

MACKENZIE COUNTY

GENERAL MUNICIPAL

IMPROVEMENT STANDARDS



PREPARED BY:



■ ■ ■ ■ ■ Naturally Resourceful

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SECTION A GENERAL CONDITIONS

A.1 INTENT

A.1.1 The General Municipal Improvements Standards (hereafter, Standards) are intended to serve as minimum standards that are to be followed by Mackenzie County (hereafter, Municipality), Developers, Engineering Consultants, Contractors and others during all aspects of municipal improvements installations, including design, preparation and submission of plans and drawings, and construction operations.

This document forms an appendix to the Municipality Development Agreement, with clauses in the Development Agreement modifying or providing clarification of design and construction requirements on a site specific basis.

Where conditions dictate, and good engineering practices require higher standards than those indicated, the higher standards shall be incorporated into the design of the proposed subdivision. Generally, there will be no departures from the standards put forth in these Standards without prior written approval of the Municipality. In case of deviation from the requirements of these Standards, the Developer shall follow the final design by the Municipal Engineer and approved by the Municipality.

The standard drawings, as referenced throughout the document, shall form an integral part of these standards.

A.1.2 These Standards 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 These Standards shall only be considered as minimum requirements. The Developer, the Engineer and the Contractor 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 the use of standards that are more stringent.

A.1.4 These Standards, 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.1.5 These Standards are to be read in conjunction with the Municipality's current Land Use Bylaw. In the event of conflicting statements, the Land Use Bylaw shall generally govern. Where situation dictates, the Municipal Engineer, at his own discretion and based on best engineering practices, will provide the Municipality and the Developer with an expert opinion and professional advice as to which of the conflicting statements is to be used as guidance in further proceedings.

A.2 DEFINITIONS

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

Applicant - shall mean a person or a corporation who has applied for approval of a proposed municipal improvement or subdivision, or to service an existing or proposed parcel of land, whether as the owner or the owner's agent of the land included therein.

Building Permit - 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 subdivision. The permit issuance shall be in accordance with the minimum requirements of the Alberta Building Code.

Consulting Engineer or Engineer - shall mean a Professional Engineer(s) and/or firm licensed to practice engineering in the Province of Alberta and retained by the Applicant to be responsible for the design, studies, reports, engineering drawings and documents, layout and supervision of installation, preparing record (as-constructed) drawings and information and performing those duties in connection with the provision of municipal improvements as set out in these Standards.

Contract Drawings – Detailed drawings, specifications and any other information required to fully describe all aspects of the proposed work. Contract Drawings must be stamped by the Developers Engineer and be “Issued for Construction”.

Contractor - shall mean any person, persons or corporation which shall undertake the installation of municipal improvements on behalf of either the Applicant or the Municipality.

Construction Completion Certificate - shall mean a certificate issued after the Construction Completion Inspection pursuant to the Development Agreement indicating the completion of construction on the Development. Generally indicates the initialization of the Warranty Period.

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

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 Officer - shall mean person or persons appointed and acting on behalf of the Municipality to regulate the orderly development of subdivisions and properties.

Developer - shall mean the person, persons or corporation that has been granted a Subdivision Approval by the Municipality for the development of a subdivision or subdividing land, or an owner or owners of land, or their employee, agent or representative, as defined in the Development Agreement.

Development Approving Authority(s) - shall mean the 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.

Development Agreement - shall mean documents specifying the general requirements, terms and conditions of the municipal improvements. Such an agreement between the Municipality and the Developer shall be in place prior to installation of municipal improvements.

Development Area - shall mean the lands described in the Development Agreement.

Developers Engineer – Shall mean the same as Consulting Engineer.

Development Permit - shall mean a certificate or other document permitting a subdivision or 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.

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

Final Acceptance Certificate (FAC) - shall mean a certificate issued pursuant to the Development Agreement indicating the completion of the Developer's responsibilities to the Municipality. The FAC is generally issued after a Final Acceptance Inspection or Warranty Inspection. The FAC transfers full responsibility for a development from the Developer to the Municipality.

Final Acceptance Inspection - shall mean an inspection carried out by the Developer and the Municipality at the end of the warranty period of the project to assess any remaining obligations prior to the issuance of the FAC.

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

Geotechnical Report - shall mean a document prepared by a Geological or Geophysical Professional Engineer 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 subdivision area to a desired horizontal gradient.

Holdback – shall mean funds which the Municipality will withhold from each payment to the Developer till such time when the FAC is issued and proof is provided that all contractors have been paid and all liens and claims have been released. Amounts and timelines and other conditions of holdback shall be outlined in the Development Agreement.

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 subdivisions 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 subdivision as described in 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 subdivision as described in the Development Agreement.

Municipality - shall mean Mackenzie County.

Municipal Improvement - shall mean any addition or modification or proposed addition or modification to a service or facility that the Municipality will ultimately become responsible for. These include, but are not necessarily limited to, watermains, sanitary and storm sewers, roadways, park areas, signs, street lights and fencing.

Municipal 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, or
- ii. undeveloped reserve land as either: reserve, municipal reserve, school reserve, environment reserve or combination of reserves, or
- iii. municipal right-of-way including all forms of public roadways (roads, lanes, streets, highways), sidewalks, boulevards, road allowances, utility rights-of-way, public utility lots, public spaces, undeveloped rights-of-way and storm water management facilities, bridges, culverts and water bodies, or
- iv. any property developed as a pathway or park trail system, or
- v. any property owned or titled to the Municipality including buildings, structures and parking facilities.

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.

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

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 subdivision may utilize.

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

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 subdivision 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.

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.

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

Record Drawings - shall mean design drawings up-dated to accurately show utility and municipal improvements as constructed in the field. Such drawings shall be stamped and signed by the Engineer.

Subdivision - shall mean creation of lot(s) within existing boundaries of hamlets.

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

Traffic Accommodation Strategy - shall mean the plans and written procedures detailing the proposed measures to accommodate traffic safely and efficiently for the duration of the project.

Unauthorized Use - shall mean the use of the Municipal property either by constructing, storing, landscaping, erecting, placement or removal of any structure, or item on, over or in the Municipal 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, or
- ii. permanent buildings, relocatable structures or accessory structures such as a detached garage, barn, shed, greenhouse or lean-to composter, or
- 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, or
- iv. installation of utilities, antenna, satellite receiving dish or other telecommunication facilities and devices, or
- v. storage of vehicles or trailers or off-road equipment, building materials, rubble, stockpiles, debris or chattel, or
- 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, or
- 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 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 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 DOCUMENTS

A.3.1 All references to Acts, Bylaws, Standards, Specifications, or methodologies of technical associations will be made to the current or latest adopted amendment or revision.

A.3.2 It is the Developer's responsibility to satisfy the requirements established in the Standards unless stated otherwise.

Should conflicts or inconsistencies with the Standards 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.3.3 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 Geometric 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 Bylaws*
- ✓ *Other Provincial/Federal Government Authorities*

A.3.4 It is the Developer's or the Developer's Consulting Engineer's responsibility to obtain, at their own cost, copies of the referenced documents from the applicable authority.

A.3.5 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 Standards for reference. The Developer and the Developer's Engineer shall remain responsible for the design and construction of the proposed subdivision according to accepted best engineering and work practices.

A.3.6 The following are abbreviations commonly accepted for use with these Standards:

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

AFPA	Alberta Forest Products 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 (UK)
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
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
TAC	Transportation Association of Canada
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.4 DEVELOPER'S RESPONSIBILITY

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

- i. Design and construction of the proposed Municipal Improvements including necessary off-site upgrades and utility up-sizing associated with the Development.
- ii. Quality control and materials testing by an independent third party qualified engineering firm.
- iii. Certification by an independent third party that the construction has been completed in accordance with the approved drawings and specifications shall be required.
- iv. Acquisition of additional land for roadways widening and municipal utilities and services as required.
- v. Registration with Alberta Land Titles all easements including plans and documents for the construction of municipal improvements outside of the municipal right-of-way.
- vi. Register a Plan of the Subdivision, made in accordance with the Plan approved by the Municipality's Subdivision Approving Authority, at the Land Titles Office.
- vii. Supply to the Municipality both digital and hard copies of the Plan of the Subdivision drawings and Record (as-built) 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.

A.4.3 The Developer shall engage a qualified Professional Engineer who is licensed to practice in the Province of Alberta and who is a member of The Association of Professional Engineers, Geologists and Geophysicists of Alberta, who shall undertake all phases of Engineering for the proposed Municipal Improvements including conceptual design, detailed design, general engineering, construction supervision and inspection, and preparation of Shop and Record Drawings. The Developer's Engineer shall design the proposed Municipal Improvements in accordance with accepted engineering practices and principles to meet or exceed the minimum standards as set in this document or established by government authorities. All drawings and documents shall identify the Developer and shall be stamped, signed and sealed by the Developer's Engineer.

A.4.4 The Developer shall demonstrate conformance to the satisfaction of the Municipal Engineer if there is a question as to whether any product or system is in conformance with applicable Standards and shall pay the costs associated with any testing or certification to demonstrate such conformance. In case of a conflict between the requirements of these Standards and those of the listed Referenced Standards, the requirements of these Standards will prevail.

A.5 SUBDIVISION APPLICATION

A.5.1 Prior to any subdivision construction taking place, the Developer shall submit a Subdivision Application to the Municipality using the Subdivision Application form provided by the Municipality, for review by the Municipality. The Application must include all pertinent information as to standards of construction, anticipated types of subdivision, requirements for capacity of utility systems and easements, roadways, street patterns and other significant aspects relating to the proposed subdivision.

A.5.2 The Development Application shall include drawings at a scale of 1:1000 or 1:2000. These drawings shall outline the proposed concept for the layout of all lots, blocks and roadways including the following information:

- i. preliminary subdivision plan;
- ii. proposed lot grading plan;
- iii. contours of existing land surface relative to geodetic elevation datum;
- iv. location and size of utilities, roadways and other facilities;
- v. anticipated impacts on existing facilities as a result of the proposed subdivision;
- vi. proposed schedule;
- vii. other information that the Developer considers necessary to facilitate the proper assessment of the proposed subdivision.

A.5.3 No construction shall proceed until a Development Agreement has been approved.

A.6 DEVELOPMENT AGREEMENT

The Developer will be required to enter into a Development Agreement with the Municipality prior to the construction and installation of the proposed subdivision. No Development Permit will be issued for any construction on any particular area or lot within the proposed subdivision until:

- i. all required Municipal Improvement Plans are in place and accepted by the Municipality;
- ii. Subdivision Plans are endorsed and registered at Alberta Land Titles.

A.7 SUBMISSION AND REVIEW OF ENGINEERING DETAIL DESIGN

- A.7.1** The Developers Engineer shall submit electronically three (3) complete sets of plans, drawings and specifications for the proposed subdivision to the Municipality for review, including the following:
- i. prints of the registered plans of the proposed subdivision;
 - ii. detailed sanitary and storm sewer capacity and pipe loading calculations;
 - iii. water distribution system network analysis;
 - iv. Geotechnical investigation if required as a result of the application review;
 - v. Any additional requirements as a result of the application review;
 - vi. Storm Water Management Plan if identified as being required during the Application review.
- A.7.2** Existing road names shall be shown on the drawings for reference. Proposed road names must be approved by the Municipality prior to submission and also shown on the drawings.
- A.7.3** The Consulting Engineer shall bring to the attention of the Applicant, and the Municipality, the need for any right-of-way outside the area of the proposed subdivision which the Applicant may have to obtain. Where easement or right-of-way documents and plans are deemed necessary, they shall be prepared by a licensed Alberta Land Surveyor at the Applicant's expense.
- A.7.4** The Consulting Engineer shall bring to the attention of the Applicant, and the Municipality, the need for any utility crossing agreements which the Applicant may have to obtain.
- A.7.5** All design drawings, specifications and relevant data will be reviewed by the Municipality and all necessary revisions shall be incorporated by the Consulting Engineer in the final design. Such revisions will in no way lessen the responsibility of the Developer and their Consulting Engineer for the work.
- A.7.6** Upon completion of all revisions, the Consulting Engineer shall submit electronically four (4) sets of Contract Drawings to the Municipality for review and approval.

A.7.7 Upon completion of final design review, the Municipality will certify, via their Municipal Engineer signature, the drawings and will return one (1) approved set to the Consulting Engineer.

A.7.8 Review certification does not, in any manner, imply approval of the technical aspects of the reviewed design. No construction activities will be started within any parcel of land or on any of the municipal property until the Contract Drawings are certified by the Municipality, the Subdivision Plans are approved, and the Development Agreement is in place.

A.8 APPROVAL TO PROCEED

A.8.1 Upon receipt of approved Contract Drawings from the Municipality, the Applicant may proceed with the construction of the proposed Municipal Improvements subject to following:

- i. satisfactory execution of the required Development Agreement, and
- ii. all required approvals from the Municipal, Provincial and Federal Regulatory Authorities are obtained by the Applicant.

A.8.2 A full copy of all approved drawings and specifications shall be maintained at the construction site during the installation of the proposed Municipal Improvements.

A.8.3 The Developer shall give 48 hours written notice to the Municipality before commencement of work, changes in work schedules, or working hours in order to coordinate adequate Municipality inspection staff.

A.9 ENGINEERING AND SUPERVISION

A.9.1 Where the Development Agreement requires that the Developer construct local improvements, the Developer shall obtain an accredited Consulting Engineer or a firm which will carry out preliminary surveys, prepare and submit design drawings for approval, supply construction survey layout and engineering supervision during construction, certify acceptable completion of the work, and submit record (as-built) drawings of all work performed.

A.9.2 The Developer shall obtain an accredited Geotechnical Engineer or a firm to carry out all material testing deemed necessary to determine and certify whether workmanship and materials incorporated into the work meet the specified requirements.

A.9.3 The Developers Engineer(s) or their authorized representative(s) shall have a presence at all times on site during the Municipal Improvements installation to ensure that all construction activities are carried out in conformance with the standards specified by the Municipality and the requirements of the approved plans and specifications.

- A.9.4** The Developer shall be responsible to have the necessary construction layout carried out to ensure the finished construction conforms to the lines and grades shown on the Contract Drawings.
- A.9.5** In addition to supervision carried out by the Developer's Consulting Engineer, the Municipal Engineer appointed by the Municipality may periodically inspect the work. The Municipal Engineer will bring to the attention of the Consulting Engineer and/or the Contractor the use of any unacceptable materials or practices. If remedial action is not taken to the satisfaction of the Municipal Engineer, he may order a stoppage of work. No work will be resumed until required remedial actions are taken by the Contractor to the satisfaction of the Municipal Engineer.
- A.9.6** If the Developer's Consulting Engineer, on behalf of the Developer, wishes to make any changes to the Contract Drawings, either before or during the execution of the work, he shall submit drawings and other supporting materials, showing the proposed revisions to the Municipality for review and approval. No revised construction work will be allowed until the proposed changes to the Contract Drawings are approved by the Municipality and new revised Contract Drawings are issued.

A.10 SURVEY CONTROL SYSTEM

- A.10.1** The Developer shall provide, at the discretion of the Municipality, a survey control system within, and adjacent to, the proposed subdivision. The survey control system shall consist of Alberta Survey Control Monuments (ASCM) that are of a design and quality acceptable to Alberta Sustainable Resource Development (ASRD). The Municipality and ASRD shall be provided with the survey measurements for the survey control system.
- A.10.2** The Developer shall ensure that all existing and new ASCM are properly preserved. Should it be necessary to destroy a monument, the Developer shall establish a new one in lieu of the lost monument and provide the Municipality and ASRD with survey measurements for its proper location.
- A.10.3** Any survey monuments disturbed or removed during construction must be replaced prior to Final Acceptance by the Municipality. The Developer shall provide certificates from a registered legal land surveyor, who is practicing member with the Alberta Land Surveyors Association, that all survey monuments are intact or properly replaced at their proper locations.

A.11 UTILITIES

- A.11.1** The Developer or the Developer's Contractor shall take all precautionary measures as may be necessary when working over or adjacent to utilities, whether above or below ground, and shall control his equipment and method of construction to prevent any damage to the utility and/or appurtenances.

- A.11.2** The Developer shall be responsible to obtain an appropriate crossing agreement with the utility owner, and provide proof of such an agreement to the Municipality prior to commencement of the improvement installation. 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.11.3** Under no circumstances shall any construction operations be carried out over or adjacent to any pipeline until the required adjustments and protection required for the proposed construction have been completed. Additionally, he shall provide a minimum forty eight (48) hours notice to the pipeline owner, in advance of commencing his construction operations in that area. The Developer shall also maintain appropriate liaison with the pipeline owner.
- A.11.4** Upon completion of the pipeline work, the Contractor shall continue to work in close liaison with the pipeline owner and, if required, ensure that a representative of the affected utility company is present at all times during active equipment operations. The Contractor shall ensure that no equipment crosses or operates over any pipeline at locations other than where protection has specifically been provided. Where construction is involved over an uncased or otherwise unprotected line, extreme caution shall be exercised to ensure that the line is not damaged as a result of the construction equipment loading.
- A.11.5** The Developer shall be responsible for the installation of power, natural gas and telephone services in the subdivision. Any other utilities that may be required shall be provided at the sole expense of the Developer.
- A.11.6** The Developer of the proposed subdivision is responsible for all arrangements with the utility companies as to the locating and moving of all existing utilities such as power poles, pipelines, telephone poles, buried cables, or any other utility as may be required.
- A.11.7** Gas, power and telephone location plans shall be submitted to the Municipality for approval prior to installation. Approval shall be given in writing once the plans have been approved. The Developer shall be responsible for payment of all costs related to these local improvements.
- A.11.8** If lines cannot be installed in the streets or lanes of the subdivision, the Developer shall provide registered easements or rights-of-way in the name of the Municipality to accommodate the utility services. The required easements or rights-of-way shall be registered on each individual lot prior to the sale of any lot in the subdivision area.
- A.11.9** 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.12 SAFETY AND ACCOMMODATION OF TRAFFIC

- A.12.1** The Developer is responsible, either solely or through his Contractor, for all aspects of site safety, including traffic control and signage. With respect to site safety, the Developer shall be considered to be acting as the Prime Consultant, and shall save the Municipality, its employees and agents, from all actions arising from issues of safety.
- A.12.2** The Developer is solely responsible for safety on the site. Nothing contained herein removes, lessens or transfers this responsibility. Signage, accommodation of traffic and other related issues shall conform to industry standards.
- A.12.3** A Traffic Accommodation Strategy may be required to be submitted for review and approval by the Municipality prior to commencement of improvement installation.
- A.12.4** The Developer or the Developer's Contractor shall, at his own expense, make suitable provisions to accommodate all traffic, whether pedestrian or vehicular, over or around any part of the subdivision, and shall supply and maintain such signs, barriers, fences, lights, and flag persons as may be required for this purpose. Where the traffic is required to use a route over or around the work which is of a lower standard than was available before the work commenced, the Contractor shall, at his own cost, continuously provide assistance to traffic as required on a 24 hour per day and 7 day per week basis, particularly during periods of inclement weather. The Contractor shall provide dust control where considered necessary by the Municipality to reduce nuisance or for the safety of the travelling public.
- A.12.5** Flag persons shall be instructed in the proper traffic control procedures for the work and shall be dressed and equipped in a manner consistent with Alberta Transportation requirements.
- A.12.6** When work is not in progress and on days such as Holidays and Sundays, the Contractor shall remove all regulatory signs not essential for the protection of the public, in order to reduce inconvenience to a minimum.
- A.12.7** All signs and guide posts encountered that must be removed in the prosecution of the work shall be carefully salvaged by the Contractor. Certain signs, such as those marking railroad crossings, intersection warning or stop signs, shall be maintained on the work for the protection of traffic using the roadway.
- A.12.8** Where the subdivision is closed off and traffic is diverted entirely off the subdivision, the Contractor shall, at his own expense, provide and maintain such signs, barriers, lights, and flag persons as may be necessary to direct the travelling public over the detour.

- A.12.9** Traffic must be controlled by flag persons and sufficient warning signs to ensure the safety of the public when any traveled roadway is being entered or crossed by hauling equipment to the satisfaction of the Municipality. Where required for public safety, additional signs will be used. Signage and sign placement shall be consistent with TAC “Manual of Uniform Traffic Control Devices for Canada”.
- A.12.10** Road closures and detours must be approved by the Municipality in writing a minimum of 48 hours prior to scheduled work.
- A.12.11** Haul routes must be kept clear and free from dust by grading and sprinkling. Trucks must be loaded in such a manner that no spillage occurs.
- A.12.12** Where, in the opinion of the Municipality, additional warning signs or other safety devices are required on the work, the Contractor shall supply, erect and maintain the additional facilities as requested.

A.13 EASEMENT AND RIGHT OF WAY

It is the Developer’s responsibility to obtain all easements and rights-of-way 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.14 PERMITS AND LICENSES

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

A.15 SUBDIVISION DISPLAY SIGN

Where required by the Municipality, the subdivision display sign shall be erected to the following standards:

- i. The subdivision display sign will include the lot layout and subdivision name carved and painted. The sign must be coated with a weatherproof finish. The sign is to be set on a minimum 200mm x 200mm square post or minimum 200 mm diameter round post.
- ii. The size, design and location of the subdivision sign is to be approved by the Municipality in writing, prior to improvement installation. The Developer shall be responsible for the maintenance of the sign for a period of two (2) years following the Municipality acceptance of the construction completion of the sign.

A.16 INSPECTIONS, WARRANTY PERIOD AND FINAL ACCEPTANCE

A.16.1 Upon completion of all municipal improvements associated with the proposed subdivision, the Developer shall request in writing a Construction Completion Inspection. Prior to the Construction Completion Inspection, an inspection conducted by the Developer's Consulting Engineer to reveal and mitigate potential deficiencies shall be considered as good practice. Upon the receipt of such request, the Municipal Engineer, on behalf of the Municipality, will inspect the municipal improvements, prepare a deficiency list and forward it to the Developer through the Municipality.

A.16.2 At the sole discretion of the Municipality or their representative, if during the Construction Completion Inspection, more than three (3) deficiencies are noted the inspection will stop. The Developer and/or his Contractor will be required to correct all deficiencies on the entire subdivision before requesting a re-inspection. During any re-inspections, if more than three (3) deficiencies are noted the re-inspection will stop and the process will be repeated as above.

The Municipality will charge the Developer for the initial Construction Completion Inspection or the Final Acceptance Inspection. The Municipality will invoice the Developer to recover all costs for re-inspections. Costs to be recovered may include but are not limited to the following: travel, municipal staff time, Municipal Engineer cost and administration cost.

A.16.3 The Developer shall be responsible for, at his own expense, all remedies to correct any defects, faults, or deficiencies in the completed works identified during the Construction Completion Inspection.

A.16.4 Upon rectification of all deficiencies to the satisfaction of the Municipal Engineer, the Construction Completion Certificate will be issued to the Developer, notifying of the following:

- i. acceptance of work by the Municipality, and
- ii. commencement date of Maintenance and Warranty Period for all installed Municipal Improvements.
- iii. Registration of all lots shall be completed before starting construction on lots.

A.16.5 Municipal utilities and services installed by the Developer shall not be permitted to operate as part of the existing systems until such time as respective utilities and services have been properly inspected, tested and approved in writing by the Municipal Engineer. Formal approval shall be in the form of an approved Construction Completion Certificate.

- A.16.6** Within a two (2) month period after the date of issuance of the Construction Completion Inspection, the Developer's Consulting Engineer shall submit Record (As-Built) Drawings to the Municipality. The Developer must also provide the costs of each improvement in a format satisfactory to the municipality; costs must include but are not limited to engineering, materials and installations.
- A.16.7** The Warranty Period for the Municipal Improvements shall commence on the date of issue 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 two (2) years, terminating with the Final Acceptance of work, unless otherwise stated in the Development Agreement. During the Warranty Period, the Developer shall be responsible for, at his own expense, all remedies to correct any defects, faults, or deficiencies in the completed work.
- A.16.8** The Developer shall provide, for the duration of the Warranty Period, an irrevocable Letter of Credit as required by the Municipality to register the property.
- A.16.9** Prior to the expiry of the Warranty Period, the Developer shall notify the Municipality in writing and arrange for an inspection. Upon the correction of all deficiencies to the satisfaction of the Municipal Engineer, the Municipality will issue a Final Acceptance Certificate.
- A.16.10** Where staged construction has been approved by the Municipality in writing, separate Construction Completion and/or Final Acceptance Certificates may be issued for distinct components of the subdivision, with separate Warranty Periods as appropriate. Separation of the project into components shall be at the sole discretion of the Municipality.
- A.16.11** Where the Warranty Inspection indicates expected failures in the work (due to faulty workmanship or materials) shortly after expiration of the Warranty Period, the municipality may request an extension of the Warranty Period on select portions of the work in lieu of requiring immediate corrective action by the Developer prior to issuance of the FAC. Such warranty extension will be limited to an additional two (2) years from issuance of the Final Acceptance Certificate.

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SECTION B ENGINEERING PLANS AND DRAWINGS

B.1 GENERAL REQUIREMENTS

- B.1.1** Detailed engineering plans and drawings submitted to the Municipality for review and approval must comply with the requirements stated herein and shall be submitted a minimum eight (8) weeks prior to commencement of construction. Submitted drawings must be legible and contain sufficient information, in the opinion of the Municipality, to allow full review of the proposed work and survey layout on the proposed site.
- B.1.2** The standard drawing size of 841mm by 594mm shall be used for all plan submissions. The index plan may be a reduction of the standard scale to allow the plan to fit the standard size sheet. Original drawings will be prepared in ink on paper and identified appropriately, with the Municipality being provided with a digital AutoCAD copies as specified.
- B.1.3** Drawing scales:
- i. Key plans: 1:10000.
 - ii. Overall plans: 1:5000.
 - iii. Index plans: 1:1000.
 - iv. Plan and profile drawings: horizontal 1:500, vertical 1:50.
 - v. Cross section drawings: horizontal 1:100, vertical 1:50.
- B.1.4** Elevation data will be relative to the Alberta Survey Control system. The reference Alberta Survey Control Monument (ASCM) and elevation will be shown on the engineering drawings.

B.2 SUBMISSION REQUIREMENTS FOR DEVELOPMENT AND GRADING PERMIT

- B.2.1** Pursuant to the Municipality's Land Use Bylaw, the Developer is required to submit:
- i. A General Site Plan illustrating existing elevation contours at 0.5 m intervals preferred, and not to exceed 1 m maximum. Elevations shall be relative to Geodetic Datum. Reference benchmarks shall be indicated on the General Site Plan.

- ii. 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 subdivision area including roadway rights-of-way, laneways, drainage, utility easements, municipal reserve and all lots. Rough grades shall ensure that the requirements of the Municipality approved Overall Drainage Plan are met and no standing water or areas where water may pool or pond shall occur. 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, and Engineering requirements for grading of each lot which requires 1 m or more of fill.
 - iii. A Geotechnical and Hydrogeological Investigation of the proposed site completed by a qualified Geotechnical Engineer or a firm to a level that will allow the Municipality to assess the site geotechnical and hydrogeological conditions and their effect on the proposed subdivision and the adjacent areas. The report shall include general recommendations and outline any findings of contamination that may exist.
 - iv. A Phase I Environmental Site Assessment (ESA) of the proposed subdivision Area completed in accordance with Canada Standards Association requirements. A Phase II ESA shall be required if recommended in the Phase I ESA report.
 - v. A Plan of the Floodplain and a letter outlining the recommended measures to ensure that the proposed subdivision and adjacent areas and subdivisions would not be exposed to flooding, where a major watercourse may affect the proposed site.
 - vi. Overall conceptual plans and description for the proposed subdivision 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.2.2** Additional to the submission requirements listed above, 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 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.2.3** 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 paleontological resources within or adjacent to the boundaries of the proposed subdivision.

B.3 PREREQUISITES TO REVIEW OF ENGINEERING DRAWINGS

- B.3.1** The Conceptual Subdivision Plan shall be approved by the Municipality prior to the submission of engineering drawings for review and approval.
- B.3.2** 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.3.3** The submission of drawings shall be accompanied by all supporting documents, reports, studies, calculations or any other information as required by the Municipality.

B.4 ENGINEERING DRAWING SUBMISSION AND APPROVAL PROCEDURE

- B.4.1** The Developer shall submit complete engineering drawings a minimum eight (8) weeks prior to the commencement of construction. The Municipality is not responsible for any delay of approval if submissions are incomplete or found to contain excessive errors or omissions.
- B.4.2** 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.4.3** The Municipality shall respond to the Developer's initial submissions within four (4) weeks and return one (1) set of drawings and specifications to the Developer with comments for revision.
- B.4.4** 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 three (3) copies of specifications and one (1) digital copy to the Municipality for approval, along with any additional information as required by the Municipal Engineer.
- B.4.5** Upon receipt of revised drawings satisfactory to the Municipal Engineer, the Municipality shall return one (1) complete set of approved drawings to the Developer with a stamp of "Approved for Construction".
- B.4.6** The Developer shall not proceed with construction until the engineering drawings have been approved for construction.
- B.4.7** The Municipality's Approval for Construction shall not relieve the Developer's or its Consulting Engineer's from the responsibility for the adequacy of the designs or the liability arising thereof.

B.5 REQUIREMENTS AND STANDARDS FOR ENGINEERING DRAWINGS

B.5.1 All drawing shall include a suitable title block, identifying:

- i. The Developer's name,
- ii. The Developer's Consulting Engineer's name,
- iii. The proposed subdivision title, including staging and/or phasing,
- iv. Drawing title,
- v. Drawing number and job number if applicable,
- vi. Revision number and description,
- vii. Horizontal and vertical scales,
- viii. Space for signature of the designer, draftsman, checker and approving authority,
- ix. Space for the number, date, description, designer and approving authority for all revisions and drawings issued including preliminary, approval, tender, construction and record drawings,
- x. Space for professional stamps, permit stamps and preliminary acceptance for construction stamp,
- xi. Date issued,
- xii. Legend,
- xiii. Notes.

B.5.2 All dimensions shall be given from an iron pin, lot line, chainage station, a center line or any other reference that can be readily established. All dimensions and elevations shall be in the System International (metric).

B.5.3 All elevations shall be relative to a Geodetic Datum, with all reference benchmarks and elevations clearly identified on the drawing. Benchmark numbers, locations and elevations may be obtained from the Municipality.

B.5.4 All lettering shall be a minimum of 2 mm high.

B.5.5 All abbreviations and drawing symbols used in the engineering drawings shall be consistent with drawings standards provided by the Municipality.

B.5.6 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.5.7 The engineering drawings shall include:

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

- ii. Topography and Land Use Plan, scale 1:1000, indicating the existing contours at 0.5 m intervals and the proposed land uses.
- iii. Overall Plan, scale 1:1000, indicating:
 - a. Roads, sidewalks and walkways;
 - b. Sanitary sewer, storm sewer and watermains;
 - c. Franchise utilities;
 - d. Overland drainage plan;
 - e. Lot grading plan and Municipal addresses;
 - f. Proposed location of driveways in order to eliminate conflicts with services.
- iv. Lot Grading Plan, scale 1:1000, indicating:
 - a. Legal base plan including easements;
 - b. Original ground contours at 1 m intervals;
 - c. Direction of proposed drainage. Minimum rough site grading requirements to be completed by the Developer's Consulting Engineer. 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;
 - d. Municipal addresses;
 - e. Proposed lot corners elevations (top of curb) and finished building grades and sewer services invert elevations;
 - f. Any lots built up with fill. Lots with disturbed soil and areas with known unsuitable soil shall be indicated.
- v. Roadway Plans and Profiles, scale 1:500 horizontal and 1:50 vertical, indicating:
 - a. Whole site plan and proposed roadway system and all rights-of-way, walks, lanes, roadway widths and alignments, approaches and horizontal and vertical curves data;
 - b. Original and proposed ground profiles and chainage;
 - c. Access onto existing roadway system;
 - d. Roadway names where required, both existing and proposed;
 - e. Roadway traffic signing;
 - f. Sidewalks, curbs and walkways with proposed top of curb elevations;
 - g. Utilities easements with rights-of-way dimensions, lot configuration and elevations of shallow utilities at road crossings;
 - h. Proposed pavement structure;

- i. Drainage features including waterways, lakes, ponds, canals, swales, ditches and culverts, noting direction of flows and proposed catch basin locations and inlet elevations;
 - j. Profile chainage must be aligned with the plan view.
- vi. Overland Drainage Plan, scale 1:1000, indicating:
 - a. Legal base plan including easements;
 - b. Original contours at 1 m intervals;
 - c. Proposed roadway system;
 - d. Drainage easements;
 - e. Proposed retention ponds;
 - f. Culverts;
 - g. Major drainage system;
 - h. Proposed site grading contours and elevations;
 - i. Direction of proposed drainage.
- vii. Sanitary Sewer, Storm Sewer and Watermain Plans and Profiles, scale 1:500 horizontal and 1:50 vertical, indicating:
 - a. Legal base plan;
 - b. Easements and rights-of-way, streets and lanes, alignments, sizes and separation distances between each utility;
 - c. Plans showing pipe sizes, location of manholes, catch basins, hydrants, valves, fittings and other appurtenances;
 - d. Profiles showing pipe sizes and materials, length of pipe, manhole invert elevations, grades between manholes and class of pipe cover and bedding;
 - b. Service to each lot, including inspection chambers and invert elevations at property line;
 - c. Special details, such as inverted siphons, weirs, protection for high velocities, elevations of oil and gas pipeline crossings, etc;
 - d. Off-site connections;
 - e. Profile chainage must be aligned with the plan view.
- viii. Pavement Marking and Signage Plan, scale 1:1000, indicating pavement marking and proposed signage locations and specifications.
- ix. Utilities Overall Plan, scale 1:1000, indicating gas, power, telephone, television and other underground utilities locations and easements, including drawings for crossing permits for any oil, power, gas or other transmission lines or railways.

- x. 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.5.8 Details and typical details shall include:

- i. Standard detail drawings may include typical road cross-sections, trenching details, pipe bedding, valves, hydrants, pavement structure, etc. The details shall be included on a standard A-1 size sheet or may be bound into project specifications on a standard letter size (8^{1/2}” x 11”) sheets. The scale of individual details will be commensurate with the amount of information to be shown, along with clarity and legibility.
- ii. A minimum of one (1) typical roadway cross-section shall be included within the standard detail drawings. Additional cross-sections shall be provided for roadway sections requiring over 1 m of cut or 2 m of fill. Details on the cross sections shall include:
 - a. Width of right-of-way;
 - b. Finished width of roadway surface;
 - c. Width of sub-grade;
 - d. Slope ratios of side slope and back slope;
 - e. Curb & Gutter and moonwalk structures;
 - f. Depth of ditches;
 - g. Surface crown slope;
 - h. Pavement structure details including depth, class, designation and grade of materials.

B.6 REPORTS AND STUDIES

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

- i. Geotechnical and Hydrogeological reports to identify:
 - a. 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;
 - b. Proposed pavement structure based on in-situ conditions and projected traffic volume. A 20-year structure designed by a Professional Engineer shall be required;

- c. Construction methodologies and procedures for trenching and backfilling operations for proposed underground infrastructure, storm water drainage facilities and service requirements for proposed private servicing and building foundations.
- ii. Engineering design brief including design calculations and analysis of proposed municipal improvements.
- iii. An Environmental Impact Assessment may be required for the proposed subdivision depending on the circumstances.

B.7 RECORD (AS-CONSTRUCTED) DRAWINGS

- B.7.1** Within two (2) months following the issuance of the Construction Completion Certificate, the Developer shall submit two (2) complete sets of record (as-constructed) drawings for review. The plans shall show the “as-constructed” locations, profiles and details of the constructed utilities and surface improvements. All record drawings must be received by the Municipality prior to issuance of a Final Acceptance Certificate. Once the drawings are approved, the Developer shall submit two (2) bound sets of drawings, and the digital files.
- B.7.2** All drawings shall indicate “Record” and shall be stamped, signed, sealed and dated by the Developer’s Consulting Engineer.
- B.7.3** The digital files shall be in AutoCAD R12/later format and PDF format. Digital files must be geo-referenced to NAD83. This method of data storage is preferred by the Municipality. Digital files specifications are to be confirmed with the Municipality.
- B.7.4** Record drawings must contain, at a minimum, the information contained on the project design drawings. Record drawings shall also include:
 - i. Name of the Contractor responsible for construction;
 - ii. Construction completion dates of all work noted on each plan and profile;
 - iii. Dates on which record details were added to the drawing;
 - iv. Any revisions made to construction drawings to create record plans made on all plans that indicate the area of the revision (i.e. revisions shown on detail plans and profiles, will be shown also on overlapping detail drawings where they appear, as well as on the composite plan);
 - v. All pipes, hydrants, valves, plugs, bends, crosses, tees, reducers, manholes and other fittings dimensioned in two directions and detailed description of all fittings. Fittings shall be appropriately numbered and identified according to the Municipality’s numbering system;

- vi. All roadways shall be identified according to the name or number shown on the registered plan of that particular subdivision. Lanes shown on detail plans where there is no identifying roadway name shown on the detail, shall be identified as the lane east or west of a street, or as the lane north or south of an avenue, (i.e. L.W. 103 Street and/or L.N. 99 Avenue).

B.8 ABBREVIATIONS

The following are the terms and their applicable abbreviations accepted by the Municipality for the engineering drawings:

Term	Abbreviation
Access Manhole	AMH
Abandoned	Ab
Adapter	Ad
Asphaltic Concrete Pavement	ACP
Asphaltic Stabilized Base Course	ASBC
Begin Horizontal Curve	BC
Begin Vertical Curve	BVC
Bench Mark	BM
Block	Blk.
Cast Iron	CI
Catch Basin	CB
Catch Basin Lead	CB Lead
Catch Basin Manhole	CBMH
Center Line	☉
Class	Cl.
Concrete	Conc.
Copper	Cu
Corrugated Steel Pipe	CSP
Curb Cock	CC
Curb Face	CF
Deflection Angle	DA
Degree of Curve	D of C
East Property Line	EPL
Elevation	Elev.
End Horizontal Curve	EC
End Vertical Curve	EVC
Horizontal	Hor.
Hydrant	Hyd.
Invert	Inv.
Iron Pin	I.P.
Length of Curve	LC
Main Stop	MS

Manhole	MH
North Property Line	NPL
Not to Scale	NTS
Point of Intersection	PI
Point of Intersection Vertical Curve	PIVC
Polyvinyl Chloride	PVC
Pressure Reducing Valve	PRV
Property Line	PL
Radius	R
Right-of-way	R.O.W.
Sanitary	San.
South Property Line	SPL
Sprinkler	Spr.
Station	Sta.
Steel	Stl.
Storm	ST.
Street	St.
Survey Monument	SM
Tangent	Tan.
Tapping Valve & Sleeve	TVS
Test Hole	TH
Vertical	Vert.
Vertical Curve	VC
Vitrified Clay Tile	VCT
West Property Line	WPL

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 general guidelines outlining the level of service for a particular subdivision 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 subdivision is subject to review by the Municipality. The Municipality reserves the right to require a higher level of service for any particular subdivision.
- 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 subdivision. 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 requirements of these Standards, all regulations and conditions required by the Provincial and Federal referenced legislation and documents, the Municipality Bylaws and other applicable documents.
- C.1.5** Should the need arise where any of the referenced standards cannot be met, a written request describing the variance complete with supporting documentation shall be forwarded by the Developer to the Municipal Engineer for review. The request shall be reviewed and a written reply returned to the Developer with the final decision.

C.2 LAND USE DISTRICTS

All lands within the Municipality are divided into Zones. The proposed subdivision shall have proper reference to a zone classification according to the Municipality Land Use Bylaw.

C.3 LEVEL OF SERVICE

C.3.1 Roadways

- i. The Developer's Consulting Engineer shall be responsible for determining an estimated Annual Average Daily Traffic (AADT) generated by the proposed subdivision 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 roadways and their classifications approved for use within the Municipality.
- ii. The standard roadway cross sections included in Section G are as follows:
 - a. Access Road (7 m wide of gravel surface)
 - b. Rural Road (8 m wide of gravel surface)
 - c. Local Road (8 m wide of gravel surface)
 - d. Collector Road (9 m or 10 m wide of gravel surface)
 - e. Paved Local Road (8 m wide asphalt concrete cement)
 - f. Arterial Road (9 m wide asphalt concrete cement)
 - g. Arterial Road (9 m, 10 m or 11 m wide of asphaltic concrete cement)
 - h. Urban Road (9 m or 11.5 m wide of asphalt concrete cement)

The minimum roadway cross sectional requirements for individual land use classifications have been selected from the above list.

C.3.2 Water Systems

The proposed subdivisions may require one of the following types of water distribution systems:

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

- ii. Piped water distribution systems:
 - a. 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 type, size and layout of the proposed subdivision as well as the existing infrastructure in the area.
 - b. All piped systems shall be designed and installed according to standards outlined in this document. Additionally, other applicable standards include:
 - ✓ American Water Works Association Standards
 - ✓ Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems
 - ✓ Fire Underwriters Survey
 - ✓ Water Supply for Public Fire Protection

C.3.3 Sanitary

The proposed subdivisions may require one of the following types of sanitary sewer systems:

- i. Private sanitary sewer system (residential):
 - a. 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.
 - b. Private sanitary sewer systems shall be designed and installed in accordance with the Private Sewage Disposal System Regulation (Alberta Regulation 264/2009), Alberta Private Sewage System Standard of Practice (2009) and Canadian Plumbing Code.
 - c. 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.
- ii. Private sanitary sewer systems (non-residential):

Private non-residential sanitary sewer disposal system that is expected to receive more than 5.68 m³ of sewage per day shall be designed by a qualified Professional Engineer.

iii. 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 subdivision, 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

- i. 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 with no surface drainage. Under any circumstances, overland drainage will not be accepted for an urban type subdivision. Rural cross sections shall employ an overland drainage system consisting of ditches and swales.
- ii. 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.
- iii. It is the Developer's responsibility to construct rough grades to ensure that all storm water is properly directed and managed regardless of the stage of subdivision on either public or private property.

C.4 UNAUTHORIZED USE

- C.4.1** Unauthorized use is when a private person or a corporation accesses public or private property with encroachment, construction, storage, landscaping or removal of anything on, over or in public property without written approval of the Municipality.
- C.4.2** Unauthorized use can result in public safety issues, limit public access or use of public or private property, prevent maintenance or operation from occurring and damage natural environment.
- C.4.3** 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 or private property to ensure the public safety and to protect natural areas and ecosystems.
- C.4.4** The Municipality shall notify and work with unauthorized users of public or private property on a case by case basis providing an explanation of unauthorized use and detail what corrective measures must be completed.

C.4.5 Non-compliance with 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 Consulting 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 Consulting Engineer.
- D.1.2** The current Standards and Specifications 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
 - ✓ Environmental Protection and Enhancement Act
 - ✓ Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems as published by Alberta Environment.
- D.1.3** The specific requirements of the water distribution system will depend on whether the subdivision is defined as a rural or urban. Regardless, the intent of the water distribution system design and installation is to properly distribute potable water throughout the subdivision, including appropriate supply and treatment systems as required. The supply, treatment and distribution systems are to be approved by the Municipality and must meet these Standards.
- D.1.4** The Developer is responsible to confirm adequate capacity in any existing system to be extended into the subdivision area, if such information is not readily available from the system owner.
- D.1.5** Generally, rural systems will involve individual wells or holding tanks on each lot. Suitability of an aquifer to sustain the subdivision demand with no adverse impact on existing wells is to be evaluated in the Geotechnical / Hydrogeological Report for the proposed subdivision.

- D.1.6** Where the Developer's proposal includes a high-pressure existing pipeline crossing or other such crossings he shall be fully responsible for the preparation and submission of drawings to the pipeline owner(s) and/or proper authorities and for obtaining the necessary permission to enter upon, cross over, or construct in the vicinity of any gas or oil transmission lines or other structures. The Developer shall bear the full responsibility for any works, extra costs, damage claims or insurance costs related to any of the above mentioned crossings. The Developer shall also submit documentary evidence that such permits have been obtained at the time of his initial submission of drawings to the Municipality.
- D.1.7** The Developer shall be responsible for obtaining the registration of all features of this water system with Alberta Environment.
- D.1.8** The Developer shall be responsible for obtaining any necessary construction permits, approvals or registrations from Alberta Environment as required by the Environmental Protection and Enhancement Act.

D.2 DESIGN REQUIREMENTS FOR URBAN WATER DISTRIBUTION SYSTEMS

- D.2.1** The following are the minimum flow requirements for the proposed water distribution system:
- i. Population density (residential) - 3.5 persons/residence
 - ii. Average daily demand (ADD) - 320 L/person/day
 - iii. Peak daily demand - 2 x average demand
 - iv. Peak hourly demand - 4 x average demand
 - v. Minimum residual water pressure during peak hour flow - 280 kPa (40.6 psi)
 - vi. Minimum residual water pressure during maximum day + fire flow - 150 kPa (21.8 psi)
 - vii. Minimum residual water pressure during maximum day flow (for operation of residential fire sprinklers) - 350 kPa (50.8 psi)
- D.2.2** The minimum size of distribution watermain shall be 150 mm nominal diameter for residential subdivisions and 200 mm nominal diameter for industrial subdivisions where fire hydrants are to be installed. Smaller diameter mains may be considered where only domestic flow is being provided based upon detailed analysis being provided by the Consulting Engineer. Pipe diameters shall be large enough to provide an adequate flow of water to commercial areas or to areas beyond the subdivided area.

D.2.3 Polyvinyl chloride (PVC) pipe is the preferred option for all watermains. If required by the Municipality, sizing of watermains shall be determined by hydraulic network analysis. Results shall be submitted to the Municipal Engineer for review and approval. The minimum diameters of distribution mains shall be as follows (in certain situations, different sizes of watermains may be required by the Municipality):

- i. 150 mm diameter for single family residential subdivisions
- ii. 200 mm diameter for multi-family subdivisions
- iii. 250 mm diameter for industrial or commercial subdivisions
- iv. 150 mm diameter for cul-de-sacs (requires approval from the Municipality)

D.2.4 Lines must be sized to accommodate the anticipated land use. Where watermains run for 200 m or more without ties to other watermains, the minimum pipe diameter shall be 200 mm. For lengths of pipe containing two or more fire hydrant connections without ties to other watermains the minimum pipe diameter shall be 200 mm. The maximum velocity under normal operating conditions shall not exceed 3.0 m/sec.

D.2.5 New subdivisions shall be designed and constructed such that all watermains within the proposed subdivision are looped, except where the service into a cul-de-sac is less than 120 m or less than 20 residential lots are being serviced.

D.2.6 The Hazen-Williams equation shall be used for hydraulic calculations involving pressure pipe systems. The equation is as follows (for System International units):

$$V = 0.85 C R^{0.63} S^{0.54}$$

Where: V = velocity of flow (m/sec)

C = 140 (for PVC pipe)

R = hydraulic radius (m)

S = slope of energy gradient (m/m of length)

D.2.7 Fire Flow

- i. 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 subdivisions outside of the hamlet areas that have fire flow rates are to have fire flow rates maintained.
 - a. Fire flow requirements shall be in accordance with the Alberta Building Code, NFPA 1231 Standards and with the Insurer's Advisory Organization Standards, and generally these are:

- Single family residential - 3.64 m³/min
 - Town houses - 5.45 m³/min
 - Walk-up apartments - 9.10 m³/min
 - Schools - 5.45 m³/min
 - Commercial - 11.40 m³/min
 - Industrial - 13.64 m³/min
- b. The Developer shall design the proposed piped water distribution system in a manner that the system capacity can meet the fire flow requirements to cover, if required, existing and future developed off-site infrastructure. The minimum pipe size required will be 150 mm. Hydraulic analysis will be required to determine whether there is enough flow and pressure in the system to accommodate fire hydrants.
- ii. Consideration shall be given to maintaining the required fire flow with a supply main cut off for repair. A supply main cut off for repair should not drastically reduce flow to any area. Industries that require greater rates of flow than can be provided by the distribution system may be required to install storage and pumping facilities adequate for their needs.
- iii. For industrial areas, pipes shall be sized to provide the required fire flow and pressures recommended by the Canadian Underwriters Association for the type of proposed subdivision in industrial subdivisions. The minimum fire flow shall be 150 L/sec (2000 igpm) for low fire load areas.
- iv. Where the municipal system is capable of providing 75 L/sec (1000 igpm) at the boundary of the proposed subdivision, the water system extension shall be designed to produce a minimum of 75 L/sec (1000 igpm) fire flow in residential areas with a minimum residual pressure of 140 kPa at the hydrant from which the water is being taken. A lesser fire flow of 38 L/sec (500 igpm) may be acceptable to the Municipality if, upon their review, it is determined that the higher flow rate is impracticable.
- v. Automatic sprinkler protection conforming to NFPA 13 Standards is encouraged for all subdivisions if the minimum flow and residual pressure requirements can be met.
- vi. Where required by the current National Building Code and Alberta Building Code, the Developer and the Developer's Consulting Engineer shall design dedicated self contained fire water storage and delivery systems in accordance with the Code and NFPA 1231 Standards for the subdivision type and occupancy.

- D.2.8** 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 residential, institutional, commercial and industrial demands, and should also consider required water demands for firefighting purposes.
- D.2.9** 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 of 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.2.10** 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.2.11** 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 watermains should be designed to withstand these surges.

D.3 WATERMAIN

D.3.1 Watermain Alignment and Location

- i. Watermain shall be located within the roadway right-of-way and outside the carriageway. Minimum depth of cover for the watermain shall be 2.8 m for both urban and rural subdivision.
- ii. Watermain shall be located a minimum of 3.0 m on center (o/c) from any sewer line, 1.5 m o/c from any catch basin and 1.8 m 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 1.0 m from any valve, hydrant or curb stop.
- iii. Public Utility Lot (PUL) widths shall be at least 4.0 m for a single utility and 6.0 m for two or more utilities.
- iv. In all cases a minimum distance of 1.0 m from the watermain to property line shall be maintained.

- v. The watermain shall have sufficient depth of cover to provide complete frost protection. Watermains shall be installed to provide a minimum depth of cover of 3.4 m from the top of pipe to finished surface grade.
- vi. Under normal conditions, efforts shall be made to pass watermain pipes above the sewer pipes providing sufficient clearance between the pipes to allow for proper bedding and structural support of the watermain pipes. Pipe clearance when passing above sewer shall be a minimum of 300 mm separation between the top of the sewer pipe and the bottom of the watermain pipe. Pipe clearance when passing under any sewer shall be a minimum of 500 mm separation between the bottom of the sewer pipe and the top of the watermain pipe.
- vii. The bottom of fire hydrant flanges shall be located 50 mm above finished grade. Invert depths at fire hydrant locations shall be 2.5 m below the top of curb.
- viii. 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 120 m.

D.3.2 Watermain Materials

- i. Approved piping materials include:
 - a. AWWA C900 PVC DR 18 or DR 14 (from 100 mm to 300 mm diameter)
 - b. AWWA C905 PVC DR25 (from 350 mm to 1200 mm diameter)
- ii. 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 (2) years old at the time of installation.
- iii. Water quality testing, record keeping and reporting standards shall be as required by Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems published by Alberta Environment.
- iv. Joint lubricants must be certified for potable water use in accordance with National Sanitation Foundation Standards.
- v. PVC pipes:
 - a. All pipe materials and fabrication shall conform to AWWA C900 or C905, as applicable.
 - b. PVC watermain from 100mm through 300 mm diameter shall be DR18, Class 150 (1035 kPa), PVC watermain from 450 mm through 900 mm diameter shall be DR25, Class 165 (1138 kPa).
 - c. PVC pipe shall be certified under CSA 137.3 and 137.0.
 - d. The pipe shall be supplied with integral wall thickened bell ends and jointless elastomeric gaskets conforming to ASTM F477.

- vi. Polyethylene pipes:
 - a. The use of polyethylene pipe requires prior approval in writing by the Municipal Engineer.
 - b. All pipe materials and fabrication shall conform to AWWA C901 or C906, as applicable and meet NSF 61 standards.
 - c. Polyethylene pipe shall conform to CSA B137.1 and ASTM F714, D3035, D3350.
 - d. Watermain shall be minimum HDPE DR11 (Series 100).
 - e. Moulded fittings shall conform to ASTM D2683 or D3261.
 - f. Fabricated fittings shall be manufactured from pipe of the same series as that used in the piping system.
 - g. Pipe shall be joined by thermal butt-fusion, electrofusion coupling, flange assemblies or compression type fittings.
 - h. Compression couplings shall be used with stainless steel inserts.
 - i. Couplers shall be Victaulic Type 995 for use with HDPE piping or approved equal.
 - j. Valves shall be cast iron gates valves with flanged connections.
 - k. 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.
- vii. Pipe casing:
 - a. Steel pipe casings are to conform to AWWA C200, minimum tensile strength of 207 MPa.
 - b. Inside diameter of casing shall be at least 50 mm larger than the outside diameter of the carrier pipe bell and insulator runners.
 - c. Plastic/polyethylene carrier pipe insulators shall be used.

D.4 WATER SERVICE CONNECTIONS

D.4.1 Water Services Alignment and Location

- i. Separate water service connections shall be provided for:
 - a. each separately titled lot, and
 - b. each family dwelling in a multi-family subdivision, such as apartment building.

- ii. Minimum service diameter shall be 25 mm where the service length is 30 m or less. Where service lengths exceed 30 m, the minimum service diameter shall be 38 mm.
- iii. Non-residential service connections shall be sized according to anticipated demand.
- iv. Connections for all water services shall be installed at the time of initial subdivision development.
- v. Curb stops shall be located such that they do not conflict with driveway locations and shall not be placed within concrete sidewalks or driveways.
- vi. For trailer parks or other lots where a split into multiple separate users is present, a separate service line with metering chamber 1.5 m inside the property line is required for each lot/user.
- vii. A 3.5 m utility easement is required to be registered on all lots at the subdivision stage.
- viii. 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.
- ix. The minimum allowable distance between watermain stops shall be 600 mm and the minimum allowable distance between watermain stops and an adjacent collar or coupling shall be 300 mm.

D.4.2 Water Services Materials

- i. 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. Same curb stops can be used when using either of specified service pipe except for end fittings.
- ii. Minimum service diameter shall be 25 mm for main stops, piping and curb cocks where the service length is 30 m or less. Where service lengths exceed 30 m, the minimum service diameter shall be 38 mm.
- iii. For water services 100 mm in diameter and larger, pipes, fittings and valves shall be matched to main pipe materials.
- iv. Corporation main stops, service saddles, curb cocks, stop cocks, drain cocks, service boxes and couplings shall be according to these Standards. Compression connections with stainless steel inserts are required for all materials.
- v. All fittings shall be designed for an operating pressure of 1035 kPa.

- vi. 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.
- vii. 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. Electrofusion saddles shall be allowed on HDPE pipe.
- viii. Operating rods shall be Type 304 stainless steel with brass cotter pins and brass clevis.

D.5 VALVES

D.5.1 Valves Location and Spacing

- i. The location and spacing of valves shall be such that when the system is in operation the following requirements are met:
 - a. No more than one fire hydrant will be put out of service by a watermain shutdown,
 - b. No more than three valves are required to affect a shutdown,
 - c. No more than twenty residential lots or units are out of service due to a watermain shutdown.
 - d. A valve(s) shall be installed at the end of any waterline which runs through the proposed subdivision to provide a connection points(s) to a future subdivisions, in a manner that there will be no interruptions of water supply to the existing subdivision.
- ii. All valves shall be set in a vertical position and valve boxes must be adjustable. The top of valve boxes are to be set to grade in unpaved areas and 5 mm below grade within paved areas.
- iii. Valves should be no greater than 800 m apart on lines 450 mm in diameter and larger.
- iv. Valves shall be located on the projection of the property lines or at the beginning of curb returns at intersections.
 - v. Valves shall be located at both ends of a watermain passing through a utility lot or easement and shall be placed 500 mm from the property line.
- vi. Blow off valves (min. 50 mm) must be installed at the end of all dead end lines.
- vii. Valves shall be the same size as the corresponding main.
- viii. Gate valves on the distribution watermains shall be installed:
 - a. At the projection of property lines at mid-block,
 - b. At the projection of property lines at intersections.

D.5.2 Valve Materials

- i. 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.
- ii. All valves shall be provided with stainless steel bolts.
- iii. Operating nuts shall be located at depth 2 - 3 m below ground surface without rock shields on all valves.
- iv. 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.
- v. Gate valves for buried service (100 mm – 300 mm):
 - a. Operating pressure shall be 1035 kPa.
 - b. Gate valves shall conform to AWWA C500 for bronze mounted solid wedge valves or C509 for resilient seated valves.
 - c. 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. Provide “O” ring seal for valve stem.
 - e. Provide 50 mm square operating nut turning clockwise to close.
 - f. Interior to be factory epoxy coated conforming to AWWA C550. Corrosion protection to be provided by installation of a zinc sacrificial anode.
 - g. Cast iron valve casing conforming to ASTM A48, Class 25, sliding type with epoxy coating conforming to AWWA C213. PVC valve casing shall be allowed. Screw type versus slide type valve casings shall be determined by the Developer’s Engineer and approved by the Municipality.
 - h. For blow offs valves to be flanged to AWWA C207, Class D.
- vi. Gate valves in chambers (450 mm – 1500 mm):

Must conform to same standards as above, in addition, 50 mm square operating nut shall be provided with hand wheel, horizontal setting, bevel gears, and position indicator. By-pass with gate valve to equalize pressure on opening and closing main valve shall be also provided.
- vii. Butterfly valves in chambers (450 mm and larger):
 - a. All butterfly valves shall conform to AWWA C504, Class 150B, short body flanged, and wafer or fully lugged cast iron body, rubber seat, and bronze disk.
 - b. Provide removable “O” ring shaft seals.

- c. Provide manual geared buried service actuator conforming to AWWA C504.
 - d. Screw type versus slide type valve casings shall be determined by the Developer's Engineer and approved by the Municipality.
 - e. Exterior and interior factor applied epoxy coating conforming to AWWA C550. Corrosion protection to be provided by installation of a zinc sacrificial anode.
- viii. Check valves:
- a. Swing check valves shall only be used for sizes 300 mm and smaller conforming to AWWA C508, cast iron body, bronze trimmed cast iron disk, flanged end to ANSI B16.1, bronze seat rings (minimum 1035 kPa working pressure).
 - b. Slanting disc check valves shall be used for sizes 300 mm 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 1035 kPa working pressure).
 - c. Double door check valves shall have a cast iron body to ASTM A126, aluminum 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 1035 kPa working pressure).
 - d. 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, and ANSI 125 flanges (minimum 1035 kPa working pressure).
 - e. Rubber flapper check valves shall have a cast iron body, rubber lined Buna N replaceable flapper, and "O" ring seating (minimum 1035 kPa working pressure).
- ix. Pressure reducing valves:
- a. Valves 200 mm and smaller shall be of single diaphragm type. Valves 250 mm and larger shall be double diaphragm type.
 - b. 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.
- x. Flow control valves:
- a. Valves shall be diaphragm type, globe or angle style with cast iron body and bronze trim for pipe size less than or equal to 150 mm.
 - b. Provide an "O" ring seat seal on main valve and strainer and needle valve on pilot inlet lines.

- c. Gate valves shall be used for pipe size over 150 mm with cast iron body and bronze trim.
- xi. Air valves:

All air valves shall conform to AWWA C512 with minimum working pressure shall be 1035 kPa. Valve body and other materials will be determined by the developer's Engineer and approved by the Municipality.
- xii. Valve boxes:
 - a. Valve boxes shall be two sections, bituminous coated, Type A, cast iron adjustable type complete with a cast iron lid. An internal operating rod is not required.
 - b. Valve boxes shall be of sufficient length to provide for adjustments of up to 300 mm in the up or down directions.
 - c. Valve box extensions shall be cast iron, suitable for use with the valve boxes to be installed.
 - d. All valve boxes located in roads shall be left flush with the base course asphalt or gravel. Immediately prior to the final lift of asphalt or gravel, the valve boxes shall be raised so that they are flush with the final grade elevation of the road.

D.6 FIRE HYDRANTS

D.6.1 Fire Hydrants Location and Spacing

- i. The maximum spacing between fire hydrants shall be 160 m for residential areas and 120 m for school, industrial or commercial areas, no greater than 75 m from any building. Additional fire hydrants shall be installed in high value property areas if deemed necessary by the Municipality.
- ii. Fire hydrants shall be located at the projection of the property lines or at the beginning of curb returns at intersections.
- iii. For cul-de-sacs, the fire hydrant shall be located at the end of cul-de-sac.
- iv. Fire hydrants shall conform with curb and sidewalk designs and shall be located as follows:
 - a. Areas with no sidewalk - hydrant to be no more than 2 m from back of curb.
 - b. Areas with monolithic sidewalk - hydrant to be no more than 0.75 m from back of walk.
 - c. Areas with separate sidewalk - hydrant to be no less than 1 m and no more than 1.8 m from back of curb.
 - d. Hydrants shall be no closer than 0.3 m and no more than 3 m from back of curb.

- v. Fire hydrants shall be set plumb with the larger pumper nozzle at right angles (90°) to the road alignment. The bottom of ground flanges shall be set to an elevation 50 mm above finished grade. Fire hydrants shall be located to provide complete accessibility and to minimize possibility of damage from vehicles or injury to pedestrians. Unless otherwise approved in writing by the Municipality, the location of the hydrant shall conform to the Approved Plans.
- vi. Fire hydrants shall be located 1.5 m from the curb face when there is no walkway and 2.7 m from the curb face when walkway exists.
- vii. Fire hydrant shall be connected to the watermain with a 150 mm maximum diameter PVC lead controlled by an independent 150 mm gate valve located at least 1 m apart from the fire hydrant. All underground fittings, bolts and nuts will be Stainless steel and wrapped with Denso wrap.
- viii. Fire hydrants within commercial or industrial subdivisions 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.6.2 Fire Hydrants Materials

- i. All fire hydrants shall be Canada Valve fire hydrants with the pumper nozzle being a stortz nozzle, unless otherwise approved by the Municipality. No obstructions shall be permitted which would impede the Fire Department access or proper function of the fire hydrant.
- ii. All fire hydrants shall be certified to NSF Standard 61 – Drinking Water System Components: Health Effects and Standard 14 – Plastics and Plumbing System Components.
- iii. Compression type fire hydrants shall be supplied conforming to AWWA C502 for dry barrel fire hydrants.
- iv. Fire hydrants shall be designed for 1035 kPa working pressure.
- v. Fire hydrants shall be self-draining and a gravel drainage pit shall be provided on each fire hydrant lead. Where the fire hydrant lead is located below the water table, the fire hydrant drain port shall not be plugged, unless otherwise requested by the Municipality. The Municipality shall be notified of any fire hydrants with plugged drain ports. The record drawings shall clearly indicate each plugged fire hydrant.
- vi. Fire hydrants shall have one steamer port, facing the roadway, with a 125 mm stortz connection, and two 65 mm connections with Alberta Mutual Aid thread at least 415 mm 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 fire hydrant valve shall open counter-clockwise.
- vii. Fire hydrants shall consist of a minimum 2.45 m barrel with 300 mm extension.

- viii. Fire hydrants shall have a 150 mm cast iron inside diameter inlet elbow with bell end and harnessing lugs. Elbow shall be flanged to the barrel.
- ix. Valve stem in fire hydrant head to have “O” ring seals.
- x. Operating nut shall be either three or five sided, or as approved by the Municipality.
- xi. Fire hydrants shall have stainless steel bolt assemblies throughout.
- xii. External paint shall conform to AWWA C550 (Corrosion Resistant) and be the following colours:
 - a. Barrel – yellow as approved by the Municipality.
 - b. 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.7 FITTINGS

D.7.1 All fittings shall be coated cast iron conforming to AWWA C110 or PVC injection moulded conforming to CSA 137B with compatible rubber joints and belled ends for the pipe or as otherwise approved by the Municipality.

D.7.2 PVC fittings:

- i. Injection moulded fittings shall conform to AWWA C907 and CSA B137.2.
- ii. Extruded fittings shall conform to AWWA C900 and CSA B137.3.
- iii. 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.7.3 Thrust blocks:

Thrust blocks shall be installed at all locations where there is a bend or a joint of pipes or a fitting. Thrust blocks shall be installed between solid ground and the bend, joint or fitting and shall be anchored so that the pipe and fitting joints are accessible for repair. Metal harnesses or corrosive resistant tie rods and pipe clamps shall be used to prevent movement when requested by the Municipality. Please also refer to the applicable drawings for more details.

D.8 COUPLINGS AND ADAPTORS

- D.8.1** PVC couplings shall conform to AWWA C900, C906, or C907 as applicable.
- D.8.2** Bolted sleeve couplings shall conform to AWWA C219 with carbon steel bodies with epoxy coating conforming to AWWA C213 or AWWA C550 as applicable. Couplings shall have a minimum operating pressure of 1035 kPa. Linings shall be in accordance with AWWA C210, C213 or C550 and be suitable for use with potable water.
- D.8.3** Flange adaptors shall conform to AWWA C219 with carbon steel bodies with epoxy coating conforming to AWWA C210, C213 or C550 as applicable. The minimum operating pressure shall be 1035 kPa. 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.8.4** Couplings for grooved and shouldered joints shall conform to AWWA C606 and shall have operating pressures, coatings and linings as above.

D.9 TAPPING SLEEVES

- D.9.1** Tapping sleeves shall conform to AWWA C207, Class D with carbon steel body with fusion bonded epoxy coating or Type 304 stainless steel.
- D.9.2** 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.10 METERS

- D.10.1** The Municipality utilizes Sensus or Master meters. All water meters shall conform to AWWA C700, C701 and C710. Meters are provided by the Municipality and the Developer shall be billed.
- D.10.2** Meter chambers are required for trailer parks and other similar types of subdivisions. The meter chambers shall be water tight and frost-free manhole type.
- D.10.3** The meter box shall be Mueller/McCullough Thermal-Coil or approved equal.
- D.10.4** Chamber shall be 380 mm diameter PVC SDR 35 with a 3 m bury.
- D.10.5** Chamber shall be insulated on the sides with 50 mm 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 equivalent. The top shall be insulated with 100 mm factory supplied insulation.

D.11 CATHODIC PROTECTION

- D.11.1** All buried metallic fittings and valves shall be cathode protected with 2.3 kg zinc anodes and all fire hydrants shall be cathode protected with a 5.5 kg zinc anode. Zinc anodes shall conform to ASTM B418-73 Type II.
- D.11.2** All old steel, cast iron, or ductile iron being connected to must have at least two 7.7 kg magnesium anodes at point of connection as specified by the Engineer.
- D.11.3** Lead wires shall be No. 10A WG/7 and be 2 m in length. Wire shall be connected to fittings, valves, and hydrants with cadwelds.
- D.11.4** A minimum of 3 litres of water shall be poured on each anode to initiate the galvanic reaction.

D.12 GENERAL MATERIAL REQUIREMENTS

- D.12.1** Unless specified with better material accepted by the Municipal Engineer, all underground water retaining structure and associated structures (valve chambers, pump chambers, etc.) shall be designed against frost and sulphate attack (ASTM Type V) and it shall conform to ACI 350R – 89 "Environmental Engineering of Concrete Structure" and to CSA A23.1. Concrete Grade 30 shall be used and tested in accordance with CSA 23.2.
- D.12.2** Minimum of 100 mm thick bedding of granular material (gravels or sand, with no particles larger than 32 mm) must be placed and compacted to form a leveling bed for the aforesaid structures.

D.13 CONSTRUCTION**D.13.1 Trenching, Bedding and Backfilling**

- i. All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.
- ii. 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.

- iii. Granular materials shall be well graded and approved by the Municipality before use. 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 100 mm below the pipe and shall extend up both sides to the trench wall and provide a minimum cover of 300 mm above the pipe. Where necessary, the Developer’s Consulting Engineer shall determine special pipe foundation measures for areas where unsuitable pipe foundation conditions exist. Bedding sand bedding sand must be clean and meet the following requirements:

Sieve Size Passing	% Passing, By Mass
2,500	100
630	60 or more
315	30 or less
160	20 or less

- iv. The minimum trench width measured at the pipe spring line shall be the pipe outside diameter plus 450 mm. The maximum trench width measured at the pipe spring line shall be the pipe outside diameter plus 600 mm. The Municipal Engineer must be notified and consulted with if the trench must be excavated deeper or wider than specified.
- v. Excavated material shall be stockpiled at a safe distance from the edge of the trench. Backfill material shall be the soil excavated from the trench although approved granular materials may be substituted for poor existing soils. All backfill material will be subject to approval by the Municipality. If possible, the excavated material shall be placed back in the trench in the vertical and horizontal order in which it was excavated. Backfill shall be placed in uniform lifts not exceeding 300 mm loose thickness. Where clay is used as backfill material, its moisture content shall not exceed the Plastic Limit by more than ten percent (10%).
- vi. Within roadways, under no circumstances shall backfill material containing ice, snow, organic or any other deleterious material be used. Trench excavations shall be kept free of water.
- vii. Compaction and densities.
- a. Prior to street construction: all excavations under proposed carriageways, sidewalks, street lights or other similar surface structures shall be backfilled in lifts with compacted thickness of 300 mm or less per lift and compacted to minimum density of not less than 98 % of the Maximum Standard Proctor Density or as otherwise approved by the Municipality. A minimum of two (2) density tests per 100 lineal meters of trench per 600 mm of compacted backfill thickness shall be taken. Additional tests may be called for as deemed necessary. Any free water in a trench shall be removed prior to placing additional lifts.

- b. Under existing carriageways: all excavations under existing carriageways, sidewalks, lanes or other similar surface structures shall be backfilled to meet the following specifications:
 - 300 mm or more below final grade – backfill materials shall be compacted to minimum density of not less than 98 % of the Maximum Standard Proctor density.
 - 0 - 300 mm below final grade – backfill materials shall be compacted to a minimum of 100 % of the Maximum Standard Proctor Density and based on a minimum of two (2) field tests per 100 lineal meters of trench of compacted backfill. Backfill shall be placed in uniform lifts not exceeding 150 mm of compacted thickness.
- c. Adjacent to existing carriageways: all material 300 mm below the finished grade shall be compacted to a density not less than 98 % of the Maximum Standard Proctor Density of a five point Standard Proctor Compaction Test and based on a minimum of one (1) field test per 150 lineal meters of trench for each 600 mm of compacted vertical backfill.
- d. Sand or gravel backfill shall be compacted to meet the following density requirements:
 - 300 mm or more below grade - the minimum acceptable density shall be 98 % of the Maximum Standard Proctor Density.
 - 0 - 300 mm below grade - all sand or gravel in this zone shall compact to 100 % of the Maximum Standard Proctor Density.
- e. For all density tests indicating insufficient compaction, two (2) more density tests, proportionately representative of the trench length, shall be taken at that depth. If the average of the three (3) tests is below the required density, the area of deficient density shall be re-excavated and re-compacted to meet the specified density. Densities greater than 100 % shall be deemed to be at 100 % for calculating the average of the three tests.
- viii. The Developer's Consulting Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.
- ix. If the above standards cannot be achieved due to a large variation in soil types throughout the subdivision, 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 Consulting Engineer justifying the required changes to the compaction standards.

- x. If the established 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 shall not be permitted as an alternate testing procedure due to wet soil conditions. The Developer's Consulting Engineer shall be required to suggest appropriate measures such as drying in-situ material or importing suitable material in order to meet the required minimum densities.
- xi. All landscaping, pavement structures, sidewalks, curb and gutter, and any other existing structures and facilities damaged or removed during trenching shall be restored or replaced at the Developer's expense.
- xii. All debris, surplus fill and unused materials must be removed from the site as directed by the Municipal Engineer.

D.13.2 Watermain Installation

- i. The pipe and gasket installation shall be conducted in compliance with the pipe manufacturer's specifications.
- ii. Installation of PVC pipe and fittings shall conform to AWWA M23.
- iii. Field welding procedures shall be in accordance with CSA Z662. Welders shall be qualified as B pressure welders.
- iv. Pipes shall be carefully aligned when jointing. Joints are to be kept free of mud, gravel and foreign material and shall be completed as outlined in the manufacturer's specifications. Each joint shall be completed before laying the next length of pipe. Deflections shall not exceed those permitted by the pipe manufacturer.
- v. The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete. When pipe installation is not in progress, the open ends of installed pipe shall be closed with an approved plug or cap to prevent entrance of trench water and/or any foreign or other material into the line.
- vi. Adequate backfill shall be placed on the pipe to prevent floating. Any pipe which has floated shall be removed from the trench and be re-installed as directed by the Municipality.
- vii. The alignment of pipes less than 900 mm in diameter shall not be more than 150 mm off the designated alignment. The alignment for pipes larger than 900 mm shall not deviate by more than 50 mm per each 300 mm of diameter.
- viii. The invert of the pipe shall not deviate from the design grade by more than 40 mm.
- ix. Each valve and fitting shall be permanently supported independently of the pipe with 30 MPa concrete.

- x. All bell and spigot joints shall be sealed with rubber rings, unless otherwise approved in writing by the Municipality. All defective joints shall be cut out and entirely replaced with new material.
- xi. The cutting of pipe for closure to fittings, valves and other reasons shall be done in a neat and workmanlike manner, without damage to the pipe and so as to leave a smooth edge at right angles to the axis of the pipe. Pipe cutting for valves and fittings shall be done accurately so as to bring all valves and fittings to their correct positions. Cut standard pipe used with rubber gasket joints shall be field machined and chamfered as required by the manufacturer's instructions.
- xii. Standard plugs shall be inserted into the bells of all dead end fittings and plain ends of pipe. A concrete thrust block shall then be placed behind this plug backing onto undisturbed material. A valve shall be placed within a distance of two full pipe lengths (12 m typical) from the end of the pipe or between the plug and fitting, as required.

D.13.3 Valves Installation

- i. Valves, valve casings and fittings shall be installed in accordance with the manufacturer's specifications.
- ii. All valves shall be installed with a concrete thrust block.
- iii. Valve casings shall be set at grade for unpaved areas and between 5 to 15 mm below grade for paved surfaces and sidewalks.
- iv. Upon completion, all valve casings must be checked to ensure that they are plumb and that the operating nut can be turned properly.

D.13.4 Fire Hydrants Installation

- i. Fire hydrants shall be installed in accordance with the manufacturer's specifications and AWWA M17.
- ii. All fire hydrants shall be installed with a concrete thrust block.
- iii. A gravel drain shall be provided at the base of the fire hydrant barrel consisting of a minimum of 1 m³ of washed rock.
- iv. Fire hydrant drain ports shall be left open except where the water table is above the fire hydrant drain. The Municipality shall be notified of fire hydrants with plugged drain ports.
- v. Upon completion, all hydrants must be checked to ensure that they are plumb and that the operating nut is functioning properly.

D.13.5 Water service connections installation:

- i. 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.

- ii. Tapping into the existing watermain for new residential service connections shall be done with full operating pressure in the existing watermain. 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.
- iii. A tapping valve and sleeve must be used for services 100 mm in diameter and larger.
- iv. Curb stops shall be installed 300 mm into right-of-way from the property line.
- v. Services crossing existing roadways and/or sidewalks shall be augured, bored or tunnelled unless otherwise approved by the Municipal Engineer.

D.14 OPERATION OF BOUNDARY VALVES AND EXISTING FIRE HYDRANTS

- D.14.1** The Developer shall notify the Municipality at least 48 hours (two full business days) in advance of valve operation requirements. The designated Municipality personnel shall operate the boundary valves.
- D.14.2** The Developer shall not use a fire hydrant as a water source for construction without permission from the Municipality. Arrangements for payment for water used may be required. The Municipality may outline conditions of use depending on the circumstances.
- D.14.3** The Developer may be required to tie into an existing water distribution system, or to temporarily shut off the existing water supply, in order to undertake construction activities related to the proposed subdivision. When these situations are required, the Developer shall take the following actions at his own expense:
- i. Notify the Municipality of the proposed work and anticipated schedule.
 - ii. Supply all water needed for the work. If the required water supply is withdrawn from the existing water distribution system, an arrangement that details compensatory requirements shall be made between the Developer and the Municipality.
 - iii. Obtain written permission from the Municipality prior to operating any of the Municipality's water valves, fire hydrants, or other appurtenances associated with an existing water distribution system. The Developer shall be held responsible for any damage to existing appurtenances or the surrounding area that result from the construction activities. The Municipality may require their own personnel to operate the existing water valves, fire hydrants, or other appurtenances.
 - iv. Provide 24 hours written notice to all customers affected by disruptions in the existing water distribution system.
 - v. Supply an alternate source of potable water to all customers affected by water distribution system disruptions greater than 4 hours in duration.

- vi. Provide an alternate continuous source of potable water to all customers that require an uninterrupted source for their daily operations.

D.15 INSPECTION AND TESTING

D.15.1 All water distribution system installations shall be subject to inspections by the Municipal Engineer prior to issuance of the Construction Completion Certificate and Final Acceptance Certificate.

D.15.2 Hydrostatic Pressure Testing

- i. The entire system shall be subjected to a hydrostatic pressure test in the presence of the Municipal Engineer. The Developer shall be 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.
- ii. Acceptable test sections shall be selected in consultation with the Municipal Engineer. The maximum length of distribution watermain test sections shall be 450 m. The maximum length of transmission watermain sections shall be 800 m.
- iii. 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.
- iv. Ensure that all watermain valves and fire hydrant isolation valves in the test section are open and that the fire hydrants are closed.
- v. Ensure that all air is expelled from the test section using fire 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 1035 kPa, whichever is greater.
- vi. 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 20 kPa of the specified test pressure throughout the duration of the test.
- vii. Measure the water level at the end of the test and calculate the observed leakage. Compare against the allowable leakage calculated as follows:

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

$$L = \text{NDP}^{1/2}/32,046 \quad \text{for ductile iron pipe}$$

Where: L = allowable leakage (L/hr)

N = total number of joints

D = nominal pipe diameter (mm)

P = test pressure (kPa)

viii. The allowable leakage shall be determined by the following table:

LEAKAGE ALLOWANCE IN LITRES PER 100 JOINTS PER HOUR

(PVC pipe, new construction)

Test Pressure (kPa)

Pipe Ø

(mm)	345	515	690	860	1035	1380	1550
150	2.17	2.65	3.07	3.42	3.76	4.34	4.60
200	2.89	3.54	4.09	4.57	5.02	5.79	6.14
250	3.62	4.42	5.19	5.71	6.27	7.24	7.67
300	4.34	5.31	6.14	6.86	7.52	8.69	9.21
450	6.51	7.96	9.21	10.29	11.28	13.03	13.81
600	8.69	10.61	12.28	13.71	15.05	17.37	18.41
750	10.86	13.27	15.35	17.14	18.81	21.72	23.01
900	13.03	15.92	18.42	20.57	22.57	26.06	27.62

Leakage allowance for new construction for materials of other than PVC shall be in accordance with the applicable AWWA standard.

Each section between valves shall be brought to test pressures with the valves closed, to test the valves under pressure. Test pressure shall be held without loss for 2 minutes before opening the valve and releasing the pressure into the next section.

- ix. No watermains shall be charged and no pressure and leakage tests shall be permitted between October 15th and April 15th inclusive, unless approved by the Municipality.

D.15.3 System Disinfection

- i. Watermains are to be disinfected and flushed in accordance with AWWA C651 using continuous feed method.
- ii. The Developer shall notify the Municipality at least 24 hours in advance of the testing.
- iii. Chlorine residual tests shall be performed at the beginning and at the end of the disinfection procedure and shall be repeated again after flushing the lines.
- iv. Under Alberta Environment standards and regulations, super chlorinated water used for disinfection of the system cannot be directed into a storm sewer or open water body. Dechlorination will be required prior to flush water being discharged into the environment.

- v. Approximately 16 hours after flushing the chlorine, one (1) bacteriological sample for each 90 m of watermain shall be taken and submitted for analysis unless otