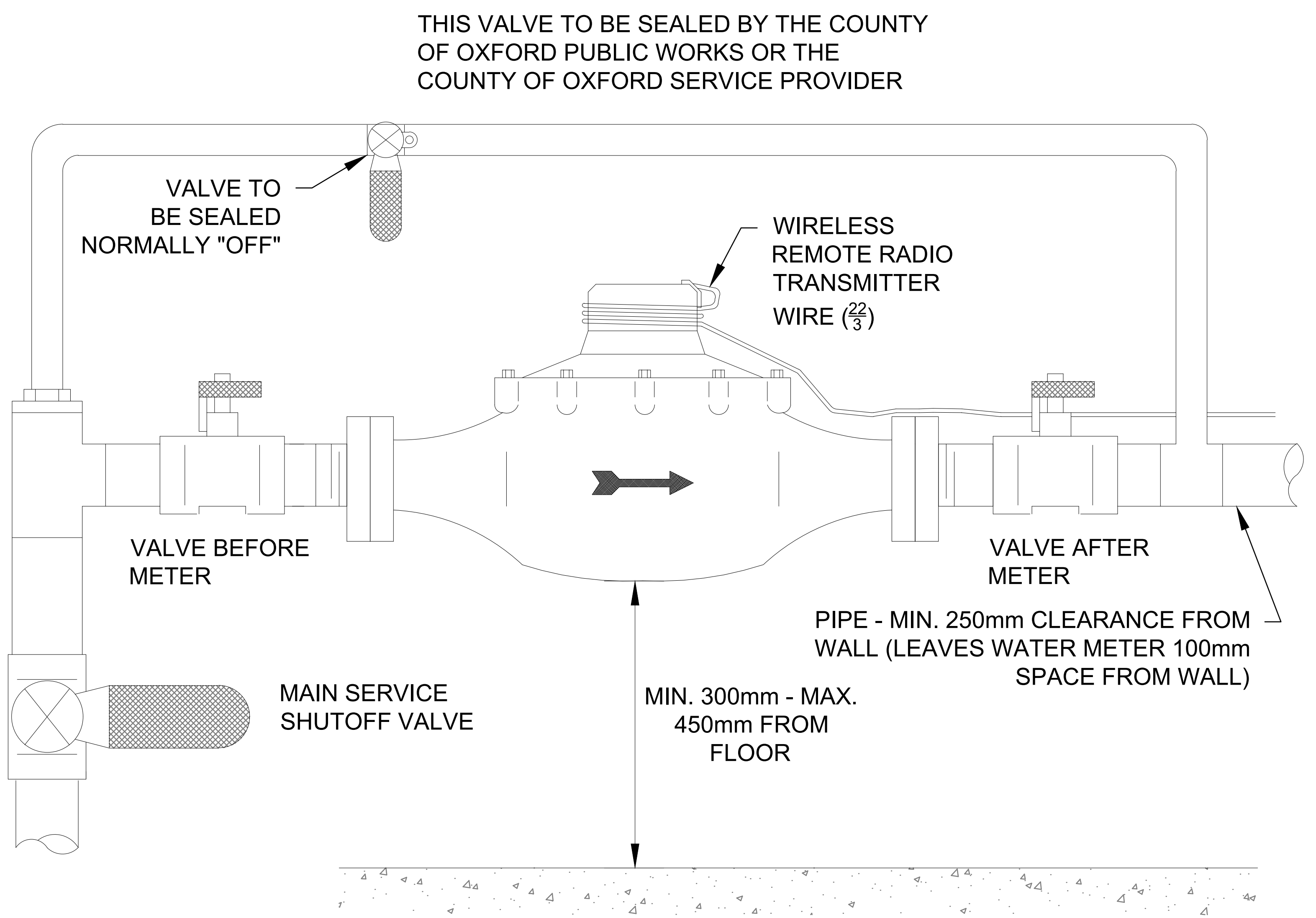
REV#: 3

08/2025

Oxford County
Growing stronger together

FIG. 6.02

PREVIOUSLY: D1807-1-2004



OXFORD COUNTY STANDARD DRAWING	REV#: 3	Oxford County Growing stronger together
1" TO 2" WATERMETER w/ BY-PASS RESIDENTIAL & COMMERCIAL	08/2025	
	FIG. 6.03	

PREVIOUSLY: D1811-1-2004

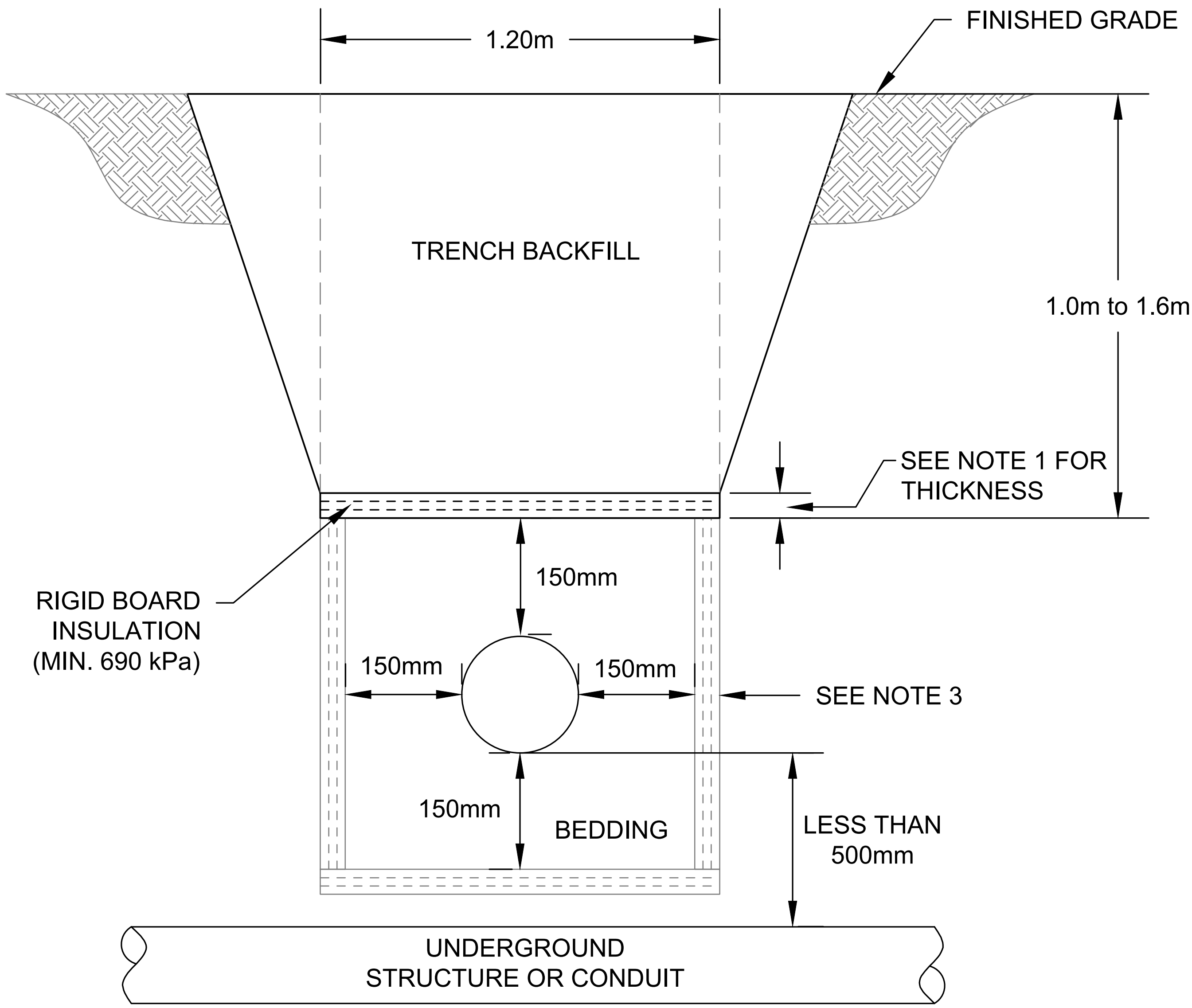
1.
1.1. IF GROUND COVER IS LESS THAN 1.0m LOWER WATERMAIN TO 1.8m.
1.2. IF GROUND COVER IS 1.0m - 1.3m USE 75mm THICK INSULATION.
1.3. IF GROUND COVER IS 1.3m - 1.6m USE 50mm THICK INSULATION.

2. INSULATION REQUIREMENTS 1.6m - 1.8m WILL DEPEND ON SITE CONDITIONS AND AT THE DIRECTION OF OXFORD COUNTY OR ITS SERVICE PROVIDER.

3. FOR CROSSING OR UNDERGROUND STRUCTURES OR CONDUIT A "FROST BOX" IS REQUIRED.

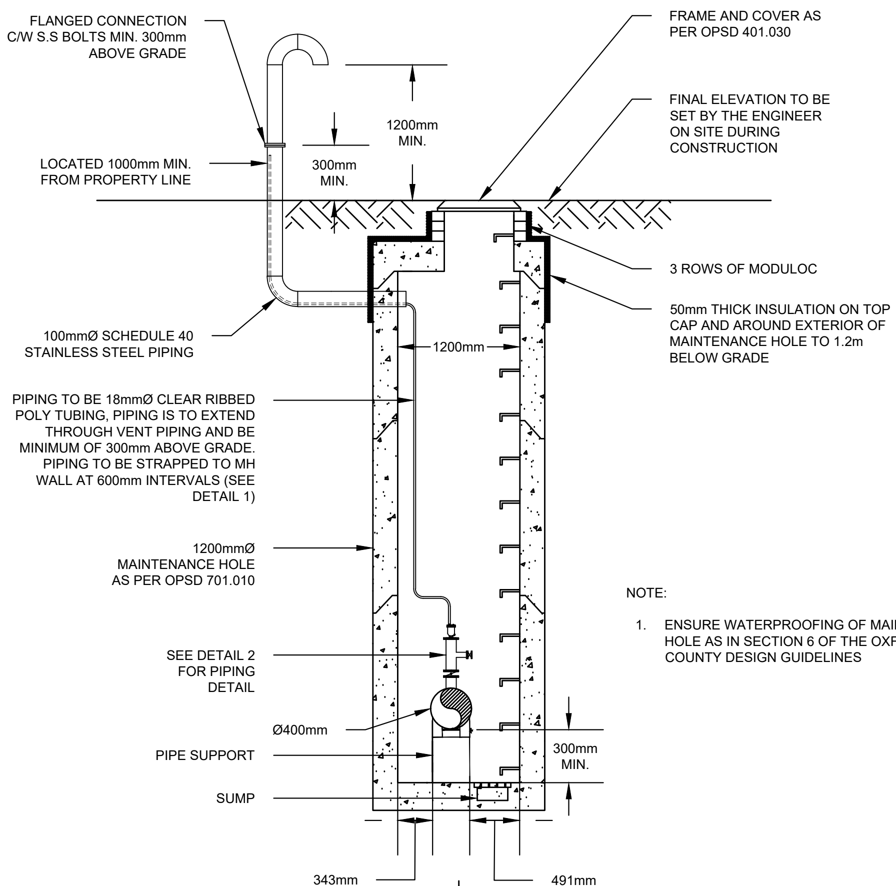
4. FOR WATERMAIN AND SERVICES LOCATED 500mm OR LESS HORIZONTALLY ADJACENT TO MAINTENANCE HOLES OR CATCHBASIN REQUIRES A MINIMUM 50mm INSULATION IS REQUIRED.

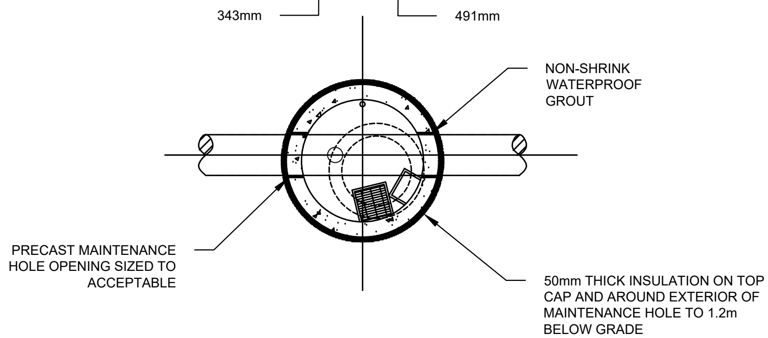
5. INSULATION IS REQUIRED ON ALL NEW OR RECONSTRUCTED WATER SERVICES IF ADEQUATE COVER AS LISTED ABOVE CANNOT BE ACHIEVED.



OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County Growing stronger together
RIGID BOARD INSULATION-SLAB TYPE FOR WATERMAIN AND SERVICES/LOW PRESSURE SANITARY SERVICES	08/2025	
	FIG. 6.04	

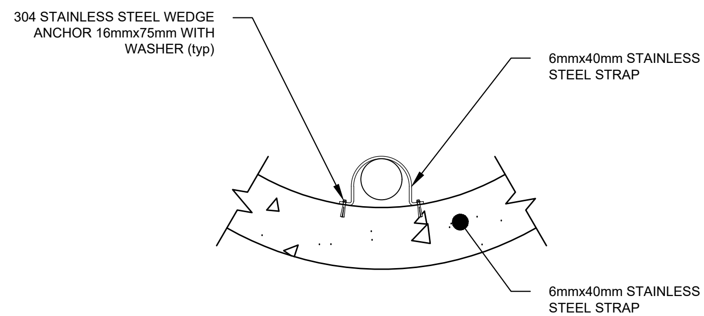
PREVIOUSLY: D1812-1-2007



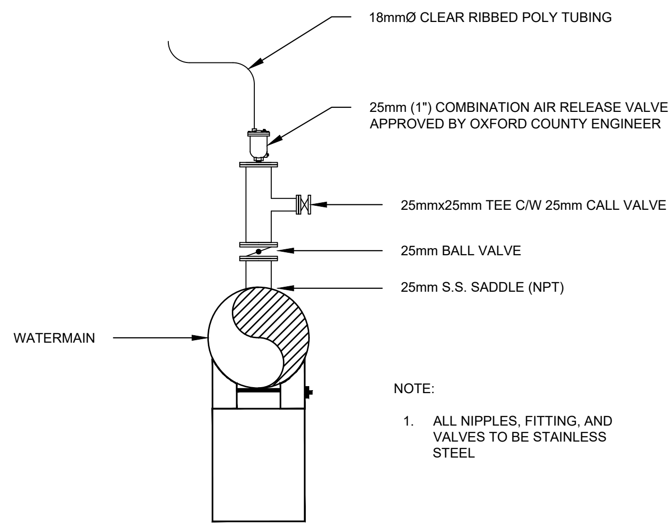


NOTE:

1. ENSURE WATERPROOFING OF MAINTENANCE HOLE AS IN SECTION 6 OF THE OXFORD COUNTY DESIGN GUIDELINES



1 FASTENER DETAIL
Scale: N.T.S.



NOTE:

1. ALL NIPPLES, FITTING, AND VALVES TO BE STAINLESS STEEL

2 25mm AIR RELEASE VALVE DETAIL
Scale: N.T.S.

OXFORD COUNTY STANDARD DRAWING

25mm AIR RELEASE CHAMBER

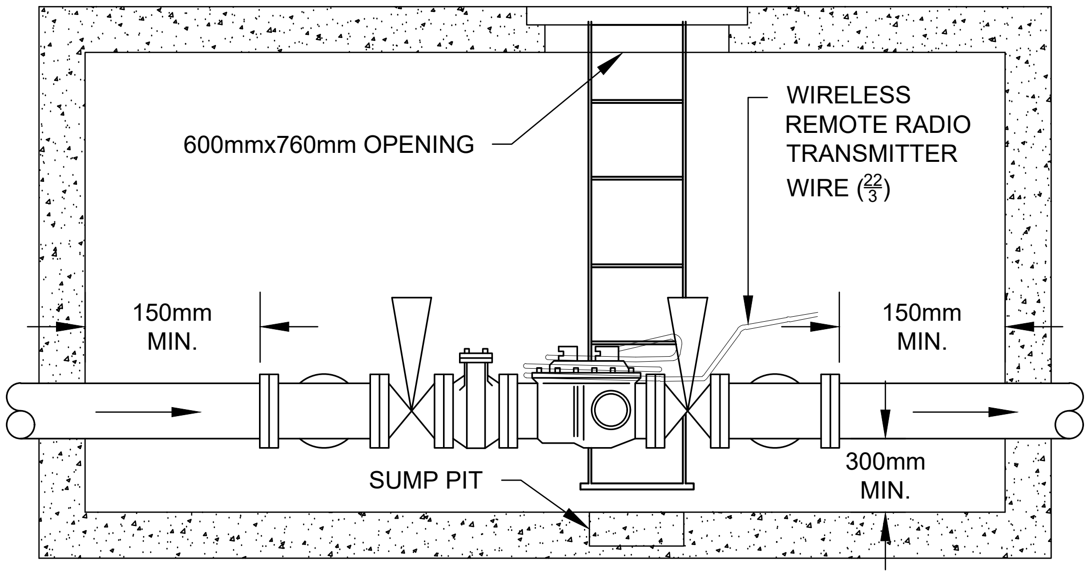
REV#: 1

08/2025

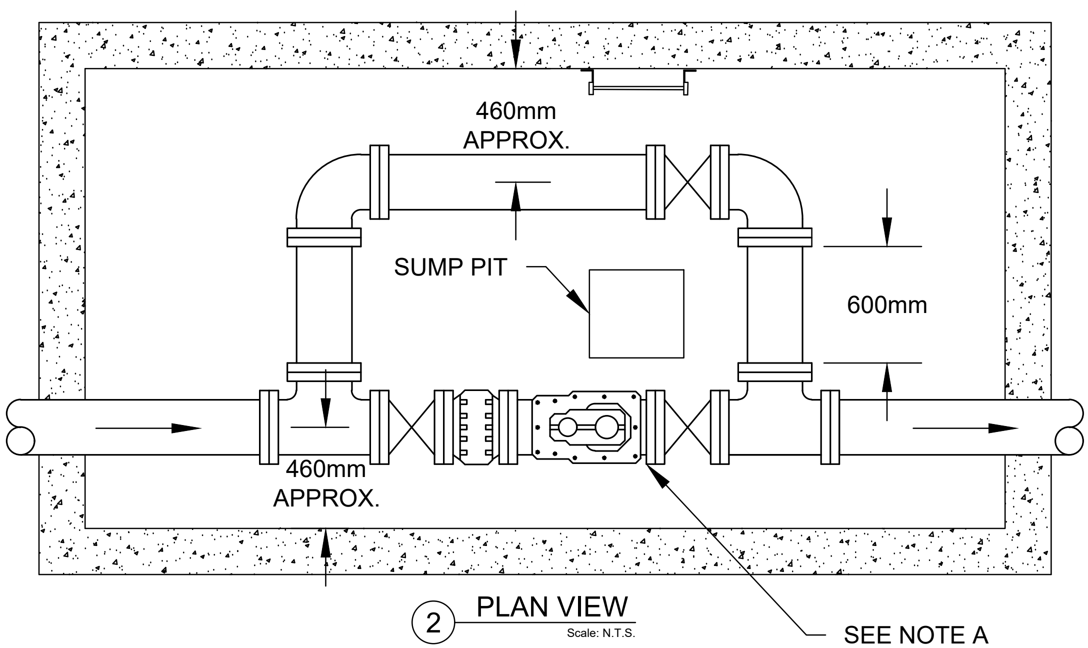
Oxford County
Growing stronger together

FIG. 6.05

PREVIOUSLY: D1814-1-2021



① SECTION VIEW
Scale: N.T.S.



② PLAN VIEW
Scale: N.T.S.

GENERAL NOTES:

1. MINIMUM SIZE PIT IS: 1.83m HIGH
   3.05m LONG
   1.83m WIDE
2. VALVING, BYPASS AND MANHOLE TO BE SUPPLIED BY CUSTOMER
3. INQUIRIES MAY BE DIRECTED TO THE WATER DISTRIBUTION SUPERVISOR.
4. THE COUNTY OF OXFORD REQUIRES SHUT-OFF VALVES ON BOTH SIDE OF ALL WATER METERS
5. METERS SHOULD BE INSTALLED IN A LOCATION NO MORE THAN 450mm FROM THE FLOOR AND IN AN OPEN POSITION FOR EASE OF READING AND MAINTENANCE

NOTE A:

1. APPROVED WATER PROOF METER
2. FIRE FLOW STRAINER
3. UNIFLANGE CONNECTION ON VICTAULIC COUPLER SPACER IN LINE WITH METER/STRAINER REQUIRED (MIN. 200mm)
4. REDUCER MAY BE INSTALLED OUTSIDE CHAMBER

OXFORD COUNTY STANDARD DRAWING

TYPICAL WATERMETER IN CHAMBER

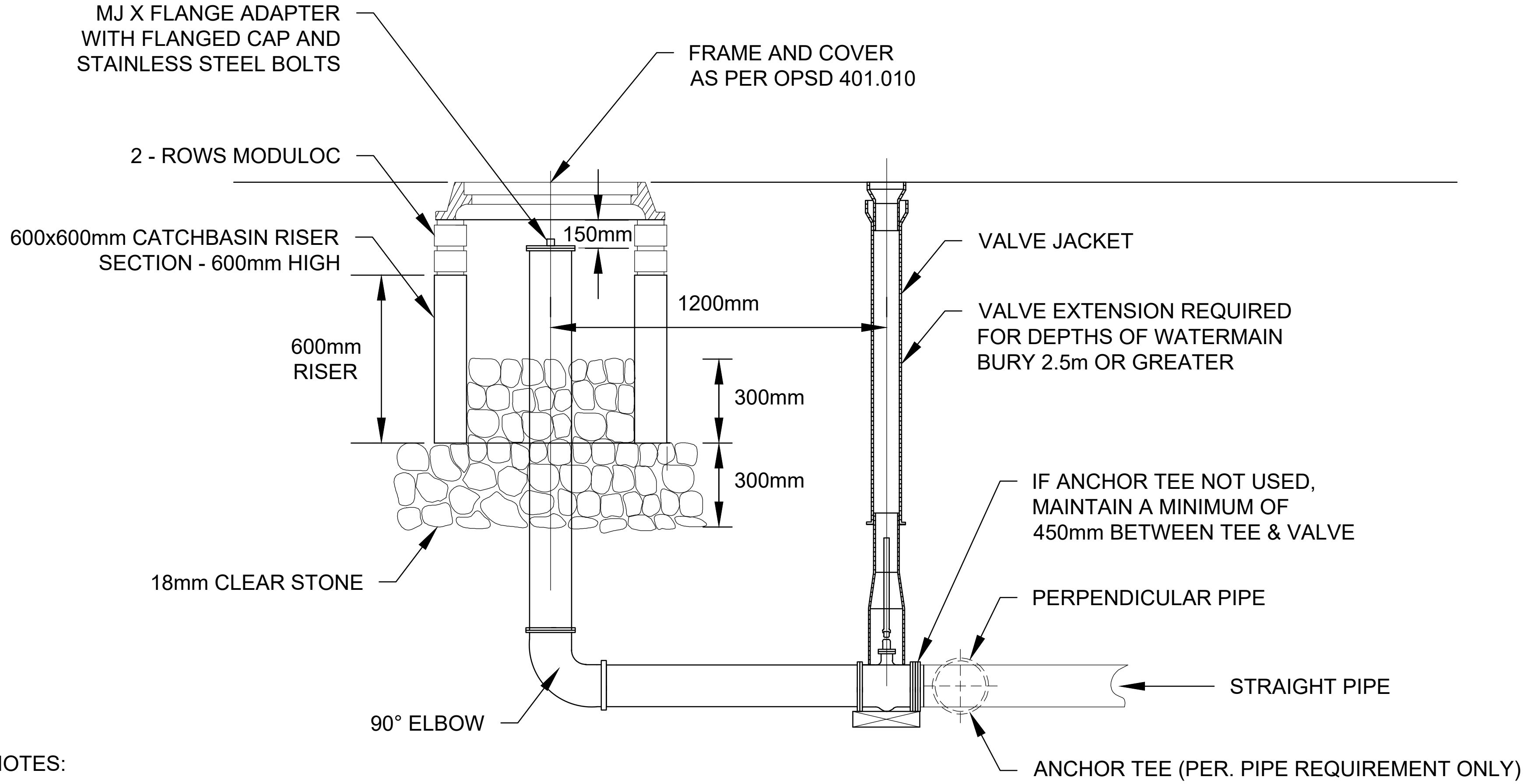
REV#: 2

08/2025

Oxford County
Growing stronger together

FIG. 6.06

PREVIOUSLY: D1818-1-2005



NOTES:

1. ALL FITTINGS WILL BE MOUNTED USING MECHANICAL JOINTS AND WILL BE RESTRAINED USING UNI-FLANGED RESTRAINTS OR APPROVED ALTERNATIVE AT ALL THRUST RESTRAINT LOCATIONS.
2. THIS DETAIL IS APPLICABLE FOR 100mmØ to 200mmØ LAUNCH SIZE.
3. SWAB LAUNCHES 250mm AND LARGER SHALL BE AS DIRECTED BY OXFORD COUNTY.

MAIN SIZE	**LAUNCH SIZE**	**TEE TYPE**
100mm	100mm	STANDARD
150mm	150mm	ANCHOR
200mm	150mm	ANCHOR

OXFORD COUNTY STANDARD DRAWING

100mm TO 200mm SWAB LAUNCHER DETAIL

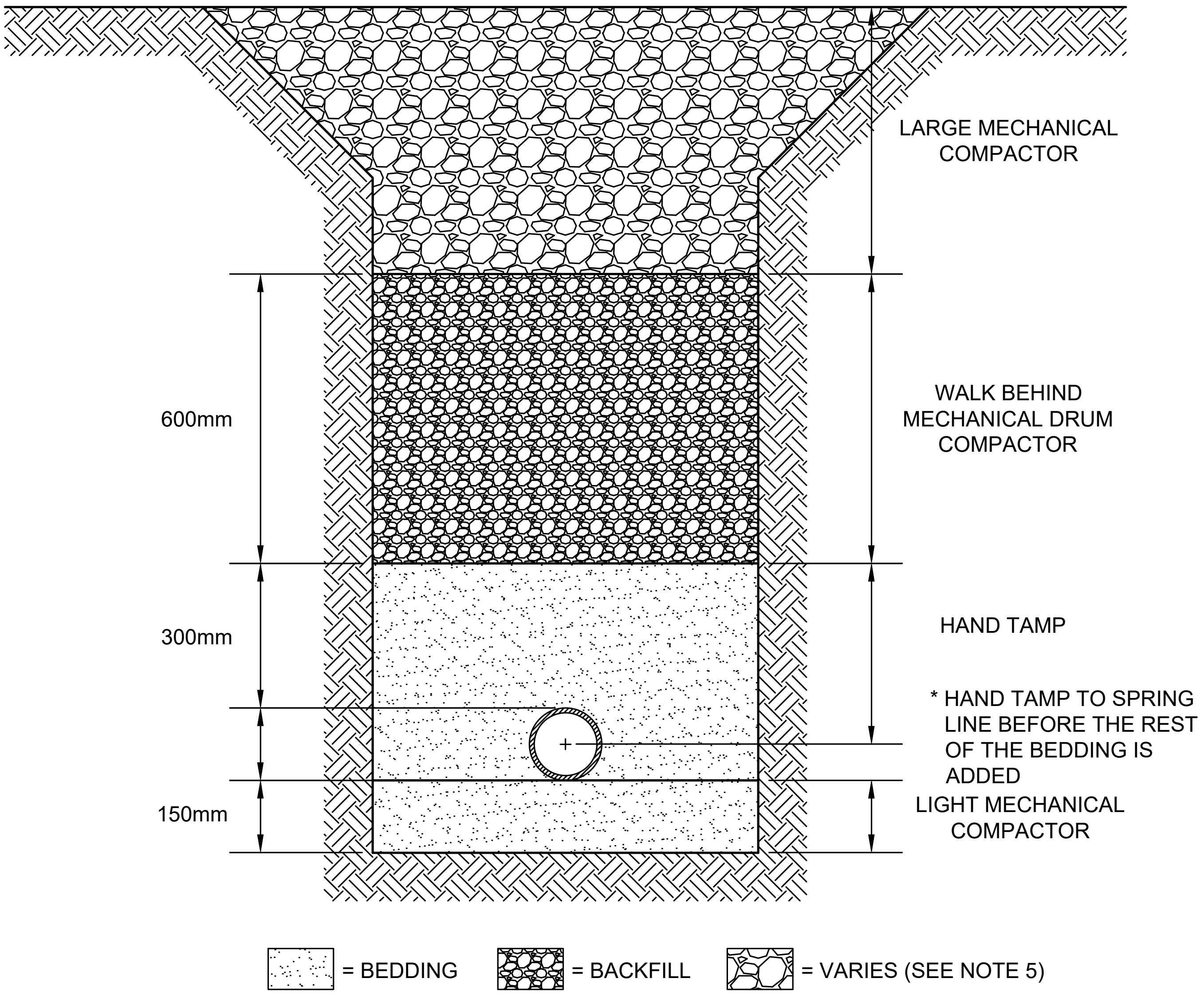
REV#: 3

08/2025

Oxford County
Growing stronger together

FIG. 6.07

PREVIOUSLY: D1822-1-2005



NOTES:

1. THE TRENCH CONFIGURATION WILL DEPEND ON SOIL CONDITIONS AS PER OPSD 802.010
2. THE BEDDING MATERIAL SHALL BE PLACED AND COMPACTED TO A DEPTH OF 150mm BEFORE THE PIPE IS PLACED IN THE TRENCH. THE REMAINDER OF THE BEDDING MATERIAL SHALL BE PLACED AND TAMPED IN 150mm LAYERS TO 300mm ABOVE THE TOP OF PIPE.
3. THE BEDDING MATERIAL WILL BE APPROVED BEDDING SAND OR GRANULAR WITH NO PARTICLES OVER 19mm.
4. THE BACK FILL MATERIAL ABOVE THE BEDDING WILL BE EITHER APPROVED NATIVE MATERIAL OR APPROVED GRANULAR MATERIAL THAT WILL ACHIEVE THE EXPECTED 100% STANDARD PROCTOR DENSITY.
5. CONTACT LOCAL AUTHORITIES FOR ROAD/SUBGRADE/ASPHALT REQUIREMENTS.

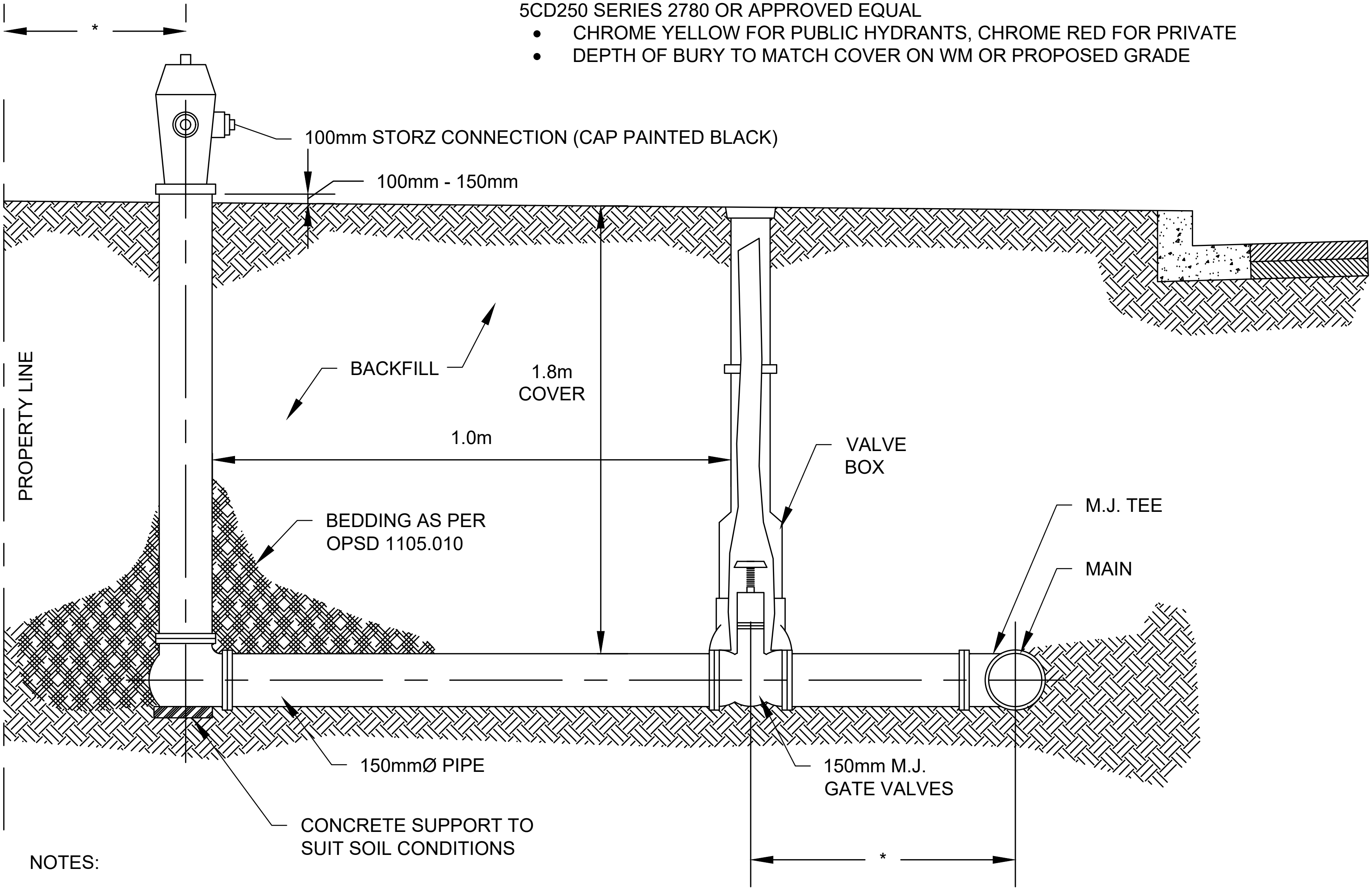
OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County Growing stronger together
BEDDING FOR WATERMAINS	08/2025	
	FIG. 6.08	

PREVIOUSLY: D1824-1-2007

* DIMENSION ARE AREA SPECIFIC

CANADA VALVE (DARLING), CENTURY, MACIVITY M67, EAST JORDAN WATERMASTER 5CD250 SERIES 2780 OR APPROVED EQUAL

- CHROME YELLOW FOR PUBLIC HYDRANTS, CHROME RED FOR PRIVATE
- DEPTH OF BURY TO MATCH COVER ON WM OR PROPOSED GRADE



NOTES:

1. HYDRANTS TO BE LOCATED AT COMMON LOT LINES.
2. USE MECHANICAL RESTRAINTS WHERE POSSIBLE.
3. ALL MECHANICAL JOINTS TO BE PRIMED AND WRAPPED WITH DENSO TAPE.
4. TRACER WIRE TO BE LOPPED INSIDE OF VALVE BOX AND RETURNED TO WATERMAIN.

OXFORD COUNTY STANDARD DRAWING

FIRE HYDRANT & VALVE INSTALLATION

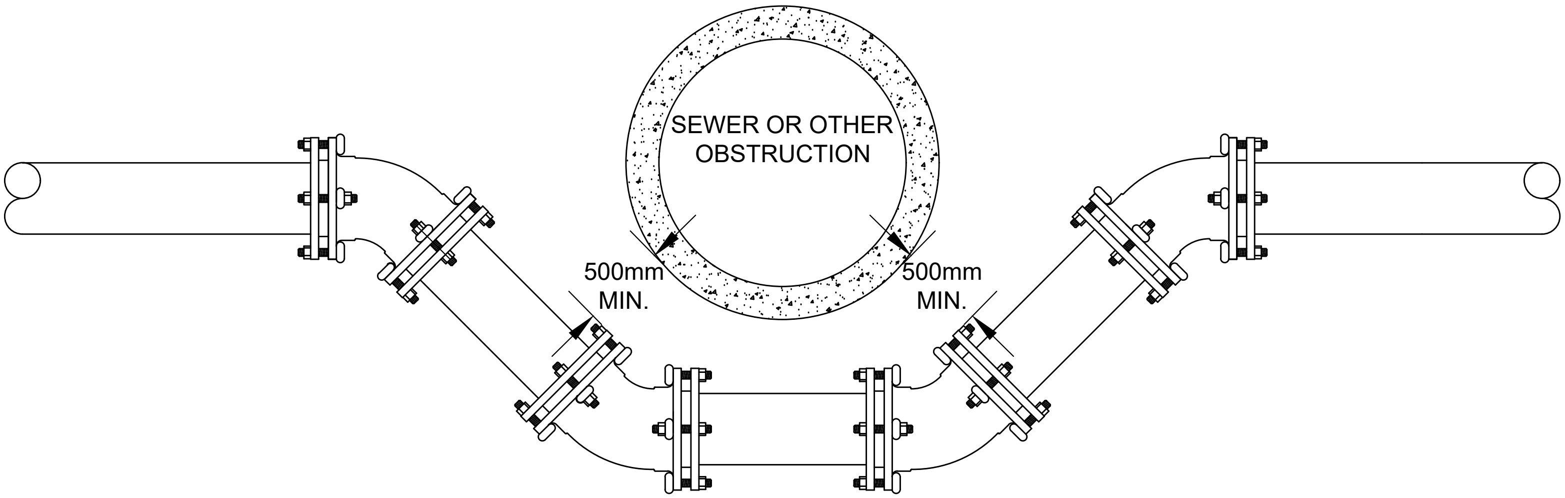
REV#: 5

08/2025

Oxford County
Growing stronger together

FIG. 6.09

PREVIOUSLY: D1828-1-1993

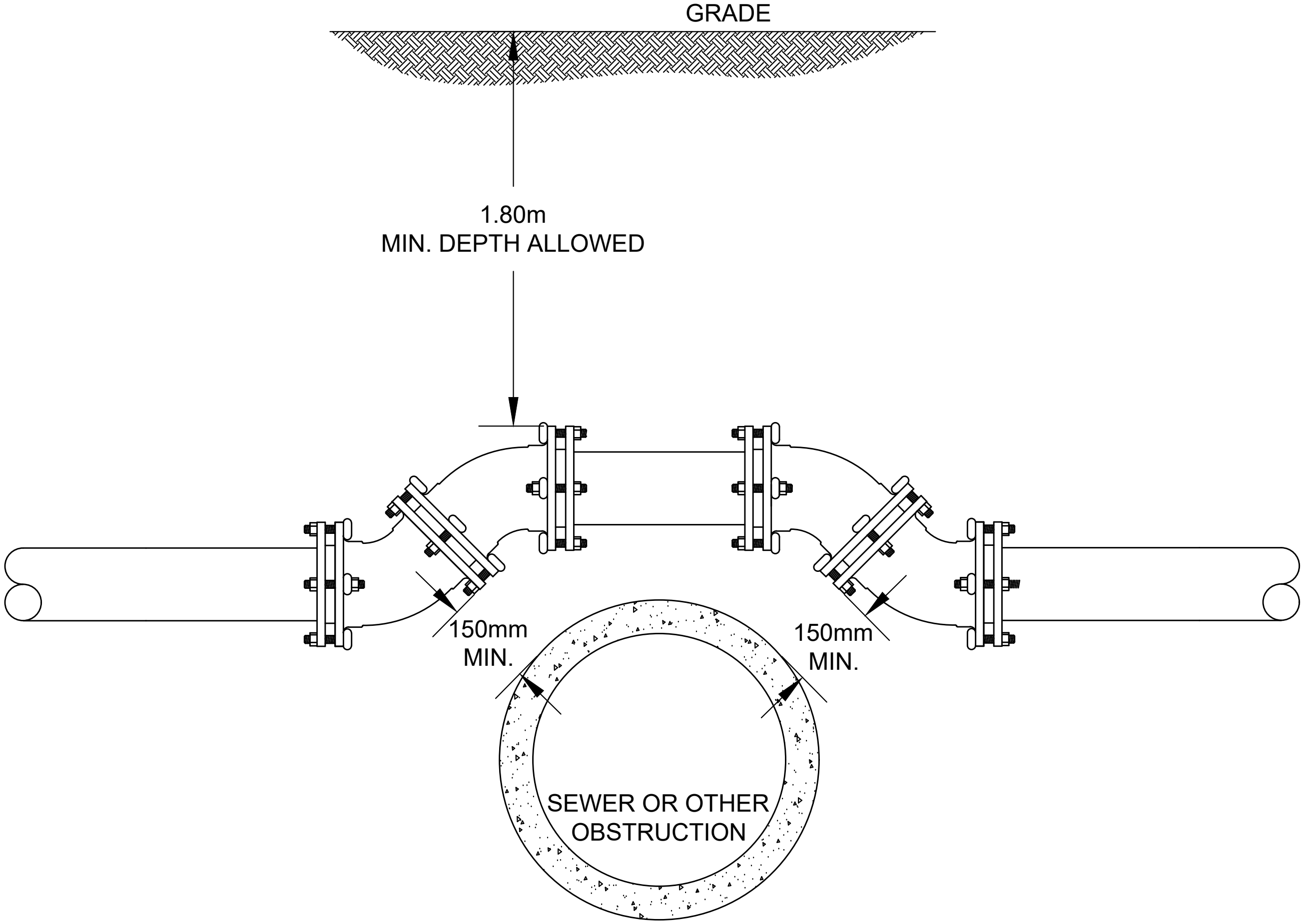


NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SHOWN OTHERWISE.
2. THIS DETAIL TO BE USED FOR OFFSET ON 100, 150, & 200mmØ MAINS. OFFSETS ON LARGER MAINS REQUIRE INDIVIDUAL APPROVAL BY THE WATER DISTRIBUTION SUPERVISOR.
3. IF OFFSET IS INSTALLED IN HORIZONTAL OR INVERTED POSITION, MINIMUM COVER TO BE DECIDED BY ENGINEER.
4. INSULATION MAY BE REQUIRED, REFER TO FIG. 6.04.
5. RESTRAINTS AS LISTED IN OXFORD COUNTY DESIGN GUIDELINES OR AS PER MANUFACTURERS RECOMMENDATIONS. THE STRICTER OF THE REQUIREMENTS SHALL APPLY.

OXFORD COUNTY STANDARD DRAWING	REV#: 3	Oxford County Growing stronger together
PIPE OFFSET INSTALLATION - UNDER	08/2025	
	FIG. 6.10	

PREVIOUSLY: D1832-1-1993

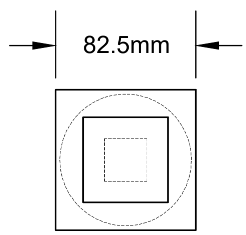


NOTES:

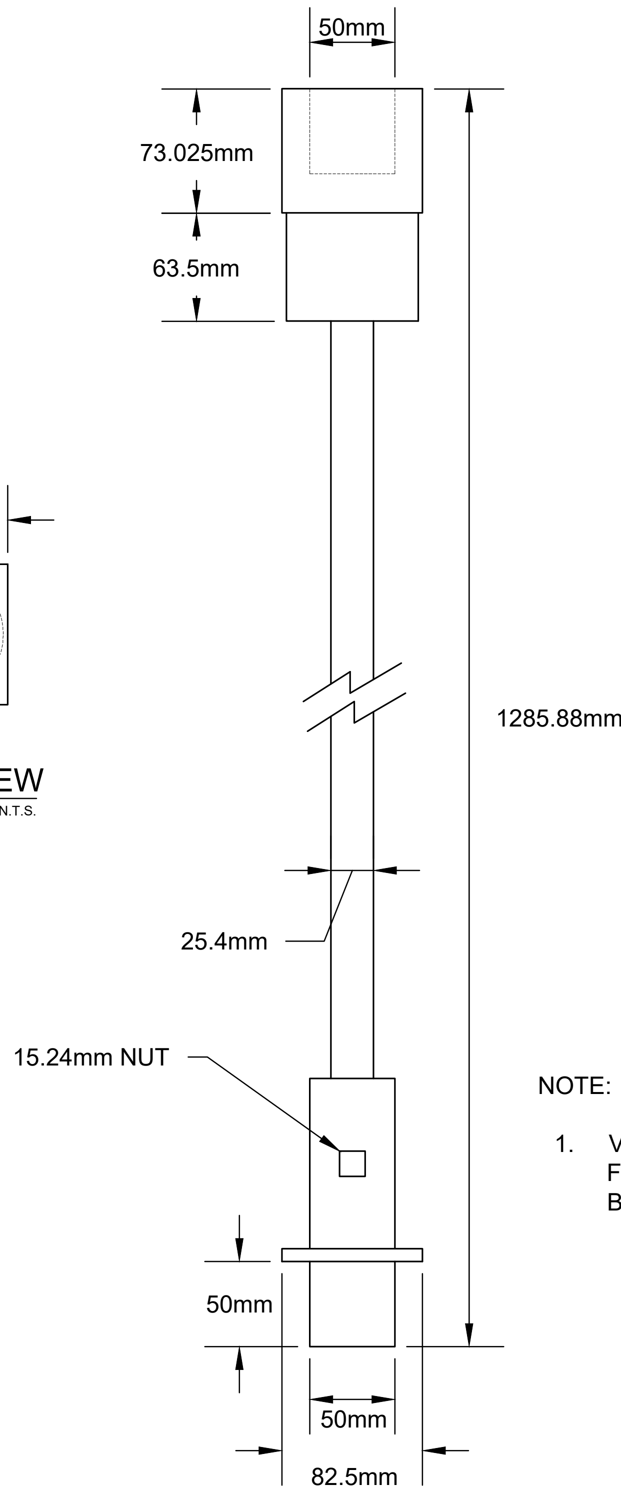
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SHOWN OTHERWISE.
2. THIS DETAIL TO BE USED FOR OFFSET ON 100, 150, & 200mmØ MAINS. OFFSETS ON LARGER MAINS REQUIRE INDIVIDUAL APPROVAL BY THE WATER DISTRIBUTION SUPERVISOR.
3. IF OFFSET IS INSTALLED IN HORIZONTAL OR INVERTED POSITION, MINIMUM COVER TO BE DECIDED BY ENGINEER.
4. DEPENDING ON BURIED DEPTH OR WHEN CROSSING STORM SEWERS WITH A SEPARATION OF 500mm OR LESS INSULATION SHALL BE REQUIRED. REFER TO FIG. 6.04.
5. RESTRAINTS AS LISTED IN OXFORD COUNTY DESIGN GUIDELINES OR AS PER MANUFACTURERS RECOMMENDATIONS. THE STRICTER OF THE REQUIREMENTS SHALL APPLY.

