GENERAL MUNICIPAL SERVICING STANDARDS

SUBMITTED TO:

THE TOWN OF PEACE RIVER

PREPARED BY:

Stewart Weir

Naturally Resourceful

FINAL
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SECTION A GENERAL

A.1 INTENT

A.1.1 The General Municipal Servicing Standards (GMSS) are intended to provide specific guidelines to assist the Municipality and the Developer in the design, preparation and submission of plans and specifications for construction of municipal improvements and systems (roadways, water distribution systems, low-pressure/gravity sewer systems, storm water management facilities) that shall meet the servicing requirements for commercial, industrial and residential development within the Municipality.

A.1.2 The GMSS have been developed to:

i) ensure that the Municipality is provided with a quality product that will meet an acceptable long-term life expectancy while maintaining cost efficiency and practicality so as not to prohibit land development;

ii) minimize the maintenance requirements associated with land development.

A.1.3 The GMSS presented in this document shall only be considered as minimum requirements. The Developer remains fully responsible for the design and construction of municipal improvements according to accepted engineering practice and standards that address and meet the specific needs and site conditions of the development. Certain site-specific conditions may warrant the use of standards that are more stringent.

A.1.4 The GMSS, as well as the latest editions of any referenced legislation or documents, form part of the requirements for the design and construction of any project within the Municipality.

A.2 DEFINITIONS

Adjacent shall refer to those lands next to the proposed development area and includes those lands severed by a roadway, utility right-of-way, railroad, river, stream, reserve lands or other means of natural barrier.

Consulting Engineers shall mean the consulting professional engineer(s) retained by the Developer.

Construction Completion Certificate shall mean a certificate issued pursuant to Article V (2) of the Development Agreement and shall be in the format as shown in Schedule B of the Development Agreement.

Municipality shall mean the Town of Peace River.

Municipality Property shall mean:

i) any property owned or leased by the Municipality developed for use as public park, sports field, playground or other recreational area;

ii) undeveloped reserve land as either; reserve, municipal reserve, school reserve, environment reserve or combination of reserves;

iii) municipal right-of-way including all forms of public roadways (roads, lanes, streets, highways) sidewalks, boulevards, road allowances, utilities right-of-ways, public utility lots, public spaces, undeveloped right-of-ways and storm water management facilities, bridges, culverts and water bodies;

iv) any property developed as a pathway or park trail system;

v) any property owned or titled to the Municipality including buildings, structures and parking facilities.

Municipality Manager shall mean the Chief Administrative Officer, or designate, of the Municipality.

Council shall mean persons duly elected to the Council of the Municipality.

Developer shall mean the proponent of a land development proposal, or the Owner as defined in the Development Agreement.

Developer's Engineer shall mean the professional engineer(s) and/or firm retained by the Developer for the preparation of design, reports, studies, engineering drawings, specifications and all other documents associated with the design and construction of the municipal improvements.

Development shall mean the carrying out of any construction or excavation or other operations, in, on, over or under land, or the making of any change in the use or the intensity of use of any land, buildings or premises.

Development Agreement shall mean documents specifying the terms and conditions for the construction of municipal improvements necessary to service the approved development.

Development Area shall mean the lands as described in Schedule A and as shown in Schedule A-1 of the Development Agreement.

Development Approving Authority(s) shall mean that person(s) designated and known to be the Development Authority to exercise the duties and powers and perform the functions prescribed in the Land Use Bylaw pursuant to the Municipality's Development Authority Bylaw.

External Road shall mean any public road which is not an internal road or provincial highway.

Final Acceptance Certificate shall mean a certificate issued pursuant to Section 1.7 of the Development Agreement.

General Design Standards shall mean the General Municipal Servicing Standards as amended by the Municipality and approved by the Municipal Engineer for construction and installation of the local improvements.

Geotechnical Report shall mean a document prepared by an Engineer, Geological or Geophysical Professional licensed to practice in the Province of Alberta and that bears the seals or stamps signed and dated by the professional in accordance with the enactments that govern their profession.

Grading shall mean an operation or process intended to level or to grade the development area to a desired horizontal gradient.

Internal Road shall mean a public roadway, the primary function of which is to provide access to individual sites within a multi-lot subdivision, with the exception of mobile home communities or bare land condominium developments in which case the internal roads are privately owned.

Local Improvements, External shall mean all of the local improvements or the portions thereof to be constructed by the Developer outside of the proposed development as described in Schedule D of the Development Agreement.

Local Improvements, Internal shall mean all of the local improvements or the portions thereof to be constructed by the Developer within the proposed development as described in Schedule D of the Development Agreement.

Municipal or Local Improvements shall mean the installation of municipal services including, but not limited to, roadways, water and sewer systems, storm sewer and storm water management systems, landscaping, street lighting, power, gas and telecommunication as required and specified in the Development Agreement.

Municipal Engineer shall mean the professional engineer(s) and/or firm retained by the Municipality to review, inspect and recommend approval or rejection of the work proposed or performed by the Developer under the terms of the Development Agreement.

Off Site Levies shall mean the monies collected by the municipality from the Developer or industry to assist with the payment of the portion of the off-site services that the development will utilize.

Order shall mean an order issued under the Land Use By-Law in accordance with the municipal Government Act, or an order issued under provisions of other municipal bylaws and the governing Provincial Act.

Permit, Building shall mean a certificate or other document permitting the construction or alteration of a building or structure, which constitutes part or all of the specified development. The permit issuance shall be in accordance with the minimum requirements of the Alberta Building Code.

Permit, Development shall mean a certificate or other document permitting a specified development and includes, where applicable a plan or drawing, or a set of plans or drawings, specifications or other documents as authorized by the Development Approving Authority to proceed with the specific development.

Person shall mean one or more individuals, partnerships, corporate bodies, unincorporated organizations, government body, trustees, executors, administrators or legal representative other than the Municipality or its legal counsel.

Plans and Specifications shall mean plans, specifications, material lists and performance criteria for the development approved by the Municipal Engineer covering design, construction and installation of the municipal improvements.

Private Sewage Disposal System shall mean a separate system for treatment and disposal of sewage, including a septic tank and absorption field, which is not connected to a municipal sewage disposal system.

Private Property shall mean land owned by a person, group, corporation or entity that is not a government body.

Property shall mean any land, building, structures or premises including any personal property located on, over or in the property that is located within the municipal boundaries of the Municipality.

Suitable Development Area shall mean that each lot created by either a single lot or multi-lot subdivision development that is suitable for the construction and use of a residence, ancillary building, an access road, a privately owned domestic water well and a private sewage treatment system.

Unauthorized Use shall mean the use of the Municipality property either by constructing, storing, landscaping, erecting, placement or removal of any structure, item or thing on, over or in the Municipality property without written authorization from the Municipality, which include but are not limited to:

i) the placement of surface structures such as a driveway, parking area, walkway, patio, deck, stairs or retaining wall;

ii) permanent buildings, relocatable structures or accessory structures such as a detached garage, barn, shed, greenhouse, lean-to composter;

iii) landscaping including fencing, fire pits or fire wood storage, the addition or removal of vegetation or a use that interferes with the growth of existing vegetation;

iv) installation of utilities, antenna, satellite receiving dish or other telecommunication facilities and devices;

v) storage of vehicles or trailers or off-road equipment, building materials, rubble, stockpiles, debris or chattel;

vi) site drainage including the use of pipes, culverts, catch basins, ditches, swales, sump drainage, dry wells, sewage disposal systems, detention ponds or related ancillary structures;

vii) excavating, cutting, filling or undermining.

Units of Measurement shall mean that the standard units of measurement approved by the Municipality are System International (metric) only, and any reference to imperial measurement units may be allowed for convenience purposes only.

Utilities shall mean those utilities together with all necessary appurtenances, which are described in Schedule E of the Development Agreement.

Utilities, Franchise shall mean those utilities provided by a service company such as electrical service, natural gas, telephone or cable television.

Warranty Period shall mean the minimum period of time commencing on the date of issuance of the Construction Completion Certificate and ending on the date of issuance of the Final Acceptance Certificate.

A.3 REFERENCE STANDARDS

A.3.1 Latest Editions

All references to Specifications, standards, or methods of technical associations refer to the latest adopted revision, including all amendments.

A.3.2 Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AADT	Average Annual Daily Traffic
ABC	Alberta Building Code
ACI	American Concrete Institute
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association

AISC	American Institute of Steel Construction
AMCA	Air Moving and Conditioning Association
ANSI	American Iron and Steel Institute
AISI	American Iron and Steel Institute
API	American Petroleum Institute
ARI	Air-Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AT	Alberta Transportation
AWMAC	Architectural Woodworkers Manufacturers Association of Canada
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
CAN	Canadian National Standard
CBM	Certified Ballast Manufacturers
CBTIC	Clay Brick and Tile Institute of Canada
CCA	Canadian Construction Association
CCDC	Canadian Construction Documents Committee
CEC	Canadian Electrical Code
CEMA	Canadian Electrical Manufacturers Association
CGA	Canadian Gas Association
CGRA	Canadian Good Roads Association
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CITC	Canadian Institute of Timber Construction
CLA	Canadian Lumbermen Association
CMAA	Crane Manufacturers Association of America
CMHC	Canada Mortgage and Housing Corporation
CPCA	Canadian Painting Contractors Association
CPCI	Canadian Pre-stressed Concrete Institute

CRCA	Canadian Roofing Contractors Association
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSSBI	Canadian Sheet Steel Building Institute
CUA	Canadian Underwriters Association
CWB	Canadian Welding Bureau
CWC	Canadian Wood Council
CSPI	Corrugated Steel Pipe Institute
DFO	Department of Fish and Oceans
EEI	Edison Electrical Institute
EEMAC	Electrical and Electronic Manufacturers of Canada
FFPC	Federal Fire Prevention Committee
FM	Factory Mutual Engineering Corporation
GMSS	General Municipal Servicing Standards
IAO	Insurers' Advisory Organization
IBRM	Institute of Boiler and Radiator Manufacturers
IEC	International Electro Technical Commission
IEE	Institution of Electrical Engineers (U.K)
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IGMAC	Insulated Power Cable Engineers Association
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Standardization Organization
LEMA	Lighting Equipment Manufacturers Association
LTIC	Laminated Timber Institute of Canada
MMA	Millwork Manufacturers Association
MMCD	Master Municipal Construction Documents
NAAMM	National Association of Architectural Metal Manufacturers
NBC	National Building Code of Canada

NEC	National Electric Code
NEMA	National Electrical Manufacturers
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NLGA	National Lumber Grade Authority
OECI	Overhead Electrical Crane Institute
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PMBC	Plywood Manufacturers Association of British Columbia
RLM	RLM Standards Institute
RTAC	Road Transportation Association of Canada
SAE	Society of Automotive Engineers
SBI	Steel Boilers Institute
SJI	Steel Joint Institute
SSPC	Steel Structures Painting Council
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters' Laboratories of Canada
USFG	United States Federal Government
WCB	Workers' Compensation Board
WCLIB	West Coast Lumber Inspection Bureau

A.3.3 Conformance

Conform to these Standards, in whole or in part as specifically requested in the Specifications. They are part of the Specifications as specified and modified. In case of a conflict between the requirements of the Specifications and those of the listed referenced Standards, the requirements of the Specification will prevail.

Demonstrate conformance to the satisfaction of the Engineer if there is a question as to whether any product or system is in conformance with applicable Standards. Pay the costs associated with any testing or certification to demonstrate conformance.

A.4 DEVELOPER'S RESPONSIBILITY

A.4.1 The Developer shall, at his own cost and expense, provide the following:

A.4.1.1 Design and construction of the proposed municipal improvements including necessary off-site upgrades and utility up-sizing associated with the Development;

A.4.1.2 Quality control and materials testing by a third party independent qualified engineering firm;

A.4.1.3 The certification by an independent third party that the construction has been completed in accordance with the approved drawings and specifications shall be required;

A.4.1.4 Acquisition of additional land for roadways widening and municipal utilities and services as required;

A.4.1.5 Registration with Alberta Land Titles all easements including plans and documents for the construction of municipal improvements outside of the municipal right-of-way;

A.4.1.6 Register a Plan of the Development (Subdivision), made in accordance with the Plan approved by the Municipality's Subdivision Approving Authority, at the Land Titles Office;

A.4.1.7 Supply to the Municipality both digital, and hard copy, of the Plan of the Development (Subdivision) drawings and as-built (as-constructed) drawings, as per Municipality drawing standards.

A.4.2 It is the Developer's responsibility to satisfy all statutory requirements governing the proposed works and obtaining approvals for compliance with those requirements from the applicable jurisdiction authorities. Should conflicts or inconsistencies with the GMSS and referenced documents arise due to compliance with or amendment of statutory requirements, the Developer shall be responsible for satisfying the more stringent requirements.

A.4.3 It is the Developer's responsibility to satisfy the requirements established in the GMSS unless stated otherwise. All design criteria, methodologies, materials, installation and testing shall be in accordance with the most recent editions of the referenced documents, which include but are not limited to:

- ✓ *Public Lands Act*
- ✓ *Municipal Government Act*
- ✓ *Water Act*
- ✓ *Environmental Protection & Enhancement Act*
- ✓ *Canadian Environmental Assessment Act*

- ✓ *Fisheries Act*
- ✓ *Species at Risk Act*
- ✓ *Navigable Water Protection Act*
- ✓ *Safety Codes Act*
- ✓ *Rural Utilities Act*
- ✓ *Provincial Offences Procedures Act*
- ✓ *Plumbing Code*
- ✓ *Alberta Private Sewage Standards of Practice*
- ✓ *Alberta Building Code*
- ✓ *Provincial Wetlands Policy*
- ✓ *Alberta Environment, Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*
- ✓ *Alberta Highway Design Guide*
- ✓ *Transportation Association of Canada Geometric Design Guidelines*
- ✓ *Transportation Association of Canada Uniform Traffic Control Devices for Canadian Roads*
- ✓ *Transportation Association of Canada Highway Lighting Design Guide*
- ✓ *Municipal By-Laws*
- ✓ *Other Provincial/Federal Government Authorities*

A.4.4 It is the Developer's or the Developer's Engineer responsibility to obtain, at their own cost, copies of the referenced documents from the applicable authority.

A.4.5 The above compiled list of referenced documents shall not be considered as all inclusive, as other applicable standards and documents may be listed in specific sections of the GMSS for reference. The Developer and Developer's Engineer shall remain responsible for the design and construction of their development according to accepted best engineering and work practices.

A.5 DEVELOPMENT AGREEMENT

The Developer shall enter into a Development Agreement with the Municipality prior to the construction and installation of proposed development. There shall be no Building Permit issued for any construction on any particular area or lot within the proposed development until all required municipal improvement plans are in place and accepted by the Municipality and endorsement of the development plans and registration at Alberta Land Titles is completed.

A.6 CHANGES IN DESIGN STANDARDS

It is the Developer's responsibility to ensure that the design and construction is in compliance with the latest edition of the Municipality's General Municipal Servicing Standards including any revisions thereto up to the date of acceptance of the detailed design.

A.7 INSPECTIONS AND FINAL ACCEPTANCE

A.7.1 Upon completion of all municipal improvements associated with the proposed development, the Developer shall give notice to the Municipality and arrange for inspections. Upon the receipt of a Construction Completion Certificate from the Developer, the Municipal Engineer, on behalf of the Municipality, shall inspect the municipal improvements, prepare a deficiency list and forward it to the Developer through the Municipality.

A.7.2 All deficiencies shall be rectified to the satisfaction of the Municipal Engineer prior to the acceptance and approval of the Construction Completion Certificate by the Municipality.

A.7.3 The warranty period shall commence upon acceptance and approval of the Construction Completion Certificate. During this period, the Developer shall repair any defects in materials or workmanship.

A.7.4 Prior to the expiry of the warranty period, the developer shall notify the Municipality and arrange for an inspection. Upon the correction of all deficiencies satisfactory to the Municipal Engineer, the Developer's Engineer shall issue a request for the Final Acceptance Certificate.

A.8 WARRANTY PERIOD

A.8.1 The warranty period for the municipal improvements shall commence upon acceptance of the Construction Completion Certificate by the Municipality and shall be governed by the terms outlined in the Development Agreement. Warranty periods generally extend for:

A.8.1.1 Two (2) years for site clearing, topsoil stripping, stockpiling, grading, erosion and sediment control and storm water ponds;

A.8.1.2 Two (2) years for surface work related to roadway construction including road structure, curb, gutter, sidewalks, walkways, trails, ditches, swales , other storm water facilities and drainage structures with the exception of the surface layer of asphalt concrete pavement and pavement markings;

A.8.1.3 Two (2) years for the surface layer of asphalt concrete pavement and pavement markings;

A.8.1.4 Two (2) years for underground utilities and related above ground components such as valves, hydrants and manhole and catch basin covers;

A.8.1.5 Two (2) years for power and street lighting components;

A.8.1.6 Two (2) years for landscaping features;

A.8.1.7 Two (2) years for topsoil placement and seeding.

A.8.2 Where there is a delay in the application of the surface layer of asphalt concrete pavement on internal roads and approaches, the warranty period for the surface layer of asphalt concrete pavement shall be extended for a period of twelve (12) months from the date of acceptance of the Construction Completion Certificate by the Municipality.

A.8.3 The Developer shall provide, for the duration of the warranty period, an irrevocable Letter of Credit as required by the Municipality.

A.9 UTILITY, PIPELINE AND RAILWAY CROSSINGS

A.9.1 It is the Developer's responsibility to obtain the Crossing Agreement where a crossing of utility, roadway, pipeline or railway is required for the installation of the municipal improvements.

A.9.2 The Developer shall comply with all terms and conditions of the Crossing Agreement and make application to transfer the Agreement to the Municipality's name prior to the application for the Construction Completion Certificate.

A.10 FRANCHISE UTILITIES

It is the Developer's responsibility to coordinate the design and installation of works with franchise utilities. The Developer shall be responsible for any deficiencies noted as a result of installation such as fill settlements and damages occurred to curb and gutter, roadway pavement structure, boulevards or landscaping features.

A.11 EASEMENT AND RIGHT OF WAY

It is the Developer's responsibility to obtain all easements and right-of-ways for the installation of municipal improvements located outside of the normal right-of-way or utility lot. Prior to application for the Construction Completion Certificate all the permanent easements, including applicable plans and documents, shall be registered at the Land Titles Office naming the Municipality as the Grantor.

A.12 PERMITS AND LICENSES

It is the Developer's responsibility to obtain all permits and licenses in compliance with the Provincial and Federal statutory requirements.

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SECTION B EXISTING INFORMATION

B.1 SUBMISSION REQUIREMENTS FOR DEVELOPMENT AND LOT/SITE GRADING PERMIT

B.1.1 Pursuant to Municipality's Land Use By-Law, the following technical information shall be submitted with a Development Permit Application to begin site stripping, stockpiling of topsoil and cut and fill operations only:

B.1.1.1 For multi-lot subdivision development the Subdivision Application shall be approved by the Municipality's Subdivision Authority prior to the submission of engineering drawings for review and approval;

B.1.1.2 For large-scale industrial or commercial development, where site grading may be desirable in advance of all other approvals, the Municipality's Development Authority at its own discretion may issue a separate Development Permit for site grading;

B.1.1.3 For excavations other than for construction or building purposes, including, but not limited to, sand and gravel, topsoil stripping, peat moss, and construction of artificial bodies of water;

B.1.1.4 Pursuant to the Soil Conservation Act, appropriate measure shall be implemented to prevent soil loss or deterioration from taking place or to stop soil loss and deterioration from continuing.

B.1.2 Development permit submission requirements are:

B.1.2.1 Provide a General Site Plan illustrating existing contours at 0.5m intervals preferred, and not to exceed 1.0m maximum. Elevations shall be relative to geodetic datum. Reference benchmarks shall be detailed on the General Site Plan.

B.1.2.2 Provide a Conceptual Site Plan illustrating proposed site stripping, cut and fill requirements and proposed contour elevations. The Developer is responsible for the completion of rough grading for the entire development or subdivision area including roadways rights-of-way, laneways, drainage and utility easements, municipal reserve and for all lots. The benchmarks to be used in the control of construction of the project shall be indicated on the plan. Other information to be shown includes proposed locations for stock piling and windrows.

B.1.2.3 A Geotechnical and Hydrogeological Investigation of the proposed site shall be completed by a qualified geotechnical engineering firm to a level that will allow the Municipal Engineer to assess the site geotechnical and hydrogeological conditions and their effect on the development or subdivision. The report shall outline any findings of contamination that may exist and any general recommendations.

B.1.2.4 For the development or subdivision sites that require 1m or more of fill a geotechnical evaluation and engineering requirements for each site or lot shall be submitted to support the development of each lot or site. Each lot shall be identified on the Conceptual Site Plan. The Developer is responsible for the supply, placement and compaction of necessary fill for rough grading. The rough grades shall ensure that the overall drainage plan requirements are met. No standing water or areas where water may pool or pond shall be allowed.

B.1.2.5 A Phase I Environmental Site Assessment (ESA) of the proposed development area shall be completed in accordance with Canada Standards Association requirements. A Phase II ESA shall be required if recommended in the Phase I ESA report.

B.1.2.6 If a creek, river or other major watercourse crosses the proposed site, the Developer shall submit a Plan of the Floodplain and a letter outlining the recommended measures to ensure that the proposed development and adjacent areas and developments would not be exposed to flooding.

B.1.2.7 Overall conceptual plans and description for the proposed development or subdivision shall be required for review and approval, as well as roadways layout, water and sanitary sewer servicing and storm water management plan. The storm water management plan shall address the capacity of existing systems, and the proposed additional measures to accommodate the new flows shall be required for review along with supporting calculations.

B.1.2.8 Any development or subdivision involving pipeline, power transmission line and/or public utility right-of-way shall be sited to comply with all relevant Federal and Provincial legislation. Setbacks from pipelines and other utility corridors shall be in accordance with appropriate Provincial Regulations of Acts and any regulation or directive established by the Energy and Utilities Board. Letters of crossing agreements shall be provided with the application.

B.1.3 The standard drawing size of 841mm by 594mm (or other standard sheet size) shall be used for all plan submissions with a scale of 1:1000, with a scale of 1:5000 acceptable as an option for larger areas. The index plan may be a reduction of the standard scale to allow the plan to fit the standard size sheet.

B.1.4 The Municipality reserves the right to request submission of relevant non-technical information as part of the application, such as a Historical Resource Report to identify any significant historical, archaeological and palaeontological resources within the boundaries of the proposed development.

B.2 PREREQUISITES TO REVIEW OF ENGINEERING DRAWINGS

B.2.1 The Development or Subdivision Plan shall be approved by the Municipality prior to the submission of engineering drawings for review and approval.

B.2.2 The engineering drawings shall be prepared and signed by a qualified Professional Engineer registered in the Province of Alberta and shall be stamped with a Permit to Practice seal.

B.2.3 The submission of drawings shall be accompanied by all supporting documents, reports, studies, calculations or any other information as required by the Municipality.

B.3 ENGINEERING DRAWING SUBMISSION & APPROVAL PROCEDURE

B.3.1 The Developer shall submit complete engineering drawings at least eight weeks prior to the start-up of construction. The Municipality or its designated Engineer is not responsible for any delay of approval if submissions are incomplete or found to contain excessive errors or omissions.

B.3.2 Initially, the Developer shall submit six (6) complete sets of drawings and three (3) copies of specifications to the Municipality along with all supporting documents and reports.

B.3.3 The Municipality shall respond to the Developer's initial submissions within four weeks and return one set of drawings and specifications to the Developer with comments for revision.

B.3.4 The Developer shall promptly revise the engineering drawings to the satisfaction of the Municipal Engineer and re-submit six (6) complete sets of revised drawings and specifications and one (1) digital copy to the Municipality for approval, as per Section B.4 "General Requirements and Standards for Engineering Drawings" along with any additional information as required by the Municipal Engineer.

B.3.5 Upon receipt of revised drawings, satisfactory to the Municipal Engineer, the Municipality shall return one (1) complete set of drawings to the Developer with a stamp of "Approved for Construction".

B.3.6 The Developer shall not proceed with construction until the engineering drawings have been approved for construction.

B.3.7 The Municipality's Approval for Construction shall not relieve the Developer's or its Engineer's from the responsibility for the adequacy of the designs or the liability arising thereof.

B.4 GENERAL REQUIREMENTS AND STANDARDS FOR ENGINEERING DRAWINGS

B.4.1 Each drawing shall include the following:

B.4.1.1 A suitable title block, identifying:

i) Name of the Project,

ii) The Municipality File No.,

iii) Draft or Revision No.,

iv) Revision Date,

v) Date of Drawings Issued;

B.4.1.2 The scale of the drawing;

B.4.1.3 A north direction indicator;

B.4.1.4 An appropriate space for the Professional Engineer Permit to Practice seal.

B.4.2. All dimensions and measurements shown in the engineering drawings shall be in metric units. All elevations shown in the engineering drawings shall be referenced to geodetic datum and shall be noted as such.

B.4.3 Geodetic Datum, surveys and plans shall be prepared utilizing North American Datum NAD83 (Adopted).

B.4.4 The standard drawing size of 841mm by 594mm shall be used.

B.4.5 All lettering shall be a minimum of 2.5mm high.

B.4.6 All abbreviations and drawing symbols used in the engineering drawings be consistent with drawings standards provided by the Municipality.

B.4.7 The engineering drawings shall provide a complete description of all existing and proposed municipal improvements, including any provisions for future extensions of utilities and systems.

B.4.8 The engineering drawings shall include:

B.4.8.1 **Cover sheet** of standard size, indicating the names of the development or subdivision, the Developer and the Consultant, and the legal location or address of the development or subdivision;

B.4.8.2 **Index plan** of standard size, scale 1:1000 or a reduction thereof, duplicating the legal plan, indicating drawing sheet number and related title;

B.4.8.3 **Topography and Land Use Plan,** scale 1:1000, indicating the existing contours at 0.5m intervals and the proposed land uses;

B.4.8.4 **Lot Grading Plan, s**cale 1:1000, indicating:

i) proposed lot corner elevations,

ii) The proposed finished grades at the buildings,

iii) directions of surface drainage on the lots, roadways and swales,

iv) proposed building elevations and sewer services invert elevations,

v) All lots on fill, disturbed or unsuitable soil must be identified,

vi) minimum rough site grading requirements to be completed by the Developer (Rough grades shall ensure that the overall drainage concept is satisfied. No standing water or areas where water may pool or pond shall be allowed at the rough site grading stage.);

B.4.8.5 **Roadway Overall Plan,** scale 1:1000, indicating all walks, lanes, roadway widths and alignments;

B.4.8.6 **Drainage Basin Plan,** showing 1.0m contours, indicating areas adjacent to all roadways, existing overland drainage routes and flood plains or water ponding areas;

B.4.8.7 **Pavement Marking and Signage Plan,** scale 1:1000, indicating pavement marking and proposed signage locations and specifications;

B.4.8.8 **Sanitary, Storm and Water Main Overall Plan,** scale 1:1000, indicating the alignments and sizes of sanitary sewers, storm sewers and

water mains and services, locations of manholes, catch basins, valves, hydrants and other proposed underground utilities;

B.4.8.9 **Gas, Power and Telecommunication Overall Plan,** scale 1:1000, indicating: gas, power, telephone, television and other underground utilities locations and easements;

B.4.8.10 **Landscaping Plan,** scale 1:1000, identifying street names and landscape amenities, including fencing, signage, screening berms, Canada Post mail boxes and pads, entrance features, entrance signs location and specifications and name and location of all trees and shrubs (Street naming approval will be completed by the Municipality. The Municipality reserves the right to select or reject proposed names.);

B.4.8.11 **Roadways Plans & Profiles,** scale 1:500 horizontal and 1:50 vertical, showing:

i) Roadway right-of-way width, roadway width offset from property line and horizontal curve data,

ii) Original ground profiles & chainages,

iii) Proposed centreline profiles & chainages,

iv) Proposed top of curb elevations,

v) Proposed catch basin locations and inlet elevations,

vi) Vertical curve data,

vii) Elevations of shallow utilities at road crossings,

viii) Proposed pavement structure;

B.4.8.12 **Water, Sanitary and Storm Sewers Plans & Profiles,** scale 1:500 horizontal and 1:50 vertical, showing:

i) Horizontal alignment and separation distances between each utility,

ii) Water main plan showing pipe sizes, location of hydrants, valves and fittings,

iii) Water main profile showing grades, cover, pipe sizes, pipe materials and class of pipe bedding,

iv) Storm and sanitary sewer plan showing pipe sizes and manhole locations,

v) Storm and sanitary sewer profile showing pipe sizes and materials, manhole invert elevations, length of pipe, grades between manholes and class of pipe bedding,

vi) Location of services and invert elevations at property line,

vii) Elevations of oil and gas pipe line crossings.

B.5 REPORTS AND STUDIES

The Developer shall provide all relevant reports and studies in the submission of engineering drawings including:

B.5.1 Geotechnical and hydrogeological report to identify:

i) Existing soil and sub-soil conditions, groundwater tables, limits of identified site contamination, top of bank setbacks for adjacent creeks or ravines with stability problems,

ii) Proposed pavement structure based on in-situ conditions and projected traffic volume (A 20-year structure recommended by the Geotechnical Engineer shall be required; however, minimum pavement structure thickness as illustrated on the cross-sectional standard drawings shall be maintained),

iii) Construction methods and procedures for trenching and backfilling operations for proposed underground infrastructure, storm drainage facilities and service requirements for proposed private servicing and building foundations;

B.5.2 Engineering design brief including design calculations and analysis of proposed municipal improvements;

B.5.3 Environmental impact assessment may be required for the proposed development depending on the circumstances.

B.6 AS-CONSTRUCTED RECORD DRAWINGS

B.6.1 Within six (6) months following the issuance of the Construction Completion Certificate, the Developer shall submit to the Municipality a set of as-constructed record drawings in a digital format, as determined by the Municipality, along with three (3) sets of printed copies and one (1) digital copy.

B.6.2 All drawings shall indicate “As-Constructed” and shall be stamped, signed, sealed and dated by a Professional Engineer.

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SECTION C LAND USE DISTRICTS AND LEVEL OF SERVICE

C.1 INTENT

C.1.1 This section is intended to assist the Municipality and the Developer with a general guideline outlining the level of service for a particular development based on the land use district. The Developer shall use this section to determine the most appropriate servicing standards presented in the following sections.

C.1.2 The level of service applicable to any particular development is subject to review by the Municipality. The Municipality reserves the right to require a higher level of service for any particular development.

C.1.3 The guidelines and standards presented in this document shall only be considered as minimum requirements. The Developer shall remain fully responsible for the design and construction of municipal improvements according to accepted engineering practice and standards that address and meet the specific needs and site conditions of the development. Certain site-specific conditions may warrant that standards that are more stringent be met.

C.1.4 It is the Developer's responsibility to satisfy, in addition to these requirements, all regulations and conditions required by referenced legislation or document, Municipality By-Laws, as well as Provincial and Federal Government Authorities.

C.1.5 Should the need arise where any of the following standards cannot be met, a written request describing the variance complete with supporting documentation shall be forwarded to the Municipal Engineer for review. The request shall be reviewed and a written reply returned with the final decision.

C.2 LAND USE DISTRICTS

All lands within the Municipality are divided into Zones. The proposed development shall have proper reference to a zone classification according to the Municipality By-Law.

C.3 LEVEL OF SERVICE

C.3.1 Roadways

C.3.1.1 The Developer's Engineer shall be responsible for determining an estimated Annual Average Daily Traffic (AADT) generated by the proposed development in order to determine the required roadways cross sectional elements and pavement structure. Section G provides a geometric design table and cross sections for the various roadway classifications.

C.3.1.2 The standard roadway cross sections included in Section G are as follows:

i) Access Road (9m minimum wide of cold mix or asphalt concrete surface),

ii) Rural Road (14.8m minimum wide of cold mix or asphalt concrete surface),

iii) Local Residential and Commercial Road (14.8m minimum wide of cold mix or asphalt concrete surface),

iv) 2-Lane Residential Collection Road (11 or 13m wide of cold mix or asphalt concrete surface),

v) Front and Back Residential Local Road (9m minimum wide of cold mix or asphalt concrete surface),

vi) Undivided Urban Arterial Road (14.8m minimum wide of cold mix or asphalt concrete surface),

vii) 4- Lane Undivided Urban Arterial Road (14.8m minimum wide of cold mix or asphalt concrete surface),

viii) 4- Lane Non- Berm Undivided Urban Arterial Road (20.3m minimum wide of cold mix or asphalt concrete surface),

ix) 4- Lane Berm Undivided Urban Arterial Road (20.3m minimum wide of cold mix or asphalt concrete surface),

The minimum roadway cross sectional requirements for individual land use classifications have been selected from Table 1- Geometric Design Requirements. Gravel Surface road are not recommended for permanent development.

C.3.2 Water Systems

Developments may require one of the following types of water distribution systems:

C.3.2.1 Private Water Systems

C.3.2.1.1 Private water systems shall consist of individual wells or water cisterns. Systems must be designed and installed according to the Canadian Plumbing Code and applicable Alberta Regulations. Water analysis is to be to potable water standards.

C.3.2.1.2 The Municipality will not permit the construction of communal water systems, which are designed to incorporate a water supply from an on-site well.

C.3.2.2 Piped Water Distribution Systems

C.3.2.2.1 Piped water distribution systems shall consist of a piped network at normal operating pressure or a trickle system that delivers water at lower than normal operating pressure. The specific type of system will depend on the layout, size and type of development as well as the existing infrastructure in the area.

C.3.2.2.2 All piped systems shall be designed and installed according to standards outlined in this document. Other applicable standards include:

i) American Water Works Association Standards,

ii) Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems,

iii) Fire Underwriters Survey,

iv) Water Supply for Public Fire Protection.

C.3.3 Sanitary Sewer Systems

Developments may require one of the following types of sanitary sewer systems:

C.3.3.1 Private Sanitary Sewer System (Residential)

C.3.3.1.1 Private sanitary sewer systems consist of sewage collection and treatment system located entirely within private property. Private sanitary sewer systems include septic tanks or holding tanks, disposal fields, treatment mounds, sewage lagoons, mechanical treatment units and related piping.

C.3.3.1.2 Private sanitary sewer systems shall be designed and installed in accordance with the *Alberta Private Sewage Treatment and Disposal Regulations* and *Canadian Plumbing Code.*

C.3.3.1.3 An *Information Package for Residential Property Owners* is available from the Municipality, which outlines design, material and installation standards and requirements for private sanitary sewer systems.

C.3.3.2 Private Sanitary Sewer Systems (Non-Residential)

Private sanitary sewer disposal system that is expected to receive more than $5.68 m^3$ of sewage per day shall be designed by a qualified Professional Engineer.

C.3.3.3 Communal Piped Sanitary Sewer System

Piped sanitary sewer systems consist of either gravity lines or low-pressure lines. The need for specific type of system shall be determined based on the layout, size and type of development, as well as the existing infrastructure in the area. All communal sanitary sewer systems, including municipal and co-op systems, shall be designed and installed according to the minimum standards outlined in this document. Other applicable standards include the *Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems* and *Rural Utilities Act.*

C.3.4 Storm Water Management Systems

C.3.4.1 The type of storm water management system will largely be dictated by the roadway standards. All urban cross sections with curb and gutter shall require a piped storm water sewer system. Under any circumstances, overland drainage will not be accepted for an urban type development. Rural cross sections shall employ an overland drainage system consisting of ditches and swales.

C.3.4.2 All storm water management systems shall comply with the standards outlined in this document. Other applicable standards include the *Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems.*

C.3.4.3 It is the Developer's responsibility to supply, place and compact necessary fill for rough grading for the entire subdivision area including road right-of-ways, laneways, drainage and utility easements, municipal reserve and all lots. The rough grades shall ensure that all storm water is properly directed and managed regardless of the stage of lot development on either public or private property. No low areas that could promote standing water shall be permitted at the rough grading stage.

C.4 UNAUTHORIZED USE

C.4.1 Unauthorized use is when a private person or a corporation accesses public property with encroachment, construction, storage, landscaping or removal of anything on, over or in public property without written approval of the Municipality. Unauthorized use can result in public safety issues, limit public access or use of public property, prevent maintenance or operation from occurring and damage to natural environment.

C.4.2 The Municipality as the stewards of all public property shall ensure that the use and enjoyment of public property is a benefit to all residents and is not interfered with by those who deliberately or inadvertently enter onto public lands. The Municipality shall regulate the use of all public property to ensure the public safety and to protect natural areas and ecosystems.

C.4.3 The Municipality shall notify and work with unauthorized users of public property on a case by case basis providing an explanation of unauthorized use and detail what corrective measures must be completed.

C.4.4 Non-compliance with the Municipality directions may result in legal enforcement.

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SECTION D WATER DISTRIBUTION SYSTEM

D.1 GENERAL

D.1.1 The Developer and the Developer's Engineer are responsible to ensure that the water system is designed and constructed according to accepted engineering practice. These guidelines are intended as a guide only and shall not be considered as a substitute for a detailed material and construction specification to be prepared by the Developer's Engineer.

D.1.2 The current standard and specification issued by the following organizations shall be implemented during design and construction of the water distribution systems:

ASTM - American Society for Testing and Materials,

AWWA - American Water Works Association,

CSA - Canadian Standards Association,

ABC - Alberta Building Code (firewater requirements for new construction),

AFC - Alberta Fire Code (firewater requirements for new construction),

NFPA - National Fire Protection Association,

FUS - Fire Underwriter's Survey,

Alberta Environment Standard and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems.

D.2 FLOW REQUIREMENTS

D.2.1	Average Daily Demand (minimum per residence)	-	320 L/person/day
D.2.2	Population Density (residential)	-	3.5 persons/residence
D.2.3	Maximum Daily Demand	-	2 x Average Demand
D.2.4	Peak Hourly Demand	-	4 x Average Demand
D.2.5	Minimum Residual Water Pressure		
	During Peak Hour Flow	-	280kPa
D.2.6	Minimum Residual Water Pressure		
	During Maximum Day + Fire Flow	-	150kPa
D.2.7	Minimum Residual Water Pressure During Maximum Day Flow		
	(for operation of residential fire sprinklers)	-	350kPa

D.2.8 Fire Flow: The Municipality recognizes that, due to the nature and limited extent of existing infrastructure and the high cost associated with developing off-site improvements necessary to support required flows of water for fire protection purposes, the Municipality will not provide infrastructure necessary to deliver water flows required for fire protection in non-hamlet areas. Existing residential or industrial developments outside of the hamlet areas that have fire flow rates are to have fire flow rates maintained.

D.2.8.1 Fire flow requirements will be required in the town areas but not areas outside of the town. Fire flow requirements shall be in accordance with the Alberta Building Code, NFPA 1231 Standards and with the Insurer's Advisory Organization Standards, generally these are:

Single Family Residential	3.64 m^3/min,
Town Houses	5.45 m^3/min,
Walk-up Apartments	9.10 m^3/min,
Schools	5.45 m^3/min,
Commercial	11.40 m^3/min,
Industrial	13.64 m^3/min.

D.2.8.2 Developers will be required to size any piped water distribution system such that the system can accommodate fire flow volumes if required off-site infrastructure is developed in the future.

D.2.9 If municipal fire protection is required in the development agreement, piped systems shall be designed to meet the fire flow requirements published by the Fire Underwriters Survey for the anticipated type of occupancy. Off-site improvements required by the Developer will be assessed on a case-by-case basis.

D.2.10 Automatic sprinkler protection conforming to NFPA 13 standards is encouraged for all developments if the minimum flow and residual pressure requirements can be met.

D.2.11 Where required by the current National Building Code and Alberta Building Code, the Developer and the Developer's Engineer will design dedicated self contained fire water storage and delivery systems in accordance with the Code and NFPA 1231 Standards for the building type and occupancy.

D.2.12 A general correlation exists between the available quantity of drinking water and the level of public health within a community. The waterworks system shall be capable of providing sufficient quantities of water to meet the needs of consumers, meaning that the proposed source of supply should adequately meet the demand of consumers without any adverse effects on other water users. Water quantity requirements should be based on an assessment of all existing and possible future domestic, institutional, commercial and industrial demands, and should also consider possible water demands for firefighting purposes.

D.2.13 Various components of waterworks systems should have a design life that is compatible with the function of the component. A water treatment plant should be designed for a minimum period of 10 years with provision for expansion to handle a 20 to 25 year design flow. Intakes and outfall structures, which have high base construction costs, should be designed for the entire design horizon which is at least 20 to 25 years. Storage facilities, on the other hand, should be phased to avoid operational problems (such as increased chlorine demand or oversized pumps) which are associated with excess storage and detention times.

D.2.14 The raw water supply and water treatment plant should be designed for at least 110% of the projected maximum daily design flow. This compensates for accumulated in-plant losses of up to 10% of the produced treated water.

D.2.15 In addition to the maximum operating pressures, there are transient pressures due to pump starts and stops, power failures, or rapid valve operation. Pumps should be designed to minimize these surges, and water mains should be designed to withstand these surges.

D.3 STORAGE REQUIREMENTS

D.3.1 Municipal potable water reservoirs shall be designed and constructed as an underground concrete reservoir and sized to accommodate 2 times maximum day demand when no fire storage is required.

D.3.2 When fire storage is required, potable water reservoirs shall be sized to accommodate the larger of:

D.3.2.1 **S = (A + B + C);**

S = Total storage requirement (m^3)

A = Fire storage (m^3)

B = Equalization storage = 25% of maximum daily demand (m^3)

C = Emergency storage = min. 15% of average daily demand (m^3)

D.3.2.2 Disinfection contact time storage required to meet Alberta Environment CT requirements; or

D.3.2.3 2 x Maximum Day Demand.

D.3.3 All municipal water storage facilities shall be designed with security features acceptable to the Municipality. All fences, doorways and hatches shall be lockable. Access shall be restricted to authorized personnel.

D.4 MATERIAL REQUIREMENTS

D.4.1 Unless specified with better material accepted by the Municipal engineer, all underground water retaining structure and associated structures (valve chambers and pump chambers etc.,) shall be designed against frost and sulphate attack (ASTM type V), it shall be conformed to ACI 350R – 89 "Environmental Engineering of concrete structure" and to CSA A23.1.

Concrete Grade 25 shall be used and tested in accordance with CSA 23.2.

D.4.2 The design of foundation, footing, excavation, soil, rock and liquid retaining structure shall comply with the current National Building Code (NBC) and Alberta Building Code (ABC). A surface investigation, including ground water condition, shall be carried out by or under the direction of a professional engineer having the knowledge and experience in planning and executing such investigations to a degree appropriate for the structure or substructure of its use, the ground and the surrounding condition.

D.4.3. Catchbasins shall be manufactured with pre-cast reinforced concrete conponents conform to ASTM C478. No Corrugated Steel Pipe (CSP) shall be used.

Component joint shall be supplied with a pre-formed and sealed O-ring type rubber gasket, comply to ASTM C443 or current requirement.

D.4.4 Mininuim of 100 mm thick bedding of granular gravels or sand (no particles larger than 32mm) shall be allowed for levelling bed for the aforesaid structures.

D.5 PIPE SIZING

D.5.1 Sizing of watermains shall be determined by hydraulic network analysis. Results shall be submitted to the Municipal Engineer for approval.

D.5.2 The minimum size for a distribution main shall be 150mm for residential areas and 200mm for commercial and industrial areas. Lines must be sized to accommodate the anticipated land use.

D.5.3 Where mains run for 200m or over without ties to other mains, the minimum pipe size shall be 200mm.

D.5.4 For lengths of pipe containing two or more hydrant connections without ties to other mains, the minimum pipe size shall be 200mm.

D.5.5 The maximum velocity under normal operating conditions shall not exceed 3.0m/s.

D.5.6 Hazen-Williams "C" value shall be 140 for PVC pipe.

D.5.7 Analysis shall be made to ensure that there is a minimum residual pressure of 280 kPa under Peak Hour Demand conditions.

D.5.8 Separate analysis shall be made to ensure that there is a minimum residual pressure of 150 kPa under Maximum Day Demand plus Fire Flow Conditions.

D.6 WATERMAIN ALIGNMENT AND LOCATION

D.6.1 Watermains shall be located within the road right-of-way and outside the carriageway in accordance with the typical roadway cross section (Section G).

D.6.2 Watermains shall be located a minimum of 3.0 m o/c from any sewer line, 1.5m from any catch basin and 1.8m o/c from any gas line or as required by the utility company. Where power cables, telephone cables, television cables, or duct lines cross a watermain, they shall maintain a minimum distance of 1.0m from any valve, hydrant or curb stop.

D.6.3 Public Utility Lot (PUL) widths shall be at least 4.0m for a single utility and 6.0m for two utilities.

D.6.4 Water distribution and transmission systems in new subdivisions shall be looped wherever possible. Dead ends will be allowed in residential cul-de-sacs provided that the line is no longer than 120m.

D.7 REQUIRED DEPTH FOR WATERMAINS

D.7.1 The watermain shall have a minimum depth of cover of 2.75 m measured from finished grade to the top of pipe.

D.7.2 The watermain shall have sufficient depth of cover to provide complete frost protection.

D.7.3 The bottom of hydrant flanges shall be located 50mm above finished grade. Invert depths at hydrant locations shall be 2.5m below the top of curb.

D.7.4 Under normal conditions, watermains shall cross above the sewer with sufficient clearance to allow for proper bedding and structural support of the pipes. Pipe clearance when passing over any sewer shall be a minimum of 300mm separation between the top of the sewer pipe and the bottom of the watermain.

D.7.5 Pipe clearance when passing under any sewer shall be a minimum of 500mm separation between the bottom of the sewer pipe and the top of the watermain. Efforts shall be made to pass over the sewer when possible.

D.8 VALVE LOCATION AND SPACING

D.8.1 The location and spacing of valves should be such that when the system is in operation:

D.8.1.1 No more than two hydrants will be put out of service by a watermain shutdown;

D.8.1.2 No more than four valves are required to effect a shutdown;

D.8.1.3 No more than 30 lots are out of service due to a watermain shutdown.

D.8.2 Valves should be no greater than 800m apart on lines 450mm in diameter and larger.

D.8.3 Valves shall be located on the projection of the property lines or at the BC of curb returns at intersections.

D.8.4 Valves shall be located at both ends of a main passing through a utility lot or easement and shall be placed 500mm from the property line.

D.8.5 Blow off valves (min. 50mm) must be installed at the end of all dead end lines.

D.8.6 Valves shall be the same size as the corresponding main.

D.9 HYDRANT LOCATION AND SPACING

D.9.1 The maximum spacing between hydrants shall be 300m for residential areas and 150m for school, industrial or commercial areas.

D.9.2 Hydrants shall be located at the projection of the property lines or at the BC of curb returns at intersections.

D.9.3 For cul-de-sacs less than 75m in length, the hydrant shall be located at or near the intersection.

D.9.4 Hydrants shall be located 1.5m from the curb face when there is no walkway and 2.7m from the curb face when walkway exists.

D.9.5 Each hydrant shall be connected to the main with a 150mm PVC branch controlled by an independent 150mm gate valve located at least 1.0m apart from the hydrant.

D.9.6 Hydrants within commercial or industrial developments shall be protected by steel bollards. The Municipality may require bollards to protect hydrants within residential subdivisions that may be placed such that they are at particular risk of damage from vehicles.

D.10 WATER SERVICES

D.10.1 Separate water service connections shall be provided for each separately titled lot.

D.10.2 The minimum size of a residential water service shall be 20mm. Non-residential service connections shall be sized according to anticipated demand.

D.10.3 Connections for all water services shall be installed at the time of initial subdivision development.

D.10.4 Curb stops shall be located such that they do not conflict with driveway locations and shall not be placed within concrete sidewalks or driveways.

D.10.4.1 A separate service line with metering chamber 1.5m inside the property line is required for each lot.

D.10.4.2 A 3.5m utility easement is required to be registered on all lots at the development stage.

D.10.5 The water services shall be installed to the property line. In areas where natural gas distribution facilities require an easement along the front of the property, the service connections shall be extended to the edge of the easement furthest from the roadway.

D.10.6 The minimum allowable distance between main stops shall be 600mm and the minimum allowable distance between main stops and an adjacent collar or coupling shall be 300mm.

D.11 WATER PIPE MATERIALS

D.11.1 General

D.11.1.1 Approved piping material includes:

D.11.1.1.1 AWWA C900 PVC DR 18 or DR 14 (100mm to 300mm diameter),

D.11.1.1.2 AWWA C905 PVC DR25 (350mm to 1200mm diameter),

D.11.1.1.3 AWWA C906 HDPE DR 11.

D.11.1.2 The Developer shall supply and install only new materials. All materials found to be defective or damaged shall be replaced at the cost of the Developer. The pipe shall not be more than two years old at the time of installation.

D.11.1.3 Water quality testing, record keeping and reporting standards shall be as required by "Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems" (Alberta Environment, January 2006).

D.11.1.4 Joint lubricants must be certified for potable water use in accordance with National Sanitation Foundation Standards.

D.11.2 PVC

D.11.2.1 All pipe materials and fabrication shall conform to AWWA C900 or C905, as applicable.

D.11.2.2 PVC watermain from 100mm through 300mm diameter shall be DR18, Class 150 (1035kPa), cast iron outside diameters with bell and spigot ends. PVC watermain from 450mm through 900mm diameter shall be DR25, Class 165 (1138kPa).

D.11.2.3 PVC pipe shall be certified under CSA 137.3 and 137.0.

D.11.2.4 The pipe shall be supplied with integral wall thickened bell ends and jointless elastomeric gaskets conforming to ASTM F477.

D.11.3 Polyethylene

D.11.3.1 The use of polyethylene pipe requires prior approval by the Municipal Engineer.

D.11.3.2 All pipe materials and fabrication shall conform to AWWA C901 or C906, as applicable.

D.11.3.3 Polyethylene pipe shall conform to CSA B137.1 and ASTM F714, D3035, D3350.

D.11.3.4 Watermain shall be HDPE DR17 (Series 100).

D.11.3.5 Moulded fittings shall conform to ASTM D2683 or D3261.

D.11.3.6 Fabricated fittings shall be manufactured from pipe of the same series as that used in the piping system.

D.11.3.7 Pipe shall be joined by thermal butt-fusion, flange assemblies or compression type fittings.

D.11.3.8 Compression couplings shall be used with stainless steel inserts.

D.11.3.9 Couplers shall be Victaulic Type 995 for use with HDPE piping or approved equal.

D.11.3.10 Valves shall be cast iron gates valves with flanged connections.

D.11.3.11 Each pipe length shall be marked for use with potable water, the manufacturer's name, nominal pipe size, dimension ratio, material grade, manufacturing standard, and a code indicating the date and place of manufacture.

D.11.4 Steel

D.11.4.1 The use of steel pipe requires prior approval by the Municipal Engineer and shall be used only under special circumstances.

D.11.4.2 Steel watermain materials and fabrication shall conform to AWWA C200 and ASTM A53. Compliance certificates shall be made available upon request.

D.11.4.3 The minimum yield strength shall be 207MPa.

D.11.4.4 Pipe thickness shall not be less than 6.35mm.

D.11.4.5 Pipes shall have bevelled ends for field butt welding.

D.11.4.6 Fittings shall be standard weight seamless or welded with bevelled ends for butt welding.

D.11.4.7 Flanges shall be 150lb. forged ASA type.

D.11.4.8 Each length of pipe shall be hydrostatically tested by the manufacturer conforming to AWWA C200 and to a test pressure of not less than the determined by the following formula:

$$P = 2 \times S \times t/D$$

where P = minimum hydrostatic pressure (kPa),

S = stress in pipe wall during hydrostatic test (kPa), which shall be 0.75 times the specified yield point of the steel used, unless otherwise specified,

t = wall thickness (mm),

D = outside diameter (mm).

D.11.4.9 Each pipe shall be marked with the manufacturer's name and the shipment number.

D.11.5 Concrete, Steel Cylinder Type

D.11.5.1 The use of concrete pressure pipe requires prior approval by the Municipal Engineer and shall be used only under special circumstances.

D.11.5.2 Concrete water pipe shall conform to AWWA C301 or C303.

D.11.5.3 The minimum operating pressure shall be 1035kPa.

D.11.5.4 The pipe shall be supplied with bell and spigot ends complete with rubber gaskets.

D.11.5.5 Steel connections shall be lined and coated with cement mortar.

D.11.5.6 Pipe shall be manufactured using sulphate resistant type V cement.

D.12 LININGS AND COATINGS

D.12.1 The application of lining (pipe interior) and coatings (pipe exterior) applies to steel and ductile iron pipe.

D.12.2 Cement mortar lining for use with ductile iron pipe shall conform to AWWA C104.

D.12.3 Epoxy coating and lining for use with steel and ductile iron pipes and fittings shall conform to AWWA C210, C213 or C210 as applicable.

D.12.4 Polyethylene coating for use with steel and ductile iron pipes and fittings shall be Yellow Jacket No.1extruded polyethylene or approved equal.

D.12.5 Cold applied tape coating for steel and ductile irons specials, joints and repairs shall conform to AWWA C209, C217 or C214 as applicable.

D.12.6 Hyprotec coating for ductile iron pipe shall be as supplied by Canron or approved equivalent and shall be applied by the manufacturer.

D.12.7 Heat shrinkable coatings shall conform to AWWA C216.

D.13 FITTINGS

D.13.1 PVC Fittings

D.13.1.1 Injection moulded fittings shall conform to AWWA C907 and CSA B137.2.

D.13.1.2 Extruded fittings shall conform to AWWA C900 and CSA B137.3.

D.13.1.3 Fittings shall be “push-on” type with elastomeric gaskets of pressure actuated seal design and shall be used with PVC or ductile iron pipe.

D.13.2 Steel Fittings

D.13.2.1 Fittings for PVC, steel and concrete pressure pipe shall conform to AWWA C200 and C208 with a minimum working pressure of 1035kPa and a yield point strength of 207MPa.

D.13.2.2 Slip-on flanges of forged steel shall conform to AWWA C207, Class D and flat faced or weld-neck flanges shall conform to ANSI B16.1, Class 125.

D.13.2.3 Use stainless steel double threaded studs with two nuts, ASTM A307, Grade B.

D.13.2.4 Full-faced rubber gaskets shall be used with 1035 kPa working pressure.

D.13.2.5 Weldolets and threadolets of forged steel shall comply with ASTM A105.

D.13.2.6 Welding of shop-fabricated fittings shall conform to CSA Z662 and shall include a certified welding inspector (AWS) to verify in writing that welders are qualified and welding procedures are followed with the limitation of testing and quality assurance being implemented.

D.13.2.7 The exterior of all fittings shall be factory coated with an epoxy coating conforming to AWWA C213.

D.13.2.8 All fittings shall require installation of a zinc sacrificial anode.

D.13.3 Concrete, Steel Cylinder Type Fittings

D.13.3.1 Fittings shall conform to AWWA C301 or C303 as applicable.

D.13.3.2 Push-on joints with vulcanized synthetic rubber gasket shall be used.

D.13.3.3 Cement shall be sulphate-resistant Type 50.

D.13.3.4 Steel connection shall be coated and lined with cement mortar.

D.14 COUPLINGS AND ADAPTORS

D.14.1 PVC couplings shall conform to AWWA C900, C906, or C907 as applicable.

D.14.2 Bolted sleeve couplings shall conform to AWWA C219 with ductile iron or carbon steel bodies with epoxy coating conforming to AWWA C213 or AWWA C550 as applicable. Couplings shall have a minimum operating pressure of 1035kPa. Linings shall be in accordance with AWWA C210, C213 or C550 and be suitable for use with potable water.

D.14.3 Flange adaptors shall conform to AWWA C219 with ductile iron or carbon steel bodies with epoxy coating conforming to AWWA C210, C213 or C550 as applicable. The minimum operating pressure shall be 1035kPa. Flanges shall conform to AWWA C207, Class D. Linings shall be in accordance with AWWA C210, C213 or C550 and be suitable for use with potable water.

D.14.4 Couplings for grooved and shouldered joints shall conform to AWWA C606 and shall have operating pressures, coatings and linings as above.

D.15 TAPPING SLEEVES

D.15.1 Tapping sleeves shall conform to AWWA C207, Class D with carbon steel body with fusion bonded epoxy coating or Type 304 stainless steel.

D.15.2 Tapping sleeves for concrete cylinder pipe shall conform to AWWA Manual M-9, body and tapping gland to be fusion epoxy coated to AWWA C213, outlet flange to AWWA C207, Class D.

D.16 PIPE CASING

D.16.1 Steel pipe casings are to conform to AWWA C200, minimum tensile strength of 207MPa.

D.16.2 Inside diameter of casing shall be at least 50mm larger than the outside diameter of the carrier pipe bell and insulator runners.

D.15.3 Use plastic / polyethylene carrier pipe insulators.

D.17 METERS

D.17.1 The Municipality utilizes Neptuno meters. All water meters shall conform to AWWA C700, C701 and C710.

D.17.2 Meter chambers shall be required at the property line for all properties with a building setback of 150m or greater.

D.17.3 The meter box shall be Mueller/McCullough Thermal-Coil or approved equal.

D.17.4 Chamber shall be 380mm diameter PVC SDR 35 with a 3m bury.

D.17.5 Chamber shall be insulated on the sides with 50mm polyethylene insulation complete with 1.27 mm thick, high density black polyethylene jacket. The jacket shall be factory installed using the "U.I.P." system furnished by Urecon Ltd. or approved equal. The top shall be insulated with 100mm factory supplied insulation.

D.18 VALVES

D.18.1 Valves - General

D.18.1.1 All water valves shall be certified to National Sanitation Foundation (NSF) Standard 61 – Drinking Water System Components: Health Effects and Standard 14 – Plastics and Plumbing System Components.

D.18.1.2 All valves shall be provided with stainless steel bolts.

D.18.1.3 Provide operating nuts located between 2.0m and 3.0m below ground surface without rock shields on all valves.

D.18.1.4 Air release valve should be placed at all significant high points in the transmission system. In addition, drain valve should be placed at low points of the mains to permit drainage during repairs to distribution main.

D.18.2 Gate Valves for Buried Service (100mm – 300mm)

D.18.2.1 Gate valves shall conform to AWWA C500 for bronze mounted solid wedge valves or C509 for resilient seated valves.

D.18.2.2 Valves shall be an iron body, bronze mounted gate valve with non-rising stem, bell ends, single ring gasket and push-on joints for connecting to pipe with cast iron outside diameter.

D.18.2.3 Provide "O" ring seal for valve stem.

D.18.2.4 Provide 50mm square operating nut turning clockwise to close.

D.18.2.5 Interior to be factory epoxy coated conforming to AWWA C550. Corrosion protection is to be provided by installation of a zinc sacrificial anode.

D.18.2.6 Cast iron valve casing conforming to ASTM A48, Class 25, screw or sliding type, with epoxy coating conforming to AWWA C213. Valve casings located within roadways or sidewalks shall be screw type only.

D.18.2.7 For blow offs, valves to be flanged to AWWA C207, Class D.

D.18.3 Gate Valves in Chambers (450mm – 1500mm)

D.18.3.1 Must conform to same standards as above, in addition, provide 50mm square operating nut with hand wheel, horizontal setting, bevel gears, position indicator. Provide by-pass with gate valve to equalize pressure on opening and closing main valve.

D.18.4 Butterfly Valves in Chambers (450mm and larger)

D.18.4.1 All butterfly valves shall conform to AWWA C504, Class 150B, short body flanged, wafer or fully lugged, cast iron body, rubber seat, bronze disk.

D.18.4.2 Provide removable "O" ring shaft seals.

D.18.4.3 Provide manual geared buried service actuator conforming to AWWA C504.

D.18.4.4 Provide screw type valve casing.

D.18.4.5 Exterior and interior factor applied epoxy coating conforming to AWWA C550. Corrosion protection is to be provided by installation of a zinc sacrificial anode.

D.18.5 Check Valves

D.18.5.1 **Swing check valves** shall only be used for sizes 300mm and smaller conforming to AWWA C508, cast iron body, bronze trimmed cast iron disk, flanged end to ANSI B16.1, bronze seat rings. (Minimum 1035kPa working pressure)

D.18.5.2 **Slanting disc check valves** shall be used for sizes 300mm and greater, cast iron body ASTM A126, Grade B, flanged ends to ANSI B16.1, ductile iron disk to ASTM A536, bronze seat and disc rings, stainless steel pivot pins and bushing to ASTM T303, valve position indicator. (Minimum 1035kPa working pressure)

D.18.5.3 **Double door check valves** shall have a cast iron body to ASTM A126, aluminium bronze gates to ASTM B148, Grade B, stainless steel spring 316SS, stainless steel stop pin, ANSI 125# flanges, wafer or threaded lug type, Buna N valve seat. (Minimum 1035kPa working pressure)

D.18.5.4 **Silent check valves** shall be wafer style or globe type, cast iron body to ASTM A126, Grade B, bronze trim, stainless steel spring 316 SS, Buna N valve seat, ANSI 125# flanges. (Minimum 1035kPa working pressure)

D.18.5.5 **Rubber flapper check valves** shall have a cast iron body, rubber lined Buna N replaceable flapper, "O" ring seating. (Minimum 1035kPa working pressure)

D.18.6 Pressure Reducing Valves

D.18.6.1 Valves 200mm and smaller shall be of single diaphragm type. Valves 250mm and larger shall be double diaphragm type.

D.18.6.2 Valves shall be globe style, hydraulically operated, pilot controlled with flanged cast iron body to ANSI B16.1, Class 125. Valves shall have Type 304 stainless steel seat and stem.

D.18.7 Flow Control Valves

D.18.7.1 Valves shall be diaphragm type, globe or angle style with cast iron body and bronze trim for pipe size less than or equal to 150mm.

D.18.7.2 Provide an "O" ring seat seal on main valve and strainer and needle valve on pilot inlet lines.

D.18.7.3 Gate valves shall be used for pipe size over 150mm with cast iron body and bronze trim.

D.18.8 Air Valves

D.18.8.1 All air valves shall conform to AWWA C512 with cast iron body and stainless steel float. Minimum working pressure shall be 1035kPa.

D.19 HYDRANTS

D.19.1 All hydrants shall be either Canada Valve or Macavity model hydrants unless otherwise approved by the Municipal Engineer. No obstructions shall be permitted which would impede Fire Department access or proper function of the hydrant.

D.19.2 All hydrants shall be certified to NSF Standard 61 – Drinking Water System Components: Health Effects and Standard 14 – Plastics and Plumbing System Components.

D.19.3 Compression type hydrants shall be supplied conforming to AWWA C502 for dry barrel fire hydrants.

D.19.4 Hydrant shall be designed for 1035kPa working pressure.

D.19.5 Hydrants shall be self-draining and a gravel drainage pit shall be provided on each hydrant lead. Where the hydrant lead is located below the water table, the hydrant drain port shall be plugged. The Municipality shall be notified of any hydrants with plugged drain ports prior to construction. The record drawings shall clearly indicate each plugged hydrant.

D.19.6 Hydrants shall have one steamer port, facing the roadway, with a 125mm stortz connection, and two 65mm connections with Alberta Mutual Aid thread at least 415mm above the ground flange. The ground flange shall be located above ground level. Nipples shall be provided with caps without chains or cables. The hose and pumper caps and hydrant valve shall open counter-clockwise.

D.19.7 Hydrants shall consist of a minimum 2.45m barrel with 300mm extension.

D.19.8 Hydrants shall have a 150mm cast iron inside diameter inlet elbow with bell end and harnessing lugs. Elbow shall be flanged to the barrel.

D.19.9 Valve stem in hydrant head to have "O" ring seals.

D.19.10 Operating nut shall be three sided, each side being a 36.5mm long arc.

D.19.11 Hydrants shall have stainless steel bolt assemblies throughout.

D.19.12 A 150mm gate valve shall be provided on each hydrant lead.

D.19.13 External paint shall conform to AWWA C550 (Corrosion Resistant) and be the following colours:

- Barrel – yellow as approved by the Municipality
- Bonnet – Bonnet colours shall conform to NFPA 291 (2002) "*Recommended Practice for the Fire Flow Testing and Marking of Hydrants*":

Class of Fire Hydrant	Bonnet Colour	Flow Rate
AA	Light Blue	5680 L/min (1500 gpm) or more
A	Green	3785-5675 L/min (1000-1499 gpm)
B	Orange	1900-3780 L/min (500-999 gpm)
C	Red	Less Than 1900 L/min (500 gpm)

D.20 SERVICE CONNECTIONS

D.20.1 Water service pipe shall be Type K Copper conforming to AWWA C800, Blue Kitec Water Service Tubing (200 psi rating) conforming to CSA B137.1 or Series 160 Polyethylene tubing conforming to AWWA C901 and CSA B137.1.

D.20.2 Minimum service size shall be 25mm for main stops, piping and curb cocks where the service length is 30m or less. Where service lengths exceed 30m, the minimum service size shall be 38mm.

D.20.3 For water services 100mm and larger, match pipe, fittings and valves to main pipe materials.

D.20.4 Provide corporation main stops, service saddles, curb cocks, service boxes and couplings according to the Municipality GMSS. Compression connections with stainless steel inserts are required for all materials. Stop-and-drain curb cocks are not permitted.

D.20.5 All fittings shall be designed for and operating pressure of 1035kPa.

D.20.6 Water service saddles shall be stainless steel type 304, bronze or a combination. Bronze components shall conform to ASTM B62. Single or double band design.

D.20.7 Service saddles for use on polyethylene pipe shall be Romac type 101, 202, 305 or 306 series, Robar 2706 or approved equal for use on polyethylene pipe.

D.20.8 Operating rods shall be Type 304 stainless steel with brass cotter pins.

D.21 CATHODIC PROTECTION

D.21.1 Cathodic protection shall be provided for all steel and ductile iron pipe, cast iron fittings, valves, and hydrants.

D.21.2 Magnesium and zinc anodes shall conform to the Municipality GMSS.

D.22 TRENCHING, BEDDING AND BACKFILLING

D.22.1 All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.

D.22.2 If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the design drawings or as a brief report to the Municipal Engineer prior to construction.

D.22.3 Class "B" pipe bedding shall be utilized in suitable soil conditions. Washed rock shall be used if water table is above the pipe zone. Bedding sand shall have minimum depth of 100mm below the pipe, shall extend up both sides to the trench wall and provide a minimum cover of 300mm above the pipe. The Developer's Engineer shall identify special pipe foundation measures for areas where unsuitable pipe foundation conditions exist.

D.22.4 The minimum trench width measured at the pipe spring line shall be the pipe outside diameter plus 450mm. The maximum trench measured at the pipe spring line shall be the pipe outside diameter plus 600mm. The Municipal Engineer must be notified if the trench must be excavated deeper or wider than specified.

D.22.5 Excavated material shall be stockpiled at a safe distance from the edge of the trench.

D.22.6 The Developer's Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.

D.22.7 Trench excavations shall be kept free of water.

D.22.8 It shall be the Developer's responsibility to ensure that the utility trenches are adequately compacted.

D.22.8.1 Native backfill under existing or proposed roads or laneways shall be compacted throughout the entire right-of-way width to:

D.22.8.1.1 98% of Standard Proctor Density from subgrade to 1.5m below subgrade or original ground, whichever is lower;

D.22.8.1.2 95% of Standard Proctor Density greater than 1.5m from the subgrade or original ground whichever is lower.

D.22.8.2 Granular backfill under existing or proposed roads or laneways shall be compacted to 95% of Standard Proctor Density throughout the entire trench depth below subgrade and the entire right-of-way width.

D.22.8.3 Backfill in all other areas shall be compacted to 95% of Standard Proctor Density.

D.22.8.4 Subgrade and base course compaction for roadway construction shall be as specified in Section G.

D.22.8.5 If the above standards cannot be achieved due to a large variation in soil types throughout the development, the Municipal Engineer may at his sole discretion, establish a more appropriate standard on an individual case basis. One-mould proctor density testing may be permitted if the Developer submits an acceptable proposal prepared by the Developer's Engineer, justifying the required changes to the compaction standards.

D.22.9 If the minimum compaction standards cannot be met due to abnormal weather or wet ground conditions, the Municipal Engineer may establish a more suitable standard on a site-specific basis provided adequate justification is presented by the Developer. One-mould proctor density testing will not be permitted as an alternate testing procedure due to wet soil conditions. The Developer's engineer will be required to suggest appropriate measures such as drying in-situ material or importing suitable material in order to meet the required Standard Proctor Densities.

D.22.10 All landscaping, pavement structures, sidewalks, curb and gutter damaged or removed during trenching shall be restored or replaced unless otherwise directed by the Municipal Engineer.

D.22.11 All debris, surplus fill and unused materials must be removed from the site.

D.23 WATERMAIN INSTALLATION

D.23.1 The pipe and gasket installation shall be conducted in compliance with the pipe manufacturer's specifications.

D.23.2 Installation of PVC pipe and fittings shall conform to AWWA M23.

D.23.3 Installation of ductile iron pipe and cast iron fittings shall conform to AWWA C600.

D.23.4 Installation of concrete steel cylinder pipe shall conform to AWWA M9.

D.23.5 Field welding procedures shall be in accordance with CSA Z662. Welders shall be qualified as B pressure welders.

D.23.6 Align pipes carefully when jointing. Keep joints free of mud, gravel and foreign material and ensure that the joint is complete as outlined in the manufacturer's specifications. Complete each joint before laying the next length of pipe. Deflections shall not exceed those permitted by the manufacturer.

D.23.7 The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete.

D.23.8 The alignment of pipes less than 900mm in diameter shall not be more than 150mm off the designated alignment. The alignment for pipes larger than 900mm shall not deviate by more than 50mm per 300mm of diameter.

D.23.9 The invert of the pipe shall not deviate from the design grade by more than 40mm.

D.24 OPERATION OF BOUNDARY VALVES & EXISTING HYDRANTS

D.24.1 Municipality representatives shall be notified at least 48 hours (two full business days) in advance of valve operation requirements. Municipality personnel shall operate the boundary valves.

D.24.2 The Developer shall obtain permission for using a hydrant as a water source for construction. Arrangements for payment for water used may be required. Municipality representatives may outline conditions of use depending on the circumstances.

D.25 VALVE INSTALLATION

D.25.1 Valves, valve casings and fittings shall be installed in accordance with the manufacturer's specifications.

D.25.2 All valves shall be installed with a concrete thrust block.

D.25.3 Valve casings shall be set at grade for unpaved areas and between 5 – 15 mm below grade for paved surfaces and sidewalks.

D.25.4 Upon completion, all valve casings must be checked to ensure that they are plumb and that the operating nut can be turned properly.

D.26 HYDRANT INSTALLATION

D.26.1 Hydrants shall be installed in accordance with the manufacturer's specifications and AWWA M17.

D.26.2 All hydrants shall be installed with a concrete thrust block.

D.26.3 A gravel drain shall be provided at the base of the hydrant barrel consisting of a minimum of 1.0m^3 of washed rock.

D.26.4 Hydrant drain ports shall be left open except where the water table is above the hydrant drain. The Municipality shall be notified of hydrants with plugged drain ports.

D.26.5 Upon completion, all hydrants must be checked to ensure that they are plumb and that the operating nut is functioning properly.

D.27 SERVICE INSTALLATION

D.27.1 Residential water services shall be installed in common trench with the sanitary and storm sewer services. Double services may be in a common trench to the property line.

D.27.2 Tapping for residential service connections shall be done with full operating pressure in the main. The tap shall be made within 30° of the pipe crown and goose-necked to service trench level. The service line shall be supported by sand bags until it reaches trench level.

D.27.3 A tapping valve and sleeve must be used for services 100mm and larger.

D.27.4 Curb stops shall be installed on the property line.

D.27.5 Services crossing existing roadways and/or sidewalks shall be augered, bored or tunnelled unless otherwise approved by the Municipal Engineer.

D.28 INSPECTION AND TESTING

D.28.1 Inspections

All water installations shall be subject to inspections by the Municipal Engineer prior to issuance of the Construction Completion Certificate (C.C.C.) and Final Acceptance Certificate (F.A.C.).

D.28.2 Pressure Testing

D.28.2.1 The entire system shall be subjected to a hydrostatic pressure test in the presence of the Municipal Engineer. The Developer is responsible for the supply of all necessary labour, materials and equipment to complete the testing. The Developer shall notify the Municipality at least 48 hours (two full business days) in advance of the testing.

D.28.2.2 Select acceptable test sections in consultation with the Municipal Engineer. The maximum length of distribution main test sections shall be 450m. The maximum length of transmission main sections shall be 800m.

D.28.2.3 The test section shall be filled with water 24 hours prior to the test. All thrust blocks must be cured and backfill partially or completely done.

D.28.2.4 Ensure that all main valves and hydrant isolation valves in the test section are open and that the hydrants are closed.

D.28.2.5 Ensure that all air is expelled from the section using hydrants and service taps and high points and dead-ends and raise the watermain pressure to the test pressure. The test pressure shall be 150% of the working pressure measured at the lowest elevation or 1035kPa whichever is greater.

D.28.2.6 Note the pressure and water level at the beginning of the test. The test duration shall be 2 hours. The pressure shall be maintained within 20kPa of the specified test pressure throughout the test.

D.28.2.7 Measure the water level at the end of the test and calculate the observed leakage. Compare against the allowable leakage calculated as follows:

$$L = \frac{NDP^{1/2}}{128{,}225} \quad \text{for PVC pipe}$$

$$L = \frac{NDP^{1/2}}{32{,}046} \quad \text{for Ductile Iron Pipe}$$

where L = allowable leakage, L/hr,

N = total number of joints,

D = nominal pipe diameter, mm,

P = test pressure, kPa.

D.28.3 Disinfection

D.28.3.1 Watermains are to be flushed and disinfected in accordance with AWWA C651 continuous feed method.

D.28.3.2 Chlorine residual tests shall be performed at the beginning and end of the disinfection and again after flushing the lines.

D.28.3.3 Approximately 16 hours after flushing the chlorine, one bacteriological sample for each 90m of main shall be taken and submitted for analysis unless otherwise approved by the Municipal Engineer. Where dead ends exist, samples shall be taken at the end of the line. Approved bacteriological sample bottles from the Provincial Laboratory of Public Health.

D.28.3.4 The mains shall not be commissioned and put into use until the bacteriological sample results are approved by the Municipal Engineer.

D.29 HYDRANTS

D.29.1 At least one hydrant flow test shall be conducted by the Developer in order to ensure that the flows and pressures identified in the design calculations are being provided in the field. If discrepancies are found, all hydrants in the development shall be tested and the Developer's Engineer shall indicate the corrective action that the Developer must undertake to remedy the deficiency.

SECTION E SANITARY SEWER SYSTEM

E.1 GENERAL

E.1.1 The Developer and the Developer's Engineer are responsible to ensure that the sanitary sewer system is designed and constructed according to accepted engineering practice. These guidelines are intended as a guide only and shall not be considered as a substitute for a detailed material and construction specification to be prepared by the Developer's Engineer.

E.1.2 The current standard and specification issued by the following organizations shall be implemented during design and construction of the sanitary sewer systems:

American Society for Testing and Materials (ASTM),

Canadian Standards Association (CSA),

Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater ,and Storm Drainage Systems.

E.2 FLOW GENERATION RATES

E.2.1 The sanitary system shall be of sufficient capacity to carry peak flows plus an inflow and infiltration allowance. The flow and factors listed below shall be used as minimum requirements in the design of the sanitary sewer systems.

E.2.1.1	Average Sewage Flow	320 L/person/day (minimum, residential)
		6170 L/ha/day (non-residential, inc. infiltration)
E.2.1.2	Population Density	3.5 persons/residence (residential)
E.2.1.3	Peak Sewage Flow	Average Flow x Peaking Factor
E.2.1.4	Peaking Factor:	

E.2.1.4.1 Residential (Harmon's Formula)

- $1 + 14/(4+P^{1/2})$

where P = the contributing design population in thousands

If P<1, a peaking factor of 4.5 shall be used

E.2.1.4.2 Non-Residential - 3.0

E.2.1.5 Infiltration 0.28 L/s/ha (residential)

E.2.1.6 Inflow at Sag Manholes 0.4 L/s/manhole

E.2.2 The total design peak flow rates for the sanitary sewer shall be the sum of the peak flow rates plus all extraneous flow allowances.

E.3 GRAVITY SEWER AND FORCE MAIN PIPE SIZING

The following design factors shall be used in determining the sanitary sewer pipe sizes:

E.3.1 Minimum pipe size 200 mm diameter

E.3.2 Manning's Formula "n" 0.013

E.3.3 Required sewer capacity Estimated Peak Design Flow

E.3.4 Minimum flow velocity 0.6 m/sec (during average flow)

E.3.5 Maximum flow velocity 3.5 m/sec (consider souring)

E.3.6 Minimum design slopes:

Sewer Diameter (mm)	Minimum Design Slope, %
200	0.40
250	0.28
300	0.22
375	0.15
450	0.12
525 and greater	0.10

E.3.7 Minimum slopes shall be increased by 50% on all curved sections.

E.3.8 The minimum grade of the first upstream leg shall not be less that 1.0%.

E.3.9 It is recommended that all sanitary sewers be designed with a slope of 0.4% or greater, wherever possible.

E.3.10 Sanitary sewers for the proposed development are designed as open channels with no depth or flow, under the max, min design flow condition, not to exceed 50% of the internal diameter of sewer (i.e., d/p = 0.5, where d = depth of water and p = internal pipe diameter).

E.4 LOW PRESSURE SEWER SYSTEM SIZING

E.4.1	Minimum main pipe size	50mm diameter
E.4.2	Minimum service pipe size	38mm diameter
E.4.3	Minimum flow velocity	0.6m/sec
E.4.4	Hazen Williams flow coefficient (C)	150

E.4.5 The low-pressure sewer main shall be sized according to the number of services. It is the responsibility of the Developer's Engineer to determine the maximum number of pumps that will be pumping simultaneously and to size the main accordingly.

E.4.6 A two-compartment septic tank is required with a minimum total volume of 3000 litres for a single-family dwelling.

E.4.7 Pumps may either be submersible sewage pumps installed in the second chamber (liquid chamber) of the septic tank or a centrifugal pump installed in the basement with a suction line to the second chamber. The use of a single chamber tank with a grinder pump is not permitted. All pump connections shall incorporate double check valves downstream of the pump discharge to prevent backflow into the septic tank.

E.4.8 The maximum head for a low-pressure system is 24 metres (35 psi). Pumps with a higher discharge head shall only be permitted if all pumps and mains within the system have been designed to accommodate the higher pressure.

E.4.9 All pumps within the system should typically have the same maximum discharge head in order to avoid shutting out smaller pumps. In larger systems or systems with large elevation differences, pumps located further away from the system outlet or at a low elevation may require a higher discharge pressure in order to ensure proper system operation.

E.4.10 A single pump intended to accommodate multiple services shall not be permitted unless the Developer's Engineer can demonstrate that the design will not be detrimental to the other system users.

E.5 MATERIAL REQUIREMENTS

E.5.1 Unless specified with better material accepted by the Municipal engineer, all underground and water retaining structure shall be designed against frost and sulphate attack (with sulphate resistant cement to ASTM type V) and conform to CSA A23.1 and ACI 350R-89 "Environmental Engineering of Concrete Structure".

Concrete Grade 25 shall be used and tested in accordance with CSA 23.2.

E.5.2. The design of foundation, footing, excavation, soil, rock and liquid retaining structure shall comply with the current National Building Code (NBC) and Alberta Building Code (ABC). A surface investigation, including ground water condition, shall be carried out by or under the direction of a professional engineer having the knowledge and experience in planning and executing such investigations to a degree appropriate for the structure or substructure of its use, the ground and the surrounding condition.

E.5.3. COncrete manholes, catchbasins shall be manufactured with pre-cast reinforced concrete conponents conform to ASTM C478. No Corrugated Steel Pipe (CSP) shall be used.

Component joint shall be supplied with a pre-formed and sealed O-ring type rubber gasket, comply to ASTM C443 or current requirement.

E**.5.4** Mininuim of 100mm thick bedding of granular grtavels or sand (no particles larger than 32mm) shall be allowed for levelling bed for the aforesaid structures.

E.6 SANITARY SEWER ALIGNMENT AND LOCATION

E.6.1 Sewer mains shall be located within the road right-of-way and outside the carriageway in accordance with the typical roadway cross section.

E.6.2 Sanitary sewers shall be located a minimum of 3.0m o/c from any watermain and 1.8m o/c from any gas line or as required by the utility company.

E.6.3 Sanitary sewers shall be spaced at a minimum of 0.25m between pipe walls from any adjacent storm sewer.

E.6.4 Public Utility Lot (PUL) widths shall be at least 4.0m for a single utility and 6.0m for two utilities.

E.6.5 Curved sewers shall run parallel to the curb or road centreline.

E.7 REQUIRED DEPTH FOR SANITARY SEWERS

Sanitary sewers shall be installed at a sufficient depth to meet the following requirements:

E.7.1 The main shall have a minimum depth of cover of 2.9m measured from finished grade to the top of pipe.

E.7.2 The sanitary sewer shall have sufficient depth of cover to provide complete frost protection.

E.7.3 Gravity mains shall have sufficient depth to allow all buildings to drain by gravity to the sewer. Special consideration should be taken when building floor elevations are lower than the roadway. Service lines shall have a minimum cover of 2.9m from the finished lot surface to the top of pipe at the property line.

E.7.4 Under normal conditions, sewer mains shall cross below water mains with sufficient clearance to allow for proper bedding and structural support of the pipes. Pipe clearance when passing under any watermain shall be a minimum of 300mm separation between the top of the sewer pipe and the bottom of the watermain.

E.7.5 Pipe clearance when passing over any watermain shall be a minimum of 500mm separation between the bottom of the sewer pipe and the top of the watermain. Efforts shall be made to pass under the watermain when possible.

E.8 MANHOLE DESIGN AND LOCATION (GRAVITY SYSTEM)

E.8.1 Manholes shall be located at the end of each line, at all changes in pipe size, grade and alignment.

E.8.2 The maximum distance between manholes shall not exceed 150m.

E.8.3 All manholes shall be 1200mm minimum inside diameter.

E.8.4 Manholes shall be located at the extension of property lines whenever possible in order to avoid conflicts with driveways.

E.8.5 The drop across manholes should be of sufficient magnitude to account for any energy losses in the manhole:

E.7.5.1 pipe deflections of less than 45° require a drop of at least 30mm,

E.7.5.2 pipe deflections of 45° to 90° require a drop of at least 50mm.

E.8.6 Invert drops for pipes larger then 600mm or for high flow situations shall be assessed on an individual basis.

E.8.7 The obvert elevation of a sewer entering a manhole shall not be lower than the obvert elevation of the outlet pipe.

E.8.8 Pipe deflection in the manhole shall not be greater than 90°.

E.9 SANITARY SERVICES

E.9.1 Separate sanitary sewer connections shall be provided for each separately titled lot.

E.9.2 The minimum size of a residential gravity sanitary sewer service from the main to the property line shall be 150mm diameter. The Municipality may approve 100mm diameter services under special circumstances where the total service length from main to proposed building site is less than 30m.

E.9.3 The minimum size of a residential low-pressure sanitary sewer service shall be 38mm.

E.9.4 Non-residential service connections shall be sized according to anticipated user requirements.

E.9.5 Low-pressure service lines shall require a curb stop at the property line. Curb stops for low pressure services shall use caps identifying them as wastewater services. All wastewater caps shall be painted green.

E.9.6 Connections for all proposed residential lots shall be installed at the time of initial subdivision development.

E.9.7 The grade(s) of any sewer is governed by the minimum velocity required (0.6m/s). If the design flow does not produce a minimum velocity of 0.6m/s, the minimum grade must be calculated using d/D of 0.35 and velocity of 0.6m/s. Upon this condition the minimum grades for pipes 400mm and smaller:

TABLE 9.7-1

MINIMUM GRADE FOR PIPES 400 mm AND SMALLER

Pipe Size (mm)	Grade (%)	d/D*
200	0.46	0.35
250	0.35	0.35
300	0.27	0.35
350	0.22	0.35
400	0.19	0.8

*d/D is the depth of flow to diameter of pipe ratio

E.9.8 Risers for service lines shall be required when sewer mains exceed 4 metres in depth.

E.9.9 Services shall be located such that they do not conflict with driveway locations.

E.9.10 The sanitary services shall be installed to the property line. In areas where natural gas distribution facilities require an easement along the front of the property, the service connections shall be extended to the edge of the easement furthest from the roadway.

E.9.11 Sanitary services shall always be installed to the right of the water service when facing the property line from the roadway.

E.9.12 Weeping tiles, roof leaders and other similar appurtenances handling storm or groundwater shall not be permitted to discharge into the sanitary sewer.

E.10 SANITARY SEWER MATERIALS

E.10.1 The Developer shall supply only new materials. All materials found to be defective or damaged shall be replaced at the cost of the Developer.

E.10.2 Where specific products are specified, it is intended that approved equals are also acceptable. Approval must be obtained by the Municipal Engineer prior to installation.

E.10.3 PVC pipe and fittings shall conform to the following:

E.10.3.1 CSA B182.2, ASTM D3034, ASTM F679, NQ 3624-130 and NQ 3624-135 standards with minimum stiffness of 320kPE (service lines shall have a minimum stiffness of 625kPE);

E.10.3.2 Standard Dimension Ratio (SDR) 35 unless otherwise indicated on the drawing;

E.10.3.3 Sealing gaskets shall meet requirements of CSA B182.2 and ASTM F477.

E.10.3.4 Injection moulded gasketed fittings for service connections shall conform to CSA B182.1 or CSA B182.2 and fabricated fittings shall conform to CSA B182.2 and ASTM F679;

E.10.3.5 Pipe shall be tested by the manufacturer and marked in accordance with CSA B182.2 (test results shall be recorded on a certification form signed by a qualified representative of the manufacturer);

E.10.3.6 Pipe and fittings shall be installed within two years from the production date indicated on the certification.

E.10.4 Concrete pipe and fittings shall conform to the following:

E10.4.1 All concrete pipe shall be manufactured using Type 50 sulphate resistant cement CSA A3000;

E.10.4.2 Non reinforced concrete pipe shall conform to CSA A257.1, minimum Class 3 and ASTM C14;

E.10.4.3 Reinforced concrete pipe shall conform to CSA A257.2 and ASTM C76;

E.10.4.4 Flexible rubber gasket joints shall conform to CSA 257.3 and ASTM C443;

E.10.4.5 The manufacturer of the concrete pipe shall perform quality testing and control in accordance with CSA 257.0, 257.1, 257.2 and 257.3;

E.10.4.6 Each concrete pipe shall be marked with the manufacturer's name, date of casting and quality testing passing stamp.

E.10.5 Polyethylene pipe and fittings for low-pressure systems shall conform to the following:

E.10.5.1 Polyethylene pipe shall conform to CSA B137.1 and ASTM D3035, D3350;

E.10.5.2 Minimum pressure rating of 550kPa (Series 80);

E.10.5.3 Moulded fittings shall conform to ASTM D2683 or D3261;

E.10.5.4 Fabricated fittings shall be manufactured from pipe of the same series as that used in the piping system;

E.10.5.5 Pipe shall be joined by thermal butt-fusion, flange assemblies or compression type fittings;

E.10.5.6 Flanges shall be stainless steel or epoxy coated ductile iron conforming to ASTM A536-80 with stainless steel nuts, bolts and washers;

E.10.5.7 Compression couplings shall be used with stainless steel inserts;

E.10.5.8 Service tapping saddles shall be Robar type 2706 or approved equal with bronze body, 44mm wide stainless steel straps with stainless steel nuts and bolts;

E.10.5.9 Valves shall be cast iron gates valves with flanged connections

E.10.5.10 Each pipe length shall be marked with the manufacturer's name, nominal pipe size, dimension ratio, material grade, manufacturing standard, and a code indicating the date and place of manufacture.

E.11 MANHOLE MATERIALS

E.11.1 Manholes shall be manufactured using sulphate resistant Type V cement as specified or the approved type Chemical Resistance Fibre Glass or HDPE material with proven record of 50 years life time. Material Data sheet and past record (at least 5 references in Canada) shall be submitted to the Municipal engineer for approval.

E.11.2 **Manhole sections shall be pre-cast reinforced concrete conforming to ASTM C478 and CSA A257.4.** The concrete shall be achieving a Concrete strength of 25MPa at 28 days. The precast barrel shall be water proof and supplied with preformed and confined O–ring type gasket, conforming to ASTM C433 or current version thereof.

E.11.3 All manholes shall have an inside diameter of 1200mm for pipe 900mm and less. The Developer shall submit the specification for the Municipality for review and approval with their design submission. The manhole shall be checked against floatation at H.W.L. if the manholes are not using reinforced concrete. For pipe exceeding 900mm or manhole having multiple inlets, manhole sizing shall be subject to review by the Municipal Engineer.

E.11.4 Manhole steps shall be standard safety type, hot dipped galvanized iron conforming to ASTM A615 and ASTM A123 or aluminum forged from 6061-T6, 6351-T6.

E.11.5 All pipe penetrations shall be sealed with rubber gaskets conforming to ASTM C443 and grouted with non-shrink grout.

E.11.6 Manhole frames and covers shall be cast iron conforming to Class 20 ASTM A48 and ASTM A536. Type NF80 covers shall be used for all streets and driveways, type NF90 covers with rubber gasket shall be used for manholes located in sags and low areas and type F39 covers shall be used for all other areas. Castings shall be marked with series designation, foundry identification and date of casting. Manhole covers with the Municipality identification will be encouraged. City of Edmonton or other municipal identification covers are not permitted.

E.11.7 Pre-benched manhole bases shall be used wherever possible with pre-cored connection holes and watertight Duraseal or G-Loc joints or approved equal.

E.11.8 Tee Riser manholes shall conform to CSA 257.2, ASTM C76 and CSA A257.4, ASTM C76.

E.11.9 Safety platforms are required for all manholes greater than 7.0m in depth.

E.11.10 All pre-cast units shall be market with manufacturer's identification, date of casting, type of cement and CSA standard.

E.12 TRENCHING, BEDDING AND BACKFILLING

E.12.1 All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.

E.12.2 If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the design drawings or as a brief report to the Municipal Engineer prior to construction.

E.12.3 Class "B" pipe bedding shall be utilized in suitable soil conditions. Washed rock shall be used if water table is above the pipe zone. Bedding sand shall have minimum depth of 100mm below the pipe, shall extend up both sides to the trench wall and provide a minimum cover of 300mm above the pipe. The Developer's Engineer shall identify special pipe foundation measures for areas where unsuitable pipe foundation conditions exist.

E.12.4 The minimum trench width measured at the pipe spring line shall be the pipe outside diameter plus 450mm. The maximum trench measured at the pipe spring line shall be the pipe outside diameter plus 600mm. The Municipal Engineer must be notified if the trench must be excavated deeper or wider than specified.

E.12.5 Excavated material shall be stockpiled at a safe distance from the edge of the trench.

E.12.6 The Developer's Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.

E.12.7 Trench excavations shall be kept free of water.

E.12.8 It shall be the Developer's responsibility to ensure that the utility trenches are adequately compacted.

E.12.8.1 Native backfill under existing or proposed roads or laneways shall be compacted throughout the entire right-of-way width to:

E.12.8.1.1 98% Standard Proctor Density from subgrade to 1.5m below subgrade or original ground, whichever is lower;

E.12.8.1.2 95% Standard Proctor Density greater than 1.5m from the subgrade or original ground, whichever is lower.

E.12.8.2 Granular backfill under existing or proposed roads or laneways shall be compacted to 95% of Standard Proctor Density throughout the entire trench depth below subgrade and the entire right-of-way width.

E.12.8.3 Backfill in all other areas shall be compacted to 95% of Standard Proctor Density.

E.12.8.4 Subgrade and base course compaction for roadway construction shall be as specified in Section G.

E.12.8.5 If the above standards cannot be achieved due to a large variation in soil types throughout the development, the Municipal Engineer may at his sole discretion, establish a more appropriate standard on an individual case basis. One-mould Proctor density testing may be permitted if the Developer submits an acceptable proposal prepared by the Developer's Engineer, justifying the required changes to the compaction standards.

E.12.9 If the minimum compaction standards cannot be met due to abnormal weather or wet ground conditions, the Municipal Engineer may establish a more suitable standard on a site specific basis provided adequate justification is presented by the Developer. One-mould Proctor density testing will not be permitted as an alternate testing procedure due to wet soil conditions. The Developer's engineer will be required to suggest appropriate measures such as drying in-situ material or importing suitable material in order to meet the required Standard Proctor Densities.

E.12.10 All landscaping, pavement structures, sidewalks, curb and gutter damaged or removed during trenching shall be restored or replaced unless otherwise directed by the Municipal Engineer.

E.12.11 All debris, surplus fill and unused materials must be removed from the site.

E.13 SEWER INSTALLATION

E.13.1 The pipe and gasket installation shall be conducted in compliance with the pipe manufacturer's specifications. Installation of PVC pipe and fittings shall conform to CSA-B182.11.

E.13.2 Pipe installation shall start at the outlet and work upstream.

E.13.3 Align pipes carefully when jointing. Keep joints free of mud, gravel and foreign material and apply sufficient pressure to ensure that the joint is complete as outlined in the manufacturer's specifications. Complete each joint before laying the next length of pipe. Deflections shall not exceed those permitted by the manufacturer.

E.13.4 The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete.

E.13.5 The alignment of pipes less than 900mm in diameter shall not be more than 150mm off the designated alignment. The alignment for pipes larger than 900mm shall not deviate by more than 50mm per 300mm of diameter.

E.13.6 The invert of the pipe shall not deviate from the design grade by more than 6mm plus 20mm per metre of diameter of sewer pipe.

E.13.7 The minimum cover over a sewer in a roadway is 1.5 metres and 0.9 metres elsewhere.

E.14 MANHOLE INSTALLATION

E.14.1 Manholes shall be installed as depicted on the detail drawings and in accordance with manufacturer's recommendations.

E.14.2 Backfill around manholes shall be compacted to a minimum of 98% of Standard Proctor Density.

E.14.3 Tee Riser manholes shall require Class A bedding to the elevation of the pipe spring line.

E.14.4 Pre-cast manhole bases shall be installed on a base of 100mm to 300mm of washed gravel.

E.14.5 Cast in place manhole bases approved by the Engineer shall be places directly on undisturbed ground.

E.14.6 Safety steps shall be aligned on centreline perpendicular to the main flow channel. Wherever possible the steps shall be aligned so that a person exiting the manhole would face oncoming traffic if not conflicting with the previous requirement. The distance from the top of the rim to the first step shall not be greater than 300mm. Steps shall be evenly spaced at a maximum of 410mm to within 600mm of the base of the manhole. Refer to Drawing E-08 for details.

E.14.7 The frame and cover shall be installed following manufacturer's recommendations.

E.15 INSPECTION AND TESTING

E.15.1 All sewer installations shall be subject to inspections by the Municipal Engineer prior to issuance of the Construction Completion Certificate (C.C.C.) and Final Acceptance Certificate (F.A.C.).

E.15.2 Video inspections by qualified personnel are required prior to C.C.C. A written report including still photographs and video tape recording of the entire inspection shall be submitted to the Municipal Engineer for review. The report shall indicate the location and severity of all leaks, cracks, breaks, collapses, deflections, sags, obstructions and any other defects affecting the performance of the line. Sections requiring repair will be subject to re-inspection when complete.

E.15.3 Re-inspection by camera may be required on suspect areas prior to F.A.C. at the discretion of the Municipal Engineer. All video inspection costs shall be borne by the Developer.

E.15.4 All material testing (backfill densities and concrete testing) shall be performed by an accredited agency and certified by a Professional Engineer. All test results shall be submitted to the Municipal Engineer with a report indicating any deficiencies and remediation.

E.15.5 An infiltration and/or exfiltration test may be required at the Municipal Engineer's sole discretion for any section showing deficiencies during the camera test.

E.15.5.1 The test section shall be filled with water allowing displacement of air in the line and will be allowed to stand for 24 hours to ensure absorption in the pipe wall. Prior to the test, add enough water to ensure a head of 1m to 3m over the pipe crown in the upstream manhole. The test duration shall be 2 hours. The water level should be measured at the beginning and end of the test in order to calculate the infiltration/exfiltration.

E.15.5.2 The allowable leakages are as follows:

E.15.5.2.1 **Infiltration Test**: Performed when the groundwater is above the pipe crown for the entire test length (Allowable infiltration is 5.0 L/day/mm diE./km for PVC pipe and 20.0 L/day/mm diE./km for concrete pipe);

E.15.5.2.2 **Exfiltration Test**: Performed when the groundwater is below the pipe invert for the entire test length (Allowable exfiltration is 5.0 L/day/mm dia/km and 20.0 L/day/mm diE./km for concrete pipe).

E.16 SANITARY WASTEWATER PUMPING SYSTEMS

E.16.1 General

Wastewater pumping systems shall only be installed where site constraints restrict the gravity collection system from tying to an existing sanitary trunk line. The requirement must be justified in an initial subdivision design report taking the development plans for the surrounding area into account.

E.16.2 Standards and Approvals

The design and construction of the pumping system must meet the current requirements of other governmental authorities and regulations including Alberta Environment, Alberta Occupational Health and Safety and the Alberta Building Code. The Developer is responsible for all submissions and applications required for approval.

E.16.3 Location

E.16.3.1 The pumping station shall be located in such a manner as to minimize the impact to adjacent development in terms of visibility, odour and noise.

E.16.3.2 Pumping stations shall not be located in areas subject to flooding during a major rainfall event.

E.16.3.3 Pumping stations shall always be accessible by road.

E.16.4 Configuration

E.16.4.1 A wet well configuration with submersible pump or above ground suction head pump is preferred.

E.16.4.2 A wet well / dry well configuration may be considered for larger facilities.

E.16.4.3 A building may be required for the wet well / dry well pumping stations.

E.16.4.4 A collection manhole shall intercept flow from all incoming sewers before discharge to the pumping station. The station shall receive flow from one inlet only.

E.16.4.5 Provision shall be made to shut off flow from the collection manhole if required.

E.16.4.6 Any stations without a building shall be fenced with a lockable gate to prevent unauthorized access.

E.16.4.7 The Developer shall be responsible for any necessary landscaping required to enhance the appearance of the facility when located close to a residential area. Landscaping plans are subject to approval by the Municipality.

E.16.5 Pumping Station Design

E.16.5.1 The pumps shall be sized to accommodate the maximum expected flow as determined by accepted engineering practice and according to the requirement specified in Section E.2 Flow Generation Rates.

E.16.5.2 Pumping stations shall be equipped with two or more pumps sized such that if one pump is out of service, the remaining pump(s) is/are capable of pumping the design capacity flow rate. Pumps shall be identical and interchangeable for a duplex pumping station. Pumps starts shall alternate between pumps.

E.16.5.3 Pumps shall be provided by a well-recognized manufacturer with a local repair service depot.

E.16.5.4 Submersible pumps shall have a non-clog impeller design and flush valves.

E.16.5.5 Pump motors shall operate on 3-phase power wherever possible. This requirement may be relaxed by the Municipality if 3-phase power cannot be supplied at a feasible cost.

E.16.5.6 Dead storage shall be minimized while meeting minimum depth requirements specified by the pump manufacturer.

E.16.5.7 Wet wells shall be sized based on accepted engineering practice. Storage shall be provided to minimize the frequency of pump starts but the maximum retention time in the wet well should not exceed 30 minutes. The design shall meet pump manufacturer's specifications.

E.16.5.8 Wet wells shall be sized and equipped to accommodate operator access, maintenance and safety requirements.

E.16.6 Valves and Piping

E.16.6.1 The minimum diameter for all pump suction and discharge piping shall be 100mm.

E.16.6.2 Pipe sizing shall allow for minimum and maximum flow velocities of 0.75m/s to 3.5m/s respectively within the station.

E.16.6.3 The minimum pressure rating of piping within the station shall be determined based on calculated operating pressures but shall not be less than 900kPa.

E.16.6.4 Pumps shall be connected in parallel to a common discharge header located within the station. Check valves and isolation valves shall be installed on the discharge line between each pump and the discharge header.

E.16.6.5 A forcemain isolation valve shall be installed on the main discharge pipe outside the wet well.

E.16.7 Water Supply

E.16.7.1 Water supply must be provided to the facility for washing/cleaning purposes.

E.16.7.2 The design shall ensure that the connection between the potable water supply and the wastewater pumping station does not cause contamination of the potable water supply. The design shall comply with the conditions stipulated in the current Alberta Environment "Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems" for Water Supply and Wastewater Facilities.

E.16.7.3 Where a potable water supply is to be used for washing/cleaning purposes, a break tank, pressure pump and pressure tank shall be provided. In-line backflow preventers are not acceptable. The potable water shall be discharged to the break tank through an air gap at least 150mm above the maximum flood line or the spill line of the tank.

E.16.8 Alarms and Emergency Backup

E.16.8.1 The Developer shall make provisions to mitigate environmental or property damage caused by facility failure.

E.16.8.2 Stations shall be equipped with or provided with the feature for future connection of remote sensing and telemetry equipment enabling operators to monitor the alarms.

E.16.8.3 Power must be supplied from two independent sources. In the event of a power failure, secondary power must automatically engage through a diesel generator or direct-coupled motor. Secondary power system must not be fuelled by natural gas unless a supply tank is provided on site.

E.16.8.4 Special consideration shall be made to control any possible overflow in a manner acceptable to the Municipality and Alberta Environment.

E.16.9 Access and Maintenance

E.16.9.1 Permanent hoist equipment and access hatches of sufficient size and capacity shall be provided for removal of station equipment.

E.16.9.2 All access points shall have locking devices.

E.16.9.3 Ladders shall be non-skid and shall comply with Occupational Health and Safety requirements.

E.16.9.4 Stations shall have adequate interior and exterior lighting.

E.16.9.5 The Developer is responsible for the supply of an Operating and Maintenance manual for the facility. The manual shall include a complete parts list for all mechanical and electrical components including control diagrams, schematics and manufacturer's operation, maintenance, service and repair specifications. The Developer shall submit five (5) copies to the Municipality along with all commissioning and testing results prior to issuance of the C.C.C.

E.16.10 Heating and Ventilation

E.16.10.1 Forced mechanical ventilation is required for dry wells below ground level and for wet wells containing screens or mechanical equipment requiring maintenance or inspection.

E.16.10.2 Equipment shall be able to provide at least six air changes per hour. Provision shall be made for ventilation of the wells with portable equipment in case of system failure. Ventilation failure alarms are required.

E.16.10.3 There shall be no interconnection between wet well and dry well ventilation systems.

E.16.10.4 Multiple air inlets and outlets are recommended for dry wells over 5m deep. Air intakes and outlets shall be designed to function year round and screen openings should be sized to avoid frost build-up or clogging.

E.16.10.5 Air shall be forced into the dry well at a point 150mm above the pump floor and into the wet well at a point 150mm above the high water level.

E.16.10.6 Automatic heating and dehumidification equipment shall be provided in all dry wells.

E.16.11 Building Requirements

E.16.11.1 All lift stations shall be provided with a building to house all electrical and control equipment and to provide a workspace for pump maintenance.

E.16.11.2 Buildings shall be of an adequate size to allow for the required access hatches, hoist equipment, ventilation and control equipment while allowing for an appropriate workspace for pump maintenance.

E.16.11.3 Access to the wet well shall not be from within the building.

E.16.11.4 Building layout and access shall be designed to facilitate the removal of any equipment that may require off-site maintenance.

E.16.11.5 Structural members shall be masonry, concrete or structural steel. Wood frame buildings are not permitted. Buildings shall comply with the current Alberta Building Code.

E.16.11.6 The design shall incorporate measures to reduce the noise and odour impact on the surrounding development.

E.16.11.7 Buildings shall be designed to blend architecturally with the surrounding development.

E.16.11.8 Windows shall not be permitted in lift station buildings.

E.16.12 Forcemains

E.16.12.1 System head curves shall be developed for each forcemain to be submitted to the Municipal Engineer upon request.

E.16.12.2 The minimum forcemain diameter shall be 100mm.

E.16.12.3 The pressure rating of the pipe shall be twice the operating pressure or 690kPa, whichever is greater.

E.16.12.4 The velocity shall be within 0.9m/sec to 3.5m/sec. The minimum velocity for pipes larger than 300mm shall be 1.1m/sec. Special design provisions in order to stabilize the line shall be incorporated when design velocities exceed 3.0m/sec.

E.16.12.5 The forcemain design pressure shall allow for the normal static and dynamic operating pressures including water hammer effects.

E.16.12.6 A series of 45° bends shall be used in lieu of 90° bends.

E.16.12.7 Air release valves shall be installed in concrete access chambers at all relative high points. Forcemain grades should be designed in order to avoid the requirement for an air release valve wherever possible.

E.16.12.8 Blow-off valves shall be provided at all low points.

E.16.12.9 Vacuum relief valves shall be installed wherever necessary in lines designed to drain by gravity between pumping cycles.

E.16.12.10 Provide stainless steel bolts on all valves.

E.16.12.11 Provide operating nuts located between 2.0m and 3.0m below ground surface without rock shields on all valves.

E.16.12.12 The forcemain invert at the receiving manhole shall be a maximum of 300mm above the highest invert. The outlet invert of a lagoon inlet manhole shall always be above the high water level.

E.16.12.13 When forcemain length exceeds 1000 metres, cleanouts should be installed in concrete access chambers complete with isolation valves and adaptor coupling for line flushing.

E.16.12.14 A 2 hour pressure test shall be conducted for all new forcemains in accordance with the specifications listed under Section D.27.1 Pressure Testing.

E.16.12.15 Isolation and check valves shall be provided and housed in an accessible valve chamber with removal hatch for facilitating the maintenance work.

SECTION F STORMWATER MANAGEMENT SYSTEM

F.1 GENERAL

F.1.1 The Developer and the Developer's Engineer are responsible to ensure that the storm sewer system is designed and constructed according to accepted engineering practice. These guidelines are intended as a guide only and shall not be considered as a substitute for a detailed material and construction specification to be prepared by the Developer's Engineer.

F.1.2 The stormwater management system should be designed with major and minor drainage systems. In general, a minor system consists of piping, manholes, catch basins and outfall structures that have been designed in order to avoid property damage and flooding due to runoff generated by a 1 in 5 year rainfall event. A major system consists of the roads, gutters, lot drainage and detention facilities designed to avoid significant property damage and control flooding caused by a 1 in 100 year rainfall event. When the capacity of the minor system is exceeded, the major system must provide a continuous overland flow route allowing the excess runoff to reach the designated ponding areas or water body.

F.1.3 The design of both the major and minor systems must meet the current requirements outlined in the Alberta Environment "Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems".

F.1.4 Storm sewer pipe shall have been manufactured in conformity with the latest standard by the American Society for Testing Materials (ASTM) and the Canadian Standard Association (CSA).

F.1.5 The current standard and specification issued by the following organizations shall be implemented during design and construction of the sanitary sewer systems:

ASTM – American Society for Testing and Materials,

CSA – Canadian Standards Association,

Alberta Environment "Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems"

F.2 MINOR SYSTEM

F.2.1 Flow Rates

F.2.1.1 The storm sewers shall be designed as a separate sewer system. Effluent from sanitary sewers or any potentially contaminated drainage shall not be discharged in the storm sewers.

F.2.1.2 The Minor System shall be designed to accommodate the runoff generated from a 1:5 year or more frequent rainfall event without surcharge of sewer pipes or ponding at catch basins. An allowance should be made for sump pump discharge or individual service lines from weeping tiles where required.

F.2.1.3 Roof leaders should be discharged to the ground and drain away from the building, water supply well and septic bed. Provisions shall be made to prevent soil erosion. The Municipal Engineer may approve discharge of roof leaders to the storm sewer when conditions warrant in order preventing erosion and/or property damage.

F.2.1.4 Dry wells shall be permitted only where the groundwater table is below the bottom of the dry well. Dry wells shall be not less than five metres from the building foundation and located to ensure that drainage flows away from the building.

F.2.1.5 The Rational Method shall be used in estimating flows for the design of storm sewers for areas less than 65 hectares.

$$Q = \frac{CIA}{360}$$

where Q = the design peak flow rate in cubic metres per second

I = the intensity of rainfall is millimetres per hour

A = the contributing area in hectares

C = the runoff coefficient

F.2.1.6 The five-year rainfall intensity shall be taken from climatic design values obtained by writing to Atmospheric Environment Services, Environment Canada, at 4905 Dufferin Street, Downsview, Ontario M3H 5T4.

F.2.1.7 Minimum runoff coefficients shall be according to the following table:

Land Use / Surface Characteristics	Runoff Coefficient, C
Country Residential	0.2
Urban	0.4
Grassed Areas (Parks, Playgrounds)	0.15
Undeveloped Land (Farmland)	0.1
Pavement, Concrete, Buildings	0.9
Gravel Roadways	0.3

F.2.1.8 Due to the large variation in lot sizes for rural residential developments and in impervious areas for commercial and industrial areas, a weighted runoff coefficient for these types of developments can be calculated using the following formula:

$$C = \frac{(0.9 \times \text{Impervious Area}) + (0.15 \times \text{Pervious Area})}{\text{Total Area}}$$

F.2.1.9 The intensity for the rational formula is to be sought from Atmospheric Environment Services, Environment Canada. T_c is the sum of the inlet time and travel time. The inlet time is the time for the overland flow to reach the curb. The maximum inlet time for residential areas shall be 10 minutes. Inlet times for commercial or industrial areas shall be calculated on a site-specific basis. The travel time, being the time it takes for the runoff to reach the design point from the moment it reaches the curb, is calculated based on gutter and pipe velocity.

F.2.1.10 For areas larger than 65 hectares, the Developer must submit acceptable computer modelling of the area for review.

F.2.1.11 Weeping tile flows must be presented in a detailed Geotechnical Hydrogeological Investigation prepared by a qualified geotechnical engineer or hydrogeologist. The report should outline expected weeping tile flows and any design and construction procedures required for foundation installation.

F.2.2 Pipe Sizing

The following design factors shall be used in determining the storm sewer pipe sizes:

F.2.2.1	Minimum pipe size for storm sewer main	300mm
F.2.2.2	Minimum pipe size for foundation drains main accommodating flow from weeping tiles ONLY	150mm
F.2.2.3	Minimum pipe size for catch basin leads	250mm
F.2.2.4	Manning's Formula "n"	0.013
F.2.2.5	Minimum flow velocity when flowing full	0.6m/sec
F.2.2.6	Maximum flow velocity	3.0m/sec
F.2.2.7	Minimum design slopes:	

Sewer Diameter (mm)	Minimum Design Slope (%)
300	0.194
375	0.145
450	0.114
525	0.092
600	0.077
675	0.065
750	0.057
900	0.045
1050	0.036
1200	0.031
1350	0.027
1500	0.023
1650	0.020
1800	0.018
1950	0.016
2100	0.015
2250	0.013
2400	0.012
2550	0.011
2820	0.010

F.2.2.8 Minimum slope on curved sections:

Sewer Diameter (mm)	Minimum Design Slope (%)
300	0.25
375	0.18
450	0.15
525	0.13
600 and greater	0.10

F.2.2.9 Minimum grade for catch basin leads 1.0%.

F.2.2.10 The minimum grade of the first upstream leg shall not be less than 0.5%.

F.2.3. Material Requirements

F.2.3.2 Unless specified with better material accepted by the Municipal engineer, all underground and water retaining structure shall be designed against frost and sulphate attack (with sulphate resistant cement to ASTM type V) and conform to CSA A23.1 and ACI 350R-89 ”Environmental Engineering of concrete structure”.

Concrete Grade 25 shall be used and tested in accordance with CSA 23.2.

F.2.3.3 The design of foundation, footing, excavation, soil, rock and liquid retaining structure shall comply with the current National Building Code (NBC) and Alberta Building Code (ABC). A surface investigation, including ground water condition, shall be carried out by or under the direction of a professional engineer having the knowledge and experience in planning and executing such investigations to a degree appropriate for the structure or substructure of it use, the ground and the surrounding condition.

F.2.3.4 Concrete manholes, catchbasins shall be manufactured with pre-cast reinforced concrete conponents conform to ASTM C478. No Corrugated Steel Pipe (CSP) shall be used.

Component joint shall be supplied with a pre-formed and sealed O-ring type rubber gasket, comply to ASTM C443 or current requirement.

F.2.3.5 Mininuim of 100mm thick bedding of granular gravels or sand (no particles larger than 32mm) shall be allowed for levelling bed for the aforesaid structures.

F.2.4 Storm Sewer Alignment and Location

F.2.4.1 Sewer mains shall be located within the road right-of-way and outside the carriageway in accordance with the typical roadway cross section.

F.2.4.2 Storm sewers shall be located a minimum of 3.0m o/c from any watermain and 1.8m o/c from any gas line or as required by the utility company.

F.2.4.3 Storm sewers shall be spaced at a minimum of 0.25m between pipe walls from any adjacent sanitary sewer.

F.2.4.4 Public Utility Lot (PUL) widths shall be at least 4.0m for a single utility and 6.0m for two utilities.

F.2.4.5 Curved sewers shall run parallel to the curb or road centreline.

F.2.4.6 For storm sewer pipes greater than 600mm in diameter, change in flow direction at manholes should not exceed 45^0. This limit may be exceeded if care is taken to design a proper transition manhole.

F.2.5 Required Depth for Storm Sewers and Catch Basin Leads

Storm sewers shall be installed at a sufficient depth to meet the following requirements:

F.2.5.1 The main shall have a minimum depth of cover of 1.2m measured from finished grade to the crown.

F.2.5.2 The storm sewer shall have sufficient depth of cover to provide complete frost protection.

F.2.5.3 The main shall have sufficient depth to allow all required building foundations to drain by gravity to the sewer. Special consideration should be taken when building floor elevations are lower than the roadway. Service lines shall have a minimum cover of 2.0m from the finished lot surface to the top of pipe at the property line.

F.2.5.4 The catch basin leads shall have a minimum of 1.5m of cover measured to the top of pipe.

F.2.5.5 Under normal conditions, storm sewer mains shall cross below water mains with sufficient clearance to allow for proper bedding and structural support of the pipes. Pipe clearance when passing under any watermain shall be a minimum of 300mm separation between the top of the sewer pipe and the bottom of the watermain.

F.2.5.6 Pipe clearance when passing over any watermain shall be a minimum of 500mm separation between the bottom of the sewer pipe and the top of the watermain. Efforts shall be made to pass under the watermain when possible.

F.2.6 Manhole Design and Location

F.2.6.1 Manholes shall be located at the end of each line, at all changes in pipe size, grade and alignment.

F.2.6.2 The maximum distance between manholes shall not exceed:

F.2.6.2.1 120m for sewers less than 1200mm in diameter;

F.2.6.2.2 500m for sewers 1200mm to 1650mm in diameter;

F.2.6.2.3 800m for sewers larger than 1650mm in diameter.

F.2.6.3 All manholes shall be 1200mm minimum inside diameter

F.2.6.4 Manholes shall be located at the extension of property lines whenever possible in order to avoid conflicts with driveways.

F.2.6.5 The drop across manholes should be of sufficient magnitude to account for any energy losses in the manhole.

F.2.6.5.1 Pipe deflections of less than 45° require a drop of at least 30mm.

F.2.6.5.2 Pipe deflections of 45° to 90° require a drop of at least 50mm.

F.2.6.6 Invert drops for pipes larger then 600mm or for high flow situations shall be assessed on an individual basis.

F.2.6.7 The obvert elevation of a sewer entering a manhole shall not be lower than the obvert elevation of the outlet pipe.

F.2.6.8 Pipe deflections in manholes shall not be greater than 90°.

F.2.7 Storm Services and Foundation Drains

F.2.7.1 Foundation drain service connections will be required for weeping tile flow in areas where the water table is higher than the basement foundations. Sizing of foundation drain service lines shall be based on expected flows as determined by the geotechnical investigation. Sump pump discharge collection systems with surface discharge shall not be permitted in areas with urban road cross sections.

F.2.7.2 Storm sewer connections for the connection of roof drains will only be required where geotechnical conditions dictate such as areas where slope stability is an issue.

F.2.7.3 When required, separate storm sewer or foundation drain service connections shall be provided for each separately titled lot.

F.2.7.4 The minimum size of a residential storm sewer or foundation drain service shall be 100mm. Non-residential service connections shall be sized according to anticipated flow.

F.2.7.5 Connections for all proposed residential lots requiring storm sewer or foundation drain services shall be installed at the time of initial subdivision development.

F.2.7.6 The minimum grade for a storm sewer or foundation drain service line shall be 2.0%.

F.2.7.7 Services shall be located such that they do not conflict with driveway locations.

F.2.7.8 The storm sewer or foundation drain services shall be installed to the property line. In areas where natural gas distribution facilities require an easement along the front of the property, the service connections shall be extended to the edge of the easement furthest from the roadway.

F.2.8 Catch Basins and Leads

F.2.8.1 The maximum surface/gutter flow distance shall be 120m.

F.2.8.2 The catch basin grates, leads and spacing shall be designed such that there will be no ponding during a 1:5 year rainfall event.

F.2.8.3 At sag locations, the determination of the required capacity must account for flow that may bypass inlets at upstream gutter locations.

F.2.8.4 The minimum inside diameter for a pre-cast catch basin shall be 610mm.

F.2.8.5 The minimum sump depth in catch basins shall be 500mm.

F.2.8.6 Gutter flow shall be intercepted by a catch basin prior to crossing a walkway wherever possible.

F.2.8.7 The depth of flow in gutters should not exceed the top of curb at any point.

F.2.8.8 Catch basins shall be located at the BC or EC of any curb return.

F.2.8.9 The maximum length of a catch basin lead shall be 30m. If the length must exceed 30m, a catch basin manhole must be installed on the upstream end.

F.2.8.10 All leads shall be connected to a manhole or catch basin manhole at the downstream end.

F.2.8.11 Catch basins and leads shall not be placed beyond the public right-of-way. Lots must be filled and graded to ensure that all runoff drains to a public right-of-way.

F.2.9 Storm Sewer Materials

F.2.9.1 The Developer shall supply only new materials. All materials found to be defective or damaged shall be replaced at the cost of the Developer.

F.2.9.2 Where specific products are specified, it is intended that approved equals are also acceptable. Approval must be obtained by the Municipal Engineer prior to installation.

F.2.9.3 PVC pipe and fittings shall conform to the following:

F.2.9.3.1 CSA B182.2, ASTM D3034, ASTM F679, NQ 3624-130 and NQ 3624-135 standards with minimum stiffness of 320kPa. Service lines shall a minimum stiffness of 625kPa.

F.2.9.3.2 Ultra Rib PVC or approved equal is acceptable from 250mm to 600mm. Pipe shall conform to CSA B182.2 and ASTM F794 with a minimum stiffness of 320kPa.

F.2.9.3.3 Standard Dimension Ratio (SDR) 35 unless otherwise indicated on the drawing.

F.2.9.3.4 Sealing gaskets shall meet requirements of CSA B182.2 and ASTM F477.

F.2.9.3.5 Injection moulded gasketed fittings for service connections shall conform to CSA B182.1 or CSA B182.2 and fabricated fittings shall conform to CSA B182.2 and ASTM F679.

F.2.9.3.6 Pipe shall be tested by the manufacturer and marked in accordance with CSA B182.2. Test results shall be recorded on a certification form signed by a qualified representative of the manufacturer.

F.2.9.3.7 Pipe and fittings shall be installed within two years from the production date indicated on the certification.

F.2.9.4 Concrete pipe and fittings shall conform to the following:

F.2.9.4.1 All concrete pipes shall be manufactured using Type 50 sulphate resistant cement CSA A3000;

F.2.9.4.2 Non reinforced concrete pipe shall conform to CSA A257.1, minimum Class 3 and ASTM C14;

F.2.9.4.3 Reinforced concrete pipe shall conform to CSA A257.2 and ASTM C76;

F.2.9.4.4 Flexible rubber gasket joints shall conform to CSA 257.3 and ASTM C443;

F.2.9.4.5 The manufacturer of the concrete pipe shall perform quality testing and control in accordance with CSA 257.0, 257.1, 257.2 and 257.3;

F.2.9.4.6 Each concrete pipe shall be marked with the manufacturer's name, date of casting and quality testing passing stamp.

F.2.10 Manhole Materials

F.2.10.1 Manholes shall be manufactured using sulphate resistant Type 50 cement, or the approved type Chemical Resistance Fibre Glass or HDPE material with proven record of 50 years life time. Material Data sheet and past record (at least 5 references in Canada) shall be submitted to the Municipal Engineer for approval.

F.2.10.2 Manhole sections shall be pre-cast reinforced concrete conforming to ASTM C478 and CSA A257.4.

F.2.10.3 All manholes shall have an inside diameter of 1200mm for pipe 900mm and less. For pipe exceeding 900mm or manhole having multiple inlets, manhole sizing shall be subject to review by the Municipal Engineer.

F.2.10.4 Manhole steps shall be standard safety type, hot dipped galvanized iron conforming to ASTM A615 and ASTM A123 or aluminum forged from 6061-T6, 6351-T6.

F.2.10.5 All joints shall be sealed with rubber gaskets conforming to ASTM C443 and grouted with non-shrink grout.

F.2.10.6 Manhole frames and covers shall be cast iron conforming to Class 20 ASTM A48 and ASTM A536. Type NF80 covers shall be used for all streets and driveways, type NF90 covers with rubber gasket shall be used for manholes located in sags and low areas and type F39 covers shall be used for all other areas. Castings shall be marked with series designation, foundry identification and date of casting. Manhole covers with the Municipality identification will be encouraged. Manhole covers with names of other municipality names are not permitted.

F.2.10.7 Pre-benched manhole bases shall be use wherever possible with pre-cored connection holes and watertight Duraseal or G-Loc joints or approved equal.

F.2.10.8 Tee Riser manholes shall conform to CSA 257.2, ASTM C76 and CSA A257.4, ASTM C76.

F.2.10.9 Safety platforms are required for all manholes greater than 7.0m in depth.

F.2.10.10 All pre-cast units shall be market with manufacturer's identification, date of casting, type of cement and CSA standard.

F.2.11 Catch Basin Materials

F.2.11.1 Catch basin barrels shall be manufactured using sulphate resistant Type 50 cement.

F.2.11.2 Catch basin frames and grates shall be cast iron conforming to Class 20 ASTM A48 and ASTM A536. Type F38 or F39 grates shall be used for all round top inlet catch basins, type F51 or F36A grates shall be used for straight face curbs and type F33, K7 or DK7 shall be used for rolled face curb. Any other types must obtain approval by the Municipal Engineer. Castings shall be marked with series designation, foundry identification and date of casting.

F.2.11.3 If required, catch basin steps shall be standard safety type, hot dipped galvanized iron conforming to ASTM A615 and ASTM A123 or aluminium forged from 6061-T6, 6351-T6.

F.2.11.4 All pre-cast units shall be market with manufacturer's identification, date of casting, type of cement and CSA standard.

F.2.12 Trenching, Bedding and Backfilling

F.2.12.1 All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.

F.2.12.2 If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the design drawings or as a brief report to the Municipal Engineer prior to construction.

F.2.12.3 Class "B" pipe bedding shall be utilized in suitable soil conditions. Washed rock shall be used if water table is above the pipe zone. Bedding sand shall have minimum depth of 100mm below the pipe, shall extend up both sides to the trench wall and provide a minimum cover of 300mm above the pipe. The Developer's Engineer shall identify special pipe foundation measures for areas where unsuitable pipe foundation conditions exist.

F.2.12.4 The minimum trench width measured at the pipe spring line shall be the pipe outside diameter plus 450mm. The maximum trench measured at the pipe spring line shall be the pipe outside diameter plus 600mm. The Municipal Engineer must be notified if the trench must be excavated deeper or wider than specified.

F.2.12.5 Excavated material shall be stockpiled at a safe distance from the edge of the trench.

F.2.12.6 The Developer's Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.

F.2.12.7 Trench excavations shall be kept free of water.

F.2.12.8 It shall be the Developer's responsibility to ensure that the utility trenches are adequately compacted.

F.2.12.8.1 Native backfill under existing or proposed roads or laneways shall be compacted throughout the entire right-of-way width to:

F.2.12.8.1.1 98% of Standard Proctor Density from subgrade to 1.5m below subgrade or original ground, whichever is lower;

F.2.12.8.1.2 95% of Standard Proctor Density greater than 1.5m from the subgrade or original ground, whichever is lower.

F.2.12.8.2 Granular backfill under existing or proposed roads or laneways shall be compacted to 95% of Standard Proctor Density throughout the entire trench depth below subgrade and the entire right-of-way width.

F.2.12.8.3 Backfill in all other areas shall be compacted to 95% of Standard Proctor Density.

F.2.12.8.4 Subgrade and base course compaction for roadway construction shall be as specified in Section G.

F.2.12.8.5 If the above standards cannot be achieved due to a large variation in soil types throughout the development, the Municipal Engineer, at his or her sole discretion, may establish a more appropriate standard on an individual case basis. One-mould proctor density testing may be permitted if the Developer submits an acceptable proposal prepared by the Developer's Engineer, justifying the required changes to the compaction standards.

F.2.12.9 If the minimum compaction standards cannot be met due to abnormal weather or wet ground conditions, the Municipal Engineer may establish a more suitable standard on a site specific basis provided adequate justification is presented by the Developer. One-mould proctor density testing will not be permitted as an alternate testing procedure due to wet soil conditions. The Developer's engineer will be required to suggest appropriate measures such as drying in-situ material or importing suitable material in order to meet the required Standard Proctor Densities.

F.2.12.10 All landscaping, pavement structures, sidewalks, curb and gutter damaged or removed during trenching shall be restored or replaced unless otherwise directed by the Municipal Engineer.

F.2.12.11 All debris, surplus fill and unused materials must be removed from the site.

F.2.13 Storm Sewer Installation

F.2.13.1 The pipe and gasket installation shall be conducted in compliance with the pipe manufacturer's specifications. Installation of PVC pipe and fittings shall conform to CSA-B182.11.

F.2.13.2 Pipe installation shall start at the outlet and work upstream.

F.2.13.3 Align pipes carefully when jointing. Keep joints free of mud, gravel and foreign material and apply sufficient pressure to ensure that the joint is complete as outlined in the manufacturer's specifications. Complete each joint before laying the next length of pipe. Deflections shall not exceed those permitted by the manufacturer.

F.2.13.4 The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete.

F.2.13.5 The alignment of pipes less than 900mm in diameter shall not be more than 150mm off the designated alignment. The alignment for pipes larger than 900mm shall not deviate by more than 50mm per 300mm of diameter.

F.2.13.6 The invert of the pipe shall not deviate from the design grade by more than 6mm plus 20mm per metre of diameter of sewer pipe.

F.2.14 Manhole Installation

F.2.14.1 Manholes shall be installed as depicted on the detail drawings and in accordance with manufacturer's recommendations.

F.2.14.2 Backfill around manholes shall be compacted to a minimum of 98% of Standard Proctor Density.

F.2.14.3 Tee Riser manholes shall require Class A bedding to the elevation of the spring line.

F.2.14.4 Pre-cast manhole bases shall be installed on a base of 100mm to 300mm of washed gravel.

F.2.14.5 Cast in place manhole bases approved by the Engineer shall be places directly on undisturbed ground.

F.2.14.6 Safety steps shall be aligned on centreline perpendicular to the main flow channel. Wherever possible the steps shall be aligned so that a person exiting the manhole would face oncoming traffic if not conflicting with the previous requirement. The distance from the top of the rim to the first step shall not be greater than 300mm. Steps shall be evenly spaced at a maximum of 410mm to within 600mm of the base of the manhole. Refer to Drawing E-08 for details.

F.2.14.7 The frame and cover shall be installed following manufacturer's recommendations.

F.2.15 Inspection and Testing

F.2.15.1 All sewer installations shall be subject to inspections by the Municipal Engineer prior to issuance of the Construction Completion Certificate (C.C.C.) and Final Acceptance Certificate (F.A.C.).

F.2.15.2 Video inspections by qualified personnel are required prior to C.C.C. for all sewers less than 1200mm in diameter. A walk through inspection is permitted for any sewer 1200mm and larger. A written report including still photographs and/or a video tape recording of the entire inspection shall be submitted to the Municipal Engineer for review. The report shall indicate the location and severity of all leaks, cracks, breaks, collapses, deflections, sags, obstructions and any other defects affecting the performance of the line. Sections requiring repair will be subject to re-inspection when complete.

F.2.15.3 Re-inspection by camera may be required on suspect areas prior to F.A.C. at the discretion of the Municipal Engineer. All video inspection costs shall be borne by the Developer.

F.2.15.4 All material testing (backfill densities) shall be performed by an accredited agency. All test results shall be submitted to the Municipal Engineer with a report indicating any deficiencies and remediation.

F.2.15.5 An infiltration and/or exfiltration test may be required at the Municipal Engineer's sole discretion for any section showing deficiencies during the camera test.

F.2.15.5.1 The test section shall be filled with water allowing displacement of air in the line and will be allowed to stand for 24 hours to ensure absorption in the pipe wall. Prior to the test, add enough water to ensure a head of 1m to 3m over the pipe crown in the upstream manhole. The test duration shall be 2 hours. The water level should be measured at the beginning and end of the test in order to calculate the infiltration/exfiltration.

F.2.15.5.2 The allowable leakages are as follows:

F.2.15.5.2.1 **Infiltration Test:** Performed when the groundwater is above the pipe crown for the entire test length. Allowable infiltration is 5.0 L/day/mm dia./km for PVC pipe and 20.0 L/day/mm dia./km for concrete pipe.

F.2.15.5.2.2 **Exfiltration Test:** Performed when the groundwater is below the pipe invert for the entire test length. Allowable exfiltration is 5.0 L/day/mm dia/km and 20.0 L/day/mm dia./km for concrete pipe.

F.3 MAJOR SYSTEM

F.3.1 General

The major conveyance system accommodates flows not intercepted by or beyond the capacity of the minor drainage system through planned surface flow routes and storage facilities. The intent of the major system is to provide surface flow management in order to minimize flooding and property damage from a 1:100 year rainfall event. The design of the major drainage system must not be limited to the immediate development area but must consider overland flows that may enter the area from adjacent land as well as downstream effects on adjacent development and receiving water bodies.

F.3.2 Lot Grading

F.3.2.1 Proper lot grading is the first step towards a well planned major drainage system. The goal of the lot grading shall be to ensure that water flows away from the building, water supply well, and septic bed, and in no case shall ponding levels come within 150mm from the finished ground elevation at the building during a 1:100 year rainfall event. Flow from lots shall always have an escape route to a public right-of-way. The lot-grading plan shall develop a proper balance between the road and gutter elevations, proposed building elevations, surrounding development and existing topography.

F.3.2.2 Generally, the lots shall be designed to drain from back to front. Drainage towards the back of lot will be permitted where laneways or public right-of-ways are in place to accommodate drainage directly from the lot without crossing adjacent lots. An overall drainage plan will be required for all subdivisions.

F.3.2.3 An initial grade of 10% sloping away from the building for a distance of 2m shall be required on all sides. The slope shall continue at a minimum grade of 2.0% to the property boundary. Larger slopes are desirable if topography allows to a maximum of 10%.

F.3.3 Swales

F.3.3.1 Drainage swales on municipal or private property shall be constructed prior to any development of subdivision lots. Complete swale construction shall be a prerequisite to the issuance of the Construction Completion Certificate.

F.3.3.2 Drainage swales located on private property shall be covered by an easement in favour of the Municipality. A minimum clearance of 200mm should be provided between the edge of the swale and the property line. Major rainfall event flows shall be contained within the easement.

F.3.3.3 Drainage swales crossing several properties for the collection of runoff shall not be permitted unless special circumstances warrant.

F.3.3.4 Concrete swales shall be required when accommodating flow from more than three adjacent lots.

F.3.3.5 Earthen swales shall be protected from erosion by grass cover, appropriate ground cover or geotextile fabric.

F.3.3.6 The minimum design slope for concrete swales on private property is 0.75%.

F.3.3.7 The minimum design slope for concrete swales on public property is 0.5% or as required to provide adequate hydraulic capacity.

F.3.3.8 The minimum design slope for swales without a concrete gutter is 1.5%.

F.3.4 Roadways

Grading of streets comprising the major drainage system shall follow the guidelines listed below:

F.3.4.1 Continuity of overland flow routes between adjacent developments shall be maintained;

F.3.4.2 Collectors shall have at least one lane that is not inundated;

F.3.4.3 Local roads should not have a depth of water more than 50mm above the crown of the road;

F.3.4.4 The depth of water at the curb shall be less than 500mm for all roadways.

F.3.5 Stormwater Storage Facilities

F.3.5.1 Stormwater Storage Facilities - General

F.3.5.1.1 This section identifies the general design parameters for the planning and design of stormwater storage facilities.

F.3.5.1.2 A drainage master plan must be prepared by the Developer providing a detailed description of the development area including overland flow, catchment areas, natural storage and planned storage.

F.3.5.1.3 Several different storage methods may be employed for a stormwater storage facility such as:

F.3.5.1.3.1 Retention Storage (wet ponds) – collects and stores runoff for a period of time and releases it after the inflow has ceased. Retention storage also includes constructed wetlands.

F.3.5.1.3.2 Detention storage (dry ponds) – provides a control outlet to the area restricting flow. When the inflow exceeds the allowed outflow, water is detained in the designated storage area until flows diminish. Low flows are not usually detained.

F.3.5.1.3.3 Channel Storage – channels constructed with wide bottoms and small grades will provide a type of storage as the channel fills with water.

F.3.5.1.4 The design of the storage facility shall be based on a 1:100 year rainfall event. The Developer's Engineer shall include detailed calculations for a range of storm durations to determine the critical volume as well as an analysis of the capacity and characteristics of the downstream receiving drainage course. Measures shall be taken in order to avoid flooding, erosion or sedimentation in the downstream receiving drainage course.

F.3.5.1.5 These minimum standards are not intended to restrict Developers from formulating innovative stormwater management processes intended to protect the environment and improve the stormwater quality prior to release. All stormwater management plans must be submitted to the Municipality for review and approval.

F.3.5.2 Design Standards for Lakes and Wet Ponds

F.3.5.2.1 Lands covered by the facility including areas covered by water at the normal water level (NWL), inlets, outlets, control structures and access routes shall be designated as Public Utility Lot (PUL).

F.3.5.2.2 Private property subject to potential flooding shall be covered by an easement in the favour of the Municipality.

F.3.5.2.3 A restrictive covenant shall be placed on the lots abutting the facility as required to control development that will restrict the capacity.

F.3.5.2.4 The design shall incorporate a semi-annual turnover at average annual precipitation.

F.3.5.2.5 The high water level shall be at least 300mm below the lowest building opening on adjacent lots.

F.3.5.2.6 The minimum surface area at normal water level shall be 2 ha in order to discourage a large number of small facilities.

F.3.5.2.7 The lake shall have maximum side slopes of 3H : 1V from the lake bottom to 1m below the NWL. Slopes above this level shall have a maximum slope of 7H : 1V. These slopes may be revised in confined spaces or areas with extreme topography at the discretion of the Municipal Engineer.

F.3.5.2.8 The minimum depth from the NWL to the lake bottom shall be 2.5m in order to discourage growth of vegetation.

F.3.5.2.9 Where the ground water level is below the NWL, the lake bottom shall be of impervious material. Where the ground water level is near or above the NWL, the lake bottom may be made of a pervious material based on geotechnical investigation.

F.3.5.2.10 Inlets and outlets are to be placed in order to maximize detention time and water circulation thereby avoiding dead storage areas.

F.3.5.2.11 Inlet and outlet pipes are to be fully submerged and at least 200mm above the Lake Bottom and 1.0m below the NWL.

F.3.5.2.12 The inlet manhole invert shall be at or above the NWL in order to avoid sedimentation.

F.3.5.2.13 Provision shall be made in order to drain the lake completely by gravity or portable pump system.

F.3.5.2.14 An overflow channel and overland drainage route must be provided the high water level.

F.3.5.2.15 Edge treatment is required for erosion protection due to wave action from 0.3m below the NWL to 0.3m above the NWL.

F.3.5.2.16 All weather vehicle access must be provided to all control works. Access to the lake for launching boats shall also be available.

F.3.5.2.17 Approved fencing and signage shall be installed where necessary for safety purposes.

F.3.5.3 Design Standards for Dry Ponds

F.3.5.3.1 Lands covered by the facility including areas covered by water at the 1:5 year level, inlets, outlets, control structures and access routes shall be designated as Public Utility Lot (PUL).

F.3.5.3.2 Private property subject to potential flooding shall be covered by an easement in the favour of the Municipality.

F.3.5.3.3 A restrictive covenant shall be placed on the lots abutting the facility as required to control development that will restrict the capacity.

F.3.5.3.4 All dry ponds shall be designated as off-line storage areas designed to temporarily detain excess flow and control downstream flow to acceptable limits. Low flow conditions shall not be diverted to the dry pond.

F.3.5.3.5 The maximum storage depth shall be 1.5m measured from the invert of the outlet pipe.

F.3.5.3.6 The pond shall be designed to drain completely after excess flow has dissipated. The pond bottom shall have a minimum slope of 1.0% towards the outlet.

F.3.5.3.7 Side slopes shall have a maximum slope of 7H : 1V within private property and 5H : 1V within public property.

F.3.5.3.8 Grass cover shall be established after completion of construction.

F.3.5.3.9 All inlets and outlets shall have grates with a maximum bar spacing of 150mm over their openings in order to prevent access. The possibility of plugging shall be considered in the sizing of the outlet pipe. Maximum flow through the grating shall be 1.0m/sec.

F.3.5.4 Inlets, Outlets and Outfall Structures

F.3.5.4.1 Obverts of outfall pipes shall be above the 1:5 year flood level of the receiving drainage course.

F.3.5.4.2 Inverts shall be above the winter ice or completely submerged with obverts 1.0m below NWL.

F.3.5.4.3 Drop structures, energy dissipaters, riprap and filter fabric shall be used where necessary to prevent erosion.

F.3.5.4.4 Removable grates shall be installed on openings to discourage unauthorized access.

F.3.5.4.5 All piped inlets and outlets for stormwater storage facilities shall be capped with compacted clay or other impervious material at the pond inverts in order to prevent water from washing out the granular bedding material.

SECTION G TRANSPORTATION

G.1 INTENT

G.1.1 This section is intended to provide guidelines to assist the Municipality and the Developer in the design of transportation infrastructure projects that will meet the servicing requirements for commercial, industrial and residential development.

G.1.2 The servicing standards have been developed to ensure cost efficiency and practicality to minimize the maintenance requirements associated with design and construction of transportation infrastructure projects.

G.1.3 The guidelines and standards presented in this section shall only be considered as minimum requirements. It is the Developer's responsibility to design and construct of municipal improvements according to accepted engineering practices and standards that address and meet the specific needs and site conditions of the development. Site-specific conditions may warrant more stringent standards are met.

G.1.4 It is the Developer's responsibility, in addition to these General Municipal Servicing Standards, to satisfy all requirements and conditions required by the following acts and regulations:

- ✓ *Public Lands Act*
- ✓ *Municipal Government Act*
- ✓ *Water Act*
- ✓ *Environment & Enhancement Act*
- ✓ *Provincial Wetlands Policy*
- ✓ *Alberta Environment, Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*
- ✓ *Alberta Highway Design Guide*
- ✓ *Transportation Association of Canada (TAC) Geometric Design Guidelines*
- ✓ *TAC Uniform Traffic Control Devices for Canadian Roads*
- ✓ *TAC Highway Lighting Design Guide*
- ✓ *Municipality By-Laws*
- ✓ *Fisheries Act*
- ✓ *Species at Risk Act*
- ✓ *Navigable Water Protection Act*
- ✓ *Other Provincial and Federal Government Authorities*

G.2 LEVEL OF SERVICE ROADWAYS

G.2.1 The Developer's Engineer shall be responsible for determining an estimated Annual Average Daily Traffic (AADT) generated by the development in order to determine the required cross sectional elements and pavement structure.

G.2.2 Generally local roads with an AADT of 200 or less are designed to have gravel surface finish. The Municipality may require provision for a wider subgrade to allow for future base paving.

G.3 GENERAL

G.3.1 For each proposed development, the appropriate roadway classifications and design designation shall be determined during the planning stages in consultation with the Municipality officials. A general guideline identifying the minimum applicable roadway designation for each type of Land Use Districts is provided in Section C.

G.3.2 Where conflicts or inconsistencies with the General Municipal Servicing Standards arise due to adoption of other transportation planning documents, the Developer shall be responsible for satisfying the more stringent requirements.

G.3.3 Should the need arise where any of the following standards cannot be met, a written request describing the variance complete with supporting documentation shall be forwarded to the Municipal Engineer for review. The request shall be reviewed and a written reply returned with the final decision.

G.3.4 The Developer shall be responsible for quality control testing related to the roadway construction including but not necessarily limited to sieve analysis, densities, mix design, core sampling and concrete testing. Quality control shall be performed by an independent party and certified by a Professional Engineer licensed to practice in the province of Alberta.

G.4 DESIGN CRITERIA

G.4.1 It is the Developer's responsibility to assess the traffic impacts associated with a proposed land development. This assessment shall include a projection of the AADT over a 20-year design life for the internal subdivision roadways as well as any adjacent provincial highways or municipal roadways.

G.4.2 All off-site road improvements required as a result of land development shall be identified in the design stage by the Developer. An off-site levy will be assessed and charged to the Developer.

G.4.3 The trip generation rate for single detached housing in the Municipality shall be nine (9) one–way trips per household. Trip generation rates for other types of development shall be justified by the Developer and approved by the Municipal Engineer.

G.5 DESIGN DESIGNATIONS

G.5.1 The Municipality uses the following design designations identified as Rural and Urban Roadways. The cross section elements for each of these design designations are shown in the attached drawings.

G.5.2 For the purpose of these servicing standards, all roadways within the Municipality other than primary and secondary highways and some major grid roads will be considered as local roads. Although some roadways may perform minor collector functions, the above design designations shall apply to most roadways.

G.5.3 The roadway design shall be prepared considering the future requirements, economic factors, safety considerations, staging, and other road users not associated with the development.

G.5.4 The design speed selected should relate to the expected operating speed on the road after improvement. It shall reflect public expectations and include an allowance for safety. The design speed typically shall be 10 km/hr higher than the anticipated posted speed limit.

Table 1 – Geometric Design Requirements

Classification		Road Width [1] (m)	Curb and Gutter			Recommended Minimum [2] Right-of-Way (m)	Intersection Spacing (m)	Parking	Access
			Face Type	Gutter	Min. Return				
URBAN /COMMERCIAL ARTERIALS 4 lanes									
Undivided		14.80	Vert.	500	Design	30.00		No	Restricted
Divided	Non-Berm	20.30	Vert.	500	Design	35.00		No	Restricted
	Berm	20.30	Vert.	500	Design	44.80		No	Restricted
URBAN /COMMERCIAL ARTERIALS 6lanes									
Divided	Non-Berm	27.7	Vert.	500	Design	43.0		No	Restricted
	Berm	27.7	Vert.	500	Design	52.2		No	Restricted
RESIDENTAL LOCAL									
Front Lot Servicing									
Sidewalk	Monolithic	9.00	Mod-Roll	250	9.00	19.25	60	Permitted	[3]Driveways
	Separate	9.00	Mod-Roll	250	9.00	19.00	60	Permitted	[3]Driveways
Back Lot Servicing									
Sidewalk	Monolithic	9.00	Mod-Roll	250	9.00	19.25	60	Permitted	[3]Driveways
	Separate	9.00	Mod-Roll	250	9.00	19.00	60	Permitted	[3]Driveways
Rear Lane Servicing									
Sidewalk	Monolithic		*Identical to Back Lot Servicing*						
	Separate		*Identical to Back Lot Servicing*						
RESIDENT. COLLECT.									
Front Lot Servicing									
Minor									
Sidewalk	Separate	11.00	Mod-Roll	250	10.00	22.25	60	Permitted	[3]Driveways
Major									
Sidewalk	Separate	13.00	Mod-Roll	250	12.50	24.25	60	Permitted	[3]Driveways
Back Lot Servicing									
Minor									
Sidewalk	Separate	11.00	Mod-Roll	250	10.00	21.75	60	Permitted	[3]Driveways
Major									
Sidewalk	Separate	13.00	Mod-Roll	250	12.50	23.75	60	Permitted	[3]Driveways
Rear Lane Servicing									
Minor									
Sidewalk	Monolithic		*Identical to Back Lot Servicing*						
	Separate		*Identical to Back Lot Servicing*						
Major	Monolithic		*Identical to Back Lot Servicing*						
	Separate		*Identical to Back Lot Servicing*						

[1] Between F.O.C. (Face of Curb)
[2] Right-of-Way width dependent on infrastructure required in the right-of-way
[3] Driveways restricted to lanes when available

G.6 PAVEMENT STRUCTURE

G.6.1 Roadway subgrade and pavement structures design shall be based on results of a geotechnical investigation. A report shall be submitted specifying the required structure and all design factors including design traffic loading and the pavement design life. The pavement structures indicated on the cross sections are intended as minimum standards only. It is the Developer's responsibility to design the subdivision roadways to meet or exceed these standards in accordance with good engineering practices and specific site conditions.

G.7 SUBGRADE PREPARATION

G.7.1 The subgrade shall be prepared by placing and compacting soils below the subgrade to an average of 100% of Standard Proctor Density, with no test result being less than 97% of Standard Proctor Density. The soils below the subgrade shall be compacted in consecutive layers with thickness of each layer not exceeding 150mm. Each compacted layer shall be accurately shaped and graded parallel to the design grades. If the specified compaction range cannot be met then the subgrade is to receive cement stabilization treatment as determined by a Geotechnical Engineer.

G.7.2 During compaction, the soil shall be at its optimum moisture content as determined by a Geotechnical Engineer. When a deficiency in moisture content exists, the soils shall be watered and thoroughly mixed prior to compaction until optimum moisture content is uniformly attained. When there is an excess of moisture the soil shall be worked and aerated prior to compaction until the optimum moisture content is reached. One-mould Proctor density testing shall not be permitted as an alternate testing procedure due to wet soil conditions. The Developer's Engineer shall be required to determine appropriate measures in order to meet the required Standard Proctor Densities.

G.8 PIT-RUN MATERIAL

G.8.1 Pit-run materials shall be used to stabilize the subgrade in areas where silty in-situ soil materials exist. The minimum structural requirements shall be shown on the detailed cross section drawings.

G.8.2 After removal of unsuitable subgrade materials, pit-run material shall be placed in the excavation in consecutive layers not exceeding 150mm and compacted to 100% of Standard Proctor Density.

G.8.3 Water shall be applied and mixed uniformly with the pit-run material prior to compaction until the moisture content is at least the optimum moisture for the material, and preferably from 1% to 2% above the optimum moisture. The optimum moisture content for pit-run materials shall be determined by the Geotechnical Engineer. If necessary, water shall be applied to the pit-run material during compaction to maintain the required uniform moisture content.

G.9 BASE COURSE

G.9.1 Base course granular material shall be laid and compacted in a single layer when the compacted design specified thickness does not exceed 150mm. When a thickness in excess of 150mm is specified the material shall be laid and compacted in layers not exceeding 150mm.

G.9.2 Each layer of granular material shall be compacted to 100% of Standard Proctor Density. Water shall be applied and mixed uniformly with the granular material until the moisture content is at least the optimum moisture for the material, and preferably from 1% to 2% above the optimum moisture. The optimum moisture content for the material shall be determined by the Geotechnical Engineer. If necessary, water shall be applied to the granular material during compaction to maintain the required uniform moisture content.

G.10 CUL-DE-SACS

G.10.1 The maximum length for any cul-de-sac without a Public Utility Lot (PUL) shall be 120m from the centreline of the intersecting street to the start of the bulb. Cul-de-sacs in excess of 120m shall require a 6m wide PUL allowing for emergency vehicle access and watermain looping.

G.10.2 The PUL provided to allow for emergency access shall not be utilized for storm water storage. The PUL shall be properly graded to ensure positive drainage toward the road and seeded or sodded to prevent erosion.

G.10.3 Cul-de-sacs shall be graded to drain towards the intersecting street unless a PUL is provided to allow drainage to escape.

G.10.4 The minimum cul-de-sac bulb radius for residential areas shall be 18m measured to the face of curb or shoulder.

G.11 INTERSECTIONS

G.11.1 Intersections and approaches shall be designed at 90 degrees wherever possible. The minimum angle of intersection for two roadways shall be 75 degrees unless otherwise approved by the Municipal Engineer.

G.11.2 Intersection design shall incorporate accepted sight distances based on the roadway classification and best engineering practice.

G.11.4 Minimum intersection spacing shall be 60m measured from centreline to centreline.

G.11.5 Intersectional treatments shall be designed based on estimated 20-year traffic volumes. All necessary widening of existing right-of-ways shall be provided by the Developer.

G.12 CONCRETE CURB AND GUTTER

G.12.1 Concrete curb and gutter shall be constructed on all urban roadways according to the typical cross sections shown in the attached drawings.

G.12.2 The vertical face curb and gutter cross section shall be used on all roadways fronting public lands such as parks and Public Utility Lots. Vertical face curbs shall also be used within the right-of-way when crossing pipelines unless separate vehicle barriers are provided to prevent unauthorized access.

G.12.3 The rolled face curb and gutter shall be used on all local and residential roadways allowing driveway access.

G.12.4 Curb returns on all residential street intersections shall have a minimum radius of 9m.

G.12.5 Curb returns on all commercial and industrial street intersections shall have a minimum radius of 15m and shall be designed to accommodate heavy truck turning movements.

G.12.6 The minimum gutter grade shall be at 0.5% except for cul-de-sac bulbs, curb returns and catch basin approaches, which shall be at 0.8%. The 0.5% minimum grade shall be maintained throughout sag vertical curves to avoid the short length at near-horizontal grade.

G.12.7 Curbs shall be constructed using Portland cement conforming to CSA A3000. Materials, production, delivery, placement and finishing shall conform to CSA A23.1.

G.12.8 The minimum specified 28-day concrete compressive strength shall be 30MPa. Air entrainment shall be within 6 – 8 % by volume. Concrete testing is required for every $60m^3$ of cast in place concrete.

G.12.9 Curbs shall be constructed on prepared subgrade, cement stabilized subgrade, granular base course, soil cement or asphalt concrete.

G.12.10 For all urban cross sections, wick drains shall be placed below the curb between the subgrade and granular base course. The wick drain shall be connected to the nearest catch basin.

G.12.11 Curbs shall be backfilled with suitable soil within 7 days of concrete placement and prior to placement of the roadway structure. The clay material shall be backfilled to within 100mm below the top of the curb to allow for the placement of topsoil material.

G.13 SIDEWALKS AND PAVED STRUCTURES

G.13.1 Sidewalks shall be accessible to all persons as well as being safe, functional and aesthetically pleasing.

G.13.2 Sidewalks installed for new subdivisions shall be integrated with the existing walkway system on intersecting roadways.

G.13.3 Separate sidewalks shall be a minimum of 1.5m wide, with the exception of mobile homes communities, where the minimum width of concrete sidewalk shall be 1.2m.

G.13.4 The requirements for sidewalks in commercial and industrial areas shall be reviewed on a site-specific basis in conjunction with the proposed use and other required services.

G.13.5 Curb ramps shall be used at all curbed intersections.

G.13.6 For every 200m of length all sidewalks shall be imprinted with the Contractor's stamp indicating year of construction.

G.13.7 Sidewalks shall be imprinted with a "CC" at all curb cock locations.

G.13.8 The minimum specified 28-day concrete compressive strength shall be 30MPa. Air entrainment shall be 6 – 8% by volume. Concrete testing is required for every $60m^3$ of cast in place concrete. All sidewalks shall be reinforced as per attached drawing.

G.13.9 The granular base course under the sidewalk shall consist of 150mm compacted thickness of Designation 2 Class 20 aggregate. The subgrade and gravel base course under the sidewalk shall be compacted to 100% Standard Proctor Density.

G.13.10 Horizontal sidewalk alignment for separate sidewalks shall be at a constant offset from the adjacent roadway.

G.13.11 Sidewalks shall be graded to facilitate positive drainage flow. The minimum grade shall be at 0.5%. Wick drains shall be provided under monolithic sidewalk, curb and gutter structures.

G.13.12 Cold weather concrete pouring below 5ºC shall require prior approval by the Municipal Engineer, and work shall be executed according to CSA A23.1.

G.14 GRANULAR WALKWAYS AND WOOD MULCH HIKING TRAILS

G.14.1 It is the Developer's responsibility to design and construct walkways and trails as required by the Development Agreement. Rest areas are to be incorporated into the right-of-way width for every 800m of length of sidewalk or trail.

G.14.2 Where a walkway or trail is required to be incorporated into a development, the alignments and locations within the development shall allow for adequate public access to parks, recreational areas and environmental and municipal reserves.

G.14.3 Top of bank walkways and trails shall be designed and constructed so as not to impede natural and post development drainage down the embankment. Grading shall ensure that concentrated overland flows are not generated anywhere along the bank unless an engineered outlet structures are present.

G.14.4 Where walkways and trails cross drainage swales, ditches or natural drainage courses, culverts or footbridges shall be designed to accommodate a 1:25 year storm without overtopping. Culverts and footbridges shall require approval by Alberta Environment and applicable Federal Agencies. Design of footbridges shall be in accordance with the Alberta Building Code.

G.14.5 Wherever possible, walkways and trails shall be centred within the right-of-way. Walkways and trails may be offset from the centreline in situations where this will prevent conflicts with utilities sharing the same right-of-way.

G.14.6 Walkway and trail grading shall ensure positive drainage with a minimum crown or cross fall grade of 2%. Grading shall be designed in order to incorporate the overall drainage pattern of the development.

G.14.7 Where the walkway or trail is located within an existing utility right-of-way, the Developer shall be responsible for obtaining necessary permits and agreements from the proper authority.

G.14.8 Where the walkway or trail right-of-way is not shared with other utilities, it shall be a minimum of 6m wide with a minimum clearance of 2m from the edge of the walkway or trail to the property line.

G.14.9 The subgrade shall be compacted to a minimum 95% Standard Proctor Density for a minimum depth of 150mm.

G.14.10 For granular walkways, the excavation is to be lined with a geotextile fabric liner prior to placement of the granular material. The edge return for the geotextile fabric shall be anchored 0.06m below excavation depth. The granular material shall be spread uniformly and compacted to 95% Standard Proctor Density.

G.14.11 For woodchip mulch hiking trails, the excavation is to be lined with a geotextile fabric liner prior to placement of the woodchip mulch. The edge return for the geotextile fabric is to be anchored 0.06m below excavation depth. The woodchip mulch shall be spread uniformly with a minimum 2% crown or cross fall and roller compacted in-place ensuring a uniform depth and surface appearance.

G.14.12 Where walkway or trail is planned through wooded areas, the minimum width shall be 1.5m or as specified by the Development Authority. The minimum headroom clearance at the center line of the walkway or trail shall be 2.5m. Vegetation is shall be cleared a minimum of 0.6m from either edge of the walkway or trail.

G.14.13 Surfacing material shall be approved by the Municipality prior to installation. Materials shall be selected to minimize the maintenance and replacement costs.

G.14.14 Rest areas shall incorporate a bench and a waste receptacle as approved by the Municipality.

G.15 APPROACHES

G.15.1 Approaches shall be situated such that they do not access directly onto a roadway with an estimated AADT of greater than 4000.

G.15.2 Approaches shall have a minimum lateral clearance of 1.5m from any surface feature, such as hydrants, power poles, curb cocks, etc.

G.15.3 Approaches shall not be situated on a curb return.

G.15.4 For corner lots, the approaches shall access the roadway with a lesser traffic volume wherever possible. Wherever possible, approaches shall not be located within 100m of an intersection with the exception of multi-lot subdivisions.

G.15.5 For industrial lots, the selection of the approach location may be delayed until parking lot configurations are determined. A caveat on title will be required to inform future owners of their responsibility to pay for the installation while adhering to design recommendations.

G.15.6 Residential approaches shall have 7.5m wide finished top or pavement. Industrial approaches shall have 10m wide finished top or pavement.

G.15.7 All approaches shall have the same structure as the adjoining roadway and be constructed to the property line or the right-of way boundary.

G.16 SIGNAGE

G.16.1 It is Developer's responsibility to supply and install traffic control and street identification signs as per attached drawings.

G.16.2 Traffic control signs shall be manufactured and installed in accordance with the latest edition of *Uniform Traffic Control Devices for Canada*.

G.16.3 Street identification signs shall be located within 10m of the intersection in the direction of the near-side approaching traffic. Signs shall be offset at least 1m from the edge of the road and mounted 3.0 - 3.5m above the finished roadway surface. Street identification signs shall be a minimum size of 15cm x 60cm and a maximum of 15cm x 90cm. The lettering shall be 10cm high. If the street identification does not fit on the maximum sign size, two or more signs may be joined with an end bracket and H-clip. Signs shall have silver reflective lettering with a green reflective background. Street identification sign locations shall be approved by the Municipality and included in the Development Agreement.

G.16.4 All signs shall be placed so as not to obstruct the view of oncoming vehicles.

G.16.5 Permanent subdivision identification signs located at the subdivision entrance shall be:

i) designed to be maintenance free for a minimum of 15 years from installation;

ii) constructed and installed to hold signs rigidly in their proper and permanent position;

iii) constructed of concrete, masonry, stone, non-ferrous metal or a combination thereof (no permanent wood signage shall be permitted);

iv) maintained by the Developer to the end of the maintenance period.

G.16.6 Materials for temporary signs, such as subdivision layout signs, shall be approved by The Municipality prior to installation. It is the Developer's responsibility to remove temporary signs prior to the end of the maintenance period.

G.16.7 The Developer shall install a Municipal Address Sign within the roadway right-of-way adjacent to the first lot on the right hand side at the main subdivision entrance. The sign design and location shall be submitted to the Municipality for approval prior to installation. It is the Developer's responsibility to supply materials and install the Municipal Address Sign.

G.17 DRAINAGE AND CULVERTS

G.17.1 It is the Developer's responsibility to construct a drainage system that will meet the flow requirements outlined in Section F.

G.17.2 Ditches for rural roadways shall have backslopes no steeper than 2H:1V.

G.17.3 Ditch grades shall match the roadway grades wherever practical.

G.17.4 Ditch grades shall have a minimum grade of 0.5% wherever possible. Grades less than 0.5% shall be subject to review and approval by the Municipal Engineer.

G.17.5 Drainage channels shall be provided with ditch checks and/or other means of erosion control as necessary. All drainages shall be seeded. See Section H for approved seed mixture.

G.17.6 Ditches shall have a flat bottom, and width shall be as per applicable design standard.

G.17.7 Culvert sizing is the responsibility of the Developer's Engineer. Culverts and ditches shall be designed to accommodate a 1:25 year rainfall event. Ditches shall be allowed to back up during such an event to the top of the subgrade elevation.

G.17.8 Culverts shall be new galvanized corrugated steel pipe with a minimum wall thickness of 1.6mm or as required to meet the loading criteria.

G.17.9 Minimum pipe sizes for various uses are as follows:

i) residential approach culvert 500mm diameter;

ii) industrial approach culvert 600mm diameter;

iii) roadway centreline culverts 600mm diameter.

G.17.10 All culverts shall have appropriate end treatments depending on application. Inverts shall be extended to the toe of the side slope.

G.17.11 The culvert grade shall not be less than the ditch grades at the inlet and outlet.

G.17.12 Culverts shall have a sufficient amount of cover to protect against damage from the expected traffic loading. Minimum cover shall be 300mm or one-half the diameter of the culvert, whichever is greater as measured from the finished shoulder grade to the top of the culvert.

G.18 ROAD GRAVELLING (RURAL ROADS)

G.18.1 The roadway surface gravelling application rate shall be determined by the Geotechnical Engineer based on the roadway use and soil conditions.

G.18.2 All rural residential driveways shall have gravel surface at a minimum rate of $8m^3$ per approach, placed from the roadway shoulder to the property line.

G.18.3 Gradation properties of gravel for surfacing shall be approved by the Municipal Engineer.

G.19 PAVEMENT PAYMENT PENALTIES

G.19.1 If the average core thickness of finished asphalt concrete pavement does not meet specifications, at the discretion of the Municipality, the asphalt concrete pavement may be assigned a pay factor according to the City of Edmonton Construction Specifications, Section 02741 Hot-Mix Asphalt Paving, Table 02741.1 Asphalt Thickness Pay Factors.

G.19.2 If the average core density of finished asphalt concrete pavement does not meet specifications, at the discretion of the Municipality, the asphalt concrete pavement may be assigned a pay factor according to the City of Edmonton Construction Specifications, Section 02741 Hot-Mix Asphalt Paving, Table 02741.2 Asphalt Density Pay Factors.

G.19.3 It is the responsibility of the Developer's Engineer to submit the pay factor calculations as applied to the contract price to the Municipality for approval prior to acceptance of the Construction Completion Certificate.

G.20 BOAT LAUNCH

G.20.1 Background

G.20.1.1 The Municipality recognizes that shorelines of lakes and water streams provide an abundance of recreational values. However, shoreline areas are protected by Provincial and Federal Acts and legislations to ensure that sensitive and productive fish and wildlife habitats are intact and maintained.

G.20.1.2 With increasing development within the Municipality there is an increasing demand for lake and water stream access by recreational watercraft. Existing and proposed public and private boat launches have direct, indirect and cumulative degrading impacts on sensitive aquatic ecosystems and shoreline habitat areas.

G.20.1.3 Traditional methods of boat launch construction, such as the placement of fill or the construction of hardened launch surfaces, can potentially harm shallow waters aquatic ecosystems.

G.20.1.4 During design and construction protective measures are to be incorporated to eliminate deposition of sediments, disturbance of silt and other contaminants from entering the waters and potentially impact the aquatic ecosystem.

G.20.2 Objectives

G.20.2.1 To ensure that proposed works associated with boat launch development and maintenance protect water quality, fish, wildlife and aquatic and shoreline habitat.

G.20.3 Applicable Provincial and Federal Legislation

The following is the list of applicable Provincial and Federal legislation:

- ✓ *Public Lands Act*
- ✓ *Water Act*
- ✓ *Provincial Wetlands Policy*
- ✓ *Alberta Environment, Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*
- ✓ *Canadian Environmental Assessment Act*
- ✓ *Fisheries Act*
- ✓ *Species at Risk Act*
- ✓ *Navigable Water Protection Act*

G.20.4 Best Management Practices

G.20.4.1 Due to their potential to cause Harmful Alteration, Disruption or Destruction (HADD) of the aquatic habitat, hard surface boat launches typically require authorization to be obtained prior to construction from Department of Fisheries and Oceans (DFO) under section 35(2) of the Fisheries Act.

G.20.4.2 Application of a best management practice (BMP) does not reduce the importance of individual project assessment and design, which may identify additional measures necessary to protect unique site attributes or address the potential impacts of atypical project components.

G.20.4.3 Alternative designs, such as elevated railway-like tracks, can in most instances provide for launching of personal watercraft while avoiding potential harm to aquatic habitat and are a first preference for private boat launch facilities in most situations.

G.20.4.4 It is advisable to work with qualified professionals to provide the design and construction of a boat launch, depending on the scale and scope of the activity. This could include the use of a biologist, hydrologist, fluvial geomorphologist and engineer, working either independently or in coordination.

G.20.5 Municipal Launch Facilities

G.20.5.1 The Municipality shall require provisions for public infrastructure to service recreational boating demand on water bodies. It is expected that most new municipal launch facilities will be hard surface designs, likely to cause HADD of fish habitat, and requiring an authorization to be obtained prior to construction from DFO.

G.20.5.2 The planning of development of access points to water bodies, boat launches and moorage facilities for the local community can facilitate effective public access, while helping to avoid direct, indirect and cumulative impacts to foreshore and riparian habitat areas. Such plans should consider:

i) number and location of existing municipal and private launches facilities, and whether existing facilities are located in suitable locations to meet current and projected demand, as well as to maximize seasonal duration of use and minimize potential environmental impacts;

ii) number and location of access points available for new development, and whether development of new facilities and/or rehabilitation of existing facilities would better meet current and projected demand;

iii) type of launch facilities required based on the types of watercraft to be supported;

iv) adequate provisions for vehicle turn-around and parking areas and associated services;

v) installation of signage for identification and warning of sensitive habitats in the proximity to the launch facility;

vi) use of applicable best management practices to avoid or reduce impacts to the environment during launch facilities construction, use and maintenance.

G.20.5.3 The following design details should be incorporated, where appropriate, during the launch facilities design process:

i) to ensure adequate water depth to float an average boat from its trailer, the offshore limit of a proposed launch facility shall be located no less than 1m below the 100-year low water level during the proposed season of use. An effective stop mechanism shall be incorporated at this offshore limit to protect against disturbance of sediments during boat loading and unloading.

ii) for a hard surfaced boat launch ramp, the design is to ensure that the majority of any required excavation occurs above the lake High Water Mark (HWM), with portions of the ramp located below the HWM to closely match the natural shoreline grade.

iii) width of hard surface boat launch ramp shall be sufficient to accommodate boaters of various abilities to maneuver their trailers. The ramp width shall also be wide enough to accommodate boarding floats/decks resting on the ramp surface during low water. Multiple lane designs shall consider lane overlap efficiencies to reduce the overall footprint.

iv) pre-cast concrete planks shall be required for construction of the underwater portion of hard surface boat launch ramps.

G.20.6 Maintenance and Upgrading of Existing Facilities

G.20.6.1 Where existing facilities require maintenance either as a result of general launch use or as a previous design failure, notification to DFO is required with a variance request to proceed without a Fisheries Act section 35(2) authorization if:

i) proposed maintenance or upgrade activities are limited to the existing area of disturbance;

ii) there are no impacts to riparian and/or littoral vegetation outside of the seasonal launch footprint; and,

iii) the operational best practices detailed Section G17.7 are employed. This information shall accompany the Water Act application and be copied to the appropriate DFO Field Office for consideration as early as possible in the project design process.

G.20.7 Design Best Practices

G.20.7.1 Qualified design professional shall ensure that the site assessment and design consider the following factors:

i) local soil conditions and characteristics;

ii) local shoreline and stream mouth accretion/erosion dynamics, including local water currents and associated patterns of sediment transport and deposition;

iii) local shoreline morphology and potential impacts or changes;

iv) historical water levels during the proposed seasons of use;

v) minimizing direct, indirect and cumulative impacts on existing or potential fish and wildlife use, aquatic and riparian habitat;

vi) ability to access, repair and maintain the facility with minimal impact;

vii) potential erosion or sediment releases resulting from proposed works;

viii) implementing control measures that may be required to reduce the potential for establishment of invasive aquatic plants;

ix) minimizing the potential for storm water and contaminated runoff from roadways, parking areas, etc. reaching the water body;

x) minimizing the footprint of the works and associated foreshore disturbance;

xi) minimizing the effects of watercraft wakes on adjacent shoreline areas and reducing the potential for sediment accumulation on the ramp;

xii) avoiding direct and indirect impacts to other properties or services.

G.20.7.2 The Municipality does not promote the use of wood preservatives in or around fish bearing water bodies and prefers the use of untreated wood or inert materials. Pre-cast concrete, plastic or steel structures shall be considered as environmentally sound and more durable alternative to untreated wooden pilings. Cast in place concrete is considered very toxic to aquatic organisms until it fully hardens.

G.20.7.3 When selecting a location for the launch facility, the design professional shall consider types of habitats present and select a site where the watercraft launch will cause the least impact.

G.20.7.4 Design footprint of proposed structures below the water body high water mark shall be minimized to limit potential habitat impacts. Where spawning records are not available, a qualified professional shall be

engaged in design process to assess whether the site is likely to support shore spawning.

G.20.7.5 If the qualified design professional's assessment determines that HADD of the habitat may occur due to the proposed launch facility construction, then the nearest DFO Field Office shall be contacted to discuss the potential for authorization of the HADD of the habitat. The submissions for such authorization need to include the assessment of potential direct, indirect and cumulative impacts of the launch facility construction, operation and maintenance on the habitat. These impacts shall be considered for listed wildlife individual populations and species, as well as most authorizations shall also trigger a review under the Canadian Environmental Assessment Act.

G.20.8 Construction and Operational Best Practices

G.20.8.1 Boat launch construction and maintenance shall be completed at a time of year that will reduce the in-stream risk as approved by the regional DFO Field Office.

G.20.8.2 A pre-construction meeting shall be held between the environmental monitor and the contractor to ensure a common understanding of the best work practices.

G.20.8.3 A copy of the design standards, best work practices and all appropriate plans, drawings and documents shall be forwarded to the contractor and kept readily available at all times at the site while the work is proceeding.

G.20.8.4 The measures shall be taken by the contractor to minimize the area disturbed by construction activities and to preserve trees, shrubs and grasses near the shoreline. Existing rocks and logs in the aquatic environment are important aquatic wildlife habitats, and shall not be used as building materials.

G.20.8.5 Only construction, modification, or maintenance works required to meet design specifications shall be undertaken below the water body high water mark. No foreshore filling or land reclamation shall occur, nor should any disturbance of foreshore and/or riparian vegetation occur during construction of the launch facility.

G.20.8.6 A spill containment kit shall be kept and readily accessible on site in the event of a release of a deleterious substance to the environment. On-site personnel shall be trained in containment procedures. All spills of substances that are toxic, polluting or deleterious to aquatic life and of reportable quantities shall be immediately reported to the Provincial Emergency Program.

G.20.8.7 Construction shall be monitored by an appropriate qualified professional (biologist, hydrologist, fluvial geomorphologist and/or engineer) on a full-time basis during project start-up, any in-stream work and sensitive activity periods, or, if necessary, on a daily basis to the completion of the project. The environmental monitoring shall be provided with written authority to modify and/or halt any construction activity, if deemed necessary for the protection of aquatic and shoreline wildlife habitats. A sign shall be posted at the entrance to, or in the immediate vicinity of the job site listing the monitor's company name and the contact numbers.

G.20.8.8 Within 60 days of completion of the project, the environmental monitor shall complete a monitoring report and submit a minimum of one (1) copy to the Municipality.

G.20.8.9 Upon completion of construction activities, all work areas below the water body high water mark shall be left in a smooth condition free of any depressions that may result in fry entrapment.

G.20.9 Construction Materials

G.20.9.1 Portland Cement

The following measures shall be taken by the Contractor when using Portland cement or other lime-containing materials during construction of launch facilities:

i) Portland cement or other lime-containing construction materials shall be kept in sealed containers to prevent any contact with the water body adjacent the work site and deposition of sediments;

ii) cast in place concrete shall remain inside sealed forming structures (concrete leachate is alkaline and highly toxic to aquatic life), (pre cast concrete structures pose less risk to the environment);

iii) isolated containment facilities for wash-down water from equipment, concrete carrying vehicles and tools shall be available on site;

iv) CO_2 tank with regulator, hose and gas diffuser, as well as trained personnel to operate it shall be readily available on site during concrete work to neutralize pH levels should a spill occur;

v) in the event of spills or sediments enter the water body, emergency mitigation and clean-up measures shall be immediately implemented (such as use of CO_2 and immediate removal of the material), (all such occurrences shall be reported to DFO);

vi) water body pH units shall be frequently monitored, measured to an accuracy of +/- 0.2 pH units from` the background level, immediately downstream of the site until all the works are completed (emergency measures shall be implemented if downstream pH has changed more than 1.0 pH unit, or is recorded to be below 6.0 or above 9.0 pH units).

G.20.9.2 Treated Wood

Caution shall be taken where preserved wood and preservative treatments are used. Manufacture's precautions and instructions shall be followed at all times. Wood preservatives shall not be applied near or over the water surface.

G.20.9.3 Untreated Wood

Cedar or hemlock is recommended for use as they contain natural preservatives that protect the wood from rot caused by repetitive water exposure and drying cycles. Less expensive wood species may be used in areas below the water line where they are not exposed to the air.

G.20.9.4 Metals

The Municipality does not promote use of steel as a material for construction purposes in or near water bodies. Use of painted steel structures shall be avoided at all times.

G.20.9.5 Plastics

Plastic polymer materials are not considered to affect the water quality, as well as they are generally tough and float well. Closed cell polystyrene forms are recommended for use as floatation devices. The billets require wrapping with polyethylene sheeting to help protect them from degradation due to accident watercraft fuel and oil spills. White expanded polystyrene has little effect on water quality, however the foam beads can become a hazard to fish as this material deteriorates in time.

G.20.10 Sediment Control

The following measures shall be taken by the Contractor to prevent or minimize the sediment occurrence during the construction of launch facilities:

i) minimize disturbance to existing vegetation on and adjacent to the water body shoreline;

ii) have sediment control measures (e.g. silt curtain, silt fencing) in place before starting any works that may result in sediment occurrence;

iii) remove excavated materials and debris from the site, or place it in a stable area above the high water mark or active floodplain of the water body and as far as possible from the shoreline. Protect stockpiled materials and any remaining exposed soils within the site from erosion and reintroduction to the water body.

G.20.11 Removal of Existing Structures & Site Restoration

G.20.11.1 A qualified professional shall be engaged to ensure that the removal works are undertaken in a manner that minimizes impact and ensures that areas requiring restoration are appropriately restored.

G.20.11.2 Removal of existing launch facilities shall be completed in a manner that prevents disturbance to the water body, foreshore and/or generates sediments. Construction waste shall not be deposited or stored within the water body foreshore or riparian areas.

G.20.11.3 Site restoration shall be provided for long-term recovery and eliminate any depressions that may result in fry entrapment during low water levels.

G.20.11.4 Disturbed areas above the high water mark shall be graded to a stable angle of repose.

G.20.11.5 Disturbed areas shall be seeded and/or vegetated to prevent surface erosion by hydro seeding with a heavy mulch, tackifier and seed mix; by installing erosion blankets; and/or, by heavily seeding/planting with native vegetation.

G.20.11.6 All remaining equipment, supplies and materials, as well as sediment and erosion control measures, shall be removed from the site.

G.21 PARKING LOTS

G.21.1 Parking lot design shall conform to the Municipality Land Use By-Law. The minimum parking stall standards are as follows:

Parking Angle	Width of Stall, (m)	Depth of Stall Perpendicular to Manoeuvring Aisle, (m)	Width of Stall Parallel to Manoeuvring Aisle, (m)	Width of Manoeuvring Aisle, (m)	Overall Width, (m)
30°	3.0			3.5	
45°	3.0	4.0	4.0	3.5	11.6
60°	3.0	4.8	2.8	5.5	15.6
90°	3.0	5.5	2.7	7.0	18.0

G.21.2 Parking lot pavement structure for public lands shall be determined by the Developer's Engineer based on the results of the geotechnical investigation and anticipated loading but shall not be less than the following:

G.21.2.1 Light Traffic: (gravel standard) — 175mm Granular Base, 25mm Surface Gravel;

G.21.2.2 Light Traffic: (paved standard) — 175mm Granular Base Course, 75mm Asphalt Concrete Pavement;

G.21.2.3 Heavy Traffic: (paved standard) — 225mm Granular Base Course, 100mm Asphalt Concrete Pavement;

G.21.2.4 Heavy Industrial: (paved standard) — Case specific based on projected loading.

G.22 COMMUNITY MAILBOXES

G.21.1 The Developer shall submit a subdivision plan to the Canada Post requesting mailbox locations. Requests may be sent to: Delivery Planning, Canada Post Prairie Region, 9828 104 Ave. NW, Suite 400, Edmonton, AB, T5J 0J8. Mailbox locations shall be shown on the Landscaping Plan.

G.21.2 It is the Developer's responsibility to ensure that the mailbox locations conform to the *Postal Delivery Standards Manual, Planning for Postal Service.*

G.21.3 Easements allowing encroachment onto private property shall be provided only if the mailbox pad extends beyond the right-of-way boundaries.

G.21.4 Mailboxes shall be located according to the following requirements wherever possible:

i) on the side yard of the corner lot;

ii) next to the community park or playground;

iii) on the side of the street entering the subdivision;

iv) not within 10m of a fire hydrant, bus stop, streetlights, power poles, etc.;

v) not directly above existing or proposed underground utilities;

vi) not to obscure minimum pedestrian or vehicular traffic sight distances.

G.21.5 Mailbox pullouts shall be as per attached drawing.

G.23 LOW LEVEL CROSSING

G.23.1 Low level crossings allow normal water flows to pass through the culverts, keeping the crossing surface free of standing water for most of the year. High flows, i.e. spring runoffs, flow over the top of the crossing, as the culverts are not designed large enough to carry these flood-type runoff events. The crossing surface must be constructed of erosion resistant materials to withstand the effect of water flowing over the top of the crossing.

G.23.2 A topographic survey of the water stream crossing area shall be done to ensure proper installation of the crossing and its future operational success.

G.23.3 The crossing location should be determined in relation to potential water back-up effects created by the crossing installation. Neighbouring properties, roadways, etc. shall not be affected as a result of water back-up.

G.23.4 The crossing culverts shall be designed to carry normal flows based on available historical stream flow data.

G.23.5 If a high flow velocity crossing is proposed on a water stream where fish migration takes place, proper design consideration shall be given as to propose different elevations or larger diameter culverts with baffles to reduce flow velocities.

G.23.6 The proposed culverts shall be designed long enough to allow construction of stable and erosion resistant slopes at both upstream and downstream ends. Approved filter cloth shall be placed over the subgrade prior to installation of the culverts, and is to be extended up over the end wall slopes under the erosion-resistant surface (i.e. rock riprap) and onto the top surface of the crossing immediately below the erosion-resistant top. Fill materials around the culverts shall be placed in consecutive layers with thickness of each layer not exceeding 150mm. Each layer shall be compacted to the degree specified by the Geotechnical Engineer.

G.23.7 To protect gravel surfaced approaches from washout in the event of water flow over the top of the approach, the approved filter cloth or geotextile shall be placed over the subgrade prior to surfacing of the approaches. All disturbed soils around the water stream and approaches shall be re-graded and seeded immediately after construction.

G.23.8 If deemed to be necessary to protect downstream ecosystems, the watercourse shall be diverted or dammed up while construction takes place. Control measures shall be implemented at the construction site to prevent sediments and deposits from entering the watercourse.

G.23.9 If necessary, the watercourse bed shall be excavated and shaped to obtain a firm bed to place the culvert on. The design elevation of base (invert) of the culvert shall be set at or slightly below the bottom of the watercourse. The structure shall be keyed into the banks of the watercourse at least 450-600mm to prevent erosion. The approved filter cloth shall be placed over the culvert bed prior to placing of the fill materials.

G.23.10 The culverts shall be installed providing longitudinal downstream slope equivalent to the original watercourse downstream gradient within the crossing area. If more than one culvert is used to construct the crossing, a minimum lateral spacing between culverts of 300mm shall be maintained.

G.23.11 Fill materials around the culverts shall be placed in consecutive layers with thickness of each layer not exceeding 150mm. Each layer shall be compacted as directed by the Geotechnical Engineer. Thickness of fill above the culverts is to be selected by the design professional, and shall provide an adequate base for the surface structure construction.

G.23.12 The approved filter cloth shall be extended up over the end-wall slopes of the crossing, and shall be placed over the subgrade immediately under the erosion-resistant surface structure.

G.23.13 The erosion resistant surface structure shall be constructed above the culverts, extending down over the crossing end walls and around the culverts.

G.23.14 If a cast-in-place concrete surface structure is selected, it shall have steel reinforcement and top surface roughened to provide for better traction. Erosion protection, i.e. in the form of rock riprap, shall be extended along the watercourse bed at both upstream and downstream ends of the culverts to withstand the scouring action of water entering and exiting the culverts.

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SECTION H LANDSCAPING

H.1 STREET NAMES

H.1.1 The Landscaping Plan shall include up to three alternative names for each street. Street naming approval will be completed by the Municipality. The Municipality reserves the right to select or reject any of proposed street names.

H.1.2 Section B.4 details the drawings submission requirements.

H.2 TOPSOIL AND SEEDING

H.2.1 All ditches, boulevards and disturbed areas shall be topsoiled, fertilized and seeded to grass or sodded.

H.2.2 The thickness of topsoil placed shall be a minimum of 50mm, and topsoil shall be free of rock, roots, weeds and other deleterious material.

H.2.3 The grass seed mixture shall meet the requirements of the Seeds Act for Common No. 1 Seed. Certificate of seed analysis and compliance shall be required to be supplied to the Municipality.

H.2.4 The fertilizer and seed shall be applied at a rate of 112kg and 65kg per hectare respectively.

H.2.5 Bare spots, as well as thin and eroded areas showing signs of deterioration within the warranty period shall be repaired at the Developer's expense.

H.2.6 The topsoil shall be removed from areas requiring levelling, filling, excavation or grading before landscaping work commences. The topsoil shall be stockpiled and replaced following the completion of the grading works.

H.2.7 Additional erosion control measures for ditches with grade slopes greater than 5%, outfall ditches and storm water management facilities shall be designed and implemented in order to prevent the erosion of topsoil and other landscaping features. Reinforcing mats or other alternative erosion control measures shall be considered for installation until new vegetation is fully established.

H.3 TREES AND SHRUBS

H.3.1 The Landscaping Plan shall be prepared by the qualified professional showing the species, location and spacing of the proposed trees, shrubs and other landscaping features submitted to the Municipality for approval prior to installation. The Developer shall provide samples of proposed landscaping features.

H.3.2 No landscape features, including trees and shrubs, or other similar obstructions to visibility, which extend to a height more than 1m above the top of roadway surface grade shall be allowed within 30m of the intersection of two roadways.

H.3.3 Trees and shrubs located within the limits or in a close proximity of a pipeline, power line or other utility right-of-way shall conform to the type, spacing and offset and other requirements specified by the entity operating the utility. All aspects of the proposed landscaping shall be in accordance with relevant Federal and Provincial legislation or acts and any regulations established by the Energy and Utilities Board.

H.3.4 Coniferous trees and shrubs shall be considered for planting on landscape berms.

H.3.5 Within the warranty period specified in the Development Agreement, unsuccessful trees and shrubs shall be replaced at the Developer's expense.

H.3.6 Existing trees and shrubs that are to be retained within the development shall be protected to the furthest extent of the drip line. Final grading of the site shall not impact the root zone by more than 0.2m.

H.3.7 Tree species included on the landscaping plans shall meet the following specifications:

H.3.7.1 All proposed trees and shrubs shall be tolerant to the climatic conditions of the Municipality;

H.3.7.2 Tree species at maturity shall have an average spread of crown greater than 3m;

H.3.7.3 Deciduous trees shall be at least 60mm calliper at the time of planting;

H.3.7.4 Coniferous trees shall have a minimum spread of 0.8m at the time of planting;

H.3.7.5 Coniferous shrubs shall have a minimum spread of 0.5m at the time of planting;

H.3.7.6 Deciduous shrubs shall have a minimum height of 0.5m at the time of planting.

H.4 FENCING

H.4.1 The Landscaping Plan shall be prepared by the Developer and submitted to the Municipality for approval showing the proposed fence design details, including alignment, elevations, materials, foundations, coatings and dimensions. The Plan shall include all construction and installation details. Fencing shall comply with all setback and height requirements specified in the Land Use By-Law.

H.4.2 Wherever possible, proposed fencing shall be designed and installed to match or compliment existing fencing on adjacent properties.

H.4.3 Fencing shall be designed to be maintenance free for a minimum period of 15 years past the completion of construction.

H.4.4 Fencing, including foundations, shall be located entirely within legal limits of the property it is proposed for.

H.5 LANDSCAPE BERMS

H.5.1 The Landscaping Plan shall be prepared by the Developer and submitted to the Municipality for approval showing the proposed berm design and construction details, including alignment, elevations, dimensions and slopes.

H.5.2 Berms required for noise attenuation purposes shall be designed by a Professional Engineer or Landscape Architect. The Developer shall provide design information including projected traffic volumes and noise exposure.

H.5.3 Berm sideslopes shall not be steeper than 4H:1V to facilitate future maintenance. Berms shall have a flat top minimum 1m wide.

H.5.4 All berms shall be top soiled and grass seeded according to Section H.1.

H.6 PARKING FACILITIES

H.6.1 A parking and loading area for development in a commercial district or industrial development in a prominent location requiring two (2) or more parking spaces and which is adjacent to a residential district shall have a landscaped buffer between uses. The location, planting type, thickness and height of the landscaped buffer will be at the discretion of the Development Authority.

H.6.2 A parking and loading area for a commercial or industrial use in a prominent location requiring twenty (20) or more parking spaces shall include landscaped areas within the parking lot.

H.6.3 The minimum landscaped areas shall be calculated as $1m^2$ per required parking space. Landscaped areas shall be provided in more than one location throughout the parking lot.

SECTION I STREET LIGHTING

I.1 STANDARDS AND GUIDELINES

I.1.1 The street lighting design shall be in accordance with the *Guide for the Design of Roadway Lighting* published by the Transportation Association of Canada (TAC), as well as applicable standards published by the Illuminating Engineering Society of North America (IES).

I.1.2 Street lighting for existing developments and subdivisions, access roads and playgrounds shall conform to the applicable Municipality's Policy.

I.1.3 All roadway lighting systems shall be installed in strict compliance with the Canadian Electrical Code.

I.1.4 It is the Developer's responsibility to arrange with the local power utilities operators for necessary approvals and power connections.

I.2 ENGINEERING DRAWINGS & APPROVAL

It is the Developer's responsibility to submit the design drawings and documents prepared by a qualified Professional Engineer showing the poles layout, spacing, types, heights and luminaire wattages. The street lighting plan shall include all surface and underground features and utilities. The layout, as well as products and materials proposed for supply and installation are subject to approval by the Municipality.

I.3 DESIGN AND OPERATIONS

I.3.1 It is the Developer's responsibility to work with the service supplier for the design, supply and installation of the street lighting system. The proposed street lighting system standards and specifications shall be readily available from Fortis' regular inventory.

I.3.2 The responsibility for energizing the street lighting system shall be with the Municipality.

I.3.3 Upon the energizing of the streetlights the Developer shall provide the Municipality with an irrevocable letter of credit as security for the ongoing maintenance and costs of energizing of the streetlights based on current rates. The operating cost of the street lighting system shall be the responsibility of the Developer until the subdivision area is 75% percent occupied. The Developer will pay these costs upon receipt of an invoice from the Municipality. The Municipality shall release the letter of credit upon the expiration of 60 months from the date of energizing, or if the Subdivision Area is 75% percent occupied, whichever occurs first.

I.4 SAFETY

The lighting system design shall ensure the proper illumination of conflict areas such as intersections and crosswalks. The design shall be prepared with public safety in mind.

I.5 ENERGY USAGE

The street lighting system design shall be optimized to allow for the least possible energy consumption while still maintaining compliance with current safety standards. The Municipality encourages the use of the highest efficiency luminary equipment and lamps available at the time of installation.

I.6 POLE LOCATIONS

I.6.1 In some cases, the roadways and lots configuration will dictate the pole layout. Wherever possible, poles shall be located at the projection of lot lines. Pole locations shall not conflict with other utilities, features or approaches. Spacing between the poles shall be selected by the Developer's Engineer and the Municipal Engineer based on the optimum spacing/height/light distribution combination but shall not exceed the minimum standards published by the TAC.

I.6.2 Pole setbacks shall be as outlined in the TAC guidelines. Where roadways are designated for widening within five years of pole installation, the pole setback shall allow for said widening.

I.7 TYPE OF POLE

I.7.1 Pole type, material and base to be approved by the Municipality prior to purchase. A submission of samples may be required by the Municipality for inspection.

I.7.2 Breakaway poles shall not be required for design speeds of less than 80km/h. Yielding poles are recommended for all roadways with a design speed less than 80km/h and a pole setback of less than 4m from edge of pavement.

I.7.3 Steel poles shall be galvanized and powder coated. Aluminum poles shall be powder coated. Composite poles shall be the pulltrusion method manufactured.

I.7.4 Pole types shall be consistent with adjacent developments. All poles within a proposed new development shall be of the same type and height.

I.7.5 All poles shall be resistant to climatic and environmental conditions encountered within the Municipality.

I.8 AESTHETICS

I.8.1 The Developer shall ensure that the street lighting system design is compatible with the type of development and proposed buildings and structures.

I.8.2 The use of decorative poles shall be subject to approval by the Municipality. Proposed decorative poles and luminaires shall share common optical systems and components as other decorative items found in existing developments within the Municipality.

I.9 FOUNDATIONS

Poles foundations shall be designed based on the site specific soil conditions. The foundations shall be designed to withstand all loading, wind loading in particular.

I.10 LUMINAIRES

I.10.1 Luminaries shall be approved by the Municipality prior to purchase. A submission of samples may be required by the Municipality for inspection.

I.10.2 Luminaries shall be complete with IP66 Certified Sealsafe optical chamber.

I.10.3 Luminaries optical systems shall have a seal value R rating of greater then 600

I.10.4 Luminaries shall be tool free type.

I.10.5 Luminaries shall be complete with a ¼ turn shutter system for lamp replacement.

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SECTION J REFERENCES

The following reference materials were predominantly used with Municipal consent in the preparation of these Servicing Standards:

"The City of Edmonton Design and Construction Standards", July 1999.

"Town of Peace River Land Use Bylaw"

"The City of Grande Prairie Design and Construction Standards"

Additionally the following reference materials were used in the preparation of these Servicing Standards:

"Engineering Servicing Standards", Strathcona County, 1999.

"Draft Strathcona County Engineering Servicing Standards – Rural Service Area", 2007

"Rural Servicing Standards for Subdivisions and Road Construction", County of Grande Prairie No.1, June 2000.

"Procedures and Design Standards for Development", Town of Calmar, November 1999.

"Municipal Engineering Standards", City of St. Albert, May, 1997.

"Procedures and Design Standards for Development", Town of Westlock, Oct., 2002.

"Marine Guide to Small Boat Launches" Fisheries and Oceans Canada, March 2001

"Fish Habitat & Building Materials" Fisheries and Oceans Canada, October 2003

"Best Management Practices for Boat Launch Construction & Maintenance on Lakes" Government of British Columbia, Ministry of Water, Land & Air Protection, July 2006

"Standards and Guidelines for Municipal Waterworks", Wastewater and Storm Drainage System, 2006

"Canada-Wide Strategy for Management of Municipal Wastewater Effluent", The Canadian Council of Ministers of the Environment, 2008

"Big Eddy Sewerage Planning Study", City of Revelstoke, 2007

"General Municipal Servicing Standards", Sturgeon County, 2006

"General Municipal Servicing Standards",Thorhild County, 2007

"Guidelines for Canadian Drinking Water Quality", Federal-Provincial-Territorial Committee on Drinking Water, 2008

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