OXFORD COUNTY STANDARD DRAWING	REV#: 3	Oxford County Growing stronger together
PIPE OFFSET INSTALLATION - OVER	08/2025	
	FIG. 6.11	

PREVIOUSLY: D1833-1-1993



1 PLAN VIEW
Scale: N.T.S.



2 SECTION VIEW
Scale: N.T.S.

NOTE:

1. VALVE EXTENSION REQUIRED FOR DEPTHS OF WATERMAIN BURY 2.5m OR GREATER

OXFORD COUNTY STANDARD DRAWING

STANDARD VALVE ROD EXTENSION PIECE FOR 100mm & LARGER VALVES

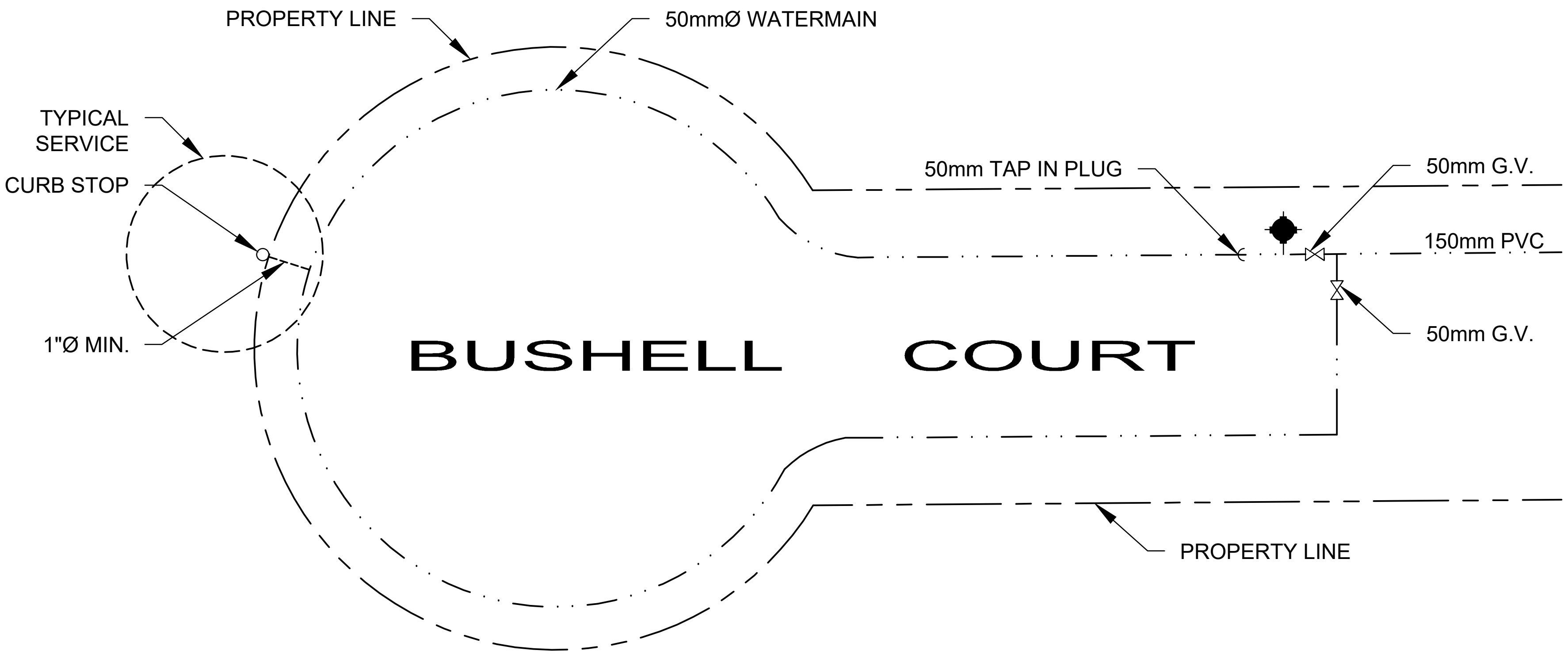
REV#: 1

08/2025

Oxford County
Growing stronger together

FIG. 6.12

PREVIOUSLY: D1834-1-1993

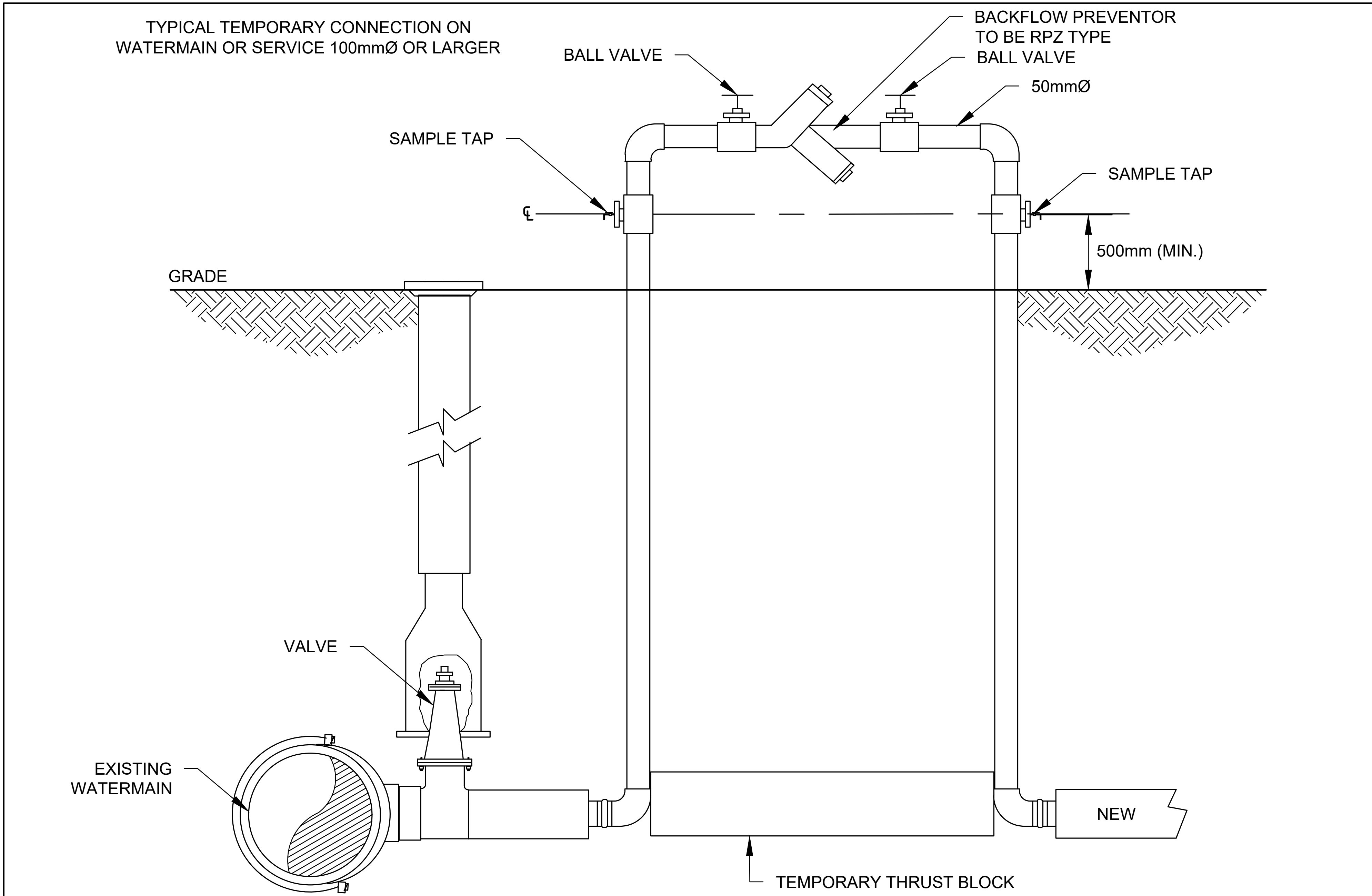


NOTES:

1. MINIMUM SERVICE SIZE IS 25mm.
2. MAXIMUM OF 7 SERVICES OFF OF 50mmØ.
3. ALL FITTINGS SHALL BE BRASS COMPRESSION, COPPER TUBING SIZE.
4. RESTRAIN JOINTS WHERE REQUIRED.
5. MATERIAL SHALL BE PEX OR P.E. SERIES 200.
6. ALL NON-METALLIC PIPE SHALL REQUIRE STAINLESS STEEL INSERTS.
7. TRACER WIRE TO BE INSTALLED AS PER OXFORD COUNTY DESIGN GUIDELINES AND SUPPLEMENT SPECIFICATIONS.

OXFORD COUNTY STANDARD DRAWING	REV#: 4	Oxford County — Growing stronger together
50mm WATERMAIN DETAIL FOR CUL-DE-SAC	08/2025	
	FIG. 6.13	

PREVIOUSLY: D1835-1-2006



OXFORD COUNTY STANDARD DRAWING

BACK FLOW PREVENTOR
EXISTING TO NEW WATERMAIN

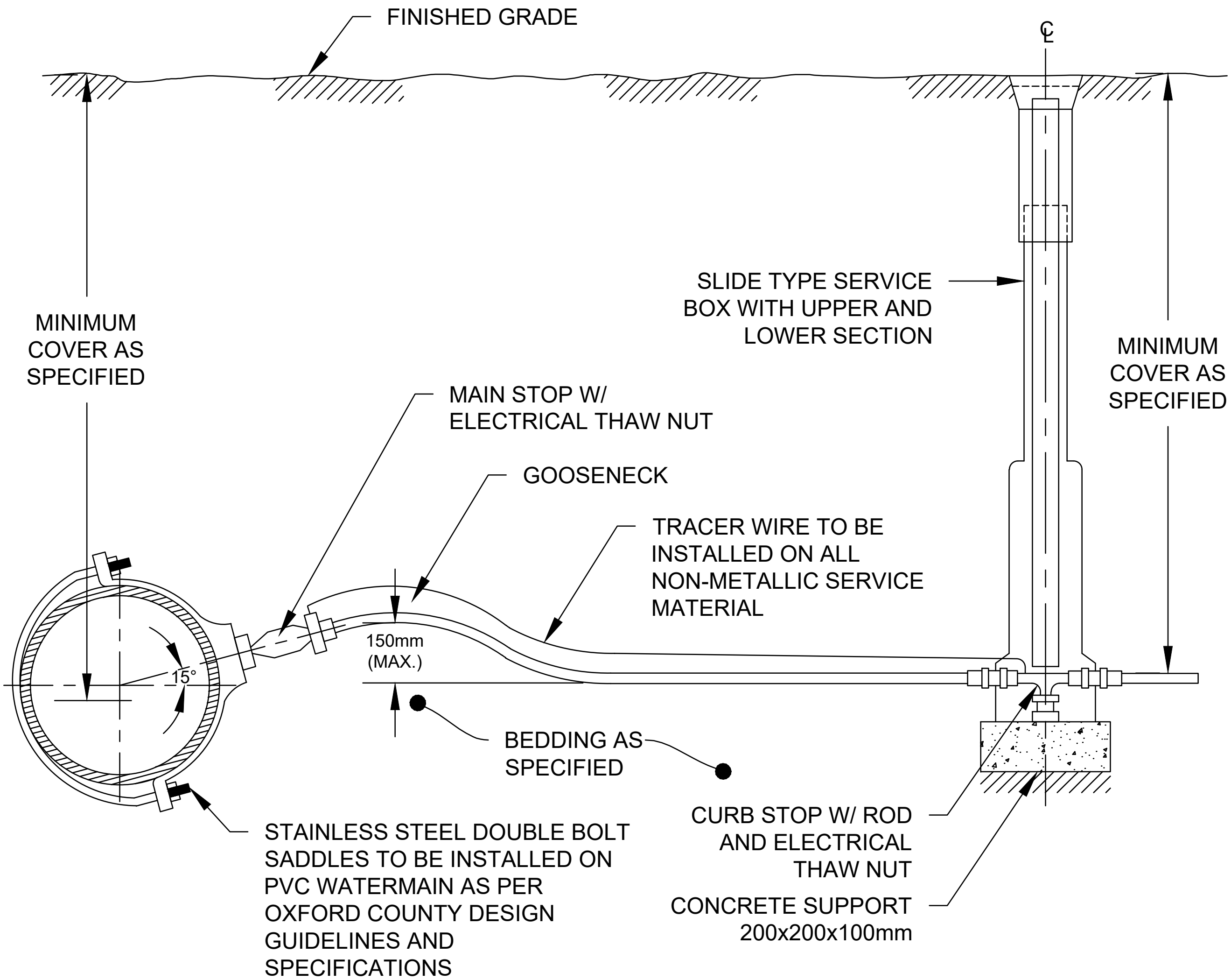
REV#: 3

08/2025

Oxford County
Growing stronger together

FIG. 6.14

PREVIOUSLY: D1836-1-2006

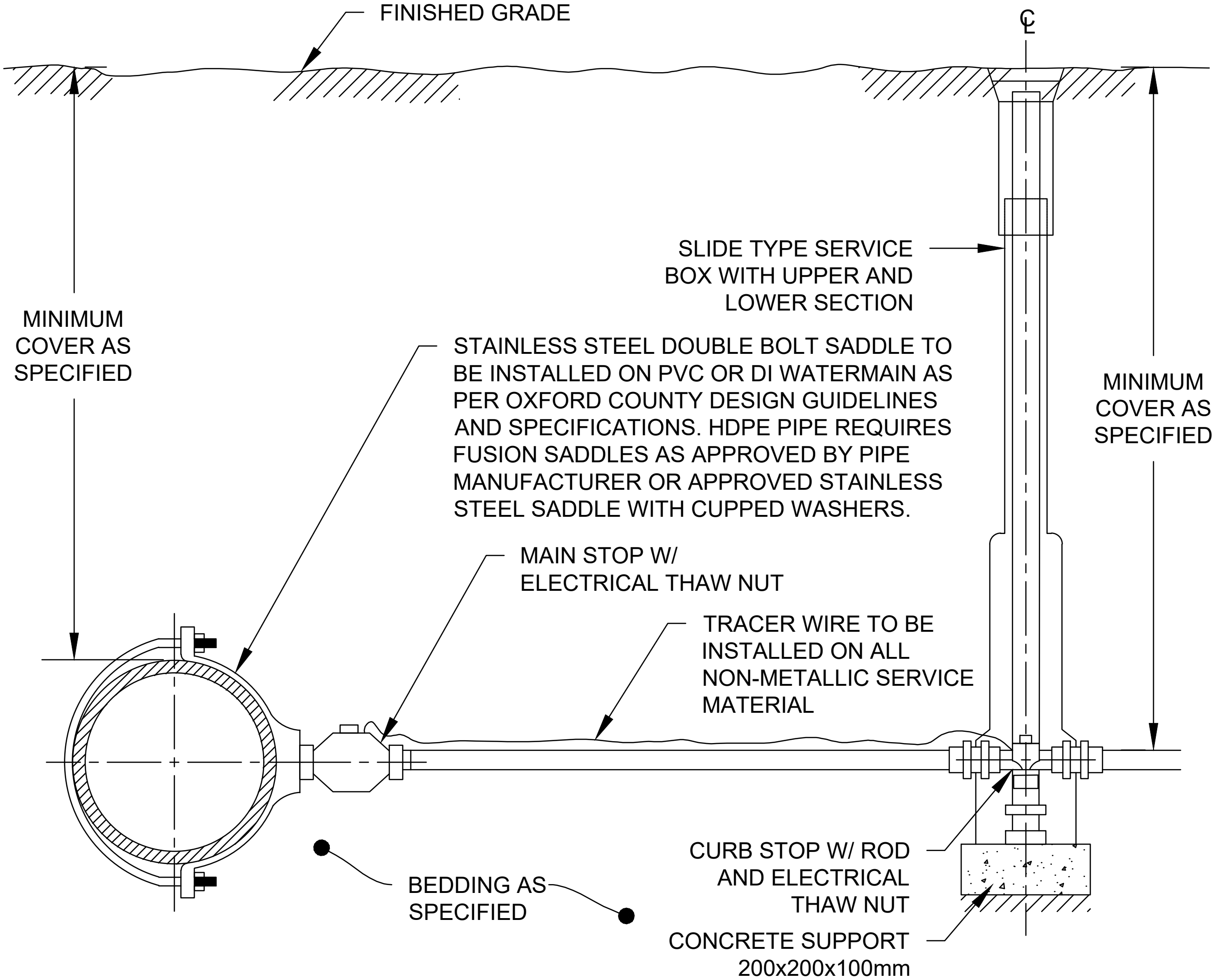


NOTES:

1. NON-METALLIC SERVICE SHALL BE MINIMUM 25mmØ.
2. FOR PLASTIC SERVICE PIPES, INSTALL MAIN STOP AT 15° ABOVE HORIZONTAL WITH A MINIMUM 1.2m LONG GOOSENECK.
3. SERVICE CONNECTIONS TO PVC OR DI WATERMAINS TO BE MADE USING STAINLESS STEEL DOUBLE BOLT SERVICE SADDLE. HDPE PIPE MUST USE FUSION TYPE SADDLES AS APPROVED BY PIPE MANUFACTURER OR APPROVED STAINLESS SADDLES WITH CUPPED WASHERS.
4. MAIN STOPS AND CURBSTOPS SHALL HAVE ELECTRICAL THAW NUT AND MATERIAL TO BE NO-LEAD BRASS, MEGATITE, OR APPROVED EQUAL. IF MEGATITE IS USED, SPLICING WITH AN APPROVED CONNECTOR IS REQUIRED.
5. ALL WATER SERVICES TO BE INSTALLED 90° TO THE LONGITUDINAL AXIS OF THE WATERMAIN.
6. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.
7. ALL NON-METALLIC SERVICES REQUIRE TRACER WIRE TO BE INSTALLED AS SHOWN ABOVE.
8. SERVICE MATERIALS AS PER OXFORD COUNTY DESIGN GUIDELINES AND SPECIFICATIONS.

OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County Growing stronger together
WATER SERVICE CONNECTION 25mm DIAMETER	08/2025	
	FIG. 6.15	

PREVIOUSLY: D1838-1-2007

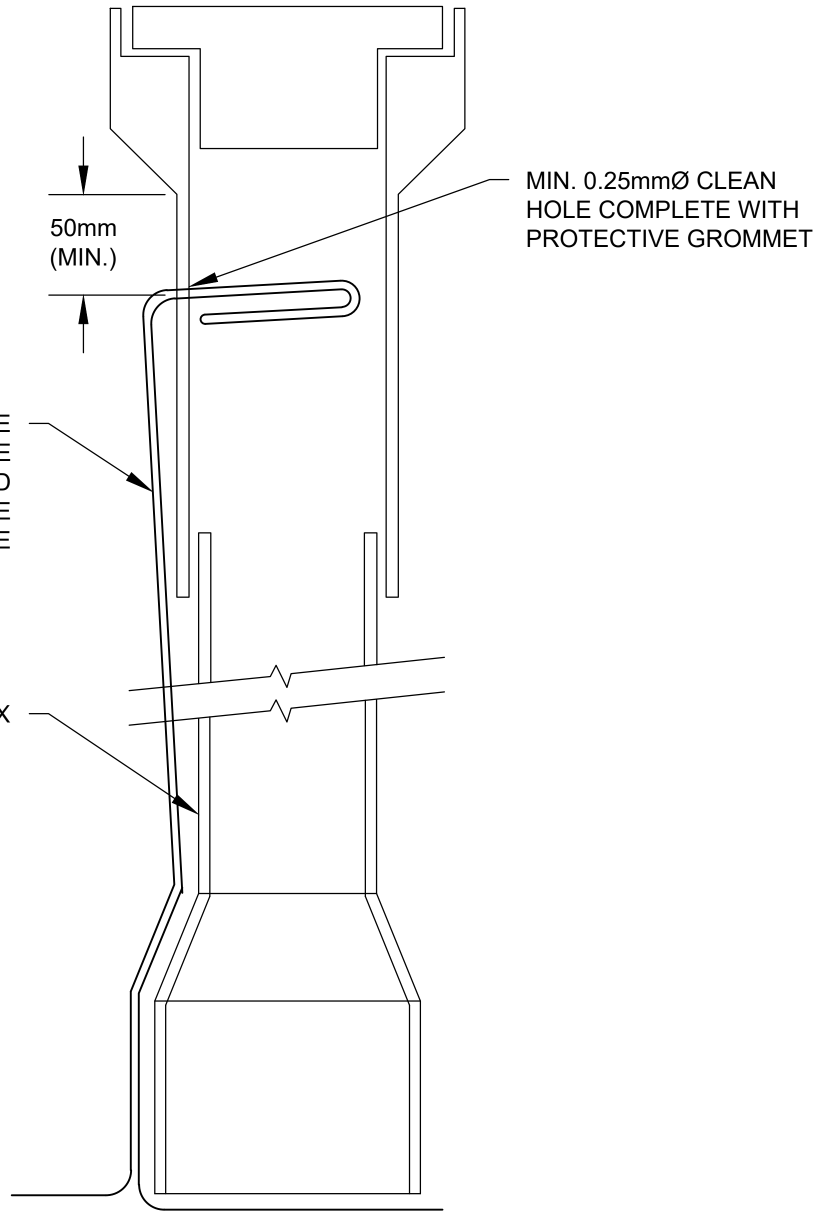


NOTES:

1. SERVICE MATERIAL AS PER OXFORD COUNTY DESIGN GUIDELINES AND SPECIFICATIONS.
2. SERVICE PIPE BETWEEN MAIN STOP AND CURB STOP SHALL BE CONTINUOUS WITH NO COUPLINGS.
3. ALL WATER SERVICES TO BE INSTALLED 90° TO THE LONGITUDINAL AXIS OF THE WATERMAIN.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
5. MAIN STOPS AND CURB STOPS SHALL HAVE ELECTRICAL THAW NUTS TO ACCOMMODATE TRACER WIRE. MATERIAL SHALL BE NO-LEAD BRASS, MEGATITE, OR APPROVED EQUAL. IF MEGATITE IS USED, APPROVED CONNECTOR SHALL BE USED TO SPLICE INTO THE MAIN LINE WIRE AND BROUGHT UP TO SERVICE AT THE CURB BOX.
6. NON-METALLIC SERVICES REQUIRE TRACER WIRE TO BE INSTALLED AS SHOWN ABOVE.

OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County Growing stronger together
WATER SERVICE CONNECTION 32mm, 38mm & 50mm SIZES	08/2025	
	FIG. 6.16	

PREVIOUSLY: D1839-1-2007



NOTES:

1. TRACER WIRE TO VALVE BOX WILL BE A SINGLE WIRE CONNECTED TO MAINLINE TRACER WIRE WITH APPROVED CONNECTOR AND AS PER OXFORD COUNTY DESIGN GUIDELINES AND SUPPLEMENT SPECIFICATIONS.
2. TRACER WIRE - #12 AWG SOLID CCS TRACING WIRE AS PER OXFORD COUNTY DESIGN GUIDELINES AND SUPPLEMENT SPECIFICATIONS.
3. TRACER WIRE SHOULD BE PLACED ON THE OUTSIDE OF ALL VALVES BOXES AND EXTENDED INTO THE VALVE BOX BY APPROX. ±500mm THROUGH HOLE 50mm BELOW THE BOTTOM OF THE COVER BELL. TRACER WIRE SHALL BE COILED INSIDE THE VALVE BOX SO AS NOT TO INTERFERE WITH VALVE OPERATION.

OXFORD COUNTY STANDARD DRAWING

TRACER WIRE
VALVE BOX INSTALLATION

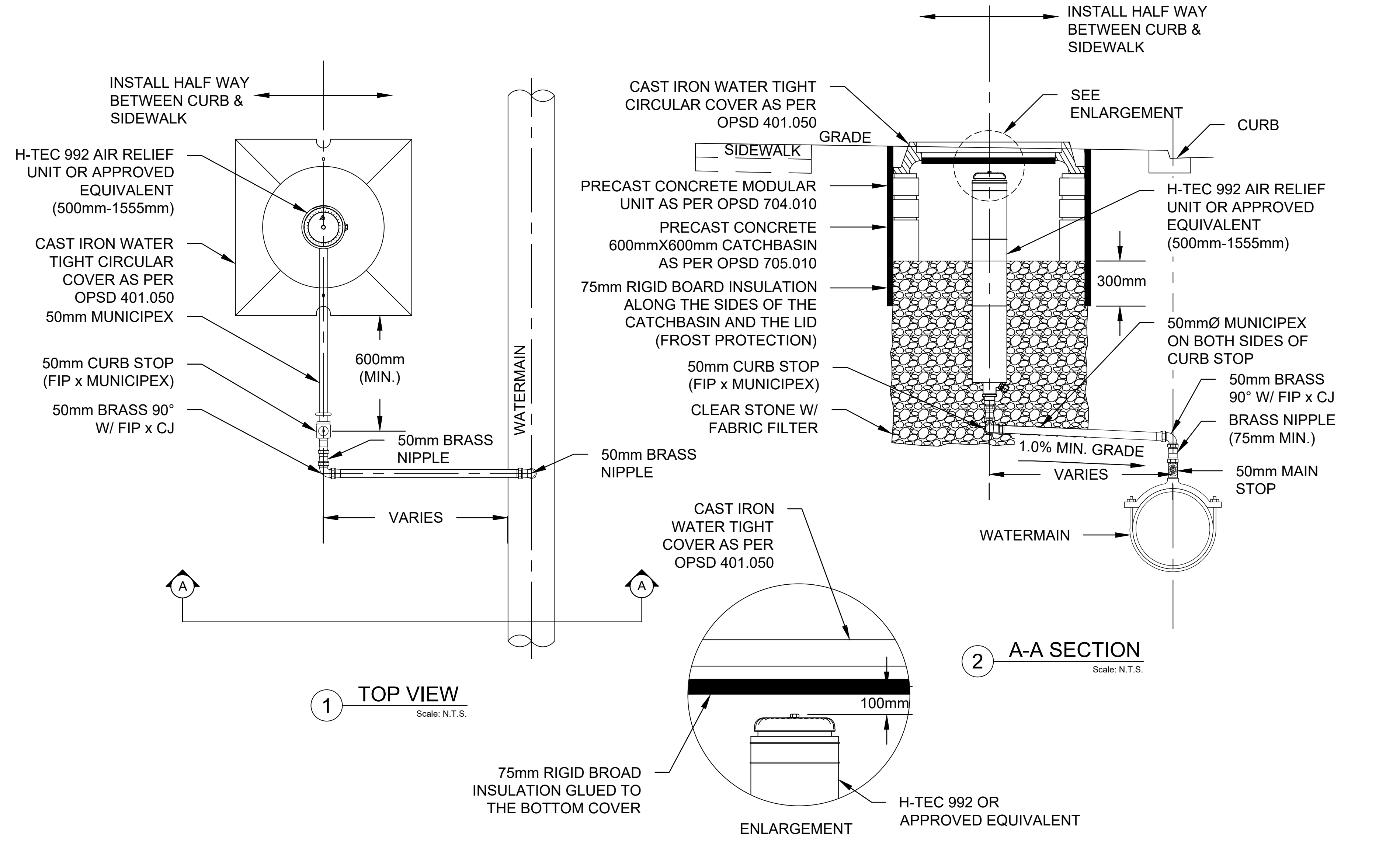
REV#: 2

08/2025

Oxford County
Growing stronger together

FIG. 6.17

PREVIOUSLY: D1849-1-2009



OXFORD COUNTY STANDARD DRAWING

DIRECT BURY AIR RELEASE w/ OPSD 704.010 CATCHBASIN

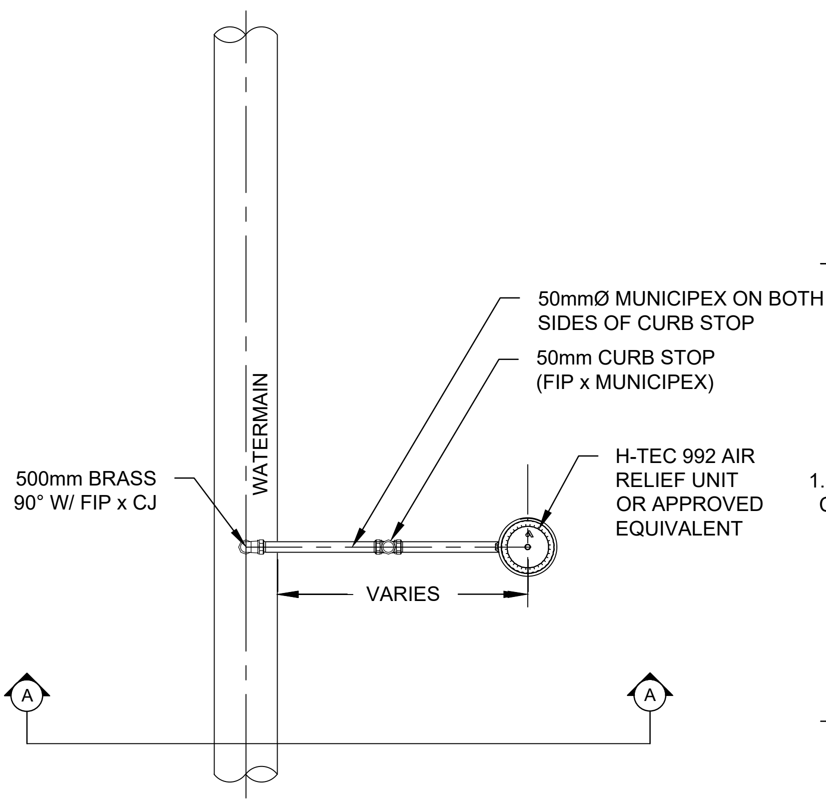
REV#: 2

08/2025

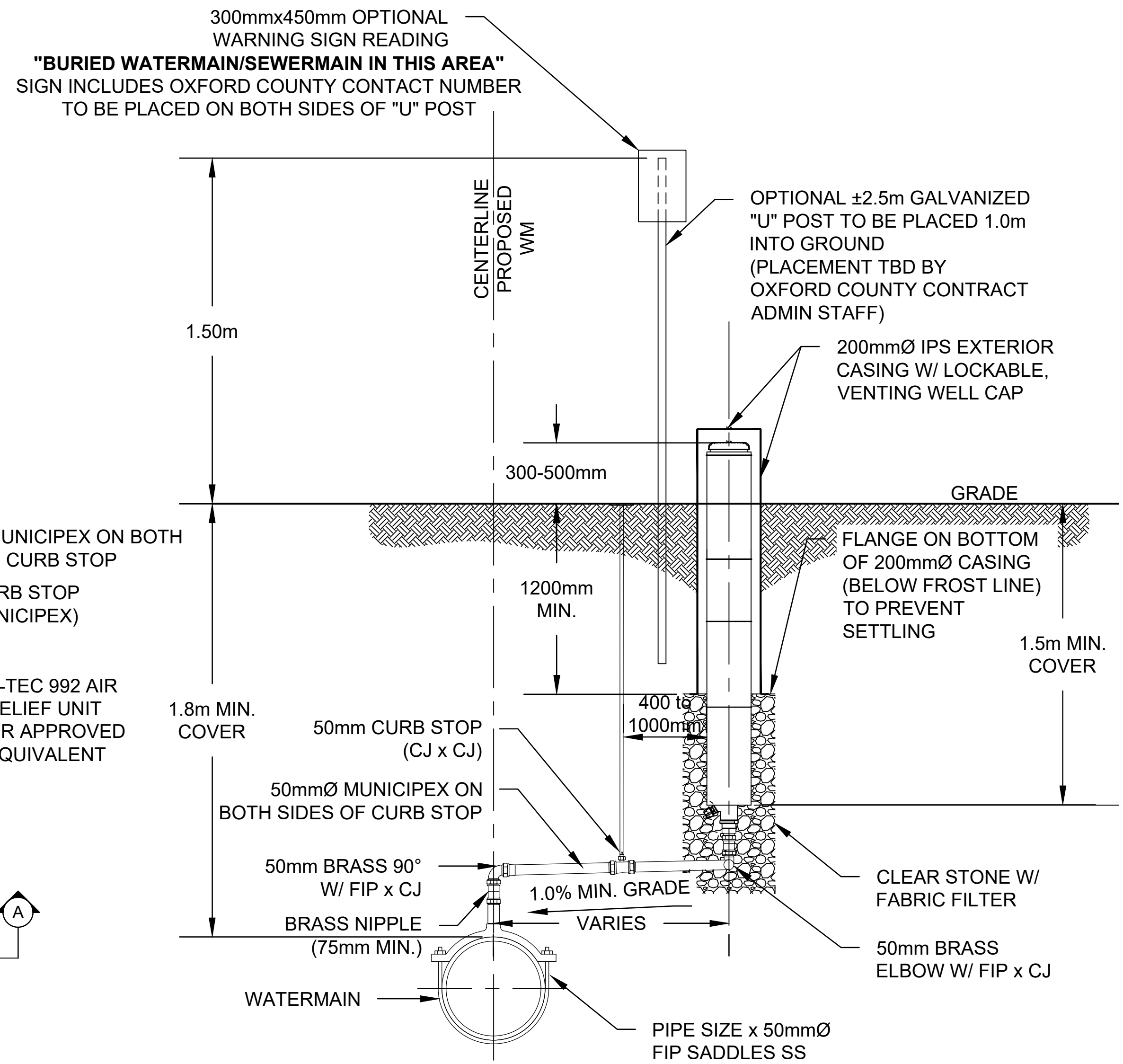
Oxford County
Growing stronger together

FIG. 6.18

PREVIOUSLY: D1852-1-2011



1 TOP VIEW
Scale: N.T.S.



2 A-A SECTION
Scale: N.T.S.

OXFORD COUNTY STANDARD DRAWING

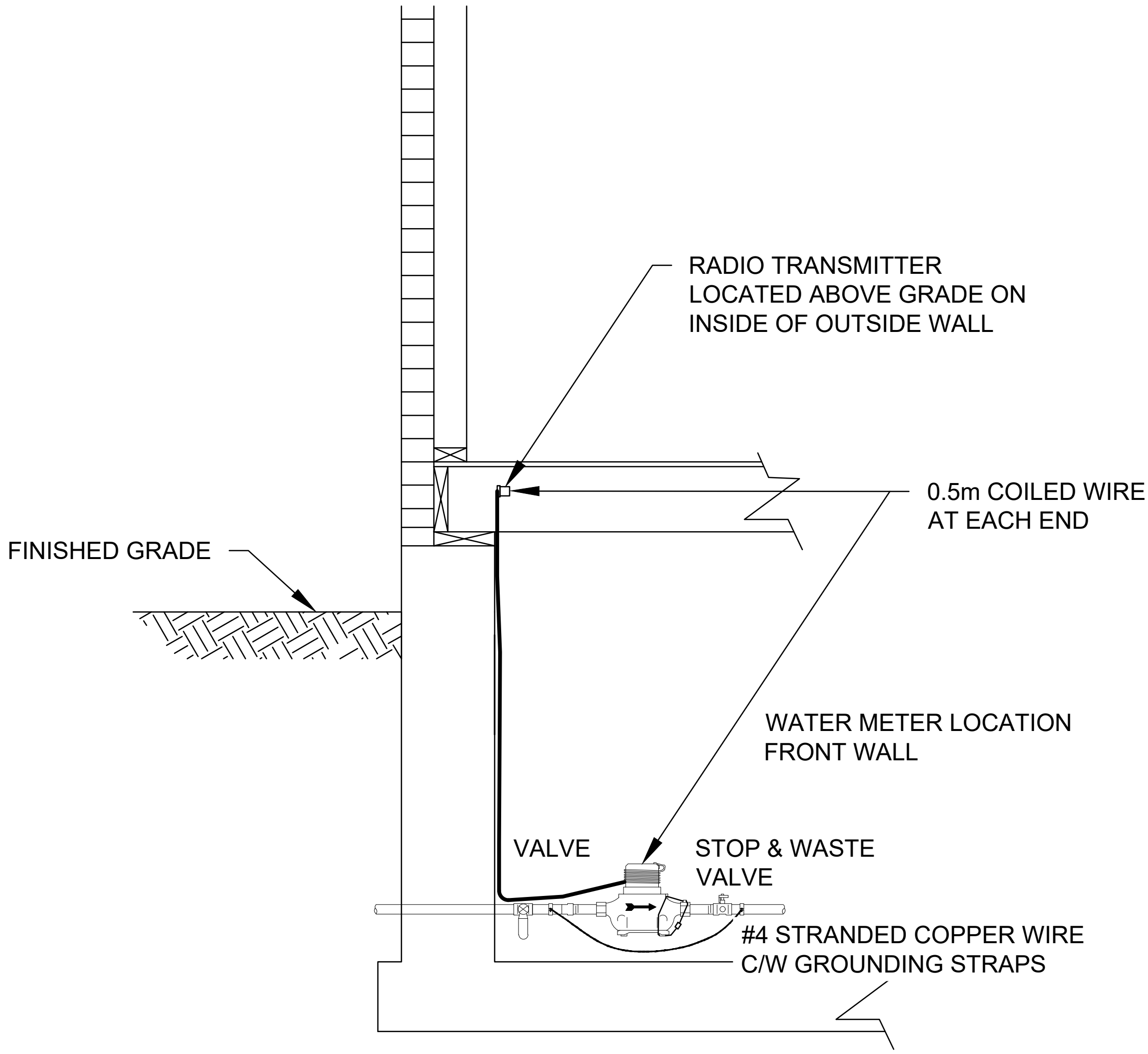
AIR RELEASE w/ CASING

REV#: 2

08/2025

FIG. 6.19

PREVIOUSLY: D1852-2-2011



1 SIDE VIEW
Scale: N.T.S.

NOTES:

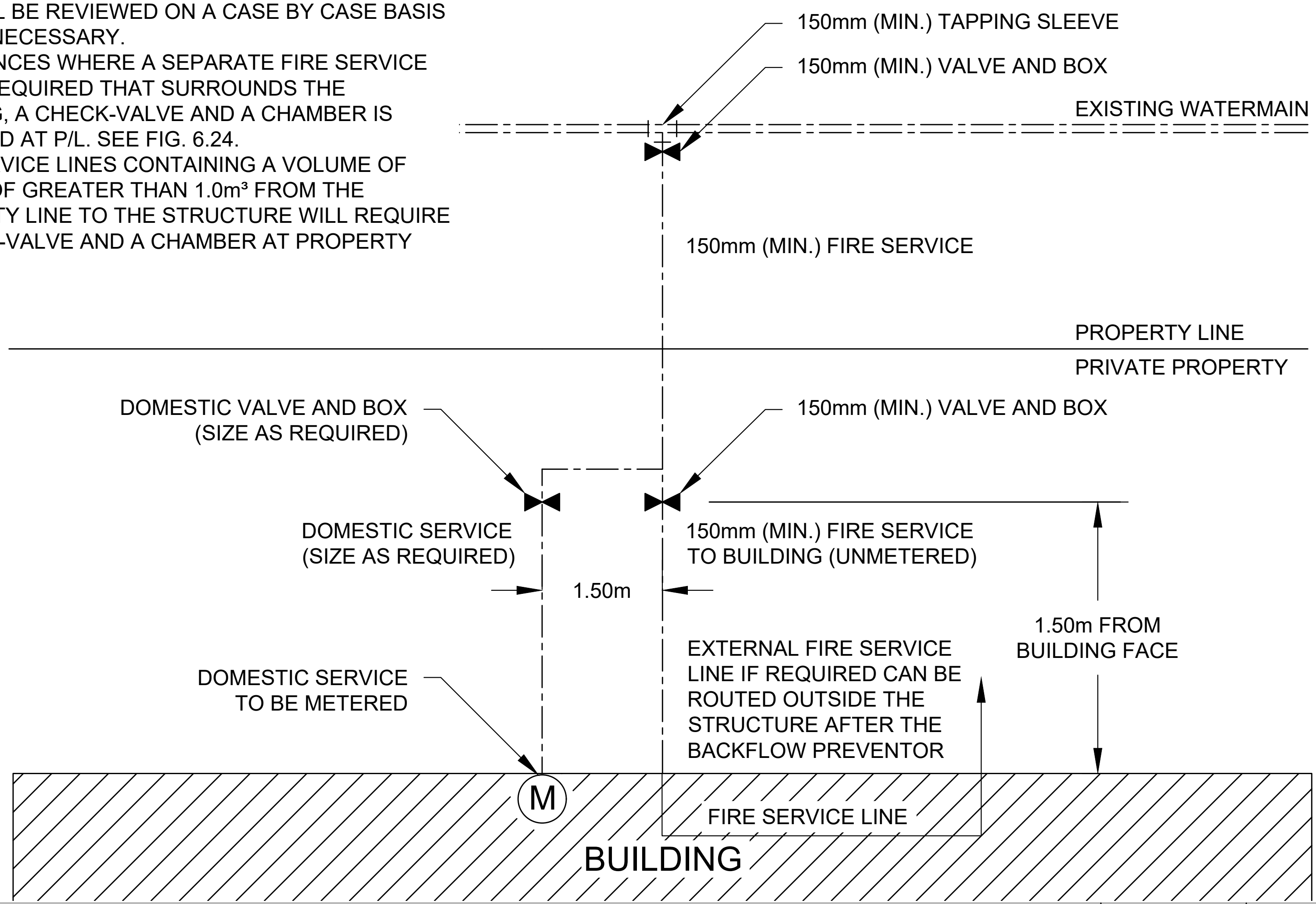
1. ONE SERVICE PER RESIDENTIAL UNIT (1.8m MINIMUM COVER FROM FINISHED GRADE).
2. WATER METERS MUST BE INSTALLED IN **HORIZONTAL POSITION**. CONTRACTOR/OWNER MUST ENSURE METER IS ACCESSIBLE FOR FUTURE MAINTENANCE.
3. RADIO TRANSMITTER MUST BE LOCATED ABOVE GRADE AND SECURELY FASTENED INSIDE ON AN OUTSIDE WALL. 22 GAUGE - 3 COND. SOLID COPPER WIRE MUST BE USED TO CONNECT THE WATER METER TO THE RADIO TRANSMITTER.
4. RADIO TRANSMITTER MUST BE INSTALLED AS PER MANUFACTURER SPECIFICATIONS.
5. COMMERCIAL/INDUSTRIAL SERVICES WILL BE ASSESSED ON AN INDIVIDUAL BASIS.

OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County Growing stronger together
WATER METER AND REMOTE RADIO TRANSMITTER	08/2025	
	FIG. 6.20	

PREVIOUSLY: D1856-1-2016

NOTES:

1. TRACER WIRE TO BE INSTALLED AS PER OXFORD COUNTY DESIGN GUIDELINES AND SUPPLEMENT SPECIFICATIONS.
2. WHERE WATERMAINS CAN BE SHUT DOWN AND A TEE INSTALLED DOMESTIC AND FIRE SERVICE VALVES TO BE PLACED ON PROPERTY LINE.
3. VALVE LOCATION AT WATERMAIN OR PROPERTY LINE WILL BE REVIEWED ON A CASE BY CASE BASIS WHERE NECESSARY.
4. IN INSTANCES WHERE A SEPARATE FIRE SERVICE LINE IS REQUIRED THAT SURROUNDS THE BUILDING, A CHECK-VALVE AND A CHAMBER IS REQUIRED AT P/L. SEE FIG. 6.24.
5. FIRE SERVICE LINES CONTAINING A VOLUME OF WATER OF GREATER THAN 1.0m³ FROM THE PROPERTY LINE TO THE STRUCTURE WILL REQUIRE A CHECK-VALVE AND A CHAMBER AT PROPERTY LINE.



OXFORD COUNTY STANDARD DRAWING

REV#: 1

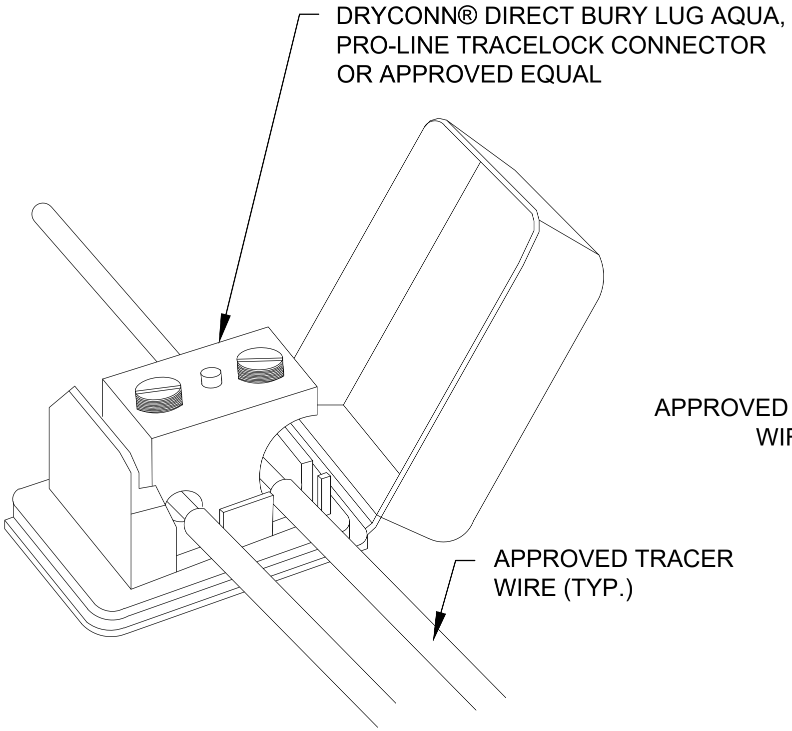
08/2025

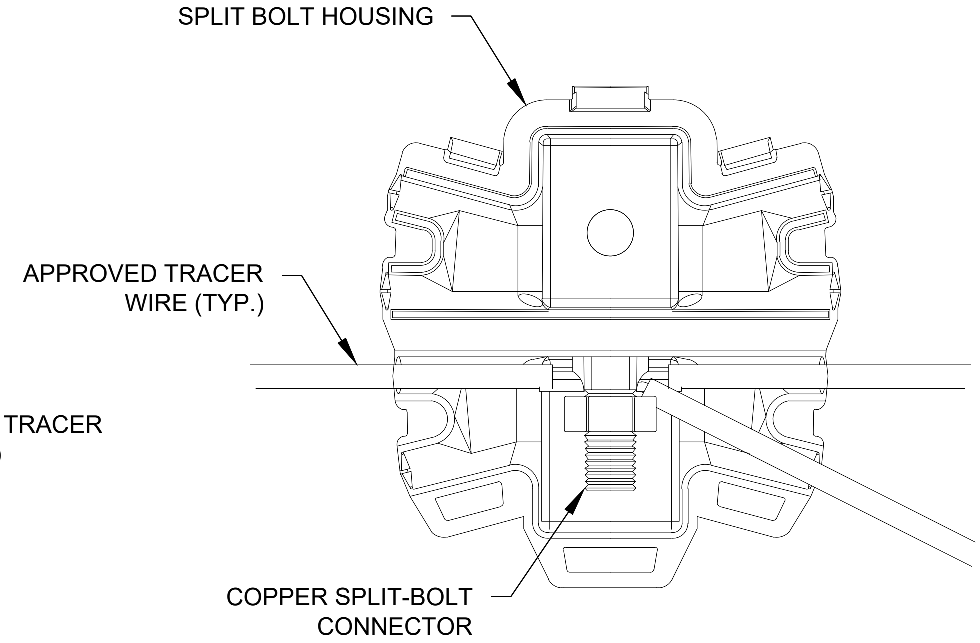
Oxford County
Growing stronger together

DOMESTIC AND FIRE SERVICE DETAIL

FIG. 6.21

PREVIOUSLY: D1857-1-2016





NOTES:

1. ALL CONNECTORS TO BE WRAPPED WITH DENSO TAPE OR APPROVED EQUAL AND COMPRESSED TIGHTLY BY HAND AROUND CONNECTOR.

OXFORD COUNTY STANDARD DRAWING

TRACER WIRE CONNECTION DETAILS

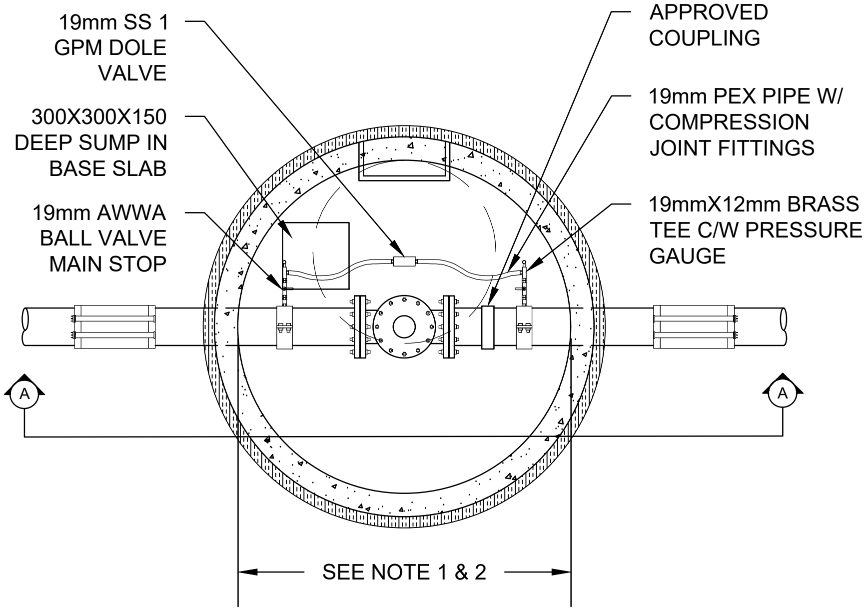
REV#: 1

08/2025

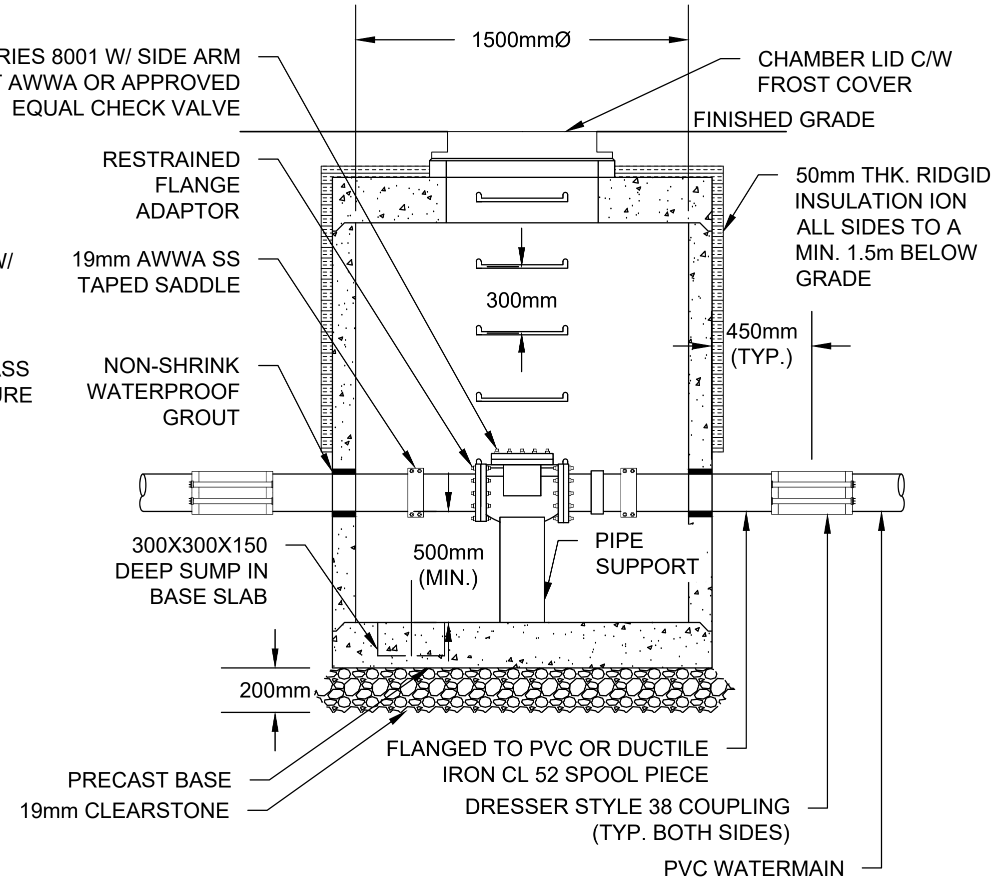
Oxford County
Growing stronger together

FIG. 6.22

PREVIOUSLY: D1858-1-2016



1 TOP VIEW
Scale: N.T.S.



2 A-A SECTION
Scale: N.T.S.

NOTES:

1. FOR 150mmØ WATERMAIN, CHAMBER SHALL BE MIN. 1500mmØ MANUFACTURED AS PER OPSD 1101.010 & 401.010 "CLOSED COVER".
2. FOR 200mmØ AND LARGER WATERMAIN, CHAMBER SHALL BE MIN. 1800mmx2400mm MANUFACTURED AS PER OPSD 1101.012 & 402.030. THREE PIECE VALVE CHAMBER COVER C/W FROST COVER.
3. CHAMBER, PIPING, AND FITTINGS TO BE INSTALLED AS PER OXFORD COUNTY DESIGN GUIDELINES.
4. CHAMBER SHALL REQUIRE FROST STRAPS AS PER OXFORD COUNTY DESIGN GUIDELINES.
5. WATER PROOFING OF CHAMBERS SHALL BE COMPLETED USING WATER PROOFING MEMBRANE-SEAL TIGHT MEL-ROL SYSTEM OR APPROVED EQUAL.

OXFORD COUNTY STANDARD DRAWING

WATERMAIN CHECK VALVE & CHAMBER c/w 19mm BY-PASS (PRESSURE ZONE)

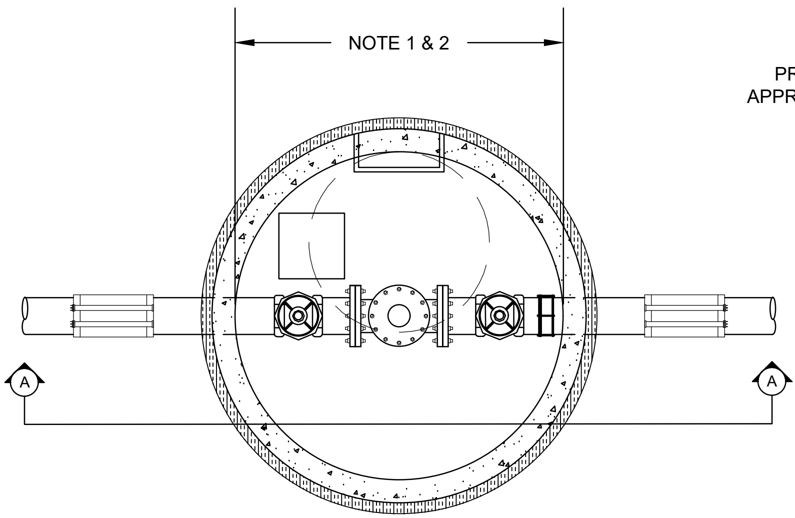
REV#: 3

08/2025

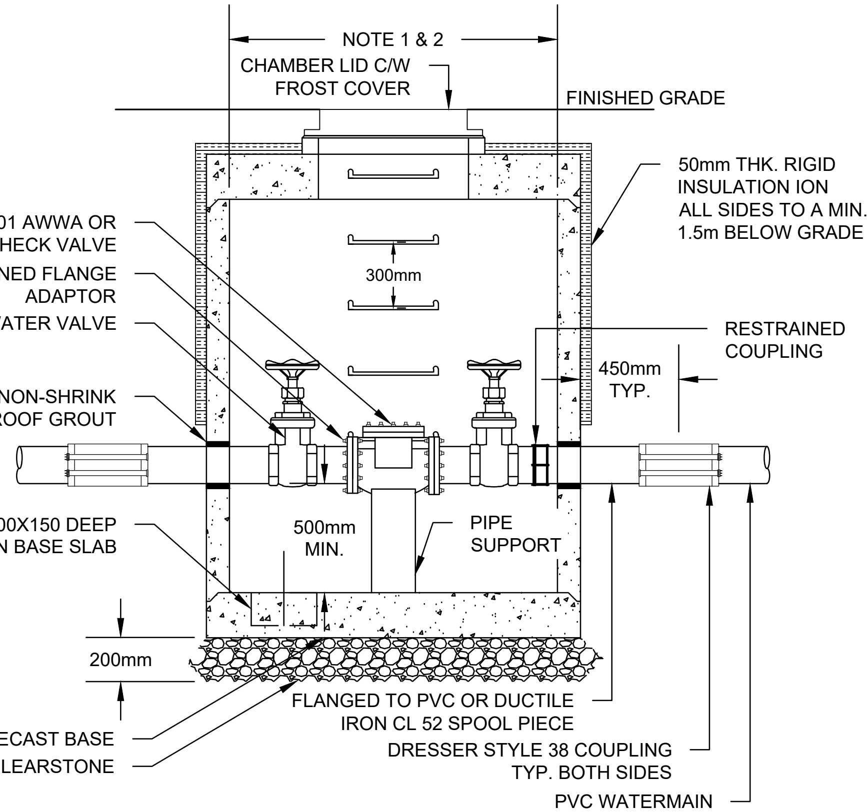
Oxford County
Growing stronger together

FIG. 6.23

PREVIOUSLY: D1860-1-2018



1 TOP VIEW
Scale: N.T.S.



2 A-A SECTION
Scale: N.T.S.

NOTES:

1. FOR 150mmØ WATERMAIN CHAMBER SHALL BE MIN. 1500mmØ MANUFACTURED AS PER OPSD 1101.010 & 401.010 "CLOSED COVER".
2. FOR 200mmØ AND LARGER WATERMAIN CHAMBER SHALL BE MIN. 1800mm x 2400mm MANUFACTURED AS PER OPSD 1101.012 & 402.030.
3. CHAMBER, PIPING, AND FITTINGS TO BE INSTALLED AS PER OXFORD COUNTY DESIGN GUIDELINES.
4. CHAMBERS SHALL REQUIRE FROST STRAPS AS PER OXFORD COUNTY DESIGN GUIDELINES.
5. WATER PROOFING OF CHAMBERS SHALL BE COMPLETED USING WATER PROOFING MEMBRANE-SEAL TIGHT MEL-ROL SYSTEM OR APPROVED EQUAL.

OXFORD COUNTY STANDARD DRAWING	REV#: 1
WATERMAIN CHECK VALVE AND CHAMBER (FIRE ALARM)	08/2025
	FIG. 6.24

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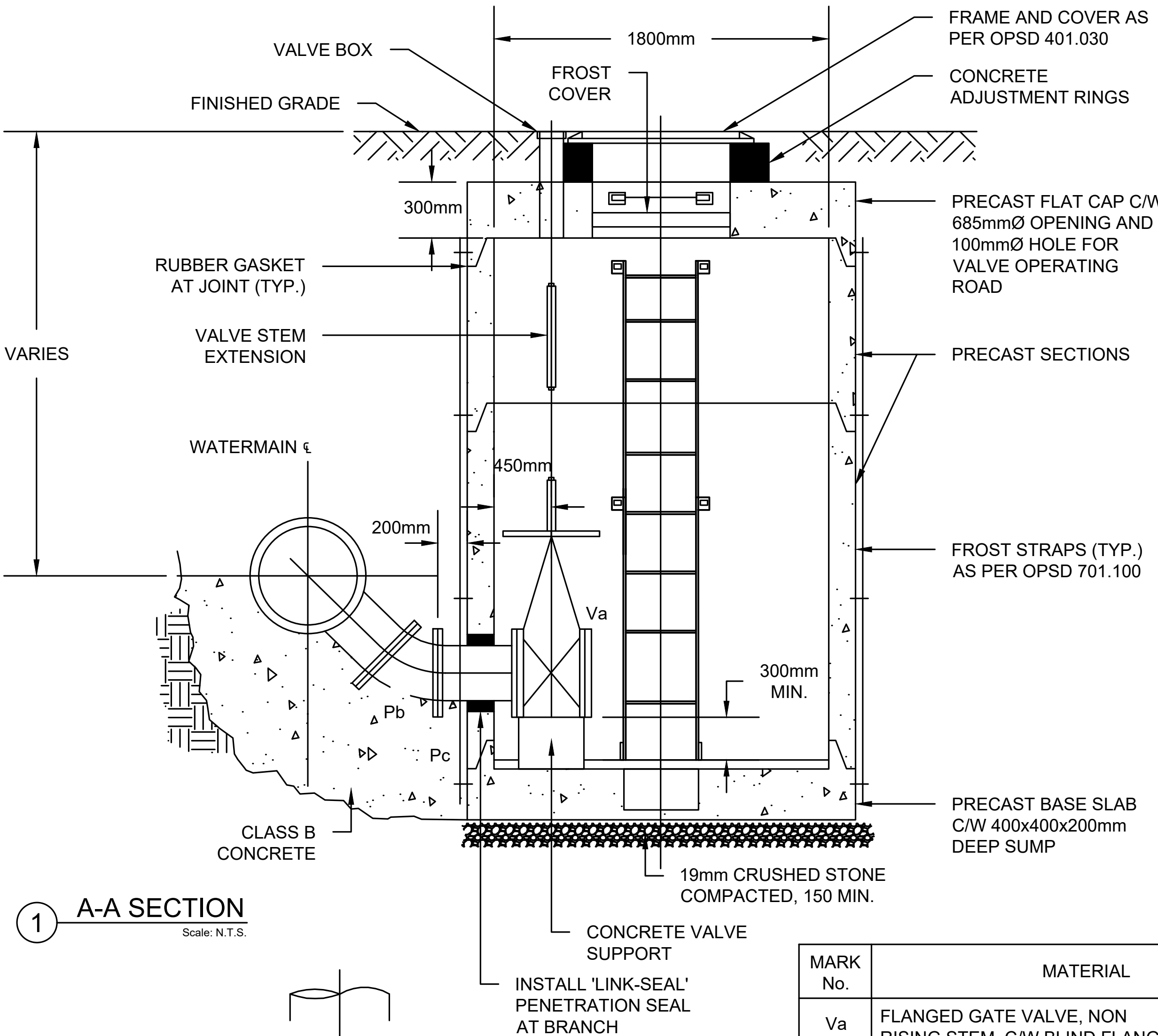
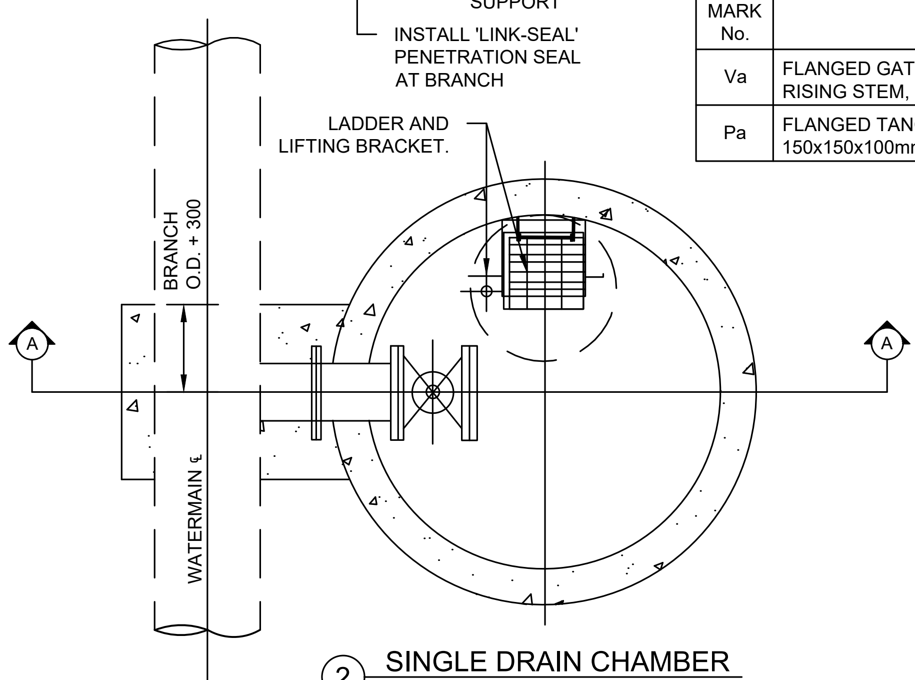
PREVIOUSLY: D1861-1-2019



1 A-A SECTION
Scale: N.T.S.

MARK No.	MATERIAL
Va	FLANGED GATE VALVE, NON RISING STEM, C/W BLIND FLANGE
Pa	FLANGED TANGENTIAL DRAIN, 150x150x100mm MECHANICAL JOINT TEE



2 SINGLE DRAIN CHAMBER
Scale: N.T.S.

OXFORD COUNTY STANDARD DRAWING

SINGLE DRAIN CHAMBER

REV#: 0

08/2025

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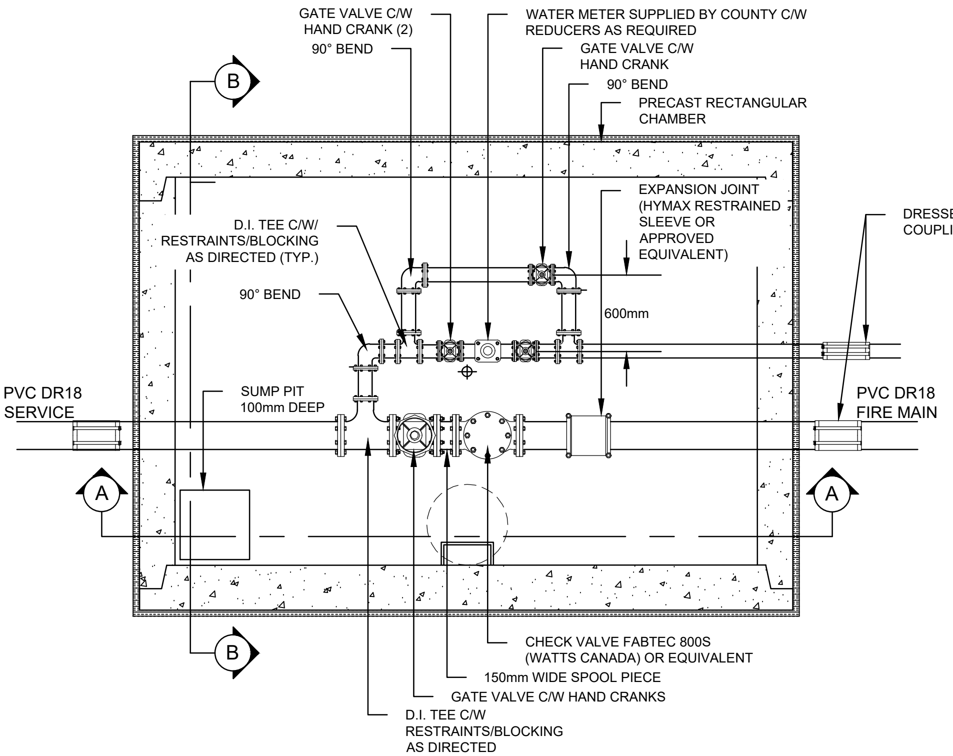
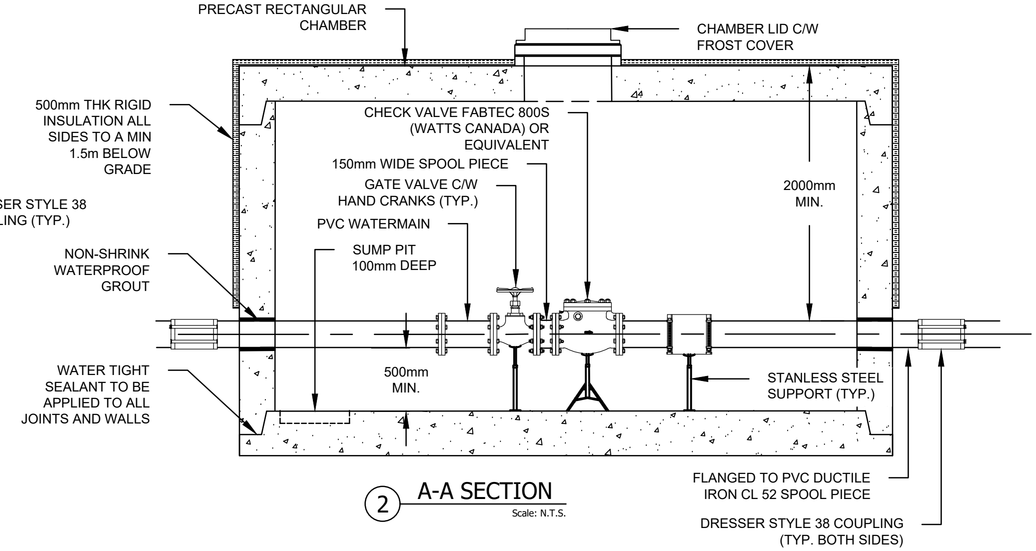
FIG. 6.25

PREVIOUSLY: N/A



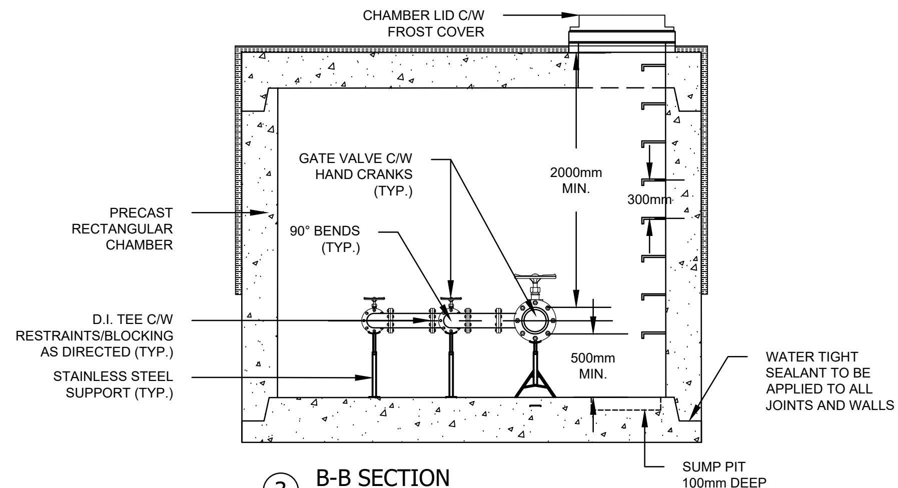
1 WATERMAIN CHAMBER

Scale: N.T.S.



2 A-A SECTION

Scale: N.T.S.



3 B-B SECTION

Scale: N.T.S.

NOTES:

1. WATERMAIN AND FITTINGS SHALL BE INSTALLED A MINIMUM OF 500mm FROM THE CHAMBER FLOOR.
2. ALL FITTINGS SHALL BE SUPPORTED BY STAINLESS STEEL RISERS.
3. WATER METER TO BE SUPPLIED BY COUNTY OF OXFORD.
4. STEPS TO BE INSTALLED AS PER OPSD STANDARDS.
5. WATERMAIN SHALL BE A MINIMUM OF 2.0m OF COVER AT THE CHAMBER.
6. CHAMBER SHALL HAVE A MAXIMUM OF 300mm OF ADJUSTMENT FOR THE FRAME AND GRATE.
7. FRAME AND GRATE SHALL BE PER OPSD 401.010.
8. FROST STRAPS REQUIRED ON CHAMBER.
9. CONCRETE CHAMBER AS PER OPSD 1108.010 OR PRECAST EQUIVALENT.
   - 9.1. ADJUSTMENT UNITS FOR FRAME INSTALLATION WILL NOT BE PERMITTED, ONE PIECE CONSTRUCTION ONLY (MAX. HEIGHT 1.0m)
   - 9.2. ONE PIECE ADJUSTMENT UNIT MUST EXTEND MINIMUM 100mm TO MAXIMUM 300mm ABOVE FINISHED GRADE.
   - 9.3. FRAME TO BE POURED INTO CONCRETE RISER.
10. CONCRETE CHAMBER TO BE APPROPRIATE SIZED AND INSTALLED IN A LANDSCAPED AREA.
11. BY-PASS LINE SIZE TO BE SAME SIZE AS THE METER LINE, BE IN CLOSED POSITION, AND SEALED BY THE COUNTY OR SERVICE PROVIDER.
12. METER CHAMBER MUST BE WATERPROOF AND PROVIDED WITH A 300mmX300mmX250mm (DEEP) SUMP.
13. NO CONNECTION FOR AN IRRIGATION SYSTEM OR OTHER TYPES OF EQUIPMENT ARE PERMITTED WITHIN CHAMBER.
14. IF A BACKFLOW DEVICE IS REQUIRED, A SEPARATE CHAMBER IS REQUIRED.
15. A FLASH MOUNT ACCESS HATCH IS AN ACCEPTABLE INSTALLATION WITHIN A WALKWAY, PROVIDING A BILCO LU-2 GALVANIZED LADDERUP SAFETY POST IS INSTALLED AT THE ENTRANCE.
16. VEHICLES MAY NOT PARK WITHIN 2.0m OF THE CHAMBER.
17. ALL NEW PIPE FITTINGS SHOULD BE RATED TO 200 PSI.
18. FLANGE MATERIAL: AWWA C207 CLASS D RINGS.
19. EXTERNAL POST MOUNTED REMOTE READER IS PREFERRED. IF THE REMOTE READER IS MOUNTED INSIDE THE CHAMBER, IT MUST BE JUST BELOW THE LID. REMOTE READER AND WIRING WILL BE INSTALLED BY COUNTY OR SERVICE PROVIDER.
20. IF THE ACCESS IS INSTALLED WITHIN A DRIVEWAY OR PARKING LOT, THE REMOTE READER IS TO BE MOUNTED ON A PERMANENT STRUCTURE WITHIN 5.0m OF THE CHAMBER. REMOTE READER AND WIRING WILL BE INSTALLED BY COUNTY OR SERVICE PROVIDER. THE CONTRACTOR IS TO INSTALL A 19mm DIA. PVC CONDUIT WITH PULL STRING FROM THE CHAMBER TO THE STRUCTURE. THE CONDUIT IS TO BE TURNED UP THE SIDE OF THE STRUCTURE AND TEMPORARILY CAPPED A MIN. OF 300mm ABOVE GRADE. CONDUIT & CONNECTIONS ARE TO BE IP68 RATED AND ALL BENDS ARE TO BE SWEEPING BENDS.

PIPE SIZE	MINIMUM INTERIOR DIMENSIONS	
	A (m)	B (m)
75mm AND 100mm	4.3	2.5
150mm	6.0	3.0
GREATER THAN 150mm	DESIGNED TO SUIT	

OXFORD COUNTY STANDARD DRAWING

WATERMETER CHAMBER w/ DOMESTIC AND FIRE SERVICE

REV#: 1

08/2025

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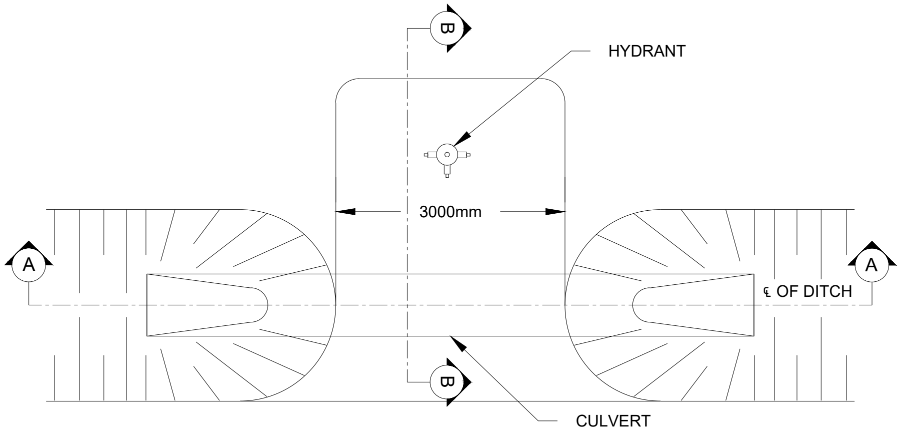
FIG. 6.26

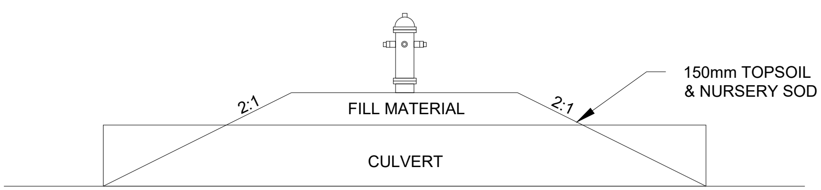
PREVIOUSLY: D1813-1-2019



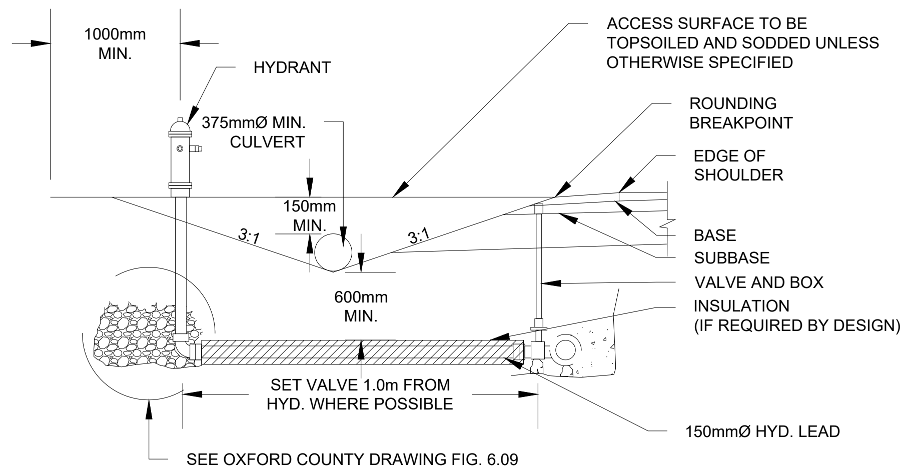
1 PLAN VIEW
Scale: N.T.S.

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.



2 A-A SECTION
Scale: N.T.S.



3 B-B SECTION
Scale: N.T.S.

OXFORD COUNTY STANDARD DRAWING

HYDRANT PLATFORM DETAIL

REV#: 1

08/2025

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FIG. 6.27

PREVIOUSLY: TSD-1331

Oxford County Design Guidelines | 7 | Sanitary

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LIST OF FIGURES

7 SANITARY

7.1 General

The current Ontario Provincial Standards, American Water Works Association Standards, Canadian Standards Association, and Ministry of the Environment, Conservation, and Parks (MECP) Guidelines for Drinking Water Systems provide the minimum requirements that must be met. In addition, the following criteria must be included in the Design presented for approval to the **County of Oxford Public Works**. If there is a discrepancy between the County Specifications and the MECP Guidelines, then the **County of Oxford Public Works** shall be contacted to resolve the issue. Any deviation from these specifications must be submitted in writing to the **County of Oxford Public Works** for approval.

7.1.1 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 wastewater 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 sanitary 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 sanitary 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 wastewater 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 wastewater 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.

7.1.2 Non-Permitted Flows

Connections from foundation, weeping tile drainage or roof drainage are not permitted to enter the sanitary sewer system, or any hazardous waste as defined under the Environmental Protection Act (EPA) Regulation 347. All wastewater discharged to the collections system must conform with Oxford County By-Law 6270-2020 Modernized Sewer Use By-Law.

7.2 Sanitary Collection System Design

7.2.1 Drainage/Sub-Drainage Area Plans

Drainage/sub-drainage area limits for which sewers are to be designed for are to contain and follow the lot/block lines to the proposed maintenance holes located on the right-of-way.

All areas and populations are to be shown for each drainage/sub-drainage areas.

7.2.1.1 External Sewer Shed Limits and Drainage Areas

When a design abuts an undeveloped or un-serviced area, the Developer shall identify the external sewer shed limit to be designed for.

All areas and populations are to be shown for all drainage areas within external sewer shed limits.

For new subdivisions, refer to **Section 2 – Procedures for Development** for additional requirements.

7.2.2 Design Flow

Sanitary sewer design calculations for approved drainage area plans are to be completed on the template shown in **Figure 7.01 Sanitary Sewer Design Sheet.**

The Developer is responsible to ensure that based on existing flow data and through the performance of hydraulic modeling, the design will not cause exceedance of capacity or level of service within the existing sanitary system. The **County of Oxford** reserve the right to validate impacts on the existing system using their hydraulic model.

7.2.2.1 Equivalent Population

.1 Residential

Unless site specific information is available, population equivalent densities are to be calculated based upon the criteria outlined in the table below.

Table 7-1 Population Equivalent Densities

Density Level	Density (Unit/Hectare)	People/Unit
Low	30	3
Medium	75	2.4
High	150-300	1.6

When the number of units and type of housing are available, calculation of the equivalent population should be based on the criteria in the table below.

Table 7-2 Housing Equivalent Population Densities

Housing Type	Density (Persons/Unit)
Single Detached	4.2
Semi-Detached	4.2
Townhouse	3.4
Large Apartment (Greater than 1 bedroom)	3.1
Small Apartment (less than or equal to 1 bedroom)	1.7

.2 Commercial/Institutional

The Developer shall consider 100 people/hectare for commercial and institutional areas, in the absence of known information. Deviation from this standard where there is known information will require approval of the **County of Oxford Public Works.**

.3 Schools

The equivalent population for schools is calculated as follows:

- Elementary Schools: 1/3 x number of students (600 students minimum)

- Secondary Schools: 1/3 x number of students (1500 students minimum)

.4 Hospitals

Apply a population equivalent of 3 persons per bed.

.5 Industrial

Use a flow allowance of 25,000 L / Ha / day, in the absence of known information. Deviation from this standard where there is known information will require approval of the **County of Oxford Public Works.**

Industrial users with sewage discharge design criteria greater than this will be considered heavy users. Heavy users should consult with the **County of Oxford Public Works** with respect to their specific requirements for water use and sewage discharge in terms of confirming capacity is available within the municipal infrastructure to meet their needs. Heavy users should also consult with the **County of Oxford Public Works** prior to any upgrades which will increase their discharge rates to the municipal sewer system.

7.2.2.2 Average Dry Weather Flow

The daily per capita sanitary flow shall be 230 L / person / day. The Average Dry Weather Flow (ADWF) shall be calculated as follows:

$$\text{ADWF} = \text{Daily per Capita Flow} \times \text{Equivalent Population}$$

7.2.2.3 Peaking Factor

The Peaking Factor (M) is the ratio of peak dry weather flow to average dry weather flow. Peaking factor calculations are to be determined based on the Harmon formula:

$$M = 1 + \frac{14}{4 + P^{1/2}}$$

where:

M = ratio of peak flow to average flow

P = tributary population in thousands

The peaking factor shall be limited to a minimum of 2.0 and a maximum of 4.0.

7.2.2.4 Extraneous Flow

An allowance for extraneous flow (E) from sources such as inflow and infiltration shall be made at a rate of 8,640 L / Ha / day.

7.2.2.5 Peak Flow Calculation

Peak flow (Q_p) calculations are to be determined based on the following formula:

$$Q_p = \left(\frac{ADWF \times M}{24 \times 60 \times 60}\right) + E$$

where:

Peak Flow (Q_p) = Peak flow within sewer

ADWF = Average Dry Weather Flow

Peaking Factor (M) = Harmon Peaking Factor

Extraneous Flow (E) = Allowance for inflow and infiltration

7.2.3 Pipe Size and Sewer Hydraulics

7.2.3.1 Minimum Pipe Size

The peak flow (Q_p) shall not exceed 70% of the full flow capacity of the pipe. Pipe capacity is determined Manning's formula:

$$Q_{full} = \frac{1}{n} \times A \times R^{2/3} \times 2 \geq \frac{Q_p}{0.7}$$

where:

Q_{Full} = Full flow capacity of pipe (m³/s)

Q_P = Peak Flow, calculated in accordance with **Section 7.2.2.5** (m³/s)

n = Mannings roughness coefficient (0.013)

A = Cross sectional area of pipe (m²)

R = Hydraulic radius (area/wetted perimeter)

S = Slope of pipe (m/m)

Notwithstanding the above, the minimum allowable size of a sanitary sewer shall be 200mm.

On private property, the minimum size for sanitary building sewer shall be determined in accordance with Part 8 of the OBC.

7.2.3.2 Flow Velocity

Velocities in sanitary 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)

The minimum velocity permitted in sanitary sewers is 0.6 m/s.

The maximum velocity permitted in sanitary sewers is 4.5 m/s.

To determine velocities based on actual flow, refer to **Figure 7.02 "Hydraulic Elements Graph for Circular Pipe."**

7.2.3.3 Minimum Grades

All sanitary sewers shall be designed and sloped to achieve self scour / cleansing and the minimum velocity as outlined in **Section 7.2.2.8**.

The minimum grade on a 200 mm diameter sanitary sewer is 0.33%. Where there are only a few dwelling units connected to the upper section of a 200 mm sanitary sewer, the minimum grades shall be adjusted as follows:

1 to 5 units	0.61%
6 to 8 units	0.52%
9 to 12 unit	0.43%
13 or more units	0.33%

On the first upstream section of sewer (e.g. cul-de-sac) a minimum grade of 1.00% is required.

7.2.4 Layout of Sewer

7.2.4.1 General

Gravity sewers shall be designed as straight lines from maintenance hole to maintenance hole. Deflection in either the horizontal and vertical directions will not be permitted.

7.2.4.2 Sanitary Sewers within Road Allowance

Sanitary sewers are to be located in the standard location indicated on the appropriate typical road cross-section in **the County's Standard Drawings,** unless otherwise approved.

7.2.4.3 Sanitary Sewers on Private Property

Sanitary sewers on private property are regulated by the OBC. Where there are no specific regulations in the NBCC, details from this manual will apply.

7.2.4.4 Sanitary Sewer Pipe Depth

The minimum depth of a sanitary sewer shall be 2.4 m from the finished ground elevation to the obvert of the pipe unless otherwise approved by the **County of Oxford Public Works**. Where frost protection is warranted, insulation is required, as per the **County of Oxford Standard Drawings**.

The maximum allowable pipe depth shall be in accordance with the relevant "Height of Fill" table in the **Ontario Provincial Standard Drawings** (latest edition), assuming an embankment condition and subject to confirmation by the Developer's Professional Engineer. Greater depths may be accepted at the sole discretion of **County of Oxford Public Works**, upon submission of the relevant engineering calculations.

7.2.4.5 Minimum Distance Between Sewers

The minimum distance between sewers shall be 2.0 m, measured horizontally from the outside of each pipe. Special cases may be reviewed by **County of Oxford Public Works** for site specific design choices and depths.

7.2.4.6 Sanitary Sewers and Other Utilities Separation

Designers should refer to Ontario Ministry of the Environment, Conservation, and Parks (MECP) F-6-1 Procedures to Govern Separation of Sewers and Watermains and the OBC (latest revision) regarding the location of sanitary sewers and services relative to watermains and water services and to the Public Utilities Act of Ontario regarding the location of watermains relative to other utilities. In all cases, clearances shall be measured from the outside of each pipe or utility.

A Subsurface Utility Engineering (SUE) investigation shall be completed and paid for by the Developer for the complete project area including test pits at critical crossing locations or as requested by the **County of Oxford Public Works**. SUE investigations shall be provided based on ASCE 38-02 Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data.

Encroachment of utilities, structures, sewers and/or any utility appurtenances, which may impact the sewer, the integrity of its bedding, and/or structural capabilities, shall have design considerations applied to adequately protect the sewer and the utilities.

It is preferable that utility crossings be at a 90-degree angle to reduce the supporting lengths required during construction.

7.2.4.7 Casings and Spacers

Where casings are required for sanitary sewers crossing bridges, roadways, railways, rivers, streams, or creeks, casing specifications shall be as set out by the governing authority.

Casings shall be steel plate ASTM A 139 Grade B welded joint. Casing materials other than steel must be approved by **County of Oxford Public Works** prior to installation.

Steel casings shall use the following inside diameters and wall thicknesses as listed below. The designer shall ensure that the minimum requirements noted will suit the project-specific parameters.

Table 7-3 Steel Casing I.D. and Wall Thickness

Nominal Pipe Size (mm)	Minimum Casing ID (mm) (I.D.)	Minimum Casing Wall Thickness (mm)
100	315	6.35
150	356	7.94
200	454	7.94
250	546	7.94
300	584	9.53
350	686	9.53
400	762	12.70
450	787	12.70
500	838	12.70
600	991	12.70

Casings shall be filled with clean sand. The use of Cellular Grout is not permitted.

Where casings containing forcemains are used in the above locations, valving shall be required at each end of the casing for isolation purposes. When a forcemain is placed inside a casing, it shall be supported by spacers using the centered configuration. Where a forcemain is located between proposed residential dwellings, it shall require a casing with fusible pipe placed inside the casing. The casing shall extend the entire length of the property. Valves should be located a minimum of 3.0 m from each end of the end of the casing. Where casings containing forcemain are located within easements between residences, the casing shall be offset a minimum of 1.0 m from the property line to avoid fence posts.

If a sewage forcemain is placed inside a casing using bell and spigot PVC material, all pipe bell joints inside the casing shall be restrained using approved restraints. All restraints shall be wrapped with a Petrolatum Coating System. Mechanical joints inside the casing are not permitted.

When a gravity sanitary sewer is placed inside a casing, the sewer shall be supported by spacers using the centered configuration. The casing shall be installed at the same design grade as the sewer to facilitate the use of the centered configuration method for spacer placement. The size, location, and number of spacers will be as per the manufacturer's recommendation. Joint restraint for gravity sewers will be at the discretion of **County of Oxford Public Works**.

Both ends of the casing will be covered using an approved rubber end seal to prevent backfill from entering the casing.

7.2.5 Pipe Material

Both rigid and flexible pipe are permitted in the construction of sanitary sewer systems including sanitary laterals. These materials include concrete, and polyvinyl chloride (PVC). The design engineer shall ensure that the use of watertight, non-corrosive materials, such as PVC is utilized for sewer pipes.

Where reinforced concrete pipes are utilized the design engineer shall denote the selection and testing process used to support resistance to sulphate and chemical degradation. Reinforced concrete pipes with sulphate-resistant cement can be considered. Refer to **Section 7.3** for additional information on pipe material requirements.

In selecting the most appropriate material for the sanitary sewers, the Designer shall specify product(s) that will not leak under the hydrostatic pressures and seasonal high groundwater table documented in the geotechnical/hydrological pre-construction report. The selected pipe and pipe gasket materials should be compatible and resistant to environmental factors such as local soil contamination, and other special considerations.

New and replacement sanitary sewers and related pipes that are deemed as significant drinking water threats (under the Clean Water Act) within Wellhead Protection Areas are to be constructed of materials and with joints that are equivalent to watermain standards of construction. **County of Oxford Public Works** may upon review of these sewers specify pipe material and colour. Associated costs are the sole responsibility of the Developer.

On private property, materials for sanitary building sewers and private sewers shall comply with Part 7 of the NBCC.

7.2.6 Pipe Bedding and Backfill

The Designer shall specify requirements for pipe bedding and backfill based on soil and groundwater conditions, and the proposed pipe material. Bedding around the sewer and services may be Granular 'A' material, 19 mm Crusher Run Limestone, or clean screened sand.

Where pipe will be installed below the groundwater table the Designer shall provide bedding requirements that will prevent erosion of the bedding following installation.

Native material may be used as backfill for pipe outside of the roadway, where it is deemed suitable in the Geotechnical Report. Backfill within roadways shall be Granular 'B' Type II or 0.4 MPa unshrinkable fill as selected by the Designer, native material will not be a permissible backfill below any roadways.

7.2.7 Maintenance Holes

7.2.7.1 Spacing of Maintenance Holes

The maximum allowable horizontal spacing (centre to centre) between maintenance holes shall be as follows:

Table 7-4 Spacing Between Maintenance Holes

Pipe Size	Maximum Spacing (m)
Less than 600mm	120
600mm and greater	190

Maintenance holes are additionally required where there is a change in the direction of the flow, slopes, or a change in the diameter of sewers.

When spacing of a maintenance hole dictates that the maintenance hole should be placed within the vicinity of a roundabout, sanitary maintenance holes are not permitted to be located within the grassed area of the roundabout. Sanitary maintenance holes must be located within the apron of the island, for maintenance purposes.

7.2.7.2 Precast Maintenance Hole Sizing Criteria

All sizing of sanitary precast maintenance holes are based on incoming and outgoing pipe sizes and should be sized and conform to **Figure 7.03**.

Precast maintenance holes should be designed in accordance with the relevant **Ontario Provincial Standard Drawings.** Where cast-in-place maintenance holes are required, their design shall be stamped by the Developer's Professional Engineer.

7.2.7.3 Head Losses

When velocities in the downstream pipe from a maintenance hole exceed a velocity of 1.2 m/s, head losses must be accounted for in the design of the sewer and larger sanitary laterals. These losses shall be accounted for by lowering the obvert of the outgoing sewer below the obvert of the incoming sewer by the amount equal to the head loss.

Drops in maintenance holes to compensate for Head Loss (HL) shall be calculated using the following formula:

$$H_L = K_L \frac{V^2}{2g}$$

where:

K_L = Head loss coefficient

V = downstream velocity (m/s) g = 9.8m/s^2

Head loss coefficients (KL) are to be applied as noted in the table below. Notwithstanding the calculation above, the minimum drop at a maintenance hole shall be the greater of the calculated head loss or the minimum drop shown in the table.

Table 7-5 Head Loss Coefficients

Alignment Change Type	Head Loss Coefficient, KL	Minimum Drop (m)
15-45 deg bend	0.70	0.030
45-90 deg bend	1.00	0.060
Tees, Crosses	1.00	0.060

7.2.7.1 Maintenance Hole Drop Structures

Sanitary drop structures are required when the difference in invert elevations between the upstream and outlet sewers in the maintenance hole is equal to or greater than 0.6 metres.

For external drop structures on 1200 mm maintenance holes only OPSD 1003.010 or 1003.020 will be accepted.

Internal drop structures shall only be used in maintenance holes 1500 mm diameter and larger where a minimum height of 600 mm from the inlet pipe invert to the bottom of the channel exists. Drop pipes shall be one size smaller than the incoming sewer with a minimum of 150 mm diameter and a maximum of 375 mm diameter. Anchor straps shall not be placed within 150 mm of any maintenance hole section joint. Internal drop structure systems shall conform with OPSD 1003.031 and must be approved by the **County of Oxford Public Works**.

7.2.7.2 Maintenance Hole Tees

Maintenance Hole tees are not allowed for any sanitary sewer less than 1200 mm diameter. Maintenance hole tees can be constructed in lieu of regular maintenance holes on 1200 mm or greater trunk sewers. Refer to OPSD 707.010 for additional requirements. Ensure sewers which slope away from the maintenance hole but are not intended to take flows from the maintenance hole, have the inverts high enough to not accept sewage.

7.2.7.3 Maintenance Hole Frame and Covers

Maintenance hole frames and covers are required for all maintenance holes and shall conform with OPSD 401.010.

Maintenance hole frames and covers are to be clear of curb and gutters on bends in the road for new construction. Maintenance hole frames and covers may be located in the curb and gutter on reconstruction projects, only as approved by **Oxford County Public Works**.

Maintenance hole frames and covers and by association steps must be aligned to avoid being located in the wheel path of the street, and to be located above a benching platform to avoid conflict with an inletting or outletting sewer pipe. The proposed location of maintenance hole frames and covers and by association steps must be shown in plain view on the engineering drawings, represented by a solid circle reflecting the above requirements.

7.2.7.4 Watertight Maintenance Hole Lids/Covers

Watertight maintenance hole lids are required when sanitary maintenance holes are located within overland storm flow routes. These locations are within 100-year flood plain areas, within gutter locations and within an easement and/or open space area where overland flow is directly over and or adjacent to the maintenance hole lids. Watertight maintenance hole lids are also required under sanitary surcharge conditions. Watertight lids shall conform with OPSD 401.030.

Watertight maintenance hole lids are not required under the following circumstances:

- Where design dictates that the maintenance hole lids end up in the curb and gutter and where it is possible to rotate the cone so that the maintenance hole lid is clear of the gutter, the cone should be rotated such that a watertight lid would not be required;

- Where, in the profile design of the street, the maintenance hole is located in the low point of an overland flow route, the maintenance hole may be in standard location but would be submerged under a greater than two-year storm event. Maintenance holes located in a standard location on streets that carry an overland flow route with a continuous grade, or cascading grade (even though some of these may be briefly submerged) do not require watertight lids.

7.2.7.5 Lockable Maintenance Hole Covers

Lockable maintenance hole covers are required to reduce access by the public, when directed by **County of Oxford Public Works** in areas such as parks and open spaces, pumping stations or pollution control plants. Lockable maintenance hole covers shall conform with OPSD 401.060.

7.2.7.6 Maintenance Hole Inserts

The use of inserts in sanitary maintenance holes will be required in areas of new construction until such time as the roadway is paved with the top asphalt layer.

7.2.7.7 Maintenance Hole Steps

Maintenance hole steps are required for access and are to conform with OPSD 405.010 or 405.020.

The following notes shall apply:

- All steps are to be galvanized steel or aluminum;
- A detail or restoration plan is required for the relocation of maintenance hole steps within existing maintenance holes, where applicable; and
- Maintenance hole steps shall be located to avoid conflict with an inletting or outletting sewer pipe. Access to maintenance holes must be above the benching platform.

7.2.7.8 Maintenance Hole Safety Landings

Maintenance hole safety landings are required at the mid-point depth of the maintenance hole, when the depth of the maintenance hole is between 5.0 and 10.0 metres. Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0 m to 15.0 m deep. Maintenance hole safety landings shall conform with OPSD 404.020. Fibre Reinforced Polymer (FRP) safety landings equivalent to the aluminum landings may be acceptable at the sole discretion of **County of Oxford Public Works**. FRP safety landings shall be designed and stamped by the landing supplier.

Incoming pipes are to be below safety landings. Where this is not possible, approval is required from the **County of Oxford Public Works**.

7.2.7.9 Waterproofing of Chambers and Maintenance holes

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

7.2.7.10 Benching

All maintenance holes require benching at the bottom of the maintenance hole. Benching shall conform with OPSD 701.021. Benching height shall be to the obvert of the highest existing pipe.

Where benching is different from OPSD 701.021, a benching detail is required.

7.2.7.11 Steps in Benching

Steps in maintenance hole benching are required when the pipe diameter is greater than 450mm.

7.2.7.12 Adjustment Units

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 maintenance hole lid. A maximum of 150 mm of adjustment rings will be permitted. Ensure that the difference in grade between the maintenance hole lid and the first ladder rung does not exceed 450 mm. Adjustment units shall conform with OPSD 704.010. Clay brick will not be allowed for use as maintenance hole adjustment units.

7.2.7.13 Maintenance Hole Access

Access to maintenance holes for the purpose of maintenance is to be provided in all circumstances, including where maintenance holes for municipal sewers are located within easements or are otherwise located outside of the paved road surface. When designing maintenance access roads for sewers, generally the maintenance access road/path will have a 3.0 metre wide hard asphalt surface with a 4.0 metre wide granular base.

Adequate curves and turn-around facilities are required for maintenance vehicles to manoeuvre. Slopes (4% maximum), cross falls (2% minimum to 4.5% maximum) and drainage of access roads are also to be addressed in the design.

Where sanitary sewer maintenance holes are installed below the 100-year flood line, **County of Oxford Public Works** shall be consulted, and access road alternatives may be considered in this situation. Watertight maintenance hole lids shall be required (Refer to **Section 7.2.6.4**).

A 0.3 m separation is required between the maintenance access and the top/bottom of any slopes, fences, and property line(s).

Wherever possible, sewer access roads in parks and open spaces shall be integrated into the public open space pathway networks and respect natural heritage features.

See **Section 7.2.8** for easement requirements.

7.2.8 Sanitary Laterals

7.2.8.1 Location

Sanitary laterals to single family and semi-detached lots are to be located in accordance with **Oxford County Standard Drawings**.

Sanitary laterals to multi-family (town housing, row housing and apartments), commercial and industrial blocks are to be connected to a maintenance hole on the Right-of-Way.

Sanitary laterals shall be installed at 90° to the sewer main where possible. In general, sanitary laterals will not be permitted to enter the main against the flow in the main. Where design constraints arise (i.e.: top end of cul-de-sac or crescent), sanitary laterals may have to be located in reverse location and identified as such on the servicing drawings for approval by **Oxford County Public Works**.

Where horizontal or vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable. Single family and semi-detached lot sanitary laterals shall NOT be connected to a maintenance hole.

Direct connection of sanitary laterals to sanitary sewers greater than 6 metres in depth will not be permitted to minimize potential Inflow and Infiltration. Where a sanitary sewer is greater than 8 metres in depth, and local servicing is required, it will be required to provide a shallower local sewer to which sanitary lateral connections may be made. Deviations from this will require the approval of **Oxford County Public Works**.

7.2.8.2 Minimum Size and Grade

Services shall have the minimum sizes and grades detailed in the table below. The actual size of the sanitary lateral required for multi-family, non-residential, commercial, and institutional blocks is dependent on the flows.

Table 7-6 Service Minimum Size and Grade

Building Type	Minimum Diameter (mm)	Minimum Grade (%)
Residential, single family and semi-detached lots	100	2.0
Residential multi-family block	150	1.0
Non-residential block	150	1.0
Commercial block	150	1.0
Institutional block	200[a]	1.0

Industrial block	200[a]	1.0

a. Design of proper service diameter for Institutional and Industrial blocks shall utilize the Functional Servicing Report submitted for those developments.

All sanitary laterals must have a maximum slope of 2.0% at a constant gradient.

7.2.8.3 Sanitary Lateral Connections to Sewers/Maintenance Holes

.1 <u>Typical Connection Requirements</u>

Sanitary laterals 100mm and 150mm in diameter must be connected to the main sewer and shall not be constructed to any sanitary maintenance hole.

Sanitary laterals 200mm in diameter and larger are to be connected to the main sewer at maintenance holes.

.2 <u>Connections to Existing Sewers for Lot Infill Situations</u>

In a situation where a lot severance or lot infill condition exists, and a new sanitary service will be connected to an existing sanitary mainline, the Property Owner must determine if the existing sanitary or combined sewer is at risk of surcharging or has a history of surcharging. This information can be obtained from **County of Oxford Public Works**. If it is determined that there is a surcharge risk, the Owner must provide surcharge protection to their development.

When connecting sanitary laterals to existing sewers in a lot infill situation, connections must be made utilizing an approved saddle or premanufactured tee, in accordance with OPSS.MUNI 410, as amended by these specifications and **Section 7.3.**

7.2.8.4 Sampling/Inspection Maintenance Holes

Sampling/Inspection maintenance holes are required where Institutional, Commercial, and Industrial developments outlet to sanitary sewers owned and maintained by the County and the County of Oxford's Service Provider, where flows are in excess of 200 m^3/day.

Sampling/Inspection maintenance holes shall be located at the property line unless otherwise approved by the **County of Oxford Public Works**. They shall be a minimum of 1200 mm diameter, or more as required by **Figure 7.03**. Sampling/Inspection Maintenance Holes are required to meet all requirements outlined for other maintenance holes in **Section 7.2.6**.

7.2.8.5 Vertical Clearance

For vertical clearances from the sanitary lateral to the watermain see **Section 6.2.4.8** of the Oxford County Design Guidelines.

7.2.8.6 Sanitary Lateral Cleanouts

Where removal is requested and approval is granted by **Oxford County Public Works**, the cleanout and tee must be removed entirely. The Property Owner may be required to install a new sanitary lateral. Approval will be given on a case-by-case basis and will apply to the entire phase of development.

7.2.8.7 Pipe Material

Refer to **Section 7.2.4** and **Section 7.3**.

7.2.8.8 Sanitary Lateral Depth

The minimum depth of a sanitary lateral shall be 2.4 metres from the finished property line elevation to the obvert of the sanitary lateral. The maximum cover on a sanitary lateral shall be as per **Section 7.2.3.4**.

7.2.9 Easements

Easements are required for all sewers to be assumed by the municipality located outside a road allowance on privately owned property.

An easement is required to ensure the municipal services and utilities crossing the site can be properly installed and maintained by the appropriate authority (municipality or private). An easement provides the right to use private land for a specific purpose which is in the public's interest.

All maintenance holes located within easements require hard surface access. Refer to **Section 7.2.6.13** for hard surface details.

7.2.9.1 Types of Easements

.1 <u>Multi-purpose Easement for Municipal Services</u>

Required for sanitary sewers and access roads that cross a site and which are maintained by the County.

.2 <u>Private Easements</u>

Private easements are required for private sanitary sewers and access roads that cross a parcel of land to service other private lands. A joint access and maintenance agreement between the interested parties shall be entered into.

.3 <u>Temporary Easements and Working Easements</u>

Temporary easements are required for sanitary sewers and access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

Working easements are required, as necessary during construction, to allow for the safe construction and finishing of the surface restoration. Once construction is completed, the working easement is released.

7.2.9.2 Minimum Easement Widths

Easement widths are determined by the diameter of the pipe being installed and the depth of cover from the centreline of the road/ground over the pipe to the invert of the sewer. The minimum width of a sewer easement at a depth of up 2.4 metres, shall be 5.0 metres (2.5 metres each side of sewer). Easement widths for sewers at depths greater than 2.4 metres shall be approved by **Oxford County Public Works**.

7.2.10 Odour Control

Sewer gases can develop which cause odours and corrosion of concrete sewer infrastructure due to:

- hydraulic design which induces turbulence in flow and encourages the release of sewer gases (i.e. sewer forcemains which jet into maintenance holes or chambers, poor benching or transitions where sewers outlet into an existing sewer, high sewer slopes which induce hydraulic jumps, elevation changes with poor transitions)
- long residence time of sewage in sewer systems (i.e.: sewer systems, pumping stations and forcemains which service new developments and have low flows initially, pumping stations and forcemains with long forcemains)
- Effluent quality which exceeds Waste Discharge By-laws

Every effort should be made to minimize the conditions or designs which may lead to the creation of sewer gases (odours and corrosion). Where it is not possible to avoid these types of situations, it will be a requirement to mitigate the impacts through the use of means acceptable to **Oxford County Public Works**. Examples of this may be:

- The use of chemical dosing of County approved or accepted oxidizing agents to address pumping stations and forcemains with long retention times, either on a short term or long-term basis.
- The use of corrosion resistant materials (such as plastic pipe or liners) in situations where it is not possible to improve hydraulic conditions which will introduce turbulence and sewer gas creation.

The MOE Design Guidelines for Sewage Works also provides information and guidelines with respect to odours and corrosion in sewers.

7.3 Sanitary Collection System Construction

Supply and installation of sanitary collection systems shall be in accordance with the current Ontario Provincial Standard Specifications (Municipal) an Ontario Provincial Standard Drawings as amended herein.

7.3.1 Approved Products and Product Approval Process

All products proposed for use on wastewater system construction projects in Oxford County shall be submitted to **County of Oxford Public Works** in writing and approved prior to use.

The County reserves the right to select any product or material they deem suitable for the application and may provide an AWWA standard and/or other specifications and conditions for the use of such products or materials. Products or materials installed without the approval shall be removed and replaced with an approved replacement at no expense to the County.

Manufacturers, distributers, contractors, designers, and other parties may request that products be considered as an approved equivalent to the products listed herein. A typical product approval submission shall include but not be limited to the following:

- Detailed product data sheet including materials and material properties, performance specifications, and any relevant standards (AWWA, ASTM, ISO, CSA, etc.)
- A list of sizes, classes, etc. with detailed dimension information
- Detailed installation guide
- Safety Data Sheet
- Material warranty information
- References for use on past projects
- Other information as may be requested by **County of Oxford Public Works** or to demonstrate equivalency to the products specified herein

Review and acceptance of an equivalent product is at the sole discretion of **County of Oxford Public Works**.

The Designer reserves the right to exclude the use of one or more of the acceptable products noted herein within their design where the use of these the approved materials listed herein is not acceptable due to project-specific constraints. Modifications may be listed in the Contract Drawings and/or Specifications.

7.3.2 Sanitary Sewer Materials

Both rigid and flexible pipes are permitted in the construction of sanitary sewer systems including sanitary laterals. These materials include PVC, concrete, and HDPE pipe. HDPE pipe shall only be used for directional drilling unless otherwise approved by **County of Oxford Public Works**. All materials shall be CSA and ASTM certified.

The Contractor must get approval for its pipe selection from the County of Oxford Public Works prior to supplying the material to the site.

7.3.2.1 Gravity Sewers

.1 <u>Polyvinyl Chloride (PVC)</u>

PVC shall only be used for sewers with nominal diameters 100mm – 600mm inclusive. PVC sewers shall be Polyvinyl chloride (PVC) pipe – smooth wall (CSA B182.2), green in colour.

Gravity sanitary PVC main shall be SDR 35 as per OPSS.MUNI.MUNI 1841, unless a higher SDR is necessitated by the design. Sanitary services shall be PVC SDR 28, green in colour, and have a factory placed tee at the main. All PVC and fabricated moldings shall be CSA certified.

.2 <u>Concrete</u>

Non-Reinforced concrete sewers shall only be used for sewers with nominal diameters up to and including 450mm. Non-reinforced concrete sewers shall be CAN/CSA 257.1 Class 3 concrete, unless a higher class is necessitated by the design.

Reinforced concrete sewers may be used for pipes with nominal diameters greater than 450mm. Reinforced concrete sewers shall be CAN/CSA 257.2 Class 65-D, unless a higher class is necessitated by the design.

Trench conditions shall be determined by the Developer’s Engineer. Trench conditions shall be as per OPSD 807.010, 807.030, and 807.040.

.3 Joints

Where indicated on Contract Drawings or as directed by **County of Oxford Public Works**, wrap joints with a waterproof membrane or the use of clay collars in high ground water areas.

7.3.2.2 Forcemains

Unless approved by **County of Oxford Public Works**, all PVC forcemain pipe shall be "Green" in colour. HDPE pipe 100mm and larger shall be manufactured with "Green Stripe". All forcemain pipe regardless of material and installation methodology shall be installed with "Green" tracer wire.

.1 Open Cut Installation

The following pipe is permitted for use in open cut forcemain installations on County projects:

- PVC AWWA C900, CSA B137.3 – Class 235 DR 18 (complete with tracer wire) 100mm through 1500mm diameter colour coded green.

.2 Trenchless Installation

The following pipe is permitted for use in trenchless (HDD) forcemain installations on County projects:

- HDPE AWWA C901 and C906, DR 11 Pressure Class 160 psi (1103 kPa), PE 3408/3608 "Green Stripe."

All HDPE material shall be Ductile Iron Pipe Size (DIPS) or Copper Tubing Size depending on the diameter of the pipe being used.

Fittings shall be butt fusion or mechanical joint only as per AWWA Specifications C110, C153 and C906. Push-on fittings are not permitted.

Pipe fittings including tees, bends, service saddles, etc. shall be rated at the same pressure rating or higher than the pipe. Mechanical joint adaptors shall include stiffener or as specified by the pipe manufacturer.

Low pressure sewer and services less than 100mm dia. shall be copper tubing size (C.T.S.) Series 200.

.3 Tracer Wire

Tracer wire is required for all forcemain installations. The use of thermoplastic High Heat-resistant Nylon coated wire (THHN) in place of tracer wire is not permitted.

Tracer wire for direct bury shall be Solid #12 AWG (0.0808" diameter), 21% conductivity, high strength (HS), copper-clad hard drawn high carbon steel (CCS) tracer wire, 30 mil. HDPE insulation jacket complying with ASTM D1248, minimum break load 452 lbs, 30-volt rating, green in colour.

Tracer wire for directional boring shall be four Solid #12 AWG (0.0808" diameter), 21% conductivity, extra high strength (EHS), copper-clad hard drawn high carbon steel (CCS) tracer wire, 45 mil. HDPE insulation jacket complying with ASTM D1248, minimum break load 1150 lbs, 30-volt rating, green in colour.

At each inline valve a single tracer wire must be brought up outside the valve box to the top of the box and inside the box through a drilled hole complete with rubber grommet. Tracer wire will attach to the mainline wire with approved connectors only. Splices of any other nature will not be permitted and will result in the total replacement of the mainline tracer wire. The length of tracer wire inside the valve box shall be +/-500mm and coiled to not interfere with valve operation. Tracer wire to be installed as per the **Oxford County Standard Drawings**.

Test stations shall be Copperhead Snakepit CD14*TP or approved equal. The maximum distance between stations shall be 500m.

All connections or repairs in the tracer wire system shall be made using a copper split-bolt connector with DRYCONN Direct Bury Waterproof Split-Bolt Housing (Aqua), DRYCONN 3-Way Direct Bury Waterproof connector (DB Lug Aqua), Pro-Line TracerLock (TL-LUG-SS) Connector, SnakeBite Locking Connector (LSC1230), or approved equal. Tracer wires at ends of rolls, or repairs shall have sufficient slack to be knotted together prior to placement of connector. All connections shall be wrapped with petrolatum tape and compressed tightly by hand around wire and connector.

At the end of forcemains a 5.5 kg zinc anode must be installed at the end of the tracer wire or the wire brought up to a test station.

No splices of the mainline tracer wire are permitted. Tracer wire connections to be installed as per **Oxford County Standard Drawings**.

Tracer wire continuity testing shall be conducted following installation and prior to final restoration demonstrating the conductivity/traceability to the satisfaction of the County or its Service Provider.

7.3.2.3 Casings and Casing Spacers

Casings shall be in accordance with the Contract Drawings. The Contractor shall submit certified shop drawings showing casings, spacers, pipe and any specials required giving details, design, and method of construction, type of joints, etc., of the casing, spacers and pipe before construction commences.

Approved Casing Spacers are as follows:

- CCI #304 Stainless Steel
- PSI Ranger II
- Cascade

Not withstanding the above, the Contractor shall comply with the casing spacer requirements of applicable Regulatory bodies.

7.3.3 Installation of Sanitary Sewer by Open Cut

The installation shall be in accordance with OPSS.MUNI 401, 404, 410, 517, and 1010 with the following exceptions/amendments.

7.3.3.1 Line and Grade

Contractors shall provide stakes to indicate the line and grade of the sanitary sewer as well as the location of fittings, bends, tees, reducers and plugged or capped dead-ends in accordance with the approved Contract Drawings before beginning any work.

Line and grade stakes shall be marked and spaced a minimum of 20m to a maximum of 50m apart. Mains shall be laid and maintained to the required grades and locations with all fittings, etc. to be plumb and in accordance with the Contract Drawing locations. No deviation in excess of 150mm will be permitted.

Contractors shall carry out explorations where necessary to establish or discover the location and elevation of existing pipes, conduits or other buried objects.

7.3.3.2 Frozen Ground

Do not place material on frozen ground. Should the bottom of the trench become frozen remove and replace the frozen material with bedding material compacted to 100 percent Standard Proctor Maximum Dry Density.

7.3.3.3 Excavation and Trench Preparation

All excavations and trenching operations shall comply with the associated provisions of the Construction Projects Regulation (O.Reg 213/91). Trenches shall be provided so that pipe can be laid with the proper alignment and depth so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at all points between the bell holes.

Where trench excavations are not kept within the design limits of the pipe, **County of Oxford Public Works** may order sheathing and shoring, and/or a heavier class of pipe, and/or use of a higher class of bedding.

Where the subgrade in its natural state is inadequate to support the pipe, the Engineer shall give instructions as to the proper procedure subject to approval by **County of Oxford Public Works**.

The sub grade shall be removed where it has been adversely changed by construction operations or field conditions and is not adequate to support the pipe. Replace with crushed stone or other approved material as directed by **County of Oxford Public Works**.

7.3.3.4 Dewatering

Always maintain the excavation free of water. Should active dewatering be required, the water elevation shall be reduced to at least 1m below the excavation subgrade.

The discharge of water from the construction site into sanitary sewers is strictly prohibited, unless a discharge permit has been obtained. The costs for cleanup of the sewer or other affected areas will be the responsibility of the Contractor / Developer.

7.3.3.5 Lowering & Laying

Before lowering and while suspended, the pipe shall be inspected for defects. Proper implements, tools and facilities as required by **County of Oxford Public Works** shall be provided by the Contractor. All materials shall be lowered into the trenches by suitable means.

The interior of the pipe shall be inspected and completely cleaned of all sand or foreign materials before placing in the line. No foreign materials are to be placed in the pipe during its laying.

The inside of the bell and the outside of the spigot shall be brushed and free from all oil, grease or dirt before jointing. Precautions must be taken to prevent dirt from entering the joint space.

At all times when pipe laying is not in progress the open ends of the pipe shall be closed by water-tight plugs or other means approved by the Inspector. This must be adhered to during any non-working periods, including breaks, overnight, and on weekends. The trench shall be kept dry and free from water. No pipe shall be laid in water except by permission of **County of Oxford Public Works**. No water shall be allowed to run through installations during construction.

Cutting of the pipe shall be done in a neat manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe.

Pipe shall be laid with the bell ends facing in the direction of laying. Deviation from this shall only be permitted upon approval by **County of Oxford Public Works**. At grades above 10 percent, laying shall start at the bottom with the bell ends facing upward.

When deflection in the line laying is required, either in the vertical or horizontal plane, the deflection may be made at the joints. Pipe deflection will be done as per manufacture's specifications, and shall not exceed **50%** of the Manufacturer's recommended maximum deflection. If in the opinion of the Inspector, the deflection is excessive, they will order the job stopped. **County of Oxford Public Works** or their representative, if deemed necessary will order the installation of special fittings in order to provide the required deflection. Offset locations and details shall be shown on Construction and As-Constructed Plans.

When a new sewer crosses existing utilities, or where an existing watermain or sewer is undermined during laying operations, **County of Oxford Public Works** may order the installation of support beams. Support beams shall be approved by **County of Oxford Public Works** prior to placement. The removal or replacement of an undermined section of the existing watermain or sewer may also be required. **County of Oxford Public Works** shall approve the method to be used. In all cases where pipe is laid on backfilled material, the backfill shall consist of granular material compacted in 150mm layers to a minimum of 95 percent Standard Proctor Maximum Dry Density. Pipe must not be laid on blocks.

No pipe shall be laid until the preceding pipe joint has been compacted and the pipe carefully embedded and secured in place.

All pipe and fittings shall be installed strictly in accordance with the manufacturer's instructions. At least two copies of the manufacturer's manual of instructions shall be kept on the job site; one copy in the possession of the foreman, the other with the pipe layers.

Installations shall be kept thoroughly clean during the progress of the work and until the completion and final acceptance thereof.

The Contractor shall supply all fittings to complete the installation to the lines and grades shown on the Contract Drawings. Where vertical or horizontal curves are shown, the pipeline shall not deviate more than 300mm from line, and not more than 75mm from grade.

Sanitary sewers installed at a depth of 3.5m or greater will require the use of settlement control joints on all service laterals. When the lateral is installed between 45° and 67.5° the controlled settlement joint shall be installed at the sewer tee. The settlement control joint permits axial movement of the riser when laterals are placed in deep excavations. These fittings shall be installed as per the manufacturer's specifications.

7.3.3.6 Bedding

For the purpose of this specification all materials placed between the trench bottom and 300mm over the top of the pipe shall be considered as bedding.

Granular materials greater than 19mm in size shall not be used for pipe bedding. Granular material shall be compacted to a minimum of 95 percent Standard Proctor Maximum Dry Density.

Bedding material shall be placed full width of trench. Compact material around the pipe with hand operated vibratory equipment properly shaped to ensure full compaction below the haunches. Mechanical tampers larger than 9.9kW shall not be used over the top of pipe where cover is less than 300mm.

The depth of trench excavations shall be sufficient to allow for the bedding required below the pipe invert.

7.3.3.7 Backfilling

Backfill shall be considered as starting from 300mm over top of the pipe. All materials below this point shall be considered as bedding.

If **County of Oxford Public Works** decides that the site selected excavation material either wholly or partially, is not suitable for backfill, then suitable imported material shall be provided of a type approved by **County of Oxford Public Works**.

Backfill trenches from the top of the pipe bedding to the underside of surface restoration with site selected excavated material. Provide backfill free of roots, organic material and stone larger than 250mm. Backfill material shall be placed in lifts not exceeding 300mm and compacted to a minimum 95 percent Standard Proctor Maximum Dry Density.

Where Trench Plugs are required the type of backfill must be considered to mitigate I/I.

Backfilling on a public road allowance, or in an area that is to be designated as a public road allowance, shall be done in accordance with the requirements of **County of Oxford Public Works** or other road authority. Backfill on all County Road allowances in the travelled portion of the roadway shall be granular material or unshrinkable fill as set out in the Ontario Provincial Standards.

Installation of material will be as directed by **County of Oxford Public Works** or other road authority.

No frozen material shall be used for backfilling nor shall backfilling be carried out where material in the trench is frozen.

The surface shall be restored so that all pavement, sidewalks, curbs, gutters, shrubbery, fences, poles, sod and other property and surface structures removed or disturbed during the work shall be restored to a condition at least equal to that before the work began.

7.3.3.8 Compaction Test

County of Oxford Public Works may order compaction tests by an independent testing company. Tests will be arranged by the County or the County of Oxford's service provider.

When tests show that the compaction does not meet the specified requirement, the Contractor shall carry out further compaction in a manner directed by **County of Oxford Public Works** and shall be responsible for paying for further testing to establish proof of the specified compaction.

For backfill compaction, tests will be performed in accordance with the testing company's recommendations.

The contractor shall co-operate with **County of Oxford Public Works** and the testing company by scheduling the placing and compaction of backfill so that tests can be progressively taken.

7.3.4 Installation of Sanitary Sewer by Directional Drilling

7.3.4.1 Scope

This specification covers the requirements for the installation of sanitary forcemains by horizontal directional drilling (HDD).

7.3.4.2 Definitions

Horizontal directional drilling is defined as trenchless installation of pipes pulled through a drilled and reamed hole.

A pilot hole is drilled under and across the surface area that cannot be disturbed along a predetermined horizontal and vertical design profile. Direction and elevation is controlled by a steering mechanism in the drill string just behind the cutting head.

Reaming is enlargement of pilot hole to a suitable size to allow for the installation of the pipe.

7.3.4.3 Submission and Design Requirements

.1 Submissions

Submit shop drawings showing all equipment and plans required to complete the pipe installation by HDD. This information shall include:

- Directional boring equipment and specifications;
- Sequence of operation;
- Location of entry and exit points;
- Location and positioning of individual plant items such as drilling equipment, slurry holding tanks, power generation units, slurry recovery units and pumps, etc;
- Disposal site for cuttings;
- Dewatering plan;

- Contingency plan; and
- Slurry management plan.
- Frac-out Mitigation Plan

.2 Design Requirements

Procedures, materials, and water management plan are to be acceptable to the Ministry of Environment Conservation, and Parks (MECP), Ministry of Natural Resources (MNR), local Conservation Authority and the other public agencies having jurisdiction over the project.

All plant, personnel and construction activity must be contained within working areas or easement limits shown on the Contract Drawings.

.3 Record Drawing Requirements

Record drawings shall be provided following pipe installation. Record drawings shall include the following details:

- Horizontal (plan) location of installed pipe tied to known reference points.
- Profile of the installed pipe with elevations.
- Location of all joints and flanged connections tied to known reference.
- Subsurface ground conditions encountered (soil, clay, rock, etc.)

7.3.4.4 Equipment

The drilling equipment shall be suitable for installation of the pipe size and length required. The boring equipment shall consist of the drilling rig, cutting and steering head, drill stems, power and control equipment, mixing tanks for drilling fluids and a slurry recovery system.

The steering system shall include a probe situated behind the cutting head that can interface with an above ground portable computer control console.

The probe shall be able to indicate the orientation of the steering and cutting tool.

The cutting tool shall be steerable from the above ground computer control console so that any deviation from the design alignment can be corrected as boring progresses.

The drilling equipment shall be capable of being retractable and reset to a different horizontal alignment should obstacles such as boulders, tree roots, etc. be encountered. The Contractor shall not change the vertical alignment without the approval of **County of Oxford Public Works**.

A surface probe shall be provided that can detect the location and depth of the cutting tool/steering system. The surface probe shall be used to confirm that the pipe alignment is within the easement and at the location identified.

7.3.4.5 Construction

.1 General

The Contractor shall provide all necessary equipment, drilling fluids, and power to perform the work specified.

.2 Dewatering

The proposed dewatering method for the entry and exit pits and all excavations shall be in accordance with the accepted plan and shall not be modified without written consent from **County of Oxford Public Works**.

All water extracted during any dewatering process shall be diverted through a filter system or settling ponds/basins to ensure minimum sediment transport.

The filter system or ponds/basins shall be located so as not to interfere with normal construction activity and the public use of such areas.

.3 Line and Grade

Line and grade control will be maintained to the locations and elevations on the Contract Drawings. Variations in grade will not be acceptable.

The control system must be capable of maintaining line and grade to 100mm (50mm up or down) over the total distance between the ground entry and exit points.

.4 Soil Transportation System

The directional boring system shall have a slurry system designed to enable excavated soil removal. The slurry system shall have a system of screens and desilting/sedimentation tanks to separate the soil from the slurry. The drilling fluids may be transported to the drill rig for reuse. Disposal of the slurry on-site or into drainage systems will not be permitted.

.5 Entry and Exit Points

The Contractor shall review site conditions and make an assessment of entry and exit points. Assessment shall take the following items into consideration:

- Entry and exit angles to facilitate boring equipment and allow for pulling pipe into reamed hole.
- Setbacks or open cut excavation requirements at entry and exit points to provide the pipe profile and construction of appurtenances as indicated on the Contract Drawings.
- Location of other surface features (e.g. adjacent structures, walkways, fences, poles, trees, etc.)
- Location of other underground features (e.g. utilities, foundations, etc.)
- Protection of water courses against the transport of excavated or other materials into receiving waters.

7.3.4.6 Pipe Installation

High Density Polyethylene (HDPE) pipe shall be butt fusion welded to the required length at ground surface. The pipe shall not be laid to a radius greater than that recommended by the pipe manufacturer.

The successfully tested pipe shall then be installed in the reamed hole. The Contractor shall ensure by the use of shear couplings or other means that the amount of tension applied does not exceed the tensile capacity of the pipe during the pipe installation process.

The Contractor shall allow sufficient time for the longitudinal stresses in the HDPE to dissipate before the pipe is cut for connection.

The installed pipe shall be cut to the length and at elevations detailed in the Contract Drawings. The ends of the pipe shall be prepared for butt fused flanged connections. All joints shall be restrained.

7.3.4.7 Disposal of Materials

Surplus excavated material and slurry shall be disposed off-site. The Contractor shall make his own arrangements for off-site disposal and for carrying out soil tests to ensure that disposal is consistent with MECP guidelines, policies and regulations.

7.3.5 Connections

7.3.5.1 Connections to Existing Sewers

The Contractor shall notify the County or the County of Oxford’s service provider in writing a minimum of 48 hours in advance of their intention to connect to the existing sanitary sewer. The method of connecting shall be confirmed with **County of Oxford Public Works**. The Contractor shall submit a program for this work which must be accepted by **County of Oxford Public Works** before the work commences.

.1 Jointing of Push on Joint Pipes

The jointing of the Push On pipes will be in accordance with the pipe manufacturer's specifications. Joints shall be bell and spigot with rubber gaskets.

The deflection of Push On joint pipes, in order to form long radius curves, shall not exceed the manufacturer’s recommendations.

On straight lengths, no lateral deviation in excess of 150mm will be tolerated and on straight grades no grade deviation in excess of 75mm will be tolerated.

7.3.6 Installation of Maintenance Holes

7.3.6.1 Construction Practices

Maintenance holes shall be supplied and installed in accordance with OPSS.MUNI 407 and the applicable Ontario Provincial Standard Drawings, as amended herein.

The void between the sewer pipe and the cored hole of the precast maintenance hole section shall be filled with cement bricks and approved non-shrinkable grout. Pre booted maintenance holes will be allowed but only with previous approval by **County of Oxford Public Works**. All joints between bricks are to be completely filled with concrete mortar. Bricks are to be parged on the outside. Parging shall contain an approved bonding agent. All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with the manufacturer’s specifications.

All precast maintenance hole section joints shall contain an approved rubber gasket. In areas of high groundwater, exterior joint collars or external wrapping (eg. ‘Cretex’ waterproofing or equivalent, installed as per manufacturer’s specifications) of the maintenance hole joints will be required.

A minimum 300mm vertical/horizontal clearance between openings on the inside of the maintenance hole is required for all sewer and lateral connections.

Where adjacent maintenance holes are located in close proximity to one another, the area between the adjacent maintenance holes shall be backfilled in accordance with the specifications in the following table:

Table 5-1 Material Between Adjacent Maintenance Holes

Distance Between Adjacent Maintenance Holes	Material
0.6 metres or less	concrete or crushed stone
0.6 metres to 2.4 metres	granular material
more than 2.4 metres	approved native material or granular material

The above noted backfill shall be compacted to the Standard Proctor Maximum Dry Density specified in the soils report, or as approved by **County of Oxford Public Works**.

7.3.6.2 Waterproofing of Chambers and Maintenance Holes

Where indicated in the Contract Drawings, construct maintenance holes with water-tight designs and appropriate venting to mitigate infiltration. Maintenance holes must be constructed using watertight materials and techniques, including sealed joints and rubber gasketed covers, to prevent surface water from entering the system. The membrane shall be applied over a prime or tack coat and hand rolled to ensure 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. Only 150mm of surface elevation adjusters and modular gaskets will be permitted, any further adjustment shall be completed using precast riser sections.

7.3.6.3 Adjustment Units

All maintenance hole frame and covers shall be adjusted to the finished road grade by means of metal shims at each corner or by means of an approved precast adjustment ring. Metal or PVC will be permitted and are to be at least 75mm x 200mm (3" x 8") and their thickness is to be determined by the adjustment required. Concrete, clay brick and wood spacers will not be allowed. The space between the bottom of the maintenance hole frame and cover and the top of the precast maintenance hole is to be at minimum the thickness of one adjustment unit and at maximum 150mm. The number and type of adjustment rings will be affected by either the use of precast concrete adjustment units or “Lifesaver” Adjusting Units as manufactured by IPEX (or approved equal).

7.3.7 Corrosion Protection and Insulation

7.3.7.1 Petrolatum Coating System – Forcemain

Material requirements shall be as per AWWA C217, CSA Z245.30-14, and be ISO 9001 and ISO 14001 compliant. The installation of the petrolatum coating system shall be in strict conformity with the manufacturer's specifications with the following exceptions/amendments.

- All flanged surfaces, nuts, bolts, tie rods, clamps, valves, sleeves, couplings, joint restraints, etc., shall be protected using petrolatum materials. Prior to application all surfaces shall be free of dirt, grease, oil, paint, or foreign material. The minimum acceptable application of a petrolatum coating system is a two-step process consisting of a primer and petrolatum tape. Where voids or other surface irregularities are encountered, filler material is required where the tape will not come into full contact with surfaces. Placement of petrolatum tape only is not acceptable.
- All surfaces of pipes, valves and appurtenances in valve chambers shall be coated using petrolatum materials. Valves or appurtenances that are epoxy coated do not require this procedure.
- Petrolatum coatings shall be DENSO or approved equivalent. After final inspection of the applied coating system any defects in the application process shall be repaired at the Developer's expense.

7.3.7.2 Cathodic Protection – Forcemain

Anodes shall be installed at the locations shown on the Contract Drawings in accordance with OPSS.MUNI 442 and OPSD 1109.011. Attaching anodes to restraint nuts or gland pack nuts is not permitted.

Connections to valves, fittings, and joint restraints will be done using the "cad weld" method and coated with mastic. Installation shall be as per the manufacturer's specifications and recommendations.

.1 <u>Minimum Anode Sizing</u>

The Minimum anode sizes used shall be in accordance with the table below.

Table 5-2 Minimum Anode Size

Scenario	Anode Size and Type
New Installations of Fittings, Joint Restraints, and Services	11kg Z-24-48 Zinc – ASTM B418 Type II
Existing metallic watermain, services, or connection between cast iron / ductile iron watermains and PVC Pipe	14kg M-32-22 Magnesium – ASTM B843 Type M-1C

7.3.7.3 Thermal Insulation

If minimum cover of 1.80m cannot be achieved due to underground obstructions or changes in surface grade, thermal insulation must be used. Insulation shall be Rigid Board Insulation – Slab

Type (See **Oxford County Standard Drawings** for additional information). No forcemain, gravity sewer, low pressure sewer, or services shall have a ground cover less than 1.0m deep from ground surface to the top of pipe. Where crossings of underground obstructions and utilities occur insulation shall be installed to a minimum of 1.0m from the outside wall of the obstruction on both sides. Material used to thermally insulate mains and services shall have a minimum compressive strength of 690 kPa. All thermal insulation joints shall be tightly butted together and secured by tape or other means to prevent movement during backfill. Manufacturer's specification of material shall be provided prior to installation.

7.3.8 Service Installation

7.3.8.1 Location

Sanitary lateral to single family, semi-detached and row housing lots are to be located in accordance with **Oxford County Standard Drawings**.

All sanitary laterals shall be installed a minimum of 1.0m past property line on all new construction.

Sanitary lateral connections to sanitary sewers shall be as per OPSD 1006.010 or 1006.020 (as applicable).

Where there is a conflict with the proposed sanitary lateral location due to maintenance holes etc., then sweeps must be used to establish a perpendicular connection at the main and perpendicular to properly locate at the R.O.W.

Services located in existing driveways, sidewalks, or curbs shall be saw-cut in clean straight lines to minimize over-break prior to repair or construction. All concrete and asphalt driveways, curbs, and sidewalks shall be restored to existing or better conditions within construction limits only. Interlocking brick driveways shall be carefully disassembled to proposed construction limits and reassembled to existing or better conditions. Coloured and/or impressioned concrete is extremely difficult to match when replacing parts of driveways, curbs, or sidewalks. The County or the County of Oxford's service providers are not responsible for an exact match of these areas.

If the property owner cannot agree to the methods and materials required to reinstate all concrete and asphalt driveways, curbs, and sidewalks to existing or better conditions the County will undertake a quotation for reinstatement to the construction limits according to existing materials. Based on the quotation the property owner may receive monetary compensation to pursue other alternatives. Prior to receiving compensation, the property owner will sign an agreement with the County or the County of Oxford's service providers acknowledging acceptance. Included in the agreement will be a holdback to ensure that where sanitary service cleanouts exist, they are placed to proper grade and are fully functional after the property owner's restoration has been completed.

7.3.8.2 Connections to Maintenance Holes, Sewers, and Services

When connecting sanitary laterals to existing sewers in a lot infill situation, connections must be made with an approved saddle or pre-manufactured tees, as per OPSS.MUNI 410 and OPSD 1006.020. Drop structures for maintenance holes shall be as per OPSS.MUNI 1003.010, 1003.020, 1003.030, and 1003.031 and shall be of the type detailed on the Contract Drawings.

Connection can only occur in the presence of the County or the County of Oxford's service provider. When connecting to existing maintenance holes only cored holes with proper rubber connectors are acceptable. Written notice is required 48 hours in advance to schedule an inspection.

.1 Connection to Existing Services

When connecting to existing sanitary laterals and size on size connection cannot be achieved, only eccentric couplings shall be used.

When connecting PVC to PVC pipe, only gasketed PVC repair sleeves shall be used. When connecting other dissimilar sizes and materials it may be necessary to use a "Fernco" or equivalent rubber coupling for connection. All materials used to connect existing services to new services shall be approved by the County or the County of Oxford's service provider.

All connections shall be inspected by the County or the County of Oxford's service provider.

7.3.8.3 Cleanouts

Where private maintenance cleanouts are required, they shall be located off the R.O.W. For private sanitary lateral cleanouts, Part 7 of the National Building Code of Canada (NBCC) takes precedence.

Where sanitary lateral cleanouts are required to be within the R.O.W., prior approval must be granted by **County of Oxford Public Works**.

For properties that require sewage grinder pumps connecting to a gravity sewer lateral, a cleanout shall be installed off the R.O.W. at 1.0m past the property line.

Cleanout and lateral connection to be installed as per **Oxford County Standard Drawings**.

7.3.8.4 Marking and Recording of Sanitary Lateral Connections

Green painted surface stakes 50mm x 100mm shall be placed during trench restoration to mark the termination of the sanitary lateral. These stakes shall extend from sanitary lateral invert to minimum 500mm above finished grade at property line.

Once the sanitary lateral has been placed, a record of its location must be produced for the As-Constructed drawings and provided digitally to the County.

Pipes are to be located on these drawings by showing proper plan view locations which include any bends and sweeps between the tee and the R.O.W. tie-in or stub. Also required on the drawing is the pipe invert elevation at property line.

7.3.9 Field Testing

7.3.9.1 General

Field testing described in this section shall be conducted as per OPSS.MUNI 409, and OPSS.MUNI 410 for gravity sanitary sewers. All testing shall be performed in the presence of the County or the County of Oxford's service provider.

For sanitary sewers in new developments leakage and deflection testing is required. In areas of reconstruction only deflection testing is required.

7.3.9.2 Cleaning and Flushing Services

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 maintenance hole structures shall be inspected by **County of Oxford Public Works**. Once the affected areas have been identified, the Contractor shall clean, flush and video those sections as directed by **County of Oxford Public Works** at their own expense.

7.3.9.3 Leakage Testing

Leakage tests shall be performed as infiltration or exfiltration tests and as outlined in OPSS.MUNI 410.

Infiltration tests shall be conducted when the groundwater at the time of testing is 600mm or more above the crown of the pipe for the entire length of the test section.

Exfiltration tests shall be conducted when the groundwater level is lower than 600mm above the crown of the pipe or the highest point of the highest service connection included in the test section.

Testing shall be carried out on completed pipe sewers 1200mm in diameter and smaller. There shall be no visible leakage for pipe sewers larger than 1200mm in diameter.

Testing shall be carried out from maintenance hole to maintenance hole. Tests may be carried out prior to service connections being installed in the section being tested.

The construction of new mainline pipe sewers shall not proceed when three previously placed sections of the pipe sewer have not been tested or have been tested and are unsatisfactory.

All costs associated with any corrective action to repair deficiencies and additional testing to ensure compliance shall be the responsibility of the Contractor / Developer. Prior to final acceptance and assumption of infrastructure all performance reports and testing results shall be reviewed by **County of Oxford Public Works**.

7.3.9.4 Pressure Testing of Forcemain, Low Pressure Sewers, and Gravity Sewers

Pressure testing of forcemain and low-pressure sewer shall be done at two times the design system pressure to a maximum of 827 kPa (120 psi) or as directed by **County of Oxford Public Works**.

The test section shall be subjected to the specified continuous test pressure for two (2) hours.

<u>All</u> sanitary sewers and related pipes that are deemed as significant drinking water threats (under the Clean Water Act) within Wellhead Protection Areas are to be pressure tested in accordance with Division 441 (formally 701) of the Ontario Provincial Standards Specifications (OPSS). The entire section of pipe from maintenance hole to maintenance hole shall be sealed and pressure tested at once, in accordance with OPSS.MUNI 441. Costs associated with the testing are the sole responsibility of the proponent.

7.3.9.5 Mandrel Deflection Testing of Sewer Pipe

Mandrel deflection testing shall be performed on all pipe sewers constructed using plastic pipe. The allowable deflection for pipes 100 to 750mm in diameter is 7.5% of the base inside diameter of the pipe. For pipes greater than 750mm in diameter, 5.0% of the base inside diameter is allowable. Base inside diameter is defined by the CSA or ASTM standard to which the pipe is manufactured.

A suitably designed device as defined by OPSS.MUNI 410 shall be pulled through the pipe sewer to demonstrate that the pipe deflection does not exceed the allowable deflected diameter. The device shall be pulled manually through the pipe not sooner than 30 days after the completion of backfilling and installation of service connections.

Any section of pipe that does not allow the mandrel to pass shall be considered to have failed the deflection test. All sections of pipe that fail the deflection test shall be repaired and retested.

7.3.9.6 Closed-Circuit Television (CCTV) Inspection

The Contractor shall undertake a video inspection after cleaning and flushing as per OPSS.MUNI 409 for all sewers upon completion of installation, as amended herein.

When performing a single service retrofit connection or sanitary sewer installation in a new development, the County requires the Contractor to conduct wastewater sewer lateral and/or sewer main CCTV Video Inspections. This must be carried out prior to assumption of the infrastructure and/or acceptance of the service connections. The work must be carried out by an Operator who holds a valid Certificate from the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). Provide a copy of the Operator’s certificate with all submissions.

Physical/Visual inspection must be completed on all work after construction to ensure any defects are rectified prior to the County's assumption. The Consultant's Inspector is responsible for the following:

- To bring the general site servicing drawing and/or the as recorded drawings to the inspection;
- To provide all labour and equipment to assist staff during the inspection;
- To ensure all structures have been pre-inspected and all imperfect work has been rectified by the Contractor, and;
- Failure to comply with any of the above will result in cancellation of the inspection and a charge back to the Developer

30 days prior to the completion of the 2-year maintenance period, the Contractor shall conduct a secondary video review of the sewers to ensure there are no defects in material or installation.

If any issues or deficiencies (such as cracks, breaks, blockages, sags etc.), are encountered with the sanitary sewer or lateral service connections within the public road allowance after final acceptance has been granted and within two years of the occupancy date, the County shall require that the Developer/Contractor rectify the matter immediately at the Developer/Contractor’s cost.

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 in USB format. Videos and reports are to be submitted directly to the County of Oxford Customer Service Department or the County of Oxford's service provider.

The following information shall be displayed on the title screen of all CCTV Videos:

- Contract Number
- Inspection Date & Time
- Asset ID
- Street Name (or address for service laterals)
- Sewer Use Type
- Start and Finish MH IDs
- Survey Direction (Upstream or Downstream)
- Pipe Material
- Pipe Diameter (Or dimensions for non-cylindrical pipe)
- Segment Length in metres
- CCTV Contractor & Operator Name

The following information shall be continuously displayed on screen for the duration of the video:

- Start and Finish MH IDs
- Distance from Start of inspection
- Defect coding at defects

Defect Coding shall be in accordance with NASSCO's PACP.

Each CCTV inspection shall be accompanied by an electronic PDF format inspection report generated from the sewer or watermain file. The inspection report shall identify all defects, including photographs. For reports on sewers installed by the Contractor the report shall also identify the Contractor's proposal for rectifying the defects, which will be completed at the Contractor's cost. The header of the report shall include the same information as requested for the title screen of the accompanying video, detailed above.

New and replacement sewers and related pipes that are deemed as significant drinking water threats (under the Clean Water Act) within Wellhead Protection Areas are required to establish operational procedures which include CCTV inspections every 5 years with records made available for inspection by the MECP. Costs associated with the testing are the sole responsibility of the Developer.

7.4 Septic Tank Effluent Pump (STEP) / Septic Tank Effluent Gravity (STEG) Systems

STEP/STEG systems shall be considered in areas in which conventional gravity sewers are not feasible or cost effective (permitted in Mount Elgin only). STEP systems must be designed in accordance with the more stringent of the most recent version of applicable codes and regulations, industry standards, and Oxford's standards. At minimum, the following design standards shall be referenced in the design:

- MECP Design Guidelines for Sewage Works, Chapter 22: Large Subsurface Sewage Disposal Systems
- The latest version of the Ontario Building Code.
- CSA B66:21 Design, material, and manufacturing requirements for prefabricated septic tanks and sewage holding tanks.

7.4.1 Tanks and Inlet Piping

Septic tanks shall be designed and manufactured in compliance with CSA B66:21 Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks. Septic tanks shall be watertight, resistant to corrosion and decay, and designed for all anticipated structural loads, including a minimum of 600 mm of earth cover. Where vehicle access is allowed, the tank shall be protected with appropriate structural slabs.

Tanks shall be equipped with an effluent screen to ensure the retention of collected solids and grease. Tank lids must be installed in a manner to prevent ponding of surface water and prevent I/I from entering the system. The tanks may require risers for this purpose. No more than 1.2 meters of cover above the tank is permitted to ensure that the tank remains accessible for access and maintenance.

Design of the STEP system shall account for areas of high groundwater. Design considerations shall be implemented to prevent tank flotation.

7.4.2 Pumps and Outlet Piping

Effluent pumps for the STEP system shall be submersible turbine pumps, appropriately sized for the head and flow requirements of the system. Conventional centrifugal pumps can be considered for low-head applications. All proposed pumps to be approved and supplied by Oxford County as per our Grinder Pump and Greywater Systems Policy.

Pressurized service lines from a STEP tank to the common collector sewer shall be minimum 25 mm diameter. A shutoff valve shall be installed in a tamperproof valve vault at the property line. In addition, a swing check valve shall be installed at the tank outlet.

7.5 Low Pressure Grinder Pump Station and Service Installation Requirements

Low pressure sanitary sewers will be considered where traditional gravity sewers are unable to service certain developments or lots. Areas that are not large enough to provide economic justification for gravity sewers, contain poor soil conditions, or topography that is not suitable for a gravity sewer, a low-pressure sewer system may be considered. This system will comprise of an outdoor on-site pumping unit for each individual property which outlets to a common forcemain or gravity sewer.

Oxford County does not guarantee basement drainage. All proposed pumps to be approved and supplied by Oxford County as per our Grinder Pump and Greywater Systems Policy.

7.5.1 System Layout

The preliminary layout of a proposed low pressure system should be approved by the **County of Oxford Public Works** before detailed design proceeds.

a) Preliminary Design

The following information is required for preliminary design submission:

- Site plans of the entire area to be served by the proposed system, including adjacent areas currently and potentially served by gravity sewers and community sewage pump stations.
- System flow rates and hydraulic profiles.
- Effluent requirements if discharged or infiltrated in the soil.
- Topographic plan.
- Report on soil conditions, including but limited to parameters such as soil permeability, absorption capacity, depth to water table, soil texture, percolation tests.
- Preliminary layout.
- Area development sequence and timetable.
- Pump unit power requirements.

b) Design Development

Basic data and design criteria for detailed system layout shall include the following:

- Location, elevation, and design flow for each pump unit
- Location and direction of flow of each lateral, branch, and main, plus details of the system discharge point. Layout of system to minimize length of runs, avoid abrupt changes in direction and avoid loops.
- Location and elevation of high points. Adjust pipe profiles where possible to avoid high points

7.5.2 Pipe Sizing

Minimum pipe sizes are as follows:

7.5.2.1 Main

The low pressure sewer shall be sized to have a flow velocity between 0.80 to 2.50 m/s with the lower limit preferred for the initial phase. Size of the low pressure sewer will be based on design flow requirements as well as number, and type of lots to be serviced. The minimum size of low pressure sewer is 50 mm diameter.

7.5.2.2 Services

For residential servicing from the grinder pump on private property to the low pressure sewer the service size shall be a minimum 32 mm diameter HDPE (DR 11) tubing size. Service valves with check valves will be placed on the property line. The minimum depth of cover shall be 1.80m.

For industrial, commercial, or institutional (ICI) servicing from the grinder pump on private property to the low pressure sewer, the service size shall be a minimum 32 mm HDPE (DR 11) tubing size, or as determined by ICI design flow rates. Service valves will be placed on the property line.

The minimum depth of cover shall be as per Detail 6.04 for Rigid Board Insulation – Slab Type from the County's Standard Drawings.

Services shall be installed as per **Figure 7.05**. Where the low pressure sanitary service connects to a gravity lateral at property line the connection will be as per **Figure 7.06** and **Figure 7.07**.

7.5.3 Tracer Wire

All low pressure sanitary sewers and services shall require tracer wire. Tracer wire material shall follow relevant standards for watermain and sanitary sewers provided elsewhere in these standards.

Tracer wire will be installed along the top of the pipe and bound at 6-metre intervals. The wire must be installed between each valve and/or the end of the sewer. At the ends of capped low pressure sewers, a minimum of 2 m of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connection. The end of the tracer wire shall be spliced to the wire of a 5.5 kg zinc anode and is to be buried at the same elevation as the sewer.

At service saddles, tracer wire is not allowed to be placed between the saddle and the sewer. Joints in the wire shall only occur at ends of rolls, services or repairs with approved splicing connectors.

Verification of conductivity of the tracer wire shall be performed upon completion of rough grading and prior to placement of base coat asphalt on all streets before substantial completion of the project. An additional locate shall be performed prior to expiration of the warranty period before final acceptance.

A locate or conductivity test with the new tracer wire shall be performed by the contractor and completed in the presence of a licensed water operator from the County of Oxford's service provider. The tracer wire shall be installed in such a manner as to be able to trace all components without loss or deterioration of signal or without the signal migrating off the tracer wire. This test shall be conducted using the industry standard low frequency (512 Hz) line tracing equipment. If it is not continuous from valve to valve, the contractor shall at his own expense replace or repair the wire. If a dispute arises as to the ability to trace all components, an independent 3rd party may be required to resolve the dispute and will be done at the contractor's expense. Continuity testing in lieu of actual line tracing shall not be accepted.

7.5.4 Grinder Pumps

Pumps shall be Simplex (single pump) for single family residential applications. Pumps for multi-family units, industrial, commercial, or institutional applications may require Duplex (two pumps) depending on estimated design flow requirements.

Pumps shall be located on private property outside the main building in a location convenient for maintenance.

Grinder pump requirements are as follows:

7.5.4.1 Residential

For residential applications, the grinder pump holding tank shall have a minimum capacity of 265L and accommodate minimum flows of 2,650 L/d.

The pump shall have a minimum 0.75 kilowatt, 1,725 rpm, high torque, capacitor start, thermally protected, 240- or 120-volt, 60 hertz, 1 phase. The inlet shall be sized to accommodate a 100mm diameter pipe. The discharge shall be sized to accommodate a 32mm diameter pipe.

Acceptable pumps are DH071 as manufactured by E/One or approved equivalent.

7.5.4.2 Industrial, Commercial, or Institutional

For Industrial, Commercial, or Institutional applications the size of the grinder pump and grinder pump holding tank will be based on estimated design flow requirements.

For light ICI applications the grinder pump holding tank shall have a minimum capacity of 570 L and accommodate flows of a minimum 11,360 L/d. The pump shall have a minimum 0.75 kilowatt, 1725 rpm, high torque, capacitor start, thermally protected, 240- or 120-volt, 60 hertz, single phase. The inlet shall be sized to accommodate a 100mm diameter pipe. The discharge shall be sized to accommodate 32mm diameter pipe.

Acceptable pumps are DH152 as manufactured by E/One or approved equal.

7.5.5 Valves

Valves shall be located at all intersections. At cross intersections, a minimum of three (3) valves shall be installed and a minimum of two (2) valves shall be installed at tee intersections. Depending on location of other utilities, and where possible, the valve locations shall be on the extension of the street line.

At each valve, the tracer wire must be brought up outside the valve box to the top of the box and inside the box through a drilled hole. Tracer wire to be installed as per **Detail 6.17**.

Prior to acceptance of the completed work the contractor shall perform a locate or conductivity test with the new tracer wire. The inspector shall be present when the tracing wire is tested.

If it is not continuous from valve to valve, the contractor shall at his own expense replace or repair the wire.

In residential areas valve spacing shall not exceed 250 m apart. In high density residential, commercial, or industrial areas valve spacing shall not exceed 150 m apart. Valves shall be placed in such a manner that no more than sixty (60) services will be isolated by operating no more than four (4) valves.

7.6 Sanitary Sewage Pumping Stations

A design brief shall be provided for the design of all sanitary sewage pumping stations to document design decisions including any deviation from this standard. The following standards shall be used in the design of sanitary sewage pumping stations.

Refer to **Section 8** for further facilities design guidelines.

7.6.1 External Standards and Guidelines

Sewage pumping stations shall be designed in accordance with the most recent version of applicable codes and regulations, industry standards, and Oxford's standards, or as approved by Oxford County. At minimum, the following design standards shall be referenced in the design:

- MECP Design Guidelines for Sewage Works
- MECP Environmental Noise Guideline - Stationery and Transportation Sources -Approval and Planning (NPC-300 shall apply to all sewage pumping stations)
- Oxford County's CLI ECA
- Ministry's Standard Operating Policy for Sewage Works
- National Fire Protection Association (NFPA 820)
- Hydraulic Institute Standards (Various)
- Canadian Standards Association (CSA) B139 - Installation Code for Oil Burning Equipment: as adopted by the Technical Standards and Safety Authority (TSSA)
- Ontario Provincial Standards Specifications (OPSS) and Drawings (OPSD)
- CSA Z462 – Workplace Electrical Safety (Arc Flash Assessment requirements)
- Occupational Health and Safety Act
- Ontario Electrical Safety Code
- O. Reg. 833, 1990 Control or Exposure to Biological or Chemical Agents

7.6.2 Sewage Pumping Station Design Summary

The station capacity shall be at minimum equal to the anticipated peak flow to the station under a five-year storm event, not including the use of standby pumps.

Sewage pumping stations within Oxford County have different requirements depending on their capacity. These requirements are summarized in the table below.

Table 7-7: Sewage Pumping Station Requirements

Type	Rated Capacity	Pumps	Wet Well Cells	Valve Chamber	No. of Forcemains
I	Up to 25 L/s	Two submersible wet well pumps (one standby plus one shelf spare)	Single wet well and upstream bypass maintenance hole	Separate below-grade structure (confined space with ladder access)	One, sized for rated capacity
II	25 L/s to 100 L/s	Three submersible wet well pumps (one or two standby)	Single wet well and upstream bypass maintenance hole	Separate below-grade structure (confined space with ladder access)	One, sized for rated capacity
III	100 L/s to 250 L/s	Three to four submersible wet well pumps (at least one standby)	Dual wet well	Separate below-grade structure with access house (stairway access, non-confined space)	Two, each sized for rated capacity
IV	Greater than 250 L/s	Four or greater dry well submersible pumps (at least one standby)	Dual wet well plus dry well	Valve room in building (stairway access, non-confined space)	Two, each sized for rated capacity

7.6.3 Site Layout

Perimeter fencing shall be 1.8 m high chainlink security fencing as per OPSD 972.130 and OPSD 972.132. Secure and lockable gates shall be provided at all access points.

Exposed surfaces such as access hatches, doors, etc. shall be designed to be vandal resistant and prevent unauthorized entry. Ensure that all ventilation louvers to the pumping station are properly secured to prevent entry of foreign material including outside debris and rodents. All hatches to be lockable with padlocks provided by Oxford County.

An asphalt driveway large enough for a large Vacuum Truck (approx. 12,000 L to 18,000 L) shall be provided. Provide a minimum of two (2) parking spaces for Type I and II stations and a minimum of four (4) parking spaces for Type III and IV stations.

The exterior of the facility shall be provided with LED lighting system and lamps suitable for horizontal, base up or base down operation. Lights shall be automatically turned on or off by motion sensors or light sensors and shall be capable of being manually turned on or off from a designated central location.

The site layout shall accommodate space and location of a standby generator, as well as the required asphalt driveway for delivery of the generator fuel.

Locate the pumping station entrance floor level and all access hatches at least 300mm above the Conservation Authority flood line and 100-year flood elevation, whichever is higher. The design of grading and stormwater management shall allow the sewage pumping station site to be fully accessible by vehicular traffic during a 25-year flood event.

Water service shall be provided to all sewage pumping stations.

Refer to **Section 8.6** of the facilities design guidelines for further site security requirements.

7.6.4 Yard Piping

Yard piping includes all watermain, sewer, forcemain and storm sewer outside the station to the property line. Yard piping shall comply with the relevant standards for watermain and sanitary sewers provided elsewhere in these standards.

For buried pressure pipe size 100 mm and larger, tandem flexible restrained pipe joints shall be provided outside of structures to allow for potential differential settlement.

Ensure yard piping has sufficient cover to protect against frost damage. Where this is not possible, insulation shall be provided.

Tracer wire should be provided on all non-metallic buried piping.

Where ferrous materials are used for the yard piping, including fittings, valves, and couplings, corrosion protection shall be provided.

7.6.5 Building Design

7.6.5.1 Building Classification

All buildings shall be designed in compliance with OBC (latest revision) and Canadian Standards Association (CSA) design standards for concrete, masonry blocks and steel. All buildings shall be designed as Post Disaster.

Dry wells and Type III Pumping Station Valve chambers shall be designed for continuous human occupancy. Provide at least two (2) means of access/egress to these spaces. Main access shall be by stairs and secondary access/egress can be via ladder.

7.6.5.2 General Requirements

A control building with a pitched steel roof should be provided for Type II, III, and IV pumping stations. If no control building is provided, install a double door enclosure with rain guard, interior

SS door panel and min 200 mm base support brackets (or approved equivalent panel). Heater and UPS are required for the inside panel. Panel sizing to accommodate all SPS controls, SCADA, and ancillary devices

The following guidelines along with those listed in **Section 8** shall be followed in designing the facility:

- The exterior materials and finishes shall be designed maintenance free.
- The building shall be insulated and complete with vapour barriers.
- For above grade structures, utilize steel reinforced concrete masonry block wall systems or combined with face brick systems or pre-cast insulated concrete wall panels. Refer to **Section 8.3.3** for thermal resistance requirements.
- Do not use exposed wood or gypsum boards on any interior walls or ceiling finishes.
- Interior walls shall have waterproof antimicrobial painted finish.
- All exterior wall surfaces including entrance doors and louvers shall be coated with an anti-graffiti clear coat.
- All floors shall be finished with a slip-resistant surface.
- Provide a sloped metal shingle roof equipped with snow guards. Roofs shall be designed to drain rainwater away from entrances.
- Water from eavestroughs and downspouts shall be discharged to a vegetated area. Discharges shall be designed to prevent ice formation on commonly utilized walking or driving areas
- Exterior doors shall be insulated hollow metal and equipped with a touch-bar panic exit device, three sets of heavy-duty hinges, heavy-duty closer mechanism, head and jamb seals, door sweep, threshold, and a kick plate. All door hardware shall be stainless steel.
- Main door electronic locking mechanism compatible with Oxford County security system.
- Interior doors shall be hollow metal and equipped with a window panel, a touch-bar panic exit device, three sets of heavy-duty hinges, heavy-duty closer mechanism, head and jamb seals, and a kick plate. Interior doors leading to the generator room shall be insulated for noise attenuation. All door hardware shall be stainless steel. Ensure that doors are sized to allow for the removal of the largest piece of equipment in each room unless other means of removal are provided (i.e., removable panels, slabs, or access hatches).
- Provide heavy-duty roll-up doors or double doors where practical to allow room for equipment delivery and removal. All roll-up doors shall be electrically powered unless they are located in classified (explosion proof) areas where manual operation is acceptable. A personnel entry door shall be provided near each roll-up door.
- Washrooms are mandatory at all Type III and IV pumping stations, as well as at pumping stations in remote areas. A hot water heater and wash sink shall be provided at all pumping stations.
- All facilities shall be equipped with a permanent eye-wash station supplied with tempered water in accordance with the latest editions of ANSI Z358.1.
- A security/alarm system specified by Oxford County shall be provided for all Type I and II pumping stations.
- A security/alarm system complete with access control specified by Oxford County shall be provided for all Type III and IV pumping stations.

7.6.6 Below-Grade Structures

All buried structures shall be designed as water retaining structures with zero leakage. Watertight lids should be provided for any structures vulnerable to flooding or within an overland flow route.

A leakage test shall be completed prior to backfilling and waterproofing installation. Leaking cracks and joints shall be repaired to achieve a fully watertight structure. Visual leakage tests are acceptable for all non-water retaining structures.

All buried structures shall be designed to withstand hydrostatic and buoyancy uplift forces assuming groundwater elevations are to the surface or maximum flood elevation, whichever is greater.

A protective concrete coating or concrete additive shall be applied to all interior concrete surfaces to enhance the concrete durability and provide additional corrosion protection as approved by Oxford County.

Interior hatches shall be flush with the floor surface. Exterior hatches shall be raised above finished grade. Exterior hatch covers shall be insulated.

Access hatches shall be equipped with EME Davit Crane Posts (Flygt or approved equivalent). Access hatches shall be equipped with interior gratings.

Maintenance holes shall be epoxy coated or complete with concrete additive to reduce H2S impacts.

7.6.7 Grinders

All Type II, III, and IV pumping stations require accommodation for an electrically driven influent grinder capable of handling the peak inlet flow to the pumping station without sewer surcharge. The need for grinders for all stations shall be evaluated on a case-by-case basis with input from Operation Staff.

Electric motors shall be explosion proof and suitably classified for the installation environment in accordance with the NFPA 820 and the Electrical Code. Motors shall be rated for 575V /3-phase / 60 hz power with a 1.15 service factor. Motors shall be designed for full time in-air operation with periodic submergence up to 12 m of head for a maximum period of 40 days. Motors shall be rated NEMA 6P (IP68) CSA certified.

The grinder shall be equipped with a lifting bail made of Type 316L stainless steel, to allow for removal or installation of the grinder without entry from operations staff. The stainless-steel lifting bail shall be able to accommodate a stainless steel lift out chain of sufficient length to clear the grinder access hatch elevation by a minimum of 1.5 m. An access hatch shall be provided above the channel frame and guide rail system suitable for installation and removal of the grinder.

The grinder's local control panel shall be CSA approved. The grinder local control panel shall be located inside the building in a non-classified area. The panel enclosure shall be wall-mount with the proper NEMA rating to suit the operating environment. The control panel shall consist of a relay-logic type without a programmable logic controller (PLC) control. Include a main circuit breaker with disconnect handle, full voltage reversing type starters, current sensor, timer counters, a transformer rated for 600/120 VAC, 250VA, pilot lights, pushbuttons, selector switches, and an E-Stop for status indication and local control.

7.6.8 Wet Well

Wet wells shall be sized for a minimum cycle time of 10 minutes for each pump. The system shall be designed for a maximum of ten (10) pump starts per hour. Refer to Section 7.2.7 of the MECP Design Guidelines for Sewage Works for additional information.

Wet wells shall be designed to avoid excessive turbulence, and excessive pre-swirl into the pump. Flow distribution at the pump intake shall be even and balanced. Avoid conditions that favour development of flow vortices. The design should reduce the potential for entrained air into the pump suction. Avoid sedimentation of solids that may impact pump performance and increase wet well maintenance requirements.

Provide benching to limit solids build-up in the wet-well and to achieve a self-cleaning system on manual pump down. Where possible, provide benching at 60 degrees or greater around the pump suctions.

For submersible wet well pump installations, the flow path between the sump entrance and the pump inlets must be long enough for entrained air to rise to the surface and escape before reaching the pumps.

Sufficiently dissipate the energy of falling water to keep high and irregular velocities from occurring within the sump. Minimize the release of odorous and corrosive compounds within the wet well through design features such as wet well geometry and hydraulics, and ventilation. Sewage free fall within the wet well shall not exceed 1.05 m from inlet sewer invert elevation to the Duty 1 Pump start elevation.

Where required, utilize inlet sump baffle wall system and slots in the floor of the baffle to direct the flow evenly toward the pump inlets.

Provide a permanent standpipe cleanout to facilitate vacuum cleaning for all wet wells deeper than 5.0 m.

Provide safe access to the floor of the wet well by ladder. The ladder shall be located to offer access directly to the base of the wet well. Provide steps in the benching as required.

A knife gate valve and swingflex check valve shall be provided on the pump riser for each pump in Type I wet well stations. A catwalk should be provided within the wet well to work on these valves.

At minimum, natural ventilation of wet wells shall be provided. Permanent supply air mechanical ventilation shall be provided for all Type III and IV wet wells. For Type I and II stations, make provisions for a portable ventilator fan and portable flexible ductwork that can adequately ventilate the wet well for confined space entry. Ensure the temporary installation of the portable duct work does not interfere with personnel access or equipment removals. The electrical supply outlet for the fan should be located nearby in a non-classified area. Fans, ductwork, and associated equipment shall be fabricated from non-sparking corrosion resistant material such as Type 316L SS or FRP.

The wet well light switch shall activate the wet well fan and be accessible without entering the wet well.

Type IV sewage pumping station wet well designs shall be supported with computational fluid dynamics (CFD) analysis to confirm uniform flow and velocity toward the pump intakes in accordance with the ANSI/HI 9.8 design criteria.

Wet wells shall be epoxy coated or complete with concrete additive to reduce H2S impacts.

7.6.9 Dry Well

Dry wells shall be completely separated from wet wells with gas tight common walls, and independent ventilation systems. The dry well shall be separated from electrical rooms and generator rooms and meet the fire separation requirements outlined in the OBC.

Pumping functionality must be maintained under flooded dry well conditions. Emergency stops, local disconnects, junction boxes, start/stop push buttons, and other instruments or equipment that is not submergence rated shall be located above the maximum wet well surcharge elevation.

A duplex sump pump shall be provided, complete with piping that discharges to a wet well inlet chamber.

Provide stair access to the dry well and a second ladder exit as a minimum.

Dry wells shall be designed for continuous human occupancy.

7.6.10 Pumps

Pump selection and station design shall be based on the system-head calculations and friction curves specified within the MECP Design Guidelines for Sewage Works. Pump selection should ensure the station can deliver the peak influent flow rate under normal wet well operating levels, using a forcemain friction factor of C=100 and without using standby pumps.

Pumps shall be optimized to achieve the highest efficiencies at average flow rates. Selection of pumps should take into consideration the full range of anticipated flows (high and low flow rates) within the planning horizon. Pumps shall be capable of operation under both maximum (low wet well level) and minimum (overflow wet well surcharge level) system-head curve conditions without overloading the motor and must remain within the Allowable Operating Region (AOR) of the pump.

All pumps shall be fully submersible, non-clog sewage design, with suction and discharge openings a minimum of 100mm and, pump body shall be protected by a factory applied sewage resistant coating.

Suction lift, and screw pumps are not permitted. Grinder pumps shall be permitted in Type I stations only (if required).

Pump and motor assemblies shall have CSA approval as one unit, per CSA standard C22.2-108.

Ensure the pump cycle working volume is sufficient to accommodate a maximum of six pump starts per hour unless the motor size requires a fewer number of starts per hour.

All pumps to be provide with timeclocks and pump sensors monitor (Flygt MiniCas or equivalent)

Submersible pumps shall be Flygt, Gorman Rupp, or an approved equal. The Gorman Rupp pump piping package is not typically permitted.

7.6.11 Valves

Stainless-steel slide gate valves per AWWA C561 shall be used for influent maintenance hole and wet well isolation applications. Slide gates must be capable of withstanding hydrostatic forces at the maximum water level that may potentially be encountered (i.e. during overflow conditions) with 40% of the allowable leakage specified in AWWA C561. The slide gate gear must also be located above the normal water level as to not submerge the gear under normal conditions. Factory test all four-sided slide gate valves as per AWWA C651. Provide access above slide gates for removal and installation.

Air release, air vacuum, or combination air valves shall be AWWA C512 fusion bonded epoxy inside and out. For Type III and IV stations, all air valve selections shall be confirmed with a detailed transient analysis.

All check valves shall be AWWA C508 fusion bonded epoxy coated inside and out, swing flex type, non-slam with rubber flapper complete with stainless steel hardware and backflow actuator. Avoid check valve cavitation by making sure the check valve is placed at an elevation not greater than 8.0 m above the pump discharge.

For valves under 450 mm in size, plug valves are preferred over knife gate valves. Plug valves shall be AWWA C517 fusion bonded epoxy coated inside and out. Knife gate valves shall be AWWA C520 fully stainless steel.

All forcemain valves should be installed within a chamber. Do not direct bury valves. Valves shall be located on the outside edge of the chamber to prevent backflow when working on the internal piping.

Gate valves are not acceptable on wastewater piping.

Provide a fully restrained flexible dismantling coupling and spool piece adjacent to all non-buried valves.

All valves within chambers shall be flanged construction. Wafer and lug style valves are not permitted.

For confined spaces, valve operators shall consist of a combination of hand wheel and extension stem such that they can be operated from the surface. The use of angled valve stems or valve stem with off-set swivel joints should be avoided as much as possible.

All valves in maintenance holes, wet wells and exterior valve chambers must be accessible for operation with a truck mounted motorized valve turner.

For non-confined spaces, ensure valves are accessible for operation staff for manual operation from floor level or platform access. Chain wheel operation is not permitted.

7.6.12 Process Piping

All non-buried process piping and hardware shall be Schedule 10 type 316L stainless steel. Process pipe size shall be a minimum of 100 mm (50 mm for Type I stations). Joints shall be Victaulic or approved equivalent.

In all interior locations, all process piping shall be equipped with a flange connection at a maximum distance of 300 mm prior to all wall or floor penetrations. All process piping wall penetrations shall be cast-in-place complete with embedded thrust flange.

Vertical pump discharge risers in wet wells and dry pits shall be designed for a velocity between 1.5 and 2.5 m/s. Adequate scouring velocities should be selected to effectively mobilize heavy solids and grit.

Process piping and fittings shall also be designed for maximum transient pressures or minimum 1,034 kPa (150 psi) as well as full vacuum, thrust restraint, and thermal expansion / contraction. Pressure test piping to a minimum of 1,034 kPa (150 psi) for two (2) hours with zero visible leakage.

Provide a bypass connection to allow for the following:

- Pumping from the wet well through the discharge header to a tanker truck (bypassing the forcemain).
- Portable pumping from the inlet bypass maintenance hole to the forcemain (bypassing the wet well and pumps).
- Bypass piping to have the ability to launch swabs.

7.6.13 Forecemains

At design pumping rates, a minimum cleansing velocity of at least 0.9 m/s shall be maintained. The maximum flow velocity shall be 3.0 m/s. The diameter for raw wastewater forcemain shall not be less than 100 mm.

Forcemains shall have a minimum cover of 1.8m. Forcemains should be designed to have positive grade, and negative discharge points to be minimized (where possible).

Air relief valves shall be installed at all high points in the forcemain to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on forcemains. The forcemain configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves.

Forcemain design shall include transient analysis and consider the provision of water hammer relief for Type II, III, and IV stations.

Forcemains should enter the gravity sewer system at a point not more than 200 mm and not less than 100 mm above the benching of the receiving maintenance hole. Each forcemain outlet shall be equipped with a removable fibergrate cover to facilitate forcemain cleaning through swabbing.

Pipe and joints shall be equal to water main strength materials suitable for design conditions. The forcemain, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. The need for surge protection chambers shall be evaluated. Forcemain pipe materials shall be Polyvinyl Chloride (PVC) or High-Density Polyethylene (HDPE).

Friction losses through forcemains shall be based on the Hazen Williams formula or other acceptable methods, including the Darcy-Weisbach equation and the Manning forumula. When the Hazen Williams formula is used, the following value for "C" shall be used regardless of pipe material:

Table 7-8 Hazen Williams Roughness Factor

Pipe Diameter (mm)	Hazen Williams Roughness Factor
Up to and including 150mm	100
Greater than 150mm, up to and including 250mm	110
Greater than 250mm, up to and including 600mm	120
Greater than 600mm	130

When initially installed, forcemains may have a significantly higher "C" factor. The forcemain shall be appropriately identified when they are constructed of material that may cause the forcemain to be confused with potable water mains.

Forcemains shall be tested to ensure there is no leakage. Specify method of testing and obtain prior approval from **County of Oxford Public Works**.

Tracer wire is required on all forcemains. Refer to **Section 7.3** for additional requirements.

7.6.13.1 Thrust Restraint

Mechanical thrust restraint is required in areas of Engineered fill. In areas of Engineered fill an additional restrained length of pipe shall apply to the requirements listed below.

Prior to construction all thrust restraint design shall be submitted to the **County of Oxford Public Works** for review. The results should be shown on the contract drawings along with the type of restraint to be used.

The following are minimum requirements with respect to thrust restraint:

- All fittings, bends, tees, hydrant tees, valves, crosses, reducers up to 200 mm shall be restrained to the pipe along with a minimum of three (3) full pipe length joints (18 m) measured from each side of appurtenance.
- All 250 to 300 mm fittings, bends, tees, hydrant tees, valves, crosses, reducers shall be restrained to the pipe along with a minimum of four (4) full pipe length joints (24 m) measured from each side of appurtenance.
- Plugged or capped dead ends up to 200 mm shall be restrained to the pipe along with a minimum of four (4) full pipe length joints (24 m) measured from the end of pipe.
- All 250 to 300 mm plugged or capped dead ends shall be restrained to the pipe along with a minimum of six (6) full pipe length joints (30 m) measured from the end of pipe.
- All piping larger than 300 to 400 mm plugged or capped dead ends shall be restrained to the pipe along with a minimum of six (6) full pipe length joints (30 m) measured from the end of pipe.

In addition to manufacturer's specifications and where possible full lengths of pipe shall be placed each way from all fittings to the lengths listed above. Any joints encountered in the restrained lengths listed above from fittings, bends, tees, hydrant tees, valves, hydrants, crosses, reducers and plugged or capped ends shall be restrained.

Where fittings, bends, tees, hydrant tees, valves, crosses, or reducers are connected or adjacent to existing infrastructure, joints on the existing system shall also be restrained to the lengths listed above.

Pipe larger than 400mm shall be restrained as per the restraint manufacturer's recommendations. Shop Drawings submitted by the pipe manufacturer shall include:

- Letter of Compliance
- Pipe design calculations
- Summary of fittings and method of restraint
- Installation Guide
- Tabulated Layout Drawings indicating restrained lengths for fittings and valves stamped and signed by a Professional Engineer licensed to practice Engineering in the Province of Ontario

On vertical offsets due to conflicting utilities such as sewers, the pipe shall be backfilled before the watermain is pressurized. **County of Oxford Public Works** reserves the right to specify the use of mechanical restraint and/or concrete thrust blocks.

7.6.13.2 Valves

Valves on forcemains in rural areas shall be located at all road crossings or at the discretion of **County of Oxford Public Works**.

7.6.13.3 Cathodic Protection

All flanged surfaces, nuts, bolts, tie rods, clamps, valves, sleeves, Victaulic couplings, joint restraints, etc., shall be protected using petrolatum materials. Refer to **Section 7.3** for additional requirements.

The size and type of anodes shall be determined through the Geotechnical report. Anode locations shall be clearly shown on the Construction and as-built drawings. In addition, a tabular listing of the stations at which the anodes are to be installed shall be provided.

Sacrificial anodes shall be installed at all valves, ductile iron, cast iron pipe and fittings, and joint restraints. At the ends of forcemain the tracer wire shall be spliced to the wire of a 5.5 kg zinc anode and is to be buried at the same elevation as the forcemain.

Valves or appurtenances that are epoxy coated do not require this procedure.

7.6.14 Emergency and Maintenance Storage

Emergency and maintenance storage shall be provided as detailed in the table below.

Table 7-9: Emergency and Maintenance Storage

Station Type	Storage Capacity at Rated Capacity
Type I	2 hours
Type II	2 hours
Type III	2 hours (minimum 1 hour on site)
Type IV	2 hours (minimum 1 hour on site)

Emergency storage can be provided by overflow pond, large diameter concrete pressure pipe, leak tested in-ground reinforced concrete chambers, upstream trunk sewers, and upstream emergency and maintenance storage.

7.6.15 Overflow

An overflow shall be provided at elevation before any finished basement floor backups. Overflows should have isolation valve and check valve complete with paddle flow switch alarm (bi-directional). The overflow elevation shall be confirmed by **Oxford County Public Works.**

7.6.16 Odour Control

Odour control studies shall be undertaken where new sewage pumping stations are being constructed within 50 m of sensitive receptors including but not limited to residential or commercial areas, parks, and schools.

Consideration shall be given to providing a permanent odour control system on a case-by-case basis, based on the results of the odour control study. Acceptable odour control systems include: biofilters, biotrickling filters, ozone systems and activated carbon systems, chemical injection systems, coagulant (ferric chloride) utilization, application of oxidizers (H202, nitrate) or a combination of these technologies, selected based on the expected or measured odorant loading and required ventilation rate. Activated carbon systems shall be equipped with a mist eliminator and grease filter. Biofilters and biotrickling filters shall be provided with a service water connection and a drain connection back to the sanitary sewer or wet well.

Wet well headspace shall be actively ventilated, treated continuously, and kept under marginal negative pressure to prevent fugitive emissions for Type III and IV stations.

All Type III and IV stations shall be designed to accommodate future odour control equipment.

7.6.17 Mechanical Requirements

7.6.17.1 General Requirements

Mechanical systems shall be robust, easily maintainable, and appropriately designed for operating conditions in which they are located. Mechanical equipment shall comply with the OBC, CEC, and MECP Design Guidelines for Sewage Works, with provisions for safe maintenance and energy efficiency.

7.6.17.2 Heating and Cooling

Areas periodically occupied by operations staff, including Type IV dry wells, Type III valve chambers, generator rooms, and all electrical and control rooms should have heating designed for an ambient temperature of 20 °C.

Refer to **Section 8.4** of the facilities guidelines for further requirements.

7.6.17.3 Ventilation

As a minimum, all wet wells and emergency and maintenance wastewater storage structures shall be equipped with a passive ventilation system to permit rising and falling liquid levels.

Portable mechanical ventilation equipment (fan and hose) is required for Type I and II stations. Permanent mechanical ventilation equipment is required for wet wells, dry wells, and valve chambers on a case-by-case basis. The ventilation system for process areas shall be designed in accordance with NFPA 820.

Refer to **Section 8.4.6** of the facilities guidelines for further requirements.

7.6.18 Water Service

A potable water service line shall be provided to all facilities. The minimum water service size shall be 50mm. Backflow prevention is required in accordance with **Section 6.2.14** of the Design Guidelines.

Refer to **Section 8.13** for further requirements.

7.6.19 Electrical

600 V MCC and motor starter panels should be separated from low voltage control panels (120 VAC or less).

The preferred electrical service entrance power supply shall be 600 volt, three phases.

An Automatic Transfer Switch (ATS) shall be provided for all facilities with standby power generators.

MCCs and all components shall be designed, manufactured, and tested in accordance with NEMA standards.

Unless otherwise specifically noted, all electric motors shall be high efficiency, explosion-proof motors. All electric motors including and over 0.50 hp must be 575 V, three phases, 60 hz (Type II, III, and IV stations)

All electrical control equipment must be located outside of process, chemical, or other hazardous areas whenever possible. The electrical design should reduce the operator risk of arc flash hazards by reducing or eliminating the need to be near high voltage electrical equipment during normal operations. Cabinets and panels can be sized to permit safe maintenance work.

Provide addressable heat and smoke detectors monitored by a vendor-specific fire alarm system when required by the NBCC.

Refer to **Section 8.11** for further requirements.

7.6.20 Standby Power

Permanent standby backup power systems shall be provided for all stations where flows are in excess of 10 L/s and must meet the full load capacity of the facility. Portable generators are not acceptable.

Backup power systems shall consist of a closed loop liquid-cooled generator within a self-contained, lockable, sound-attenuating outdoor enclosure.

Where outdoor generators are not acceptable due to neighbourhood aesthetic concerns, install standby power generator within a building. Only Type I facilities can have generators located within the electrical and control room. Otherwise, all other generators must be located in a dedicated room within a building.

Site-specific noise and emission attenuation measures shall be provided to minimize impact to neighbouring communities, comply with local noise By-Laws, and meet the requirements of NPC-300.

All generators shall be designed to use natural gas or diesel where natural gas is not available. Fuel tanks should be sized based on 36 hours of operation at the facility's firm capacity plus ancillary loads starting from a 95% full tank. Fuel tanks should include a fuel level-indicating transmitter, low fuel float switch, and an interstitial space alarm switch (where applicable). All instruments shall be installed and monitored by SCADA. An approved sight gauge shall also be provided. Either an electronic overfill or a mechanical overfill prevention device shall be installed and a vent whistle shall be provided on each common vent pipe.

The generator shall be provided with an onboard control system compatible with the automatic transfer switch (ATS) and designed to provide automatic starting, monitoring, protection and control functions.

Refer to **Section 8.11.7 Life, Safety, Emergency, and Security Systems** within the Facilities Design Guidelines for further requirements.

7.6.21 Instrumentation and Control

When selecting instruments and devices, review process operating conditions to determine the most suitable instrument technology. All instruments should be installed in locations that are safe for workers and easily accessible. Instruments shall be suitable for their intended service, easily serviceable, and calibrated.

At minimum, the instruments noted in the table below shall be included for sewage pumping stations.

Table 7-10: Instruments Included in Sewage Pump Stations

Instrument Type	Application
Level Transmitter	• Wet well level • Emergency and maintenance storage level monitoring • Diesel fuel tank level monitoring
Float	• Flood/high level monitoring • Pump backup control • Overflow monitoring (to emergency storage or environment)
Smoke, Carbon Monoxide, and Heat Detectors	• Building condition monitoring
Temperature Transmitter	• Building and PLC panel temperature monitoring
Flow	• Forcemain flow monitoring (where flows are in excess of 25 L/s) • Station inlet flow monitoring • Overflow monitoring
Pressure Transmitter	• Forcemain pressure monitoring • Pump discharge pressure for Type II and III stations • Pump discharge and suction pressure monitoring for Type IV stations • Incoming natural gas line pressure
Hazardous Gas Detection Sensors (H2S, CH4)	• Dry wells, Type III valve chambers, and building rooms that are connected atmospherically to a classified space. • Detectors will monitor for combustible gas detection with an alarm set for 10% of the lower explosive limit (LEL).

All hardware and equipment is to conform to the most recent version of the County's SCADA Standards and be approved by **Oxford County Public Works.**

See **Section 8.11** for further requirements.

RESIDENTIAL POPULATION DENSITIES

A. HECTARE BASIS
THE FOLLOWING POPULATION ALLOWANCE APPLY WHEN DESIGNING SANITARY SEWERS
LOW DENISTY (SINGLE FAMILY/SEMI-DETACHED) =30 UNITS/HECTARE @ 3 PEPOLE/UNIT
MEDIUM DENISTY (TOWNHOUSE/ROWHOUSE) =75 UNITS/HECTARE @ 2.4 PEOPLE/UNIT
HIGH DENSITY (APARTMENTS) =150-300 UNIT/HECTARE @ 1.6 PEOPLE/UNIT

B. LOT BASIS
SINGLE FAMILY =3 PEOPLE
DUPLEX/DEMI =6 PEOPLE

SANITARY SEWER DESIGN SHEET
OXFORD COUNTY

DESIGN CRITERA
SEWAGE=250 LITRES/CAPITA/DAY
INFILTRATION=8640 LITRES/HECTARE/DAY
PEAKING FACTOR: $M = 1 + \frac{14}{4+P*0.5}$

DATE: ____________________

DESIGNED BY: ____________________

PROJECT NAME: ____

PROJECT FOLE No: ____________________

LOCATION				AREA			POPULATION					SEWAGE FLOWS			SEWER DESIGN					PROFILE						
AREA No.	STREET	FROM MANHOLE	TO MANHOLE	NET OR GROSS	DELTA HECTARES	TOTAL HECTARES	PER HECTARE	PER LOT	No OF LOTS	DELTA POP.	TOTAL POP.	INFILT L/S	SEWAGE L/S	TOTAL L/S	n	PIPE SIZE (mm)	SLOPE %	CAP L/S	VELOCITY m/s	LENGTH M	FALL IN SEWER	HEADLOSS	DROP IN MANHOLE	INVERT ELEVATIONS U.S.	INVERT ELEVATIONS D.S.	PEAKING FACTOR

OXFORD COUNTY STANDARD DRAWING

SANITARY SEWER DESIGN SHEET

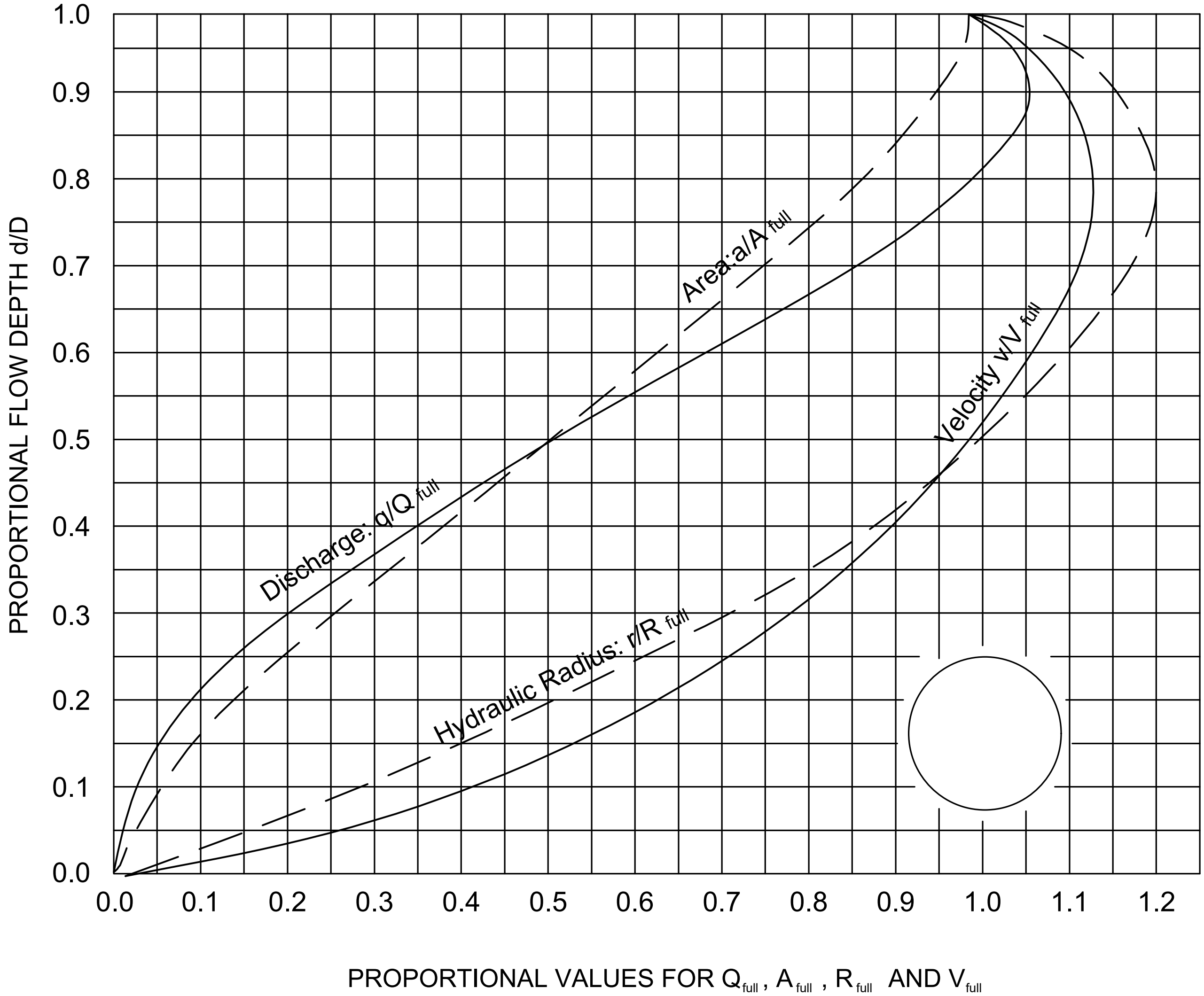
REV#: 1

09/2025

Oxford County
Growing stronger together

FIG. 7.01

PREVIOUSLY: FIG. 4.1



OXFORD COUNTY STANDARD DRAWING

HYDRAULIC ELEMENTS OF CIRCULAR PIPES

REV#: 1

09/2025

Oxford County
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FIG. 7.02

PREVIOUSLY: FIG. 4.2

MAINTENANCE HOLE INSIDE DIAMETER (mm)	MAX. PIPE SIZE FOR STRAIGHT THROUGH INSTALLATION (mm)	MAX. PIPE SIZE FOR RIGHT ANGLES INSTALLATION (mm)
1200	600 600	450 450
1500	825 825	600 600
1800	1050 1050	825 825
2400	1500 1500	1050 1050
3000	1950 1950	1500 1500
3600	2400 2400	1950 1950
3000 x 2400	1950 1950	1950 1950

NOTES:

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

OXFORD COUNTY STANDARD DRAWING

MAXIMUM PIPE SIZE FOR PRECAST MAINTENANCE HOLES

REV#: 1

09/2025

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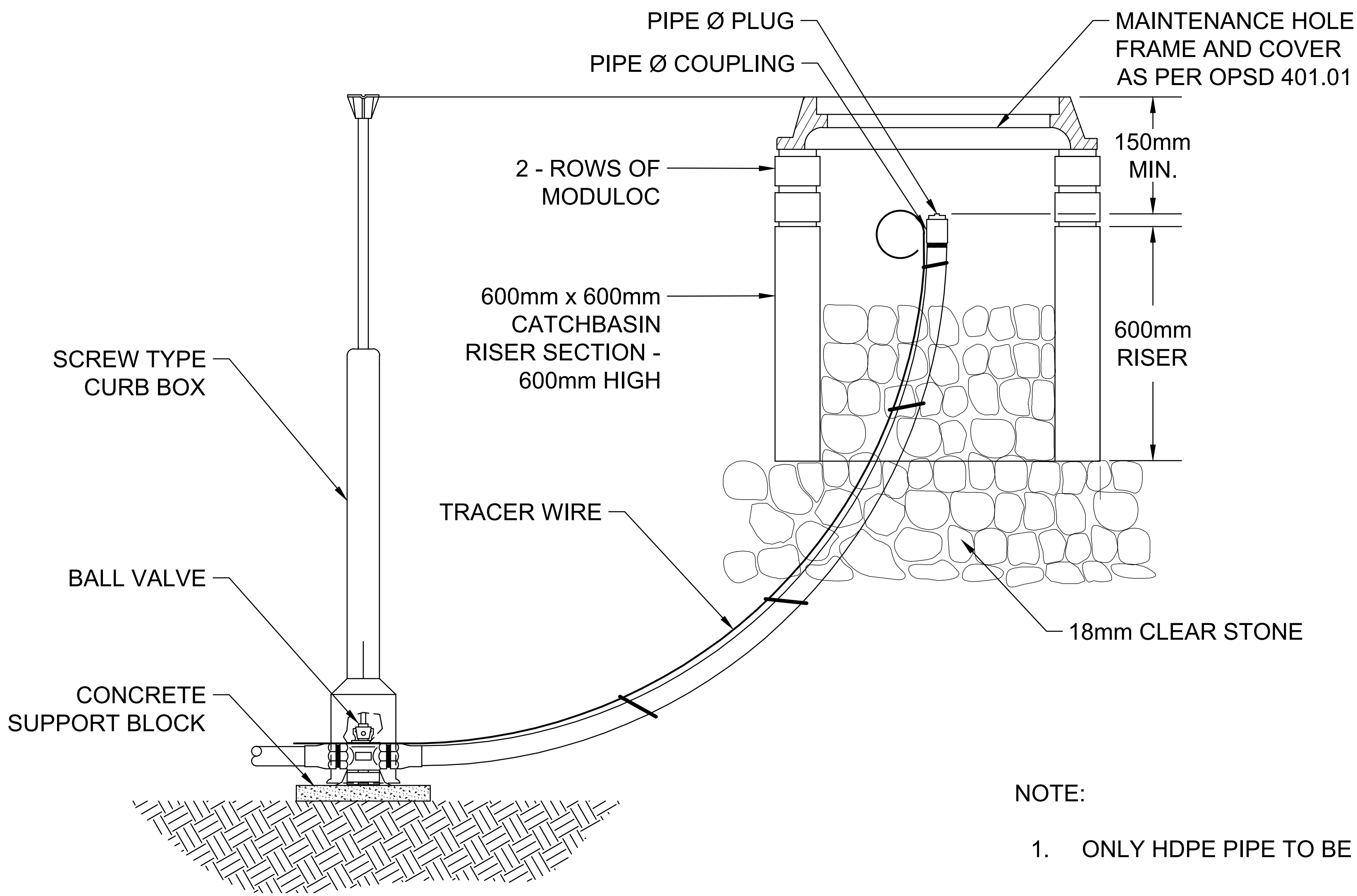
FIG. 7.03

PREVIOUSLY: FIG. 4.3



NOTE:

1. ONLY HDPE PIPE TO BE USED.

OXFORD COUNTY STANDARD DRAWING

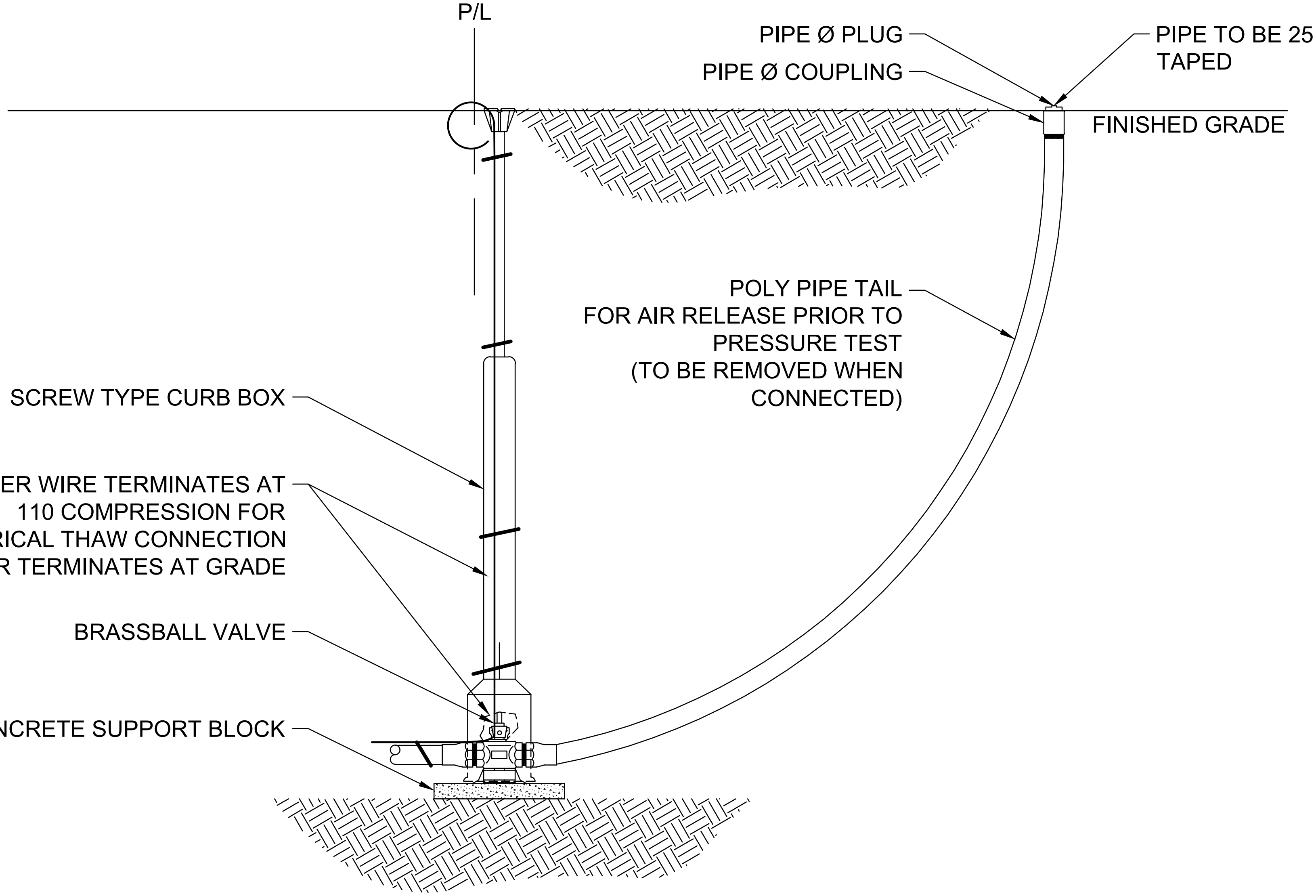
LOW PRESSURE SANITARY SEWER CLEANOUT

REV#: 2

09/2025

FIG. 7.04

PREVIOUSLY: D1847-1-2011



OXFORD COUNTY STANDARD DRAWING

LOW PRESSURE SANITARY SERVICE

REV#: 4

09/2025

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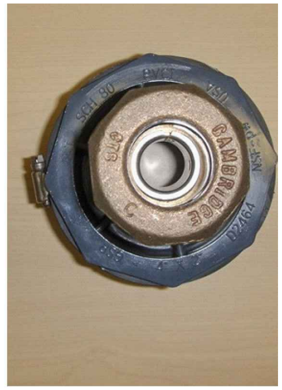
FIG. 7.05

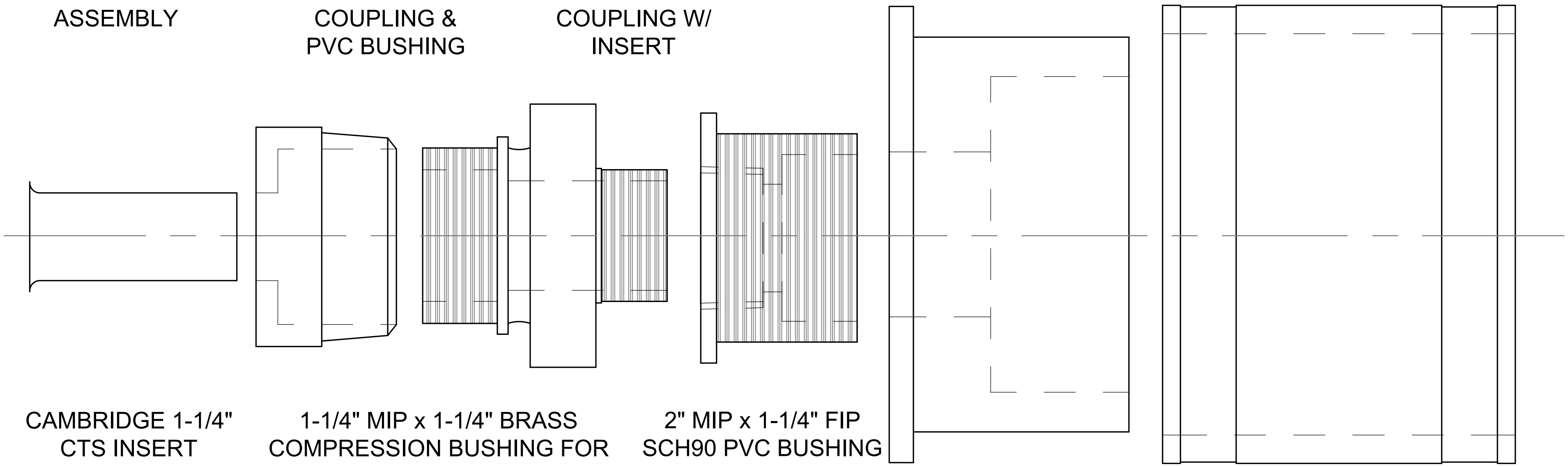
PREVIOUSLY: D1849-1-2011

COMPLETE
ASSEMBLY

FERNO
COUPLING &
PVC BUSHING



BRASS
COUPLING W/
INSERT



CAMBRIDGE 1-1/4"
CTS INSERT
OR APPROVED EQUAL

1-1/4" MIP x 1-1/4" BRASS
COMPRESSION BUSHING FOR
PEP
*
CAMBRIDGE BRASS SERIES
117(117-PE5F5)
OR APPROVED EQUAL

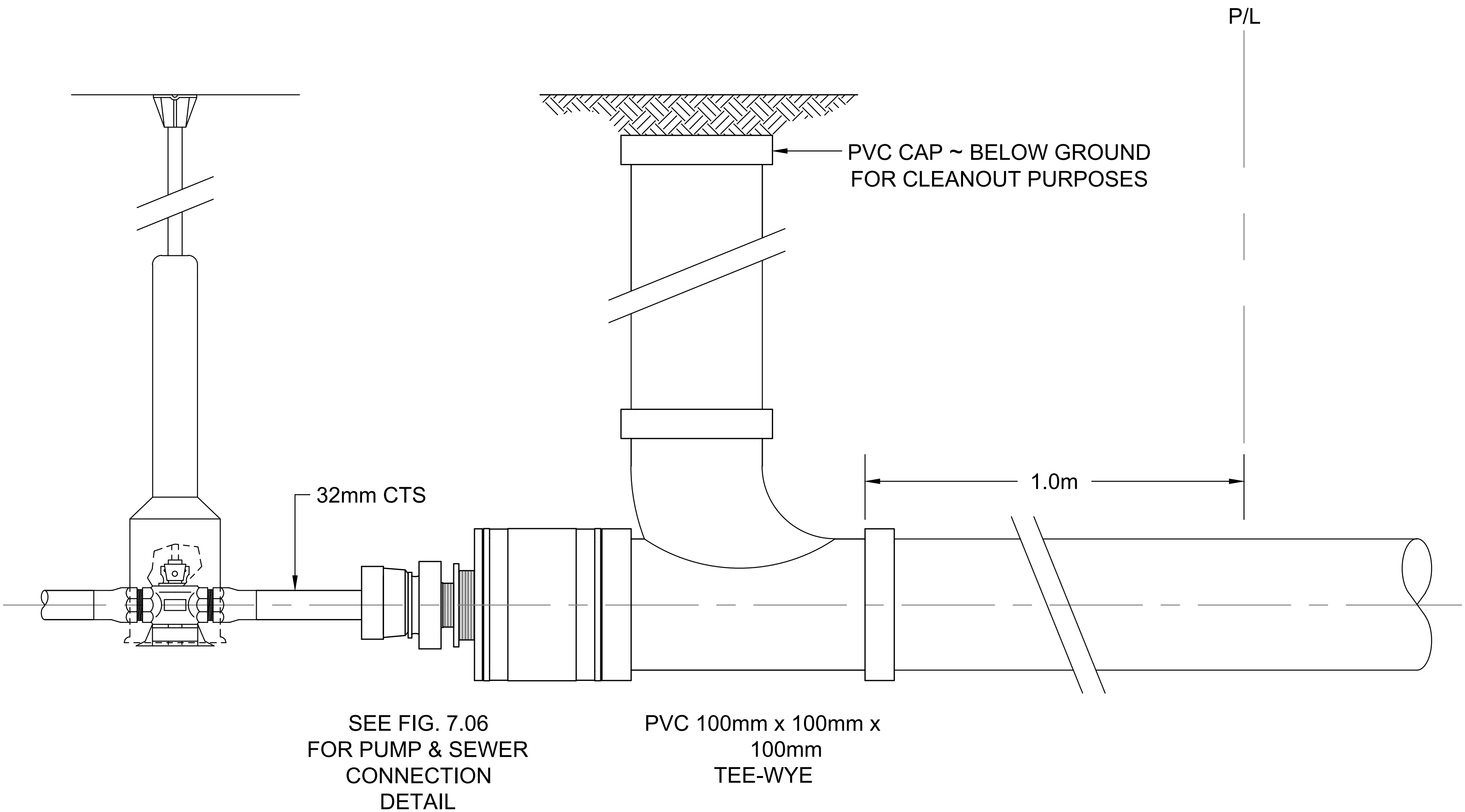
2" MIP x 1-1/4" FIP
SCH90 PVC BUSHING

4" MALE SOCKET x 2" FIP
SCH80 PVC BUSHING

FERNCO COUPLING 1056-44
4" CI/PLASTIC TO 4"
CI/PLASTIC
OR APPROVED EQUAL

OXFORD COUNTY STANDARD DRAWING	REV#: 1	Oxford County Growing stronger together
GRINDER PUMP & SEWER LATERAL CONNECTION	09/2025	
	FIG. 7.06	

PREVIOUSLY: D1850-1-2011



OXFORD COUNTY STANDARD DRAWING

GRINDER PUMP SEWER LATERAL CONNECTION W/ CLEANOUT

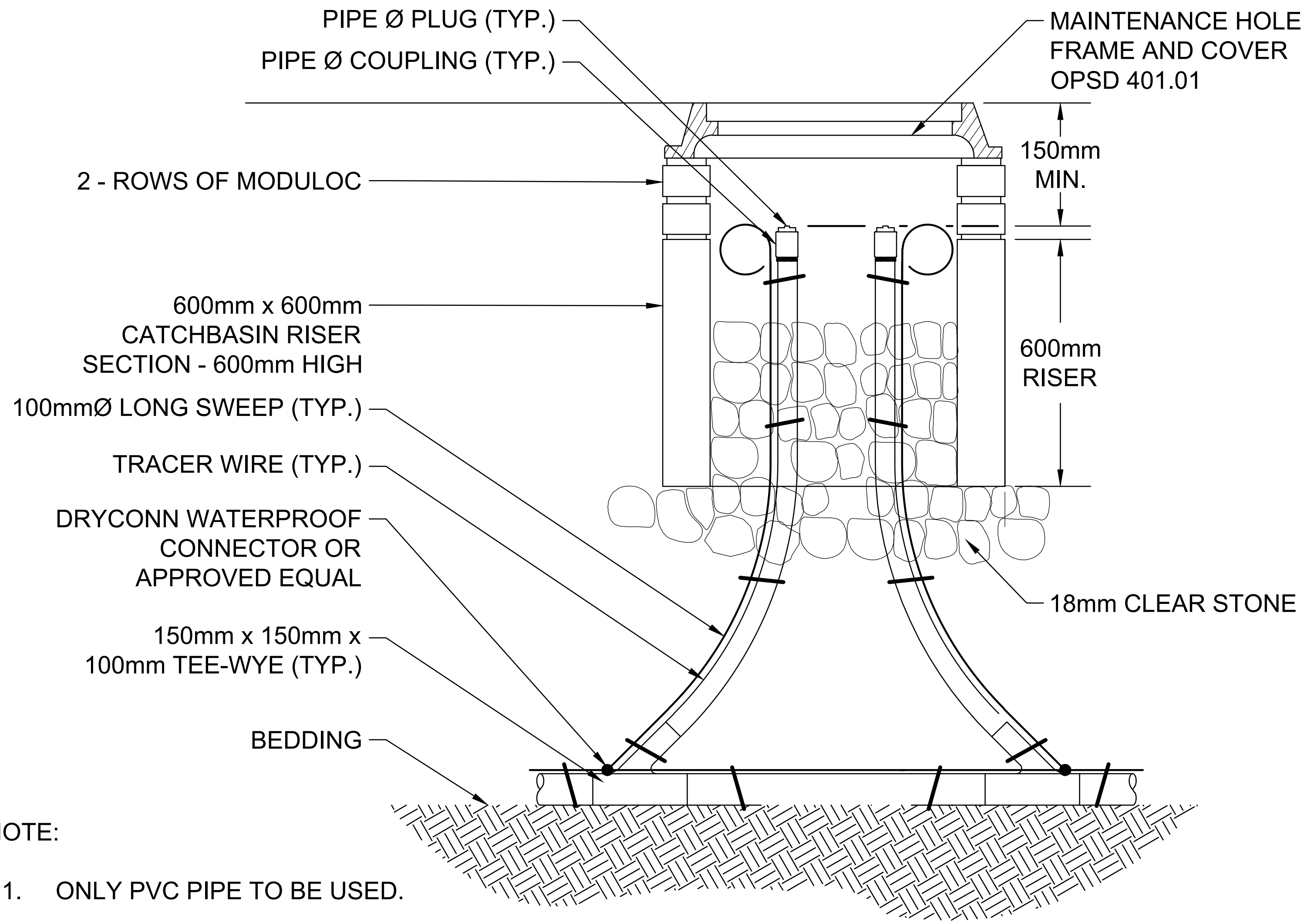
REV#: 1

09/2025

Oxford County
Growing stronger together

FIG. 7.07

PREVIOUSLY: D1850-2-2011



NOTE:

1. ONLY PVC PIPE TO BE USED.

OXFORD COUNTY STANDARD DRAWING

GRAVITY SANITARY SEWER CLEANOUT

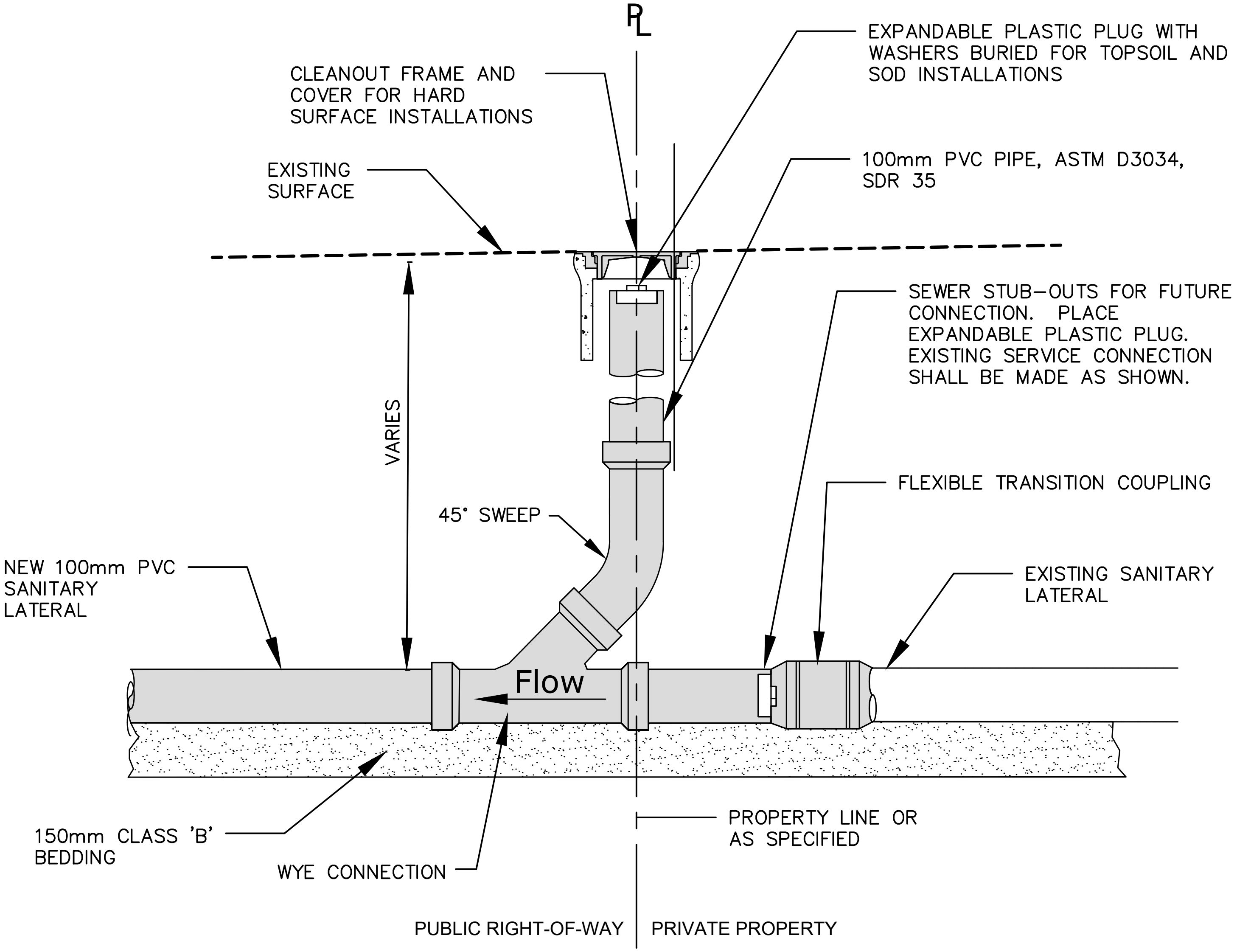
REV#: 1

09/2025

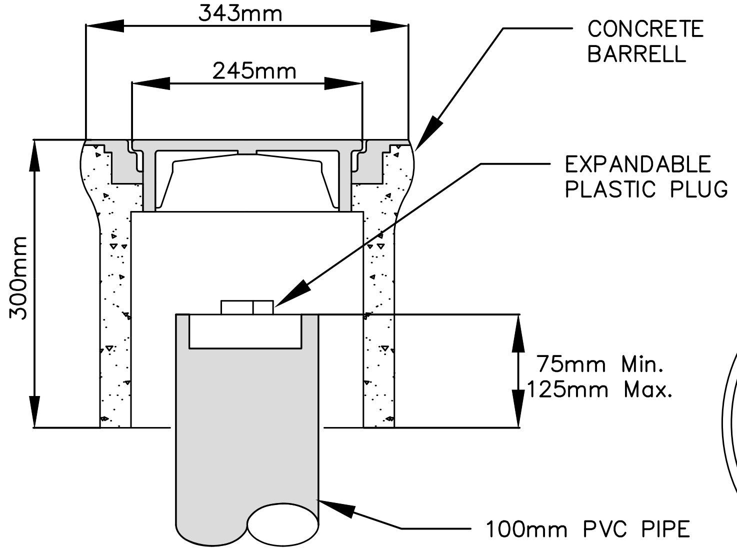
Oxford County
Growing stronger together

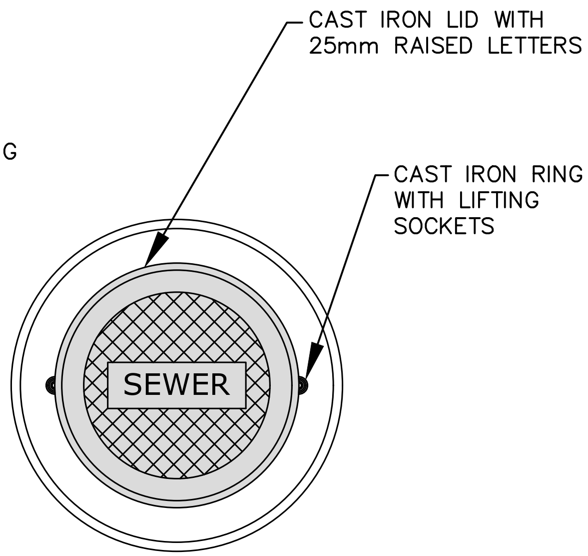
FIG. 7.08

PREVIOUSLY: D1854-1-2012



SECTION VIEW





OXFORD COUNTY STANDARD DRAWING	REV#: 1	OxfordCounty Growing stronger together
TYPICAL SANITARY CLEANOUT	12/2025	
	FIG. 7.09	

PREVIOUSLY D 1860-1-2018

Oxford County Design Guidelines | 8 | Facilities

TABLE OF CONTENTS

8 FACILITIES

8.1 GENERAL

This section contains technical guidelines to follow when designing new buildings or major renovations on the existing buildings for the Oxford County. These guidelines are to be used in conjunction with Ontario Building Code (OBC) and its supplementary standards along with professional judgment to ensure that they are followed only to the extent they are appropriate. Consultants remain ultimately responsible for the design.

More specifically, the intent of this section is to:

- Describe the minimum requirements for various building components, assemblies, and systems that have an impact on serviceability and anticipated life cycle of the facility.
- Alert consultants to design aspects that historically have been problematic.
- Provide solutions or problem avoidance techniques that have been developed through experience and have proven to be practical and effective.
- Provide a vehicle for communicating departmental design standards to consultants in an effective and expedient manner.
- Indirectly, provide a basis for evaluating designs.

No attempt is made to address every conceivable condition. Rather, common sense solutions are provided where experience has indicated that problems commonly arise. This experience can be applied to new designs as a preventative measure, and to existing buildings to address problems that are attributable to design and/or execution that does not conform to these technical design requirements.

Where these guidelines do not address a technical design issue that arises on a project, it is the consultant's responsibility to address it. When a requirement, though normally applicable, may not be appropriate for a specific project, the consultant should propose an alternative for consideration by the project team. This may include the design of facilities for temporary or short-term use.

Innovative designs or products are encouraged after thorough consideration of potential benefits and risks, value analysis, and life cycle cost. Consult project team members and persons with expertise in facility operation and maintenance.

Designs are required to comply with all applicable codes and regulations. Where the technical design requirements contained herein differ from building codes and other applicable codes and standards, apply the more stringent requirements.

Buildings are to be designed in accordance with the County of Oxford's **Official Plan Chapter 6: Rural Settlement Land Use Policies** and all development policies as outlined in **Section 2-Procedures for Development**.

Designer Responsibilities

- The Designer is required to comply with the current version of all applicable acts, codes, bylaws, regulations, guidelines, and standards recognized in the province of Ontario. Review and understand all sections of the guidelines and acknowledge that all sections may not be complete.

- It is the responsibility of the Designer to provide a complete design in accordance with the design guidelines, using industry applicable design principles. If design conditions are not addressed by the guidelines, confirm the design approach with the County prior to the project commencement.

- If the Designer determines a deviation from the guidelines is required during design development, a formal request to the County is required to identify in detail the benefits of the deviation. The deviation from the guidelines must be approved in writing; only after written approval from the County can the deviation occur for the specific project. Additionally, for specific project types, the County may give directions to deviate from portions of this guideline.

8.2 APPLICABLE REFERENCES

It is not the intent of this Guideline to supersede any active legislation standards and regulations governing the design of any projects within the County. It is the responsibility of the Designer to be aware of all applicable regulator requirements, including those not listed below, this shall include the provincial and federal legislation, and municipal standards when designing projects.

The following standards, codes, legislation, and authorities should be reviewed and referenced, at minimum, to complete the capital projects. The adopted versions of these codes and standards, as recognized by the applicable authorities having jurisdiction (AHJs), shall be used. It is the responsibility of the project team to verify and apply the most current and locally adopted editions in effect at the time of design and construction.

a) American National Standards Institute (ANSI)/Hydraulic Institute (HI) Pump Standards.
b) ANSI Standard Z358.1 entitled “Emergency Eyewash and Shower Equipment”.
c) American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbooks (Heating, Ventilation, and Air Conditioning (HVAC)).
d) American Society of Plumbing Engineers (ASPE) CEU 205 Compressed Air Systems.
e) ASPE CEU 309 Laboratory Gases.
f) American Society for Testing and Materials (ASTM).
g) ASHRAE 62.1 Standard entitled "Ventilation of Acceptable Indoor Air Quality", 2010.
h) ASHRAE 111- Standard entitled "Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning and Refrigeration Systems".
i) Canadian Standards Association (CSA) Welding Code.
j) CSA B52 Mechanical Refrigerant Code.
k) CSA B64.10.1 Selection and installation of backflow preventers/Maintenance and field testing of backflow preventers.
l) CSA B139 Series Installation code for oil-burning equipment.
m) CSA B149.1 Natural gas and propane installation code.
n) CSA B149.2 Propane Storage and Handling Code
o) Health Canada Canadian Drinking Water Quality Guidelines, 2014.
p) National Building Code of Canada (NBC)
q) National Energy Code of Canada for Buildings (NECB)

r) National Fire Code of Canada (NFC)
s) National Plumbing Code of Canada (NPC)
t) National Sanitation Foundation (NSF) 61 Drinking Water System Components.
u) National Fire Protection Association (NFPA) 10 Standard for Portable Fire Extinguishers.
v) NFPA 13 Standard for the Installation of Sprinkler Systems.
w) NFPA 14 Standard for the Installation of Standpipe and Hose Systems
x) NFPA 20 Standard for the Installation of Stationary Fire Pumps for Fire Protection
y) NFPA 90 Series- Standard for the Installation of Air Conditioning, Ventilation, Warm Air Heating, and Exhaust Systems
z) NFPA 92 Standard for Smoke Control Systems
aa) NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
bb) NFPA Standards Series as applicable and adopted by NFC and Ontario Fire Code
cc) NSF/ANSI/CAN 372 and the Safe Drinking Water Act (SDWA) Lead-Free Plumbing Requirements.
dd) Thermal Insulation Association of Canada (TIAC) Best Practices Guide.
ee) Ontario Building Code (OBC)
ff) Ontario Electrical Safety Code (OESC)
gg) Ontario Fire Code (OFC)
hh) SMACNA Standards
ii) SB-10 - MMA Supplementary Standard, Energy Efficiency Supplement
jj) SB-1 Climatic and Seismic Data
kk) Technical Standard and Safety Authority (TSSA) Regulations, Bulletins and Adopted Codes, Standards and Documents

8.3 BUILDING ENVELOPE

8.3.1 Climate Considerations

Designs should follow climate design tables found in the MMAH Supplementary Standard SB-1 Climatic and Seismic Data as well as Table C-1 in NECB. Consideration must also be given to the impact of climate change on the building envelope so that it can effectively manage these changes in the future.

All building envelopes must adhere to the requirements of the SB-10 and NECB to meet the Oxford County climate conditions.

8.3.2 Air Leakage, Vapour Diffusion and Water Management

Effective air barriers and vapour barriers are environmental separators essential to efficient and sustainable building envelope performance. An initial quality installation and subsequent maintenance of air barriers and vapour barriers comes from knowing how they work, knowing which materials can be used, providing effective quality management, and testing during building construction, and knowing how they must be conserved and maintained.

Air leakage and condensation control systems must follow the requirements stated in OBC Section 5 and 9.25.

8.3.3 Thermal Resistance and Assessment

The thermal resistance of the building envelope minimizes heat loss and thereby reduces building energy consumption and increases occupant comfort. Designers are required to perform effective thermal resistance calculations for all exterior building assemblies and must include these within their drawing package to show conformance with OBC and NECB Division B. These calculations can either be done following the requirements of the OBC or following ASHRAE standards as adopted by the Province of Ontario. Nominal insulation values are not acceptable and do not prove compliance. Thermal resistance calculations must also be used to determine the dew point within the assembly for the design temperature of the building location. This calculation must show that the dew point occurs outside of the vapour barrier material to prevent moisture condensation on the interior surfaces of the building envelope.

No thermal resistance values should be lower than the prescriptive values of SB-10 or NECB for the climate zone or local bylaw requirements. Reduced thermal resistance is allowed for all assemblies where the NECB or OBC allows due to seasonal use, or where areas have no heating requirements.

8.3.4 Basements and Crawl Spaces

Provide heating, ventilation, and moisture protection as required by the OBC section 6. Where sites are in areas where the average radon level is higher than Health Canada exposure guidelines, buildings are to include a radon depressurization system and sealed soil gas barrier under floor systems in contact with the ground.

8.3.5 Exterior Doors

Several problems are commonly experienced with exterior doors, including conductive heat loss and air leakage due to loss of material flexibility at cold temperatures, insufficient hardware adjustment, or door panel warpage.

Vestibules are required at all main entrances to separate the inner and outer entrance doors, to prevent heated air loss and drafts, and to increase indoor building comfort. Exceptions may be made for industrial/process related facilities where the interior space is not permanently occupied and accessibility to the area to transfer equipment and tools will be limited via vestibules. Where both sets of doors may be left open at the same time it is recommended to incorporate an air curtain or a revolving door. If an air curtain is installed, consideration should be given to controlling its cycle time.

All exterior doors must follow SB-10 and NECB requirements.

8.3.6 Exterior Windows

The number, size and location in the building of windows should be carefully selected for energy conservation, building envelope, climate and because of the potential for vandalism in some locations. Views and natural light character (glare, sun angles) must be carefully considered when selecting and locating windows.

The total performance of fenestration products will be based on AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for windows doors and skylights and CSA A440S1, the Canadian Supplement to NAFS.

All exterior windows must follow SB-10 and NECB requirements. The standard requirement for County buildings is the installation of gas-filled triple-pane windows, subject to the specific needs of each facility.

8.3.7 Exterior Horizontal Enclosures

8.3.7.1 Roofs

The total annual precipitation increase in some northern regions requires additional attention be given to roof water drainage design and operation. This is to ensure roof drainage water is not retained in ponds on the roof and is able to move away from the building perimeter once drained off the roof.

All roof structural designs are to accommodate future roof-mounted solar panel installations to support renewable energy development without structural deficiencies. Deviations from this standard may be discussed with **County Facilities/ Energy Management** on case by case.

Building roof insulation (R-value) must be designed as minimum in accordance with SB-10 and NECB requirements.

8.3.7.2 Skylights and Clerestory Windows

.1 <u>Skylights</u>

While skylights may be desired or required in certain situations, they should be avoided wherever possible due to maintenance concerns. If a skylight is necessary, it must be discussed and approved by **County Facilities/ Energy Management**.

Successful skylight installation and operation in Ontario conditions requires exceptional care selecting glazing type, frame materials, condensation and heat loss control features, and positioning the skylight above the main drainage plane for positive water drainage. Placement should also avoid snow and ice accumulation and related water-film deterioration of the skylight and its flashed perimeter seals.

Effective skylight performance requires incorporation of several essential technical design and thermal resistance features matching the windows in the same building, including the following:

- A steeply glazed surface slope is required for drainage, i.e., 3:12 to 6:12, or a continuous framed self-draining one-piece molded aluminum unit is used.
- Skylight units should be placed on raised curbs above the roof plane a minimum of 400mm to allow for drainage, expansion and contraction control, and flashing of joints.
- Adequate air circulation must be provided across the interior of the skylight to minimize condensation, and ample interior condensation gutters must be provided.
- Thermally broken or thermally resistive framing members should be detailed with a secondary drainage plane leading to the exterior to meet the environmental separation requirement of provincial or federal codes.
- Skylights should be equipped with blinds or have a tinted shading factor for reducing overly strong sunlight.

- Skylights are not allowed in a building where the cooling load created by heat gain through the skylight outweighs the benefits of reduced lighting requirements.

.2 Celestial Windows

Clerestory windows are preferable alternatives to skylights, provided careful design allows them to remain clear of snow accumulation and resist driven rain intrusion.

Driven rain at clerestory window heads, and drifted snow at the sill, need to be accommodated in the flashing and roofing details to resist the concentrated wind effects around the stepped portions of roofs, or on the vaulted penthouse enclosures above the general roof plane, where clerestory glazing is installed. c) A minimum height to sill of 200mm is required. Eaves extensions at the head are also required to divert driven rain away from the window head frame joint to the wall.

Clerestory windows need to be placed on the interior side of the wall plane to minimize heat loss and avoid water condensation on the interior frame and glass surfaces. Condensate capture trays in the frame and air system diffusers positioned to direct ventilation air to the glass surfaces are recommended where there is a risk of condensation on the window.

Operable clerestory sashes are not acceptable. Rather fixed glazing units are required. Building ventilation from clerestory vaults to be achieved using operable ventilation louvres and controlled by the building controls system if applicable.

8.3.8 Fall Safety

Fall safety must be considered at both the design and construction stages in accordance with the Ontario Occupational Health and Safety Act (OHSA) and Construction Projects Regulation (O. Reg. 213/91).

Designers should incorporate permanent features that minimize reliance on temporary systems, such as safe roof access, guardrails, and engineered tie-off anchor points, to facilitate safe construction, maintenance, and future operations.

Contractors are responsible for implementing and maintaining appropriate fall protection measures during construction, ensuring workers are trained and equipped with suitable systems, and preparing site-specific fall protection plans where hazards exist (e.g., where work at heights of 3 metres or more is required). Regular inspection and coordination of fall safety systems across all trades is expected.

8.4 BUILDING HVAC / BUILDING AUTOMATION SYSTEM (BAS)

8.4.1 General

Design mechanical systems according to OBC (current edition), ASHRAE standards and SB-10 as applicable. Include the following considerations:

- Design conditions shall be January 1% and July 2.5% as per the SB-10.

- A minimum safety factor of 10% shall be applied to heating and cooling load calculations.
- Do not allow a 10% safety factor for cooling loads when sizing central cooling plant equipment. Safety factors for central cooling plants to be determined based on energy code requirements and best engineering judgments.

Heating considerations shall include:

- Enclosed Parking Structures shall be designed with the ability to heat spaces to 18°C.
- Provide heat to interior envelope surfaces as required to prevent condensation on those surfaces where the indoor conditions or the building function favors condensate formation.
- Provide heat to any interior surfaces that are adjacent to spaces with different temperature and relative humidity conditions to prevent condensation.
- In enclosed ceiling spaces with roof heat loss, provide radiation elements and temperature sensors to maintain minimum 18°C within ceiling space.
- Mechanical room space temperature to be maintained between 18°C and 28°C.

Cooling and ventilation requirements for spaces housing Uninterruptible Power Supply (UPS) equipment and components, including batteries, should be coordinated with Electrical Consultant.

Minimum and maximum indoor temperature sensors for occupied spaces to follow OBC Part 6 requirements. Additionally, unoccupiable spaces to be designed for minimum temperature setpoint of 10°C.

Follow Occupational Health and Safety Act (OHSA) for temperature requirements in industrial workplace.

8.4.2 Facility Fuel Systems

The fuel source for the facility shall be selected based on the local availability of fuel, local service staff, and suitability of associated heating system. Selection of facility fuel source must be coordinated with the **County Facilities/Energy Management** team, specifically the Coordinator of Energy Management to select the proper option and also be able to plan for new utility costs and consumption. Selection of facility fuel source shall be incorporated into the Integrated Design Process and shall be included in energy modeling, life cycle costing and total cost of ownership.

Systems shall be sized to provide a minimum of two (2) weeks capacity while operating at peak building demand if fuel storage will be required. Provide additional capacity where required by local conditions.

Mechanical vehicle protection consisting of concrete filled bollards designed and spaced as per the applicable installation standard shall be provided around any tank system located in areas subject to vehicle traffic. Wooden or other removable means of protection will not be accepted. See **Section 8.6.2.4** for bollard design requirements.

8.4.3 Hydronic Systems

Preference should be given to the two-pipe reverse return system for hydronic systems. Direct return systems may be used if the design safeguards against flow imbalance to terminal units.

Pumps shall only be installed at floor level. No pumps shall be installed at elevation. Where suitable, wet-rotor type inline pumps are preferred.

All exterior piping insulation to be cladded with aluminum jacketing. Indoor insulation shall be cladded with PVC jacketing. Flame and Smoke Spread Rating for all jacketing to be less than 25 and 50 respectively where applicable. Sections of indoor piping or ductwork systems that are exposed to physical damages to be cladded with aluminum jacketing.

Provide isolation valves on supply and return mains, risers, and major branches. Provide isolation valves on suction and discharge of pumps. Provide isolation valves for terminal units at the supply and return connections. Circuit balancing valves must be provided at each terminal unit. Pressure independent control valves are encouraged to ensure proper balancing and increase energy performance.

Preferred hydronic system treatment chemicals include:

- Dispersants, phosphonates, corrosion inhibitors, and alkaline controller product.

Piping shall not be supported by floor supports unless specifically noted as required by equipment manufacturer installation instructions. Pipe supports from floor are to be a channel strut support system (Unistrut or approved equal) with pipe clamp. Threaded rod with a half riser clamp as a floor pipe support is not acceptable.

Mechanical grooved couplings shall be permitted on hydronic heating and cooling systems; but only in mechanical rooms. Mechanical grooved couplings are not to be installed in concealed locations such as shafts, above ceilings, etc.

- In addition, for mechanical grooved couplings to be allowed:
    - The grooved supplier must furnish a warranty for the entire grooved system. This warranty is to be for a minimum of 25 years and will be for full labour and materials related to any leaks or failures in the system. The warranty will not just be for the product itself but for any ancillary building elements damaged by the product failure.
    - The grooved supplier to provide inspection services to ensure that every grooved coupling is installed as per the manufacturer's specifications
    - The grooved supplier to provide training for the installing contractor at the startup on any project where these couplings are to be used. Grooved supplier to also provide ongoing support throughout the project.

Lug style isolation valves are preferred; wafer style isolation valves will not be accepted.

- Valves sized DN150 (6NPS) and larger shall be equipment with gear operators.

For variable primary pumping systems for heating or cooling a flow meter is to be provided for each chiller and / or boiler to confirm adequate flow.

Installation of balancing valves are encouraged for better balancing the hydronic systems.

Unit Heaters and terminal units to be provided with a bypass loop upstream of the unit's isolation valve to allow for prestart cleaning and testing of the hydronic loops while the equipment is isolated from the loop.

Installation of drain and vent valves are necessary at lowest and highest points of the hydronic system respectively.

8.4.4 Heating Systems

8.4.4.1 General

Heating systems shall be selected, designed and installed with a priority on efficiency, comfort, serviceability, availability of local services and simplicity.

Projects are required to exceed minimum code requirements and achieve higher efficiency standards where possible.

Consider electric heating for new installations and major retrofits. Refer to **Section 8.14** for energy management measures.

In large mechanical rooms containing natural gas or propane burning equipment, provide ventilation, heating, and or cooling to control the room temperature within the temperature ratings of equipment (i.e. electrical panels) and to maintain the space setpoints.

For buildings with high exhaust/ventilation requirements such as parking and repair garages, specify that combustion air is ducted directly to the unit from outside for all gas fired equipment where possible.

Pipe insulation jacketing is preferred to be canvas within mechanical rooms, when not exposed to moisture.

Size heating elements for:

- exterior wall envelope heat loss;
- infiltration, ventilation, and where applicable:
  - slab heat loss,
  - roof heat loss, and
  - reheat of minimum supply air quantity.
  - Thermal mass of equipment entering the building.

Utilize n+1 redundancy for major heating equipment.

Hydronic heating systems that include condensing boilers shall be designed to optimize return water temperatures.

- Possible optimization options include, but are not limited to,
  - lowering the supply water temperature,
  - sizing heating elements for large temperature drops, or
  - providing a cascading system.

Variable water flow rates through the boilers will only be accepted for boilers specifically designed for variable flow.

On primary-secondary pumping systems, provide a minimum of two (2) secondary circulation pumps, each sized for duty/standby operation at 100% of maximum design capacity.

Provide a temperature-controlled piping loop for air handling system coils, separate from the loop supplying radiation, radiant panels, and terminal reheat coils.

Provide 50% propylene glycol solution for heating coils in air handling units which may be subject to freezing. Specify pre-mixed inhibited propylene glycol only.

Include specification for chemical injection system for boiler treatment and maintenance. Preferred system would include injection points, diaphragm metering pumps, and totes/tanks for chemicals as required to ensure the performance and reliability of boilers.

Secondary containment is required for propylene glycol fill tanks within mechanical rooms.

Feasibility study will be required if geothermal heat exchange systems are to be utilized.

Heat domestic hot water with heaters or boilers independent of the building heating system when facility heating loads are intermittent or the complexity of the combined system is impractical. Proposed combined systems should be considered only where appropriate.

Where solar hot water is incorporated in the hydronic heating system, the system shall include 100% redundant pumps supplying flow to the solar collectors. An alarm is to be issued to the building controls or BAS upon failure of either pump.

Application of heat pumps are encouraged for offsetting the heating loads where applicable. Application of electric resistant heating systems to be limited to the conditions where heat pumps can't be operated for the entire heating season (e.g. peak demand conditions or cold outdoor temperatures) and alternative fuel sources aren't desired by the County (e.g. peak demand conditions or cold outdoor temperatures).

Follow SB-10 for application of heat recovery systems into the HVAC design and where possible.

8.4.5 Cooling Systems

8.4.5.1 General Requirements

Consider project specific factors affecting indoor temperature such as local climate, building envelope, orientation, shading, glazing, and internal heat gains to determine cooling requirements for the project. Provide free-cooling where practical.

Where indoor design temperature cannot be achieved, mechanical cooling may be required. Consider use of passive strategies to reduce or eliminate requirement for mechanical cooling.

Select equipment and systems on the basis of efficiency, controllability, maintainability and life cycle costing.

Provide cooling in LAN room and data centers where required to maintain temperature below design temperature. Consider heat recovery where possible.

Cooling equipment subject to condensate shall be equipped with a suitable drain pan piped to drain. Ensure suitable means of protecting against backflow and odor recirculation is provided.

Equipment shall be located to facilitate maintenance as outlined by manufacturer.

Cooling zones shall be consistent with heating zones where practical. Areas within a single zone shall have similar aspect, sizing and occupant load.

Provide insulation on any cooling distribution system in accordance with NECB.

Equipment shall be mounted with vibration isolation to reduce noise transfer to the structures.

Each piece of air conditioning equipment shall have the refrigerant type and total refrigerant charge (including pre-charge and any refrigerant added on site) permanently mounted adjacent to or on the equipment nameplate. Lamicoid's to be used on indoor equipment, metal placards to be used for outdoor.

Each condensing unit shall have an independent gravity condensate drain line run to a suitable location. If drain runs through a space subject to freezing temperatures, means of preventing freezing shall be provided.

Outdoor units shall be equipped with a lockout feature to prevent operation when ambient temperature is below the equipment rating. Reset function shall incorporate a time delay to allow equipment to warm up above low ambient shut down limit prior to resuming operation.

Each terminal unit shall be provided with an electrical lockable disconnect.

Heat pump or cooling only variable refrigerant flow systems shall be equipped with low ambient kits when they are used for cooling data centers, electrical/ VFD rooms.

8.4.5.2 Cooling Equipment

Locate equipment with consideration to maintenance access, service clearance and acoustics. Cooling equipment with output rating of 5 tonne and above shall be provided with multiple stages of cooling. Where refrigerant based systems are installed, requirements of CAN/CSA-B52 (sections adopted by the TSSA) shall be followed. All refrigerant cooling systems must be installed by TSSA registered contractors. Applicable TSSA regulations to be followed for registration of all refrigerant based equipment/ plants/ systems.

.1 <u>Outdoor units</u>

Shall be elevated above the anticipated snow level on a suitable stand rated to support the equipment and resist seismic loads.

Allowances for condensate drainage shall be provided.

Locate units to minimize transmission of noise into occupied space and onto adjacent properties.

8.4.6 Ventilation

8.4.6.1 General Requirements

Locate outdoor air intakes to maintain minimum required clearances to potential contaminates in accordance with the requirements of ASHRAE 62.1. Consider the effect of the predominate wind direction, local sources of contamination such as dirt roads or parking areas and increase the distances as appropriate. Where other codes or standards require larger separation distances, adhere to the more stringent requirement.

Provide ventilation systems with required filtration levels as required by ASHRAE 52.2 to maintain adequate indoor air quality for the intended application. Facilities requiring higher filtration, such as health care facilities, shall meet the requirements of the applicable standards. Ventilation equipment shall be provided with summer and winter filter section where subject to frost. Filter sections and rack shall be provided with sufficient clearance to facilitate filter removal and installation without bending filters.

Locate access doors around any in-duct equipment such as coils, damper, filter, and fire dampers.

Consider the use of demand-controlled ventilation.

Occupancy sensors shall be used in intermittently occupied facilities. In systems where ventilation equipment is used to provide space heating or cooling, unit shall be capable to operate in recirculation mode and/ or freeze protection mode during un-occupied periods.

8.4.6.2 Ventilation Equipment

.1 Heat Recovery Equipment

Heat recovery shall be incorporated into all exhaust systems unless life cycle costing confirms it is not practical. Select heat recovery systems for hazardous locations based on the site condition and ensure no cross contamination will cause from heat recovery systems.

Heat recovery system shall be selected based on exhaust and intake air design conditions. Consider use of heat recovery ventilators, energy recovery ventilators, heat pipes or glycol run-around loops to suit application. Utilize latent heat recovery on systems where high relative humidity is expected.

Systems where continuous ventilation is required to maintain adequate indoor air quality and low ambient operation will result in intermittent defrosting, or where low incoming air temperature may damage equipment, provide a means of pre-heating incoming air. Preheat coils shall be sized to allow maximum heat recovery.

System where cross contamination is a concern shall utilize equipment with separated air streams and leakage rates within acceptable range for the application.

In systems utilizing free cooling with outdoor air, system shall be provided with a means of bypassing air around heat recovery system.

A means of balancing shall be provided on all equipment. Use of Electrically Commutated Motors or Variable Frequency Drives (VFDs) are preferred.

.2 Distribution Equipment and Ducting

Insulate all distribution equipment and ducting in accordance with ASHRAE 90.1 (adopted version) and NECB standards.

Provide remote grease nipples on exterior of all ventilation equipment.

Zoning of ventilation system shall be consistent with space function, occupied hours and air quality requirements. Coordinate with heating and cooling zones as much as possible.

Where displacement ventilation is determined to be suitable, it shall be identified at the schematic design phase and shall include the services of a consultant for the production of temperature variation analysis or fluid dynamics simulations as required to evaluate locations of supply air outlets, return air outlets and ventilation effectiveness.

Ductwork

Design and install ductwork in accordance with ASHRAE Handbooks, OBC requirements and Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards/ manuals with consideration for reducing noise and static pressure.

Provide vapour-retardant jacketing on all cold air ducts, including but not limited to ducts serving air handling units (AHUs) with cooling coils, upstream of duct heaters, louvers, and sections of exhaust systems located within conditioned spaces and downstream of exterior wall dampers.

All ductworks and building mechanical equipment shall be designed with anti-sway supporting systems (bracing restraint cables at the very least) so that they won't sway during earthquakes and cause damage to other/ adjacent systems. Follow SMACNA for bracing requirements of systems installed in post disaster buildings.

At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.

Locate ductwork runs vertically and horizontally, avoid diagonal runs wherever possible. Run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment. For ductwork run above the ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.

Coordinate ducting and diffuser location with lighting and other building systems. Locate to prevent short-cycling and drafts. Diffuser locations should not be located directly overtop of fixed workstations.

Duct shall be sealed in accordance with SMACNA requirements. Tape shall not be used for sealing duct joints.

Select and size diffusers/ registers to suit air-flow requirements of the space and minimize noise. Conventional ceiling level, adjustable cone, mixed flow diffusers with vertical and horizontal flow are preferred. Consider air flow, velocity and throw distance when selecting diffusers/ registers to minimize drafts and excessive noise while ensuring adequate coverage.

Intakes and exhaust ports outside of the building or on exterior walls shall be located and designed to prevent snow or rain entrance. Locate above highest expected snow level. Minimum of 450 mm of snow clearance to be provided for all inlet/ outlet ports if snow accumulation data is not available.

Provide access doors where required to ensure ductwork is accessible for air duct cleaning and if applicable for damper inspections. Refer for National Air Duct Cleaners Association (NADCA) for cleaning guidelines. Follow fire damper installation instructions for access door requirements.

Fans

Provide sufficient developed length around all fans and fittings. Configure fans to control room pressurization.

Flexible connections constructed of an approved fire-resistant material, are required at the suction and discharge connections of fans and air handling units to isolate the vibration resulted from operation of the fans to the ductwork where applicable.
Fan equipment is to be installed so that the connecting ductwork is aligned with the fan inlet or outlet, and the flexible connection does not obstruct the air flow.

Provide silencers on equipment where required to meet space noise requirements.

Consider the use of de-stratification ceiling fans in high ceiling areas (e.g., in garages, theatres, etc.). Size the fans for total area coverage. Provide protective guards over fans where they may be subject to damage. In occupied areas where noise may be a concern, provide speed controls in an accessible location.

Dampers

Provide a means of balancing distribution ducting and terminal units. Locate balancing dampers away from duct openings. Balancing dampers shall be lockable quadrant type and shall be set and locked with a setting indicator marked by the balancer.

Motorized dampers installed in ductwork that are directly exposed to the outdoors shall be located as per the ASHRAE 90.1 (adopted version) and NECB and shall be of insulated, thermally broken, low-leakage dampers suitable for cold weather operation.

Fire dampers shall be “gate out of airstream” wherever possible. If a “gate in air stream” damper is to be installed, it shall be on ductwork 300mm diameter and larger and shall be accounted for in static pressure loss calculations. Dampers shall be selected and installed in accordance with the OBC, NFPA 80 and its listing. Damper shall have access on both sides of the fire separation. Consider upsizing dampers when damper size would limit access for testing. Dynamic type fire dampers to be specified.

8.4.6.3 Exhaust Systems

Provide exhaust systems where required by OBC Division B part 6, ASHRAE 62.1 or where required to exhaust local containments, smoke, odours, fumes or in heat relief applications. Consider heat recovery on all major exhaust systems if practical. Provide tempered make-up air for all exhaust systems in accordance with Ontario Building Code (OBC) part 6.

Exhaust systems shall be ducted and sealed to prevent recirculation or leakage. Discharge exhaust to minimize risk of re-entrainment. Consider intake locations and prevailing wind.

In systems sharing a common exhaust between multiple occupancies or areas and where the system operates intermittently, provide protection against back-flow or cross contamination on branch ducting.

CO_2 control should be used in facilities where variable occupancy is expected. CO_2 sensors shall be interlocked with exhaust system in areas where vehicles/ equipment may idle or run indoors such as workshops, ambulance bays, etc.

Provide refrigerant vapor detectors, interlocked with an exhaust system as required by CSA B52 in areas where leaked refrigerant is most likely to accumulate. The detector must activate at a level not exceeding the corresponding Occupational Exposure Limit (OEL) as per CSA B52 code. Upon activation, the system shall initiate ventilation and sound an audible alarm. Follow CSA B52 requirements for details.

8.4.6.4 Environmental Separation

Consider requirements of the space and maintain environmental separations. Design all ventilation system to prevent cross-contamination or recirculation of contaminants.

Design systems to maintain pressurization in occupied areas as required to maintain environmental separations. Pressurization shall not exceed ASHRAE levels or affect other areas. Positive pressurization shall be used over negative pressurization where practical to limit air flow from one area to another.

8.4.6.5 Provisions For Balancing and Monitoring

Provide means of monitoring the outdoor air temperature, return air temperature, mixed air temperature, supply air temperature, and status of all fans and dampers.

All systems must be balanced by certified balancers as per accredited program (i.e. AABC/NEB).

Consider the use of variable speed motors/ drives to allow for fan speed adjustment where demand-controlled ventilation is utilized.

Where possible, direct drive fans are preferred. Where belt-driven fans are used, they shall be provided with adjustable sheaves to allow for speed adjustment.

8.4.6.6 Ductwork pressure leak test

Ducts over 2 m in length, forming part of a supply, return, intake or exhaust ductwork system directly or indirectly connected to air handling, make up air units, VAV or fan equipment to be pressure tested for leaks for duct pressure class B (750 Pa) and higher following SMACNA HVAC Air Duct Leakage Test Manual.

Exhaust ducts serving hazardous areas must be tested completely regardless of duct pressure class.

Follow ASHRAE 90.1 standard criteria for testing outdoor duct systems.

8.4.6.7 Acoustics

HVAC systems shall be designed and selected to ensure acoustic levels attributed to HVAC equipment are in accordance with ASHRAE guidelines chapter 49: Sound and Vibration Control and the acoustic requirements of the space.

Fan speeds shall be selected and installed to limit fan noise. Additionally, air velocity shall be within the limits outlined by SMACNA.

Coordinate with architectural and noise consultants to provide sufficient attenuation around equipment to limit sound transfer. Coordinate with architectural to maintain acoustic separations between spaces and limit sound transfer between sensitive areas.

Acoustic insulation is to be provided on all ducting in a fan room, on minimum first three (3) metres of any duct run to or from a fan, on all transfer ductwork and wherever fan and duct noise may be a problem. Insulation shall be secured with pin spot fasteners.

Commissioning of HVAC system to include sound testing in all occupied spaces to ensure compliance with ASHRAE guidelines and the functional requirements of the space. Design to mitigate excessive noise in compliance with OH&S, NBC, as well as with local noise bylaws.

Discuss with the County if sound attenuation of equipment or rooms housing equipment is required in accordance with ANSI S1.13 and CSA Z107.2.

If maximum allowable decibels are confirmed, specify limitations for equipment supplier. Require third party noise testing during Factory Acceptance Testing (FAT) to confirm levels.

Require noise testing once equipment is installed on site for the equipment/ locations that maximum decibels must be met.

Confirm with a third-party acoustic consultant the modelled predicted noise levels in the facility so that appropriate acoustic panel coverage can be included in the design package. Complete a second noise study at the completion of construction to confirm if additional noise mitigation is required.

Ensure compliance with specific regulations and standards. Noise control measures should be tailored to the unique characteristics and requirements of the space to achieve an appropriate balance between operational efficiency and minimizing noise impacts.

8.4.7 Hazardous Area Classification

Hazardous area classifications can vary from plant to plant and the requirements by code can change over time. An Engineer licenced in the province of Ontario to review existing conditions, confirm code compliance, and complete thorough assessment based on the following, including but not limited to:

a) Identifying and assessing potential hazardous substances, processes, and equipment present in the treatment plant area of interest. For new construction consider chemicals, gases, flammable materials, explosion limits, toxicity, and other substances that may pose a risk as part of final operating requirements.
b) Follow applicable codes, regulations and standards governing hazardous area classification (i.e.: Ontario Electrical Safety Code, Canadian Electrical Code, NFPA series or other relevant local regulations). Ensure the design complies with requirements.

c) Where applicable, divide the facility into specific hazardous area classification zones based on the frequency and duration of hazardous material presence. Common classification zones include:
   a. Zone 0: Areas where a hazardous substance is continuously present or present for long periods under normal operating conditions.
   b. Zone 1: Areas where a hazardous substance is likely to be present during normal operation, but only for short periods.
   c. Zone 2: Areas where a hazardous substance is not expected to be present during normal operation, or if present, only for brief periods.
   d. Non-Hazardous Area: Areas where hazardous substances are not expected to be present under normal operating conditions.

d) As part of the risk assessment process, identify potential ignition sources within the hazardous areas, such as electrical equipment, hot surfaces, open flames, or sparks. Ensure that appropriate safeguards, such as explosion-proof or intrinsically safe equipment, are used in these areas to prevent ignition.

e) Design appropriate ventilation systems to the classification requirements per design code/ standard and following determined by a licenced professional engineer. Confirm if gas scrubbing equipment or containment strategies are required to prevent the spread of hazardous substances in the event of a leak or release.

f) All equipment and materials designed as part of the scope of work must be suitable for the hazardous area classification. Use explosion-proof or intrinsically safe electrical equipment, switches, and control devices that comply with the specified hazardous area requirements registered by the CSA.

g) Ensure that electrical wiring and conduits meet the hazardous area classification standards. Use appropriate conduit materials and sealing techniques to prevent the ingress of hazardous substances.

h) The Designer is to include safety signage to identify and mark hazardous areas to alert personnel to the potential risks. Complete an OH&S review of signage for the area that complies with requirements and follow standard colour-coding for different hazard levels.

i) The area classification for each distinct space within the facility to be described, along with any requirements, as part of the code review drawings. The design must ensure equipment is rated to operate for the area classification.

j) Electrical area classifications to be determined by a qualified professional process, electrical, instrumentation and controls or mechanical engineer. Coordinate with architectural/ structural team to ensure the requirements for electrical area classifications are followed in the architectural layouts.

8.4.8 BAS Systems

8.4.8.1 General

All buildings are to be designed and installed with a Distributed Digital Control (DDC) or Building Automation System (BAS) where required by the County. Consult the County in determination of the proper control system for building mechanical systems.

Consult the County for a list of approved BAS vendors.

Any renovations to a building where equipment is replaced or added, that equipment is to utilize DDC controllers. Any new DDC controllers will either connect to the existing building automation system or will be specified such that they can be added to a DDC system in the future.

Only a single BAS manufacturer is allowed in any given building. If there are multiple buildings directly connected to each other, even if they have different site IDs, there shall only be a single BAS manufacturer for those buildings. If a building is being renovated and new DDC systems are being added they must be of the same manufacturer as what is in the building already or the entire system must be removed and replaced to ensure there is only a single BAS manufacturer in the building.

All critical building mechanical equipment shall be hard wired to BAS panels. Strategically placed and located distributed BAS panels are encouraged to minimize control wiring between field equipment to each BAS panel. BAS panels shall communicate with each other using either of the following acceptable ethernet IP based communication protocols:

- BACnet/IP,
- Modbus TCP/IP

Serial based communications are considered outdated and will only be accepted on a case by case situation and only where ethernet IP based solutions are deemed not feasible. In general, proprietary protocols will not be permitted.

The base building BAS should be accomplishing the control functions for all equipment. The exceptions are boiler sequencing controllers and chiller plant controllers where we allow the manufacturer's equipment controller to control those pieces of equipment. The boiler and chiller control systems, including multistage systems, must be provided with an enable and setpoint control supplied by the base building BAS system utilizing hard points as referenced above.

Air handling unit components including fans, dampers, heating, and cooling systems for large central station air handling units shall be controlled directly by the base building BAS. There shall not be a separate integrated controller on the air handling unit unless that controller is manufactured by standardized control suppliers that is compatible with the BAS system. All control points for the components listed above are to be writable through the base building control system.

Ductless split/heat pump units to be specified so that the cooling enable and heating enable are controlled directly from the base building BAS. An adapter card may be required for these systems.

All gas and water meters connect to the BAS via a pulse output from the meter.

All BAS site name, point name, panel name, and graphics filename labeling shall follow Oxford County's **Asset Management Tagging Standards**.

8.4.8.2 Control Documents

Provide a complete schedule of physical control points. For each point provide a short description, the point type, its mnemonic (system name) as well as any alarm limits and fail-safe position.

Provide a detailed control sequence for each mechanical system and any global optimization strategies. Include set points, interlocks, and alarms.

Laminated, permanently installed I/O lists shall be secured to all BAS panels.

8.4.8.3 Hardware

Each control system to be designed in such a way to facilitate a single connection from that control system to the Oxford County network.

Specify that for each BAS panel to allow for 10% spare physical point input/output. An additional eight (8) outputs shall be specified to be allocated at the panel closest to the C-Cure security system panel for future alarm use.

The firmware on the BAS panels must be compatible with the existing building automation network infrastructure. In instances where backwards compatibility to the County server becomes an issue, the Contractor will include the cost to supply and install upgraded software on the County server.

All panels, systems, controllers, equipment etc. must be completely accessible by the County's Controls staff, including the ability to make graphical changes and access to programming. Proprietary or control systems with restricted access will not be permitted. Any specialty software needed to make changes to the system or equipment must be provided to the County. The cost of speciality software licenses shall be included in the tender price. Designer to confirm the specific specialty software required with the County directly.

Terminal control units (TCUs) shall specify standalone microprocessor-based controllers that will continue to control if communication with the sub-network fails. Use TCUs to control terminal heating/cooling devices only.

Specify electrically powered actuators to drive all valves, dampers, and other control devices. The sole exception is large three-way valves where an electric actuator cannot be sourced. All damper, valve, etc. actuators to be accessible.

Select control valves with flow characteristics to match the application. Do not oversize valves. Specify the flow coefficient (Cv) for all control valves.

Specify electronic room thermostats that allow access to TCU set points and configuration information, by either:

- a communication port for the PCs, or
- a display window and program keys incorporated into the room sensor. Program keys and display window only required for areas where user input is desired.

All controls wiring to be in EMT or rigid metal conduit unless within a protected space. Plenum rated control wiring shall be specified where appropriate. It's not allowed to use EMT for industrial applications (e.g. Water/wastewater treatment plants). Rigid Galvanized Steel or Rigid PVC conduit to be used for corrosive or outdoor use applications.

BAS communication wiring shall be CAT6A for ethernet based communications. Fiber optic cabling shall be used should the run exceed 90m.

For all analog hardwired signals, twisted shielded cable shall be used. No splices are permitted, and installation shall be from BAS panel direct to equipment.

Current switches shall not be used. Where status is required, a current transducer outputting an analog signal shall be used.

Variable frequency drives (VFDs) speed command shall be via 4-20mA (preferred) or 0-10V (only if 4-20mA is not available) signal. VFDs shall have hard wired connections for status and control signals. Preferred points for VFD control through BAS include:

- Start Command
- Stop Command
- Speed Reference
- Speed Feedback
- VFD Alarm Point
- Amperage Draw

8.4.8.4 Software

Colour graphics user interface and application software will reside on the Oxford County controls servers. Contractor to supply original graphics files to the County.

Specify dynamic colour graphic screens as follows:

- For any building where graphics are being modified or added as part of a renovation, the existing building graphics are to be modified to match the style vintage of the new graphics.
- A main screen showing the basic floor plan of the facility indicating locations of mechanical rooms and major pieces of mechanical equipment.
- A screen for each mechanical system (AHUs, VAV boxes, RTUs, fan coils, etc.).
- A screen for each floor or zone to show space temperatures.
- A screen showing the network architecture of all BAS panels. The health and status of each processor shall as well as notification of a loss of communication to any panel shall be displayed.

All BAS sites will include single point trend data, available in BACnet/IP or Modbus TCP protocol, for each hard point and event in the entire database. These trends will be polling trends, recording at 15minute intervals and the BAS panel(s) shall have sufficient memory to store all of these trends for a duration of 72 hours. The trends will be rolling trends.

- Change of Value (COV) trends will be preferred and used instead of a polling trend when fewer samples will generate a longer trend history. I.e.: A room temperature will be set up as a COV, single point trend with 1 degree granularity when the room temperature is expected to vary little.

8.5 BUILDING IT INFRASTRUCTURE / AV SYSTEMS

8.5.1 Reference

It is the responsibility of the Designer to be aware of all applicable regulator requirements, including those not listed below, this shall include the provincial and federal legislation, and municipal standards when designing projects.

The following standards, codes, legislation, and authorities should be reviewed and referenced, at minimum, to complete the capital projects:

a) ANSI/INFOCOMM 4-2012
b) DS/EN 50157-2-3
c) CAN/CSA-ISO/IEC TR 14543-4
d) T568.1-1-05

e) Ansi/TIA-568-B.1
f) Ontario Building Code
g) Ontario Electrical safety Code

8.5.2 General

- Coordinate A/V requirements with the County.
- Please provide Network bandwidth calculations prior to tender.
- Provide broadcast frequencies of devices for approval by County - devices must be tunable- all wireless / RF gear / ALD.
- Please provide POE (Power over Ethernet) budget calculations prior to tender.
- Please provide Serial # & MAC Address for each item in tabulated form.
- Page zones are to be made available to all users in smaller zones:
- Be sure to specify a wall mountable weatherproof CB style microphone to the pool deck for emergency pool page only.
- All rack mount UPS shall have data ports connected back to the Oxford County network for remote monitoring.
- Basis of design is the 70V speaker line.
- Network cabling to be installed as per **Oxford County's Network Wiring Standards**.
- Basis of Design for Arena - Wireless microphone to be a dual channel wireless receiver with both audio outputs routed to the corresponding arenas.
    - Only one (1) handheld microphone will be required at time of install. Second wireless channel is for future events or if future wireless expansion is needed.
    - Wireless system to have remote antennas mounted in each corresponding arena, antenna cable to be factory-built cable and any RF inline amplifiers to be installed according to factory specifications to have proper RF gain structure.
    - Handmade cables will not be accepted.
- Network switching manufacturer to be fully defined.

8.5.3 Assistive Listening Device Systems (ALD)

Generally, to code for assembly occupancies. Induction Loop currently preferred. Make allowances in millwork, floor, or ceiling for Induction loop at public service desk locations.

8.6 BUILDING SECURITY

8.6.1 General

Security considerations should be determined in the Functional/Spatial Program development stage and fully incorporated during the Schematic and Design Development stages. This allows security measures to be incorporated into all building systems and subsystems early in the design process.

Security measures specified for a building should consider the costs in relation to capital and operating estimates, and any potential limitation on service program delivery or capacity. The combination of security measures and flexibility to determine suitable levels of security, in keeping with program requirements, can be considered the most cost-effective protection.

Security measures may include access control systems, surveillance systems and security alarms, and are to be based on a threat and risk assessment, in accordance with Crime Prevention Through Environmental Design (CPTED) principles (Refer to Sub-Section 9.2.2). Additional costs must be identified during each project phase.

Security camera placement must be designed in accordance with **Oxford County Policy 8.11** Video Surveillance Policy.

8.6.2 Crime Prevention Through Environmental Design

Building design, site planning, and landscape design should consider the principles of Crime Prevention through Environmental Design (CPTED) to ensure the safety of users and staff, visitors and the public by deterring criminal activity through design. Designers should consider the following three principles.

- Natural Surveillance: Designing to allow for people to easily observe the space around them, and to eliminate hiding places.
- Territoriality: Allowing for a clear designation between public, private, and semi-private areas to make it easier for people to understand and participate in an area’s intended use, to create a sense of ownership, and to discourage criminal activity.
- Access Control: Reduce criminal accessibility by limiting the number of entry points to the property and building and by implementing physical and electronic access control hardware. These principles should be applied to all projects through the use of the following design and performance requirements.

8.6.2.1 Access Control

Discourage entry into non-public areas by restricting public access through the implementation of access control systems. Use locks, non-removable pin hinges, astragals, and other measures to discourage access. Avoid providing pathways that allow for unobserved access.

Clearly identify buildings with a street number to assist emergency services.

8.6.2.2 Common Spaces

Locate active interior occupancies adjacent main exterior spaces and main entries to provide natural surveillance. Design exterior garbage and recycling facilities to screen containers and minimize opportunities to hide. Exterior sidewalks should be wide enough and landscaped to avoid creating narrow corridors, which could be perceived as threatening.

8.6.2.3 Entrances

Clearly identify entrances to make them visible to users through design features and signage. Where possible, minimize the number of entry points.

Clearly guide the public to and from entrances through the use of sidewalks, paving, fencing, lighting, signage and landscaping.

8.6.2.4 Fencing, Bollards, and Landscaping

Where required, fencing, walls, or landscaping along the front of buildings should be kept low, support surveillance from the street and minimize hiding places. Avoid landscaping that obstructs views of the building entry from the street.

Use low groundcover, shrubs, or high canopied trees at parking areas and sidewalks.

Avoid placing large landscape features, accessory buildings, or utility structures next to buildings where they could provide a means of access.

Use gates, fences, walls, landscaping and lighting to prevent or discourage unauthorized access to dark or unmonitored areas. Where appropriate and suited to specific project functional and program requirements use pavement textures, signage, landscape, screening, and fences to define and outline ownership of space.

- To protect building assets, equipment, utilities, or other infrastructure from potential damage caused by vehicle or equipment traffic, bollards shall be installed where required. Bollards should be designed to: Provide sufficient height, diameter, and embedment depth to resist anticipated impact forces.
- Be constructed of durable materials (e.g., steel, concrete-filled steel) with corrosion protection.
- Be spaced to prevent vehicle access while still allowing safe pedestrian movement where applicable.
- Be clearly visible through paint, reflective striping, or other markings to minimize accidental impact.

Comply with applicable municipal standards, accessibility requirements, and Ontario Building Code provisions.
Shop drawing to be submitted by Contractor to ensure compliance with bollard design before installation.

8.6.2.5 Lighting for Building Security

Provide exterior lighting that enhances natural surveillance. Ensure adequate visibility in all outdoor areas to allow their use in the dark. In areas used by pedestrians, provide lighting to avoid possible entrapment areas, and focus lighting on safe routes. Dark sky and cut off lighting shall be used where possible.

Avoid general lighting of areas not intended for use in the dark, and provide motion activated lights in these areas. Lighting should be uniform to avoid creating contrast between over and under lit areas, which will enable hiding. All exterior lights should be controlled using photoelectric sensors in addition to any other lighting controls. Coordinate the placement of lighting and surveillance cameras appropriately.

Consider landscaping in the development of the lighting design.

8.6.2.6 Natural Surveillance

Public and semi-private spaces should be located so that they maintain an unobstructed view from high use areas. Barriers adjacent exterior sidewalks should not obstruct views.

8.6.2.7 Security

Reduce unauthorized access by incorporating security hardware at entry points. Hardware types, functions, operating conditions and other requirements are to be determined during Conceptual and Schematic Design phases. All security systems shall be hardwired to the facility.

8.6.2.8 Building Design

The building design shall include the following crime prevention measures:

- Orient main building entrances towards the main public street.
- Minimize the number of entry points.
- Staff entrances, if separate from the main entrance, should be visible from the street or other high-traffic and “generally occupied” areas.
- Avoid hidden recesses.
- Locate parking areas so they can be observed by nearby occupancies.
- Avoid large areas of parking.
- Open spaces must be clearly designated and located so they are easily observable.
- Avoid creating the potential to climb up buildings to upper levels, roofs, canopies, or ledges. Avoid fencing or other features up against walls, downspouts, or other surface articulation without some means to deter people from using them.

8.7 KEYS

Develop a keying schedule for review and approval by the County, that adheres to existing master and grand master keying systems as required. All facility keys must follow OBC Division B, part 3 guidelines.

All cores must be selected so that keying can be completed locally. If specialty or high security cores are being considered, it is recommended that the consultant confirm with local companies that the key core can be ordered and keyed.

For renovations and additions, all key cores must match the existing building for a consistent keying system.

Allow for five (5) keys per lock.

8.8 ELECTRONIC ACCESS

Provide hardwired electric or keypad access control device at all main and staff entrances and all service areas.

If not stated in the functional program, confirm the requirements for after-hours access to spaces. Design the building to allow for access to these spaces while maintaining the security of the rest of the building.

8.8.1 Access Control and Intrusion Detection

8.8.1.1 Access Control

Provide access control for all buildings accessed by the public, and for buildings containing 20 or more full-time occupants. Access control to consist of electronic access passes (cards), card readers, door hardware and door access control system.

System to be fully integrated and connected to Oxford County servers.

Access control to be designed to record events (enter/exit requests), as well as forced entry through REX detection. Connect to building management system to determine areas of occupancy or unoccupied areas. Armed and locked indicates no occupancy.

Designers to consult with **Oxford County Facilities** if electronic access is required.

8.8.1.2 Intrusion Detection

For buildings with 24-hour access (hospitals, residences, etc.) intrusion detection is limited to service spaces, LAN rooms and medication storage rooms. Provide passive infrared sensor (PIR) detection within the space, and perimeter detection of exterior and secure doors and windows using position switches and glass break devices.

Provide separate partitions based on the functional requirements, so that one (1) area can remain locked, while others are open (this is particularly important for after-hours access, such as in schools). Zone areas accordingly for after-hours access. Make allowance for the physical separation of spaces in the architectural design.

Provide a mechanical partition within the security panel, to allow for critical alarms to be passed to the alarm monitoring company.

8.9 VIDEO SURVEILLANCE

Where required by the functional program or where indicated by **Oxford County Facilities**, provide networked video surveillance of the building to allow for video surveillance on the premises and within the building. Cameras required to store footage on Oxford County's central server, and have a minimum quality of 720p (30 frames per second).

If required, camera locations to be selected in consultation with County staff to ensure compliance with **Oxford County Policy 8.11**.

All cameras to be IP based, and capable of being ported through building LAN equipment. Select camera type based upon location and application.

- Provide IR sensing, low light cameras for exterior locations.
- In large open parking lots, outside schools, or high value installations, provide IR source lights, for improved visibility of IR cameras.

Providing documentation as required to review the orientation of cameras, and to identify any areas of the camera coverage that require masking to protect sensitive information or personal privacy.

8.10 ALARM SYSTEMS

All alarm systems must follow OBC Division B requirements and designer to consult with Oxford County Facilities if building alarm systems are required (outside of process alarms through SCADA system).

Control system shall be capable of receiving building alarms and taking the necessary action to alert operator of failure. All critical building alarms shall be processed through building security system. Non-critical alarms shall alarm locally at panel or graphic display. In buildings where a Building Management Systems are installed, provision for secondary email callout shall be provided.

Buildings without access to security call-out, phone, or internet shall be provided with visual alarms, pro-talk or satellite call out. At minimum, critical alarm shall illuminate exterior strobe located in a visible location, non-critical alarms to indicate at local panel.

In seasonally occupied buildings, alarm function shall be capable of being disabled during unoccupied periods.

At a minimum the following critical alarms shall be provided as applicable.

- Building low temperature alarm, based on any one (1) room thermostat.
- Sprinkler room low temperature alarm.
- Domestic water tank low level alarm.
- Septic holding tank high level alarm with domestic water shut-off interlock.
- Sewage lift station high level alarm, and lead pump failure.
- Low fuel alarm.
- Fuel spill sensor.
- Fuel transfer pump failure.
- Boiler failure.
- DCW frost protection failure.
- Generator failure.
- Propane tank heater failure.
- Transfer switch position notification or alarm.
- Flood monitoring water level sensor alarms.

At a minimum the following non-critical alarms shall be provided as applicable.

- Domestic water tank high level alarm to notify fill operator.
- Lead domestic water pump failure.
- Lift station lag pump start.
- Ventilation system freeze protection.
- Lead boiler failure/lockout.
- Lead pump failure.

8.11 BUILDING ELECTRICAL

The intent of this section is to outline building service electrical design requirements.

8.11.1 References

Meet or exceed guidelines and standards of the following BAS organizations:

a) Canadian Standards Association
b) Illuminating Engineering Society (IES) of North America
c) Institute of Electrical and Electronics Engineers (IEEE)
d) Insulated Cable Engineers Association
e) Canadian Electrical Code (CEC)
f) Ontario Electrical Safety Code (OESC)
g) Ontario Building Code (OBC)

8.11.2 Existing Building Electrical Systems

For projects where an existing building is being renovated or being added to; the Basis of Design for the new electrical system is to match or exceed the existing base building system.

Design Consultant shall identify existing equipment to remain in place for systems being modified. Design Consultant shall coordinate with the County to determine shutdown, maintenance, and long-term preservation requirements for dormant equipment for long term construction projects as appropriate.

Design Consultant shall identify existing equipment being removed or abandoned under the project and define decommissioning procedures and requirements in the project specifications. Design Consultant shall identify if any regulatory requirements exist for equipment to be decommissioned and who will be filing the necessary documentation.

8.11.3 Service and Power Distribution

8.11.3.1 Utility Service

Coordinate new and modified services with the Electrical Utility and Facilities at energy@oxfordcounty.ca. Refer to latest Electrical Utility connection guide.

8.11.3.2 Sizing

Building loads shall be calculated in accordance with OESC and CEC Part 1.

For multi-building sites, or sites with service voltages over 750V, coordinate electrical services with the County.

- Single building services with service voltage under 750V shall be sized as follows:
  - Size main services and service transformers according to connected load with the appropriate load factor applied. Disclose service sizing criteria in design documentation.

- Calculate connected load using load factors as dictated by the type of load, plus an allowance for future load growth. Discuss future load allowances with the County.

For additions to existing service/feeder, provide calculation as per OESC Section 8. County to provide maximum demand load for most recent 12-month period where available. Final Load Calculation(s) to be included in drawing set and to be based on a detailed analysis of the building existing and additional load with an allowance for future growth.

8.11.3.3 Single Line Drawing

Provide electrical single line diagram as part of the Contract Documents, indicating the following:

- Configuration, type, voltage, and amperage ratings of switchgear, transformers, panelboards, and motor control centres (MCCs).
- Type, size, and amperage ratings of services and feeders.
- Type, frame size, and trip rating of overcurrent protective devices.
- kAIC rating of switchgear, panelboards, transformer secondaries, and overcurrent devices.
- Service and distribution grounding/bonding:
- Existing Building: Provide complete facility wide single line diagram; partial single line diagrams will not be accepted. County to provide existing master single line diagrams where available.

Provide copies of single line diagrams from Record Drawings, recording actual construction, to:

- Incorporate into Operating and Maintenance Manuals.
- Display in frame with clear plexiglass and hang in each major electrical equipment room, with equipment in the respective room highlighted. This requirement is to be included in the electrical construction specifications.

8.11.3.4 Protection and Control

Perform arc flash, short circuit, and coordination study in accordance with CSA Z462 complete with arc flash labels for all equipment to inform and validate requirements below.

Ensure priority tripping and coordination of overcurrent and ground fault devices. Provide final consolidated trip curves.

Ensure adequate fault interrupt ratings of all switchgear, panels, MCCs, and overcurrent devices. Provide calculation results when requested by the County.

Use fully rated overcurrent protective devices throughout distribution system. Series-rated combinations may only be used with permission by Oxford County.

Where ground fault protection is provided on services and feeders, ensure protection is also provided for downstream feeders and loads that are susceptible to nuisance ground faults. Ensure ground fault equipment is coordinated to prevent upstream devices tripping before downstream devices.

Evaluate the feasibility of peak demand control through the use of load shedding or emergency generation equipment. Review all options with the County.

8.11.3.5 Harmonics

Building shall meet IEEE 519 requirements at PCC. 519 compliance. Design should account for harmonic mitigation to provide compliance and a study of harmonics should be provided during the design stage. As part of a full load commissioning test and/or monitoring of ITHD & VTHD throughout the first year of operation. If harmonic level is deemed to not meet the IEEE 519 requirement, then harmonic mitigation shall be provided through active harmonic filters or VFD active front ends.

8.11.3.6 Service Spaces

For services under 200A: Main Electrical Service Room may be a shared Mechanical/Electrical space.

For services over 200A: Main Electrical Service Room to be dedicated room containing no mechanical/plumbing fixtures.

.1 Electrical Room

Locate at grade or above if in flood zone when room contains critical pieces of electrical equipment (i.e. Main Switchgear, Generator System, etc.). Electrical rooms not to be close to mechanical equipment, ducts, pipes, shafts, or water contain mains unless the equipment is serving the room.

Provide a minimum of one (1) electrical room sized 1800mm by 3000mm (6’ by 10’) for every 930 sq. m (10,000 sq. ft.) of floor area served or portion thereof.

Doors to be large enough (width and height) to allow for the removal and replacement of the largest piece of equipment.

Provide raceway system between all Electrical Rooms, Closets, and Network Access Rooms.

Where a room contains heat generating equipment, adequate cooling and/or ventilation shall be provided by mechanical.

.2 Electrical Closet

Electrical closets are not permitted to contain transformers, motors, or other heat generating equipment.

Locate electrical closets in core areas of the facility and stack vertically where possible.

8.11.3.7 Grounding & Bonding

Ensure that grounding and bonding is compliant with OESC Section 10 and with Section 36 for systems greater then 750V.

Ensure that all connections to be labelled with their destination.

Design for underground or concrete embedded connections are to be exothermically welded and/or by using a compression system that meets IEEE 837-2014 standard.

8.11.3.8 Switchgear, Panelboards, and MCCs

.1 Switching and Overcurrent Devices

Use bolt on molded case circuit breakers with thermal, magnetic trip for all circuit protective devices except as follows:

- For services over 750V, provide relaying using relay accuracy class CTs with test block and solid-state relays with trip indication for each function. Provide a DC battery source for control and tripping.
- Use industrial duty, draw out type air circuit breakers for all services and feeders 800A and over.
- Use circuit breakers with maintainable contacts, complete with electronic trip units and trip indication for all main service or feeders for all services over 400 Amps and under 800 Amps.
- Use metal enclosed switchgear with air vacuum circuit breakers for all greater then 750V.
- Obtain the approval of Oxford County for the use of fused equipment. Consideration will only be given where fault duties of equipment require a limitation of the available fault current.

.2 Bussing

Use solid copper for switchgear sized 200A and over. Provide min. 25% spare capacity for future growth and ensure bussing extends to all spaces for future growth.

.3 Metering & Power Monitoring

Metering within a facility: Include for power monitoring (recommend Owner hard spec a particular brand, i.e. Eaton PQM II Power monitors) on all main power distribution feeders and equipment. Power monitors shall communicate via Modbus TCP and shall communicate to the facility BAS.

Service entrance/Utility metering: Provide integral, multichannel, owner metering for incoming utility service and distribution feeders unless otherwise directed by the County. Contact Engineering Services for currently recommended models. On larger, more complex distributions consider sub-metering on secondary distributions & Panels. Consult with Engineering Services.

Where feasible, consider submetering to support monitoring-based commissioning services. Feasibility should be evaluated based on whether the load is sufficiently large to justify both the capital investment in metering equipment and the ongoing operational costs associated with data monitoring.

Typical power monitoring signals shall include true RMS, values for phase voltage (line to line and line to neutral), phase currents, kVA, kVAR, kW, PF, Hz, MWh, kWd, kVAd, ITHD, and VTHD.

Consultant shall ensure that any required meter setup, control, or monitoring software is to be supplied to the County.

.4 Control

Control through MCCs generally via Building Management System (BMS)/BAS connection.

.5 Panelboards

The design of panelboards shall consider the following:

- Copper bussing.
- Bolt on style breakers.

- Maximum number of breaker positions in a single tub to be 60. Double wide is acceptable. Provide minimum 225A bussing for panelboards with 42 or more positions.
- Do not use feed through.
- Provide panel schedules indicating breaker size and wattage of all connected loads. Panels to be a maximum of 75% filled at the completion of Construction.
- Hinged, door-in-door construction.
- Lockable.
- Distribution panelboards to be located in dedicated rooms and closets. Provide additional space on wall for at least one (1) future panel.
- Single pole breakers with handle ties are not permitted in place of multi pole breakers.
- Provide minimum of two (2) spare 27mm conduits c/w pullcord to ceiling space for all recessed panelboards.
- Combination (single cabinet) transformer and panel board are not acceptable.
- Wire splices required for panel replacements are to be completed with terminal blocks, housed in a separate enclosure.

.6 Accessories

Provide lifting equipment for all industrial type air circuit breakers, high voltage switches and stacked high voltage starters.

.7 Working Clearances

Provide all switchgear and MCCs with minimum 1m front clearance as required by OESC, in addition to space required for drawout equipment in full disconnect position, and all free-standing switchgear with minimum 1.0m back and side clearance.

.8 Housekeeping Pads

Provide all floor mounted equipment with a 100mm (4”) housekeeping pad except for roll-out style switchgear.

.9 Outdoor Pedestals

Provide precast concrete base and local heater to provide minimum temper heating to 5°C to facilitate proper operation of equipment and prevent condensation.

Provide protection for outdoor electrical equipment against physical damage, moisture, and corrosion as necessary.

8.11.3.9 Transformers

.1 Location

All Transformers shall be installed such that replacement is possible without unforeseen building modifications nor surface or structural damage. Provisions may include double doors, expanded hallways, reinforced and or widened routes to loading docks and grade, removable wall panels, top access pits, etc.

Main Building Transformers: Locate main power transformers outside with pads or vaults as per Electrical Utility guide. Provide bollards or screens where required by project. Location to be serviceable as required by Electrical Utility standards and as close as possible to building service entrance to reduce capital and operating costs (line losses). All primary, MV services to be in fully isolated, interior vault segregated from 600V or lower distribution.

All Indoor Transformers over 45kVA: allow for removal by wheel mounted equipment.
Indoor transformers are to be preferentially floor mounted on housekeeping pads. Suspended installation only permitted for transformers within service rooms where there is lift accessibility. Transformers 45kVA and less may be cantilevered/wall mounted where access is not impeded by other equipment. Coordinate transformer heat removal with Mechanical.

.2 Type

Use minimum K-4 rated distribution transformer. Increase K rating or opt for HMT, Zig-zag, and/or alternating phase layout where advisable due to amount of non-linear/harmonic load.

Autotransformers only permitted for dedicated equipment step-up/down applications.

Copper wound transformers are preferred and shall be specified where practical.

Combination (single cabinet) transformer and panel board are not acceptable.

.3 Secondary Voltage (isolation/distribution)

- 347/600V, three-phase, four wire, solidly grounded wye.
- 120/208V, three-phase, four wire, solidly grounded wye.
- 120/240V, single-phase, three wire, solidly grounded, center tap.
- Obtain approval from the County for other voltages, connections, or any impedance grounding schemes.

.4 Acoustical Considerations

Ensure adequate acoustic ratings, treatment location and mounting of transformers.

8.11.3.10 Power Factor Correction

For sites with considerable motor loads preliminary calculations indicating power factor to be provided.

Power factor correction shall adhere to the following:

- Correct power factor to at least 95% where normal loading yields a power factor of less than 90%.
- Locate PFC close to the motor or group of motors, preferably downstream of starters.
- Review use of automatic correction equipment with the County.

8.11.3.11 Feeders

Feeder conductors must be copper. Provide a full capacity neutral for main service and for four wire systems as well as a bonding conductor with all feeders.

Other than main service feeder cables and/or raceway, feeders are not permitted to be located in slab or below slab-on-grade.

8.11.4 Motor Protection and Control

8.11.4.1 General

Where possible, provide motors ½HP (0.37kW) and larger as three-phase units and provide motors larger than 1 hp (0.75kW) as three-phase 600V units. Provide motors smaller than ½HP (0.37kW) as single-phase, 120V units. Usually with integrated thermal overload.

8.11.4.2 Motor Protection and Control

Do not use fuses for individual motor overcurrent protection. Instead, provide single-phase protection for all three-phase motors using relays, differential overloads, or BAS shutdown. Ensure there is space on the back panel for BAS current sensors.

Consider harmonic contribution when designing VFDs and provide filtering as required.

8.11.4.3 Control Wiring

Coordinate control requirements with mechanical designers. Indicate control branch circuits on electrical schematics and panel schedules. Low voltage control wiring to be run in conduit, Teck cable or otherwise mechanically protected.

8.11.4.4 Variable Frequency Drives

.1 <u>General:</u>

VFDs, while effective for many control and energy saving system designs, should only be used if there is a positive payback and control effect not otherwise achievable by moderately sized, across the line motor starters. VFDs should not be used as a substitute for soft starts. For very small HVAC applications, ECM motors should also be considered.

Pump mounted or other equipment integrated drives with custom mountings and form factors are not acceptable.

.2 <u>Location:</u>

Drives location shall be co-ordinated with the County. Location shall be in an electrical room or located as proximate to motor loads as practicable and feasible. Drives shall not be located in any environmentally harsh or excessively dusty or dirty environment without extraordinarily rated enclosures and other mitigating methods.

Consider maintenance implications in terms of accessibility and replacement items such as filters.

.3 <u>Bypasses, Branch Circuit Wire Size & Over Current Protection (OCP):</u>

Bypasses are generally not supported or advisable as many variable speed applications cannot be run safely or effectively without speed control. High availability, when required, is best achieved by fully redundant n+1 drive trains including VFDs, motors, and rotating equipment (pump, fan, etc.) to best address all failure modes. In these scenarios be sure to consider adequate, if not necessarily full, system capacity in failure scenarios and also employ duty cycling, swapped lead, or other methods to keep all units operationally tested and worked. If a bypass is required (i.e. parkade ventilation) then all wiring, OCP, overloads, etc. shall be sized as in a standard, across the line application.

When bypasses are not specified, VFD branch OCP and conductors should match and be sized as per manufacturer's recommendations or otherwise 125-175% of drive rated FLA.

.4 Enclosures:

VFDs shall have adequate local LCD/LED control panel and display for configuration and control. Also, where the is a BAS system, full Modbus/ BACnet connectivity is required for monitoring and control.

VFD component should generally be specified with integral fusing and disconnects and in a NEMA 12 enclosure.
Drives and above input & output filter elements and bypasses may be neatly mounted separately or located in an integrator enclosure. All such integrator enclosures must be heat run tested at full load for 24 hours and not exceed manufacturer's published environmental limit for any interior components (i.e. drive, filters, etc.). All enclosures shall have active, redundant fan ventilation with over-temperature and fan failure alarms. Only filter inlet ports. When an integrator supplies an enclosure with multiple components they have full design, commissioning, and warranty responsibility for the entire package.

Input voltage rating +/- 10% or better of nominal.

.5 Motor Protection & Wiring:

Output from drive/filter to all motors (or to motor starter, overload & disconnect distribution and on to motors) shall be correctly wired. Co-ordinate with VFD vendor to determine if drive/VFD "Teck" style cable similar to Beldan Symmetrical YC4936x series or Nexans DriveRX.is required.

All motors shall be inverter grade and explicitly rated as meeting the NEMA MG1 Part 31 standard with respect to insulation withstand of 3.1 times or greater of the rated voltage with rise time of 0.1 microseconds.

Output to motors larger than 10HP shall be via a dV/dT Full Sine filter might be considered if motor accessibility is very poor or in a retrofit application to non Part31 motor.

Motors over 20HP should be specified with shaft grounding bushing if they are not otherwise shaft grounded by equipment connection or conductive fluid coupling.

Where VFDs are mounted remotely, provide local safety disconnect at motor local safety disconnect must be labeled in visible location with "Safety Lockout ONLY. Shutdown and disconnect VFD before switching."

8.11.5 Surge Protective Devices

Provide surge protective device (SPD) on Utility incoming mains. For areas containing a large group of electrically sensitive load, provide surge protection on panelboards serving the area. Coordinate surge suppression devices within the same power distribution system.

8.11.6 Branch Wiring

8.11.6.1 General

Use copper conductors minimum #12 AWG conductor size, unless otherwise specified. Provide a separate bonding conductor in all branch circuit raceways. Conduit shall not serve as bond.

Branch circuit cable and/or raceway are not permitted to be located in slab or below slab-on-grade. Minimum raceway size to be 21mm.

Obtain approval from Oxford County for the use of non-metallic sheathed cables. Consideration will only be given for buildings of combustible construction.

Use AC-90 cable only in short lengths, less than 3m, for final connections to luminaires and similar equipment or vibration isolation.

All receptacles to be specification grade.

All branch circuits to be labelled with panel name and circuit designation.

- For circuits less than or equal to 20A and 240 volt, panel name and circuit designation to be indicated with a wrap-around style label on the faceplate and permanent marker inside the box.
- Otherwise, all higher voltage and ampacity circuits to have lamacoid style labels with panel name, circuit, and voltage/phase.

For high humidity applications, ensure surface raceways are galvanized steel or PVC and painted (coordinate with Architectural).

8.11.6.2 Provisions for Computer and A/V Based Equipment

Identify electronic equipment and systems likely to be affected by electrical service disturbances including voltage sags, surges, short and long-term transients and outages. For this equipment, determine the extent of protection necessary for normal operation.

Protection and Power Conditioning:

- Isolation Transformers: electrostatically shielded transformers for equipment affected by transients and noise.
- Regulated Power Supplies: for equipment and systems affected by transients, noise, voltage sags, and surges.
- Electronic Filters: for equipment affected by power line noise.
- Uninterruptible Power Supplies: for equipment requiring continuity of service.

Computer Circuits:

- Generally, supply only two (2) computer workstations per circuit.
- Provide a separate, dedicated bond and neutral back to panel for each circuit.
- In situations where multiple circuits will supply potentially interconnected equipment in an area, ensure the circuits feed from a common panel.

Include provisions for electrical requirements to support IT network switches.

8.11.6.3 Block Heater Outlets

Design to shut off all power to outlets when outside temperature is above -10°C. Assuming supply sized to supply all outlets simultaneously, inhibit cycling below -30°C.

Use the building's BAS system to control parking lot loads where possible. Coordinate with the Mechanical Section.

Provide override switch (i.e., H-O-A) for parking lot controller testing/maintenance.

8.11.6.4 Electric Vehicle Supply Equipment

All EV charger installations are to be coordinated with County Fleet and Energy Management. Ensure that EV chargers are monitoring-enabled and payment-enabled including network connection. If more than one EV charger is planned to be installed, consider utilizing dual-port chargers in place of two (2) single port chargers. Charger to be SAE J1772 compatible.

Charging stations to be located as close as possible to the electrical supply service while also assuring that they are conveniently located for drivers. Provide self retracting cord where possible.

Provide curbs, bollards, wheel stops and/or equipment setbacks to prevent vehicle damage to equipment. See **Section 8.6.2.4** for bollard design requirements. Provide adequate lighting in area of charger to facilitate nighttime use.

Consideration to be given to using higher charge rate equipment (40A, 240V).

8.11.6.5 Provisions for Equipment

Custodial:

- Storage/Janitorial rooms to have adequate (number and current capacity/type) receptacles for any equipment charging. Ensure mechanical is aware of any exhaust requirements due to battery charging.
- Ensure adequate (number and current capacity/type) receptacles throughout facility for equipment such as floor polishers, etc.

8.11.6.6 Provisions for Mechanical

Indicate location and circuiting of all mechanical control panels on drawings.

Coordinate electrical equipment required for mechanical equipment with the mechanical designer. Items may include UPS for head end of BAS systems, power filters, regulators, electrically powered valves and dampers, lighting in air handling units, heat tracing of piping or equipment, etc.

Rooftop receptacles to be on dedicated branch circuit.

Local disconnects to be provided for all mechanical equipment.

8.11.7 Life Safety, Emergency, and Security Systems

8.11.7.1 General

Provide emergency power for all life safety, security, and Mechanical Systems. Pay particular attention to fire rating of emergency lighting feeds or feeds to smoke evacuation fans, elevators, fire pumps, or similar emergency life safety classed equipment. Provide battery backup for all systems with volatile electronic memory.

Where a Backup Power source is installed, ensure the following equipment are connected;

- All components of any heating system within the building,

- Building Automation System
- Additional freeze protection systems
- Critical systems on a case-by-case basis.
- Additional non-critical systems may be placed on standby power.

8.11.7.2 Life Safety

Automated external defibrillators (AED's) to be supplied and installed for all public facing facilities.

8.11.7.3 Fire Detection Systems

Fire detection and alarm systems to be in accordance with the Ontario Building Code (OBC) and the Ontario Fire Code (OFC).

Where a fire alarm system is not required by the OBC provide smoke and fire detection devices as discussed with the County.

Show F/A devices on plan drawing(s). Include a fire alarm system riser diagram in contract documents.

Use horn/speaker-strobe combination devices for audio-visual signals unless site conditions dictate otherwise.

Coordinate duct detectors with mechanical to ensure air velocities are compatible with detectors in accordance with OBC and OFC.

Coordinate sprinkler flow alarms and valve tamper locations with mechanical and indicate on fire alarm plan.

Indicate all auxiliary connections to the F/A panel, including elevators, BAS, emergency diallers, fire door hold-open devices, fan shut-down relays, cistern tank levels, etc.

Note that any and all consultant expenses for fire alarm verification are considered included in design and construction management fees.

All F/A wiring to be red FAS cable or fiber in conduit. BX/AC90 only acceptable for movement or vibration isolation, final device stub, or in a retrofit situation where running conduit not practical. Length to be 3m or less without explicit County approval and product must be factory supplied as red armoured FAS.

Fire Alarm Communications (dialer) to be provided for all Fire Alarm systems regardless of if required by the OBC or not.

Fire alarm panel monitoring to be completed by Fire Monitoring of Canada in alignment with the County's current service provider.

Ensure that the fire alarm system modifications are sufficiently coordinated with other systems:

- Elevator homing,
- Security system door locks,
- BAS system,
- Fire Suppression (if separate).

Update the facility fire plan as required based on modifications being made.

8.11.7.4 Generators

Environmental and Regulatory Compliance Review must be completed as part of the generator design.

Locate generator and associated electrical equipment at grade or above if in area subject to flooding. Provide sufficient clearances for maintenance and repair personnel to access all sides of the generator. Provide provisions for removal/replacement of generator at end of life that does not require substantial building modifications.

Provide protection for outdoor equipment against physical damage, moisture, and corrosion. Bollards shall be included in the design to protect generators and utility systems located outside. See **Section 8.6.2.4.** for bollard design requirements.

Transfer switches are to be capable of remote monitoring of generator status and state. When fire pump transfer switch is on generator power and pump is running, generator battle short mode shall be engaged.

Provide vibration isolators for field installation.

Paralleled generator configurations shall only be considered for extremely high availability applications and/or large loads. They shall be of integrated, PLC controlled switchgear style and fully configured to operate and load shed feeder breakers under failed generator and overload conditions. BAS only load shed not acceptable.

Service and parts shall be available within 24 hours.

Manufacturer shall provide a certified summary of prototype-unit test report. Manufacturer shall be experienced in installation and operation of generator set of comparable size.

Generator shall include at a minimum:

- Remote annunciator panel
- External Battery Charger.
- Braided fuel lines c/w union connections for fuel inspections (carburetor to tank)

Final Site Design Load Calculation(s) to be included in drawing set. Site Design load to be posted on each transfer switch with red lamacoid (white writing). Minimum size 50mm x 100mm.

.1 <u>Enclosure</u>

Generator to be installed within facility. Where not feasible and with County approval, a sound attenuated enclosure and Winter Package may be acceptable. Refer to section Generator Power Supply for Life Safety Loads for additional requirements for Life Safety loads.

.2 <u>Exhaust</u>

Exhaust shall discharge vertically for maximum dispersion modeling. Rain cap shall fully open without impeding the vertical discharge while the generator is operating. Position the exhaust point above roof level and away from air intakes.

.3 Ventilation

Outside air and recirculating motorized dampers to be provided. Ensure generator room layout allows for optimal generator cooling, intake and exhaust louvres to be configured as per manufacturer recommendations.

.4 Fuel Fill Port and Control Panel

Fill level indicator panel adjacent to exterior fuel fill port. Panel to contain six (6) indicator lights and lockable cover with clear plexiglass window:

- "Fuel Leak" (Red) (Local Audible Alarm at fill panel)
- "25%" (Yellow)
- "50%" (Green)
- "75%" (Green)
- "Tank Full - STOP FILL" (Red) (90%)
- "Overfill Alarm" (Red) (Local Audible Alarm at fill panel)

One (1) button:

- "Indicator Test" (momentarily activates all Indicator Lights (1 thru 6 and Local Audible Alarms)

Fill levels to be manufacturer set to allow for full -40C tank expanding to +40C. Automatic overfill prevention device to be used to comply with code. Fuel Port to have lockable cover. Plan for fueling accessibility and spill control during fueling.

"Fuel Leak" indicators (where applicable) to be tied to high level sensor within curbed generator room (or generator containment perimeter). CSA 282 compliant as required.

CSA Certification or approved equal.

.5 Annunciator

Panel to be located at Service Desk or Operator's station or as directed by the County.

Panel to contain four (4) indicator lights:

- "Generator Run" (Green) (Audible Alarm)
- "Generator Trouble" (Red) (Audible Alarm)
- "Generator Fail" (Red) (Audible Alarm)
- "Low Fuel" (Red) (Audible Alarm)

Two (2) buttons:

- "Silence Horn" (acknowledges and silences any alarm)
- "Indicator Test" (momentary button activating all indicators and audible alarms)

CSA Certification or approved equal.

.6 Sub-base fuel tank

Provide curb as well as built-in fuel gauge on the sub-base tank. Ensure two (2) fill ports are sufficient to facilitate fuel conditioning.

Exterior generator installation to have NEMA 4 spill containment device fitted to the inlet of the storage tank. Spill containment device to be at least five (5) gallons and must be lockable.

.7 <u>Stand-alone fuel tank</u>

Provide integral secondary containment with leak detector tied to indicators and alarms.

Provide levelometer.

Fuel tank shall rest on supports or piling made of concrete, masonry, or steel. Tank supports shall be installed on firm foundations designed to minimize uneven settling of the tank and to minimize corrosion of the part of the tank resting on the foundation.

Barriers such as bollards shall be used to protect exterior fuel tanks from mechanical damage by vehicle or other sources. See **Section 8.6.2.4.** for bollard design requirements.

.8 <u>Load bank</u>

Cam-lok connectors for load bank test to be E1016 Series, female and to be mounted in load bank quick connect (c/w non-conductive mounting plate) located inside generator room where clear path to outside is available. Otherwise, to be located adjacent Fuel Port and Control Panel (exterior).

LSI local breaker (generator) with hunt trip and aux. contacts for load bank connection.

Minimum load on generator to be 30% (or as dictated by monthly testing for installations to CSA C282). A permanent load bank is to be installed unless it can be shown that the site demand will not drop below the minimum load requirement.

.9 <u>Portable Generator Connection</u>

Cam-lok connectors for a portable generator to be E1016 Series, male and to be mounted in quick connect (c/w non-conducive mounting plate) located in close proximity to the Load bank connection.

Manual transfer switches are only permitted for installation to accommodate portable generator.

Combination Manual Transfer switch - portable generator cabinets are preferred.

.10 <u>Acoustics</u>

Refer to the section Acoustic Considerations: Electrical.

.11 <u>Overfill/Leak Protection/Diesel Piping Leak</u>

Overfill and leak protection is required on all installations as stated in **9.11.7.3.4**.

Double wall tubing is required where fuel fill tanks are stored indoors and fuel fill port is located outside.

In room spill control to be considered for elevated generator rooms or as directed by the County. Ensure room is capable of containing the capacity of the largest tank in the room.

8.11.7.5 Generator Power Supply for Standby Loads

Provide a minimum of one (1) receptacle in electrical and mechanical rooms connected to emergency power where a generator is installed.

Power to electrically actuated washroom fixtures shall be on standby power circuits if available.

8.11.7.6 Generator Power Supply for Life Safety Loads

CSA 282 shall be met for all generator installations powering Life Safety (L/S) systems as per code.

- EXCEPTION: All police, fire, and ambulance facilities shall have C282 compliant generator installations even if not required by code for L/S system service.

Generator to be installed within the facility. Where not feasible and with County approval, a climate controlled, sound attenuated, walk-in enclosure equipped with motorized louvres may be acceptable.

Where systems are required by code to run past 30 minutes, concrete encasement of conductors/conduit may be permitted in place of MI cable. County to provide direction on a case-by-case basis.

8.11.7.7 Uninterruptible Power Supply

Uninterruptible Power Supply (UPS) system are required to maintain the County Fiber network for facilities' VOIP and communications function during generator tests. Provide UPS power for all Emergency Services facilities or facilities that provide County Fiber connectivity to said facilities. OCT Network Analyst to provide a list of associated County Fiber switch sites.

Provide centralized UPS system for groups of loads unless otherwise directed. Provide all centralized UPS assemblies with a 100mm (4") housekeeping pad.

Locate the UPS within the designated area for network and server equipment, or near critical systems that require the reliable power source to prevent outages.

UPS system to include the following features.

- Static Bypass.
- External Maintenance Bypass Switches for centralized UPS systems.
- True Sine Wave output.
- Size battery for minimum 20-minute runtime at full load or as dictated by site specific requirements.
- Ensure the UPS is provided with a relay output card capable of general alarm and low-battery alarm dry contacts.
- For larger (>20 kVA) UPS consider vendor provided monitoring solutions, as directed by the County.

Consider the following for UPS design.

- Increased redundancy for complex or critical facilities.
- System scalability.
- System components to be hot swappable.

Provide ventilation and cooling requirements as required by manufacturer. Coordinate requirements with Mechanical Consultant.

UPS system to be provided the following alarm outputs to the BAS.

- AC power failure.
- Battery failure.
- Output failure.

UPS to supply power to the following systems.

- IT systems.
- BAS Head end.
- Client specific systems (Fire Rescue, Police, Public Library, Waste, etc.).

8.11.7.8 Egress/Emergency Lighting

Design emergency lighting in such a way as to ensure local emergency lighting is activated when normal lighting in the area it serves is disrupted at the branch circuit level, not just when main building power or major feeders are disrupted.

All battery powered emergency lighting unit equipment shall have auto-self test with audible battery failure alarm.

In all electrical and generator rooms provide battery powered emergency lighting unit equipment with a minimum 2-hour capacity or greater as required by any codes.

Integral batteries within standard area lighting fixtures not permitted without explicit approval from **Oxford County Facilities**.

8.11.7.9 Exit Signs

All emergency exit signs shall be designed in accordance with the Ontario Building code.

Any particular renovation/addition must be judged on its unique merit in terms of the implementation of new standard 'Green Running Man' signage vs. older 'Red Exit' signage. The factors will include, but not necessarily be limited to:

- Percentage size of new area (however *no* absolute number such as 51%)
- Impact on egress routes and need for clear wayfinding to building exits, i.e. Only one (1) signage style permitted on any egress route.

Acceptable solutions may include:

- Usage of older "Red Exit" signage in new areas to preserve the integrity of egress route wayfinding "system" and prevent confusion when exiting (particularly in lower area percentage renovations/additions).
- Mixed use of older "Red Exit" and new "Green Running Man" signage (i.e. situation where there is basically no crossing of exit routes and little to no connection between old and new areas; or situation where there would only be one (1) change of signage on the way out, such as a full floor renovation or additional building wing).
- Retrofit of entire building to new standard "Green Running Man" signage for a consistent egress route wayfinding "system" (preferred solution when renovation and addition would

be a substantial percentage, 50%+ of resultant new space, and said retrofit of old area would not result in undue cost).

Any project that is remotely questionable should be submitted to the Sustainable Development Building Inspection office for AHJ review at the conceptual stage to avoid unnecessary costs due to design changes or construction change orders.

8.11.8 Lighting

8.11.8.1 General

Design to maximize the energy efficiency of lighting systems and to lighting density level regulations from OBC.

All lighting must be LED.

Lighting controls (occupancy sensors, daylight sensors, etc.) should be considered where appropriate (i.e. not in mechanical rooms, or other areas where sudden reduced lighting levels could be considered a safety concern).

Only use the task-ambient approach where work surface and task orientations are predetermined and as agreed to by Oxford County.

Consider incorporating photoelectric layouts into the design package, discuss requirement with the County.

It is not necessary to design for worst case work surface and task orientations in general office space. Design to minimize direct and reflected glare and maximize contrast.

8.12 BUILDING FIRE SUPPRESSION SYSTEM

Automatic sprinkler systems, standpipe systems and fire extinguishers shall be provided where required by the OBC and installed to the relevant NFPA standards. Special cases, such as heritage buildings, may require automatic sprinkler systems regardless of the requirements of the code requirements and should be prescribed by the architects. Where automatic sprinkler systems are provided, they shall be designed and installed to the requirements of NFPA.

Architect to develop an Ontario Building Code (OBC) Matrix with each permit application, identifying key details as required in the OBC and herein.

8.12.1 OBC Matrix for Part 3 Buildings (Type 3)

For buildings governed by OBC Part 3, the OBC Matrix shall include the following information: project address and description, applicable OBC edition, designer name and BCIN (if applicable), major occupancy classification(s), building area (per floor and total), building height (in storeys and metres), number of streets facing the building, construction type (combustible or non-combustible), fire-resistance ratings of key elements, spatial separation and unprotected openings, occupant load, exit capacity, exit travel distances, number and types of fire protection systems (e.g., sprinklers, fire alarm, standpipe), emergency lighting and exit signage, barrier-free design provisions, and applicable energy efficiency compliance path. The Matrix must also identify any alternative solutions proposed, zoning designation, and site-related constraints affecting code compliance.

8.12.2 OBC Matrix for Part 9 Buildings (Type 9)

For buildings governed by OBC Part 9, the OBC Matrix shall include: project address and description, applicable OBC edition, major occupancy classification(s), building area and height, number of storeys, construction type, fire-resistance ratings of floors, walls, and supporting elements, spatial separation data (including limiting distances and unprotected openings), required fire protection systems (if any), emergency lighting and smoke alarms, occupant load (if applicable), number and size of exits, door swing and egress routes, basic barrier-free design requirements, and energy efficiency compliance path under SB-12. Zoning designation and any relevant site-specific considerations should also be noted.

All OBC Matrix must be sealed by a Professional Engineer or a Licenced Architects registered in the province of Ontario.

In applications where specialty systems should be considered, such as heritage facilities, data center, and archives areas, the relevant design guidelines combined with good engineering practice and the requirements set out in this document shall be used to determine the most suitable system.

8.12.3 Water-Based Fire Suppression

8.12.3.1 Water Storage Tanks

Install all fire water tanks in accordance with NFPA 22.

In facilities requiring water storage tanks for the provision of fire water, dedicated fire water tank shall be provided inside the building. Underground tanks subject to freezing and with restricted access are not acceptable.

Tanks shall be located to allow for inspection, cleaning and draining. Where the storage tank is located below the facility drainage system and a pump is required to fully drain the tank, provide a permanently mounted lift pump piped to a suitable drain location. Note that drainage systems that drain to a septic field are not considers suitable.

8.12.3.2 Fire Pumps

Fire pumps to be installed to the requirements of NFPA 20 and NFPA 13.

Electric fire pumps are preferred due to the decreased testing and maintenance requirements compared to diesel fired pumps. However, the Consultant shall perform life cycle costing analysis to compare increased cost of emergency generator supplying stand-by back-up power to an electric fire pump to the cost and maintenance requirements of a diesel pump with consideration to facility location and availability of maintenance personnel.

8.12.3.3 Dry-Pipe Systems

.1 General Requirements

Dry-pipe systems shall be used only in areas where piping is subject to freezing and adequate coverage cannot be provided using dry heads fed from an interior wet system.

Dry systems shall be installed to provide proper drainage to common auxiliary low point drains located to facilitate annual maintenance. Low point drains shall be clearly identified and a legend indicating the drain valve locations shall be clearly displayed at the sprinkler tree.

Drains shall be located inside the warm space wherever possible and be piped to a suitable drain capable of handling the expected flow.

Dry valves shall be equipped with galvanized trim package and be selected with pressure rating consistent with the air compressor.

Nitrogen based dry systems may be used where life cycle costing and total cost of ownership analysis shows it is favourable over a conventional compressed air system and where approved by the County.

.2 Air Compressors

Dry system air maintenance devices shall be selected and designed in accordance with NFPA 13.

Compressor sizing shall be designed and selected based on the dry valve requirements, systems size, and the requirements of NFPA 13. Tank mounted oil-less compressors are preferred.

For small systems requiring less than 28.3L/min (1cfm), a small riser mounted unit may be considered.

Compressors shall be equipped with integral regenerative desiccant air dryers and filtration capable of providing compressed air with a -40°C dew point. Compressor units shall be factory assembled and complete with all necessary controls for automatic operation. Shall include run time meter.

.3 Piping and Fittings

Piping shall be selected to minimize corrosion. Hot-dipped galvanized piping, or equal shall be used throughout dry systems.

Piping above 50mm shall be assembled with grooved fitting complete gaskets rated to a minimum ambient temperature of -40°C.

Gaskets shall not protrude into the pipe such that it would impede water drainage or cause water to collect at joints.

8.12.3.4 Wet-Pipe Systems

Wet-pipe systems shall be installed where required to the requirements of the Authority Having Jurisdiction, OBC, and NFPA 13.

Sprinkler heads shall be selected based on the intended hazard and area of coverage. Upright heads are preferred in areas with exposed piping. Provide concealed type heads where installed under 2.4m above floor in facilities that may be subject to vandalism such as institutional facilities.

Wet piping shall not be run in exterior walls or areas subject to temperature below 5°C.

8.12.3.5 Standpipe Systems

Install standpipe system in accordance with the OBC Section 3.2.9 and NFPA 14. Coordinate with requirements of **Area Municipality Fire Department, Oxford County Facilities** and Authorities Having Jurisdiction.

Standpipe valve shall be located in valve cabinets in areas accessible to the public or where they may be subject to vandalism.

Assess cabinet door closure and requirements for locks to be considered with respect to location and hazard. Doors without locking closures are preferred where practical.

All cabinets to have breakable glass front if locked.

8.12.3.6 Installation Requirements for Water Based Fire Suppression Systems

Piping 50mm and under to be Sch. 40 and shall be assembled using threaded, FM approved, fittings.

Quick response heads should be used wherever permitted by NFPA 13.

Systems shall be equipped with all required allowances for maintenance as required by NFPA. Arrange system to facilitate servicing and draining.

All drain valves, inspector tests and testing appurtenances shall be clearly labeled and identified on record drawings submitted at the completion of the project.

Provided all signage and identification in accordance with NFPA.

Zoning shall be in accordance with NFPA and the Authority Having Jurisdiction. Coordinate with fire alarm system. At minimum, provide individual zone at each floor and in attic.

Protect water service against back flow in accordance with National Plumbing Code.

Sway bracing shall be accordance with NFPA 13. Size bracing to resist thrust loads during operation. Connection to structure to be coordinated with structural engineer and seismic requirements.

Provide electrical supervision on all control valves. Locked handles are not permitted.

Coordinate fire department connection with local fire department.

Seismic restraint of all piping and equipment must be completed in accordance with NFPA 13 and Chapter 1, Section 8 – Seismic Restraint. A Letter of Assurance from the seismic engineer will be required as confirmation that the installation meets relevant requirements for local seismic conditions.

Conduct all required testing and include NFPA Contractors Material and Test Certificate in Operations and Maintenance Manual.

8.12.4 Fire Extinguishing

8.12.4.1 Specialty/Supplemental Systems

Where supplemental protection requiring specialty system, such as kitchen hoods or protection of sensitive equipment, is identified in the functional requirements of the facility, provide specialty system to the requirements of NFPA.

Specialty system shall not be used to replace the automatic sprinkler system as required by NFPA 13 but rather as supplement protection.

System (e.g., dry/wet chemical, FM-200 clean agent, etc.) shall be installed to the relevant standards and the requirements of the manufacturer.

8.12.5 Fire Protection Specialties

8.12.5.1 Fire Extinguishers

Follow Ontario Fire Code under Fire Protection and Prevention Act (O. Reg. 213/07) requirements for determining the type, capacity, location and rating of fire extinguishers. Fire extinguishers shall be installed in accordance with the OBC Division B, Part 3, the NFC, and NFPA 10.

Fire extinguishers in public areas shall be located in recessed or semi recessed cabinets. Coordinate cabinet type, finish, and location with the architect. Fire extinguishers located in service areas may be wall mounted. Fire extinguishers shall be located along the path of egress with the required signage.

Commercial kitchens shall be fitted with Type K extinguisher, size and quantity determined by the Consultant. This does not apply to kitchens inside residential dwelling units.

8.13 BUILDING PLUMBING SERVICES

8.13.1 General

Building Plumbing Systems must be designed in accordance with OBC Division B, Part 7.

Heat domestic hot water with heaters or boilers independent of the building heating system when facility heating loads are intermittent or the complexity of the combined system is impractical. Proposed combined systems should be considered only where appropriate.

Domestic water heating shall be achieved by a dedicated domestic water heater or boiler and storage tank. Instantaneous domestic water heaters shall only be used where the application requires it. Specify a water softener for all instantaneous domestic hot water installations.

Domestic hot water recirculation piping shall connect as close as practical to washroom lavatories. Hot water recirculation pumps to be provide following NECB/ SB-10 criteria.

Hot water heaters to be ASHRAE 90.1 Certified. Install thermal expansion tank on hot water heating systems follow OBC Chapter 7 requirement. Size thermal expansion tanks as per ASHRAE handbooks.

All commercial hot water heaters must be ASME Section VIII Stamped.

Consideration shall be given to the volume of water dispensed by a lavatory per cycle. Where applicable, low water consumption fixtures to be specified.

Domestic water recirculation systems shall be designed to maintain a water velocity below 0.9m/s. PEX piping may be considered for domestic hot water recirculation applications only.

Insulate hot water piping systems in accordance with OBC and ASHRAE 90.1 requirements to minimize heat loss and for personnel safety where surfaces exceed 60°C. Insulate cold water piping where there is potential for condensation formation, in accordance with ASHRAE 90.1 or applicable industry standards. Indoor plumbing pipe insulation jacketing shall be PVC.

Cleanouts shall be specified as 50mm or larger. Clean-outs for urinals shall be located above the rim flood level.

Backflow preventors to be designed and installed as per the most recent version of OBC and CSA B64 series, to provides protection against cross contamination as results of backflow and/ or back pressure.

For any facility with more than four (4) shower heads, a feedforward digital mixing valve shall be specified. This applies to large recreation centres. The valve is to be installed in a gender neutral, accessible area.

Domestic hot water recirculation pumps to be installed so they are readily accessible from ground level. Service valves must be installed on either side of the pump with couplings for ease of maintenance.

Follow OBC Chapter 7 for sump pump design requirements. Submersible sump pumps shall be equipped with chain, rails, or removal methods to facilitate maintenance activities. Submersed impellers with motor outside the sump are preferred.

Obtain approval for water treatment consulting services from the County when special water systems are required.

No under sink water filtration devices are to be installed unless permitted by the building operation team.

8.14 BUILDING ENERGY USE AND GREENHOUSE GAS EMISSIONS

Designer to ensure that facilities design follows OBC, SB-10 and NECB (most recent versions as adopted by OBC).

Any Project that involves new/replacement of equipment and/or building systems, shall minimize negative impacts on the targets outlined in the current version of the **County's 100% Renewable Energy (RE) Plan**, **Energy Management Plan (EMP)** and the **Renewable Energy Action Plan (REAP).**

Consider sub-metering

Reducing GHG emissions is a goal of Oxford County. The Project shall identify ways to reach the targets for consideration by the County to mitigate growth, and upgrade existing facilities. Options for consideration shall include ways to attain GHG reductions, and shall include lifecycle costs based on incremental capital, energy and maintenance costs.

8.14.1 Energy Assessments & Modelling

In order to verify energy and GHG performance of the Project, completing an energy assessment or model is essential. The project team shall discuss with **County Facilities/ Energy Management** to determine energy assessment needs for each specific project. The level of assessment required shall be determined based on the project's energy impact and compliance with OBC/ SB-10. Typically, monthly analysis models on RETScreen will be sufficient. However, if the NECB performance path is pursued, an hourly simulation software such as IES-VE/Design Builder/etc. is required to demonstrate code compliance.

Assessments and/or modelling should be completed in the early stages of design through to implementation and Commissioning (Cx) Process, as well for verification and monitoring during the post occupancy Cx phase.

Provide complete energy model for all new buildings or processes or, major renovations to existing buildings and process as well as new heating or cooling energy supply and RE harvesting Projects.

Energy Model to be develop early on, during the schematic design to assist in the decision-making process, and updated throughout design, and implementation process as required to reflect changes to design, and implementation.

Energy Model to compare reference (base case) with proposed in order to quantify energy and GHG avoidances achieved in the Project and to obtain incentives and/or grant funding.

Base Case (or Reference) for new construction or change in facilities requirements (including change in use, occupancy or process), shall follow minimum NECB (most recent version adopted by OBC) requirements for the facility or process, and for retrofits shall be existing conditions.

The energy model shall be developed using software which will be provided to the County upon completion of Project, in order for the County to measure and verify energy performance using the International Performance Measurement and Verification Protocol (IPMVP) Option D (calibrated simulation). This energy model shall be calibrated using energy data from the first full year of utility data after Project completion in order to verify actual energy savings.

The energy modeling shall reference local climate data and include as a minimum the following information for both the reference (base case) and proposed:

- Average normalized annual (by month) energy consumption and cost (by source - electrical, natural gas, solar, etc.), for total Project as well as broken down by major systems and equipment.
- Average normalized annual (by month) energy loss/gain (heating/cooling) via building envelop, broken out by Type (glazing, wall, roof, etc.).
- Average normalized annual (by month) energy loss/gain (heating/cooling) for ventilation air.
- Average normalized annual (by month) energy usage by internal heat gain.
- Peak Electrical & Natural Gas demand.
- Process Loads

8.14.2 Metering

Metering to verify and validate energy performance of the Project shall be considered for all sources of energy (electrical, gas, solar PV, solar Thermal, BTU, etc.). The project team shall discuss with **County Facilities/ Energy Management** to determine if metering is applicable to the subject project, and if so, how best to implement.

The metering data will be utilized during the post occupancy and monitoring based Cx phase of the Project to calibrate the energy model, and for identifying issues of performance of design and implementation and to identify adjustments required to mitigate as required.

Metering points shall be identified early in the design stage for consideration for inclusion in the Project. The projected value (monetary) of energy being captured by a potential meter (as determined by the energy model) will determine whether it has sufficient value to be included in Project, and at what level of accuracy and performance. If metering cost (install, verification, etc.) is less than 25% of annual energy costs being measured, the metering point should be included. Metering points shall be connected back to the County's Energy Management Information System (EMIS), where possible (i.e. via MeterConnex, or through the SCADA or BAS system) and verified for accuracy.

8.15 BRANDED SIGNAGE

Coordinate with Oxford County Facilities for specific requirements.

8.16 FACILITY ACCESSIBILITY DESIGN STANDARDS (FADS)

Oxford County strives to meet Facility Accessibility Design (FADS) where possible which exceeds OBC accessibility requirements. Contractor/ Consultant to work with **Oxford County Facilities** to determine how FADS can best be implemented on each specific project.

Building accessibility must follow the OBC Division B, Part 3 as well as Accessibility for Ontarians with Disabilities Act (AODA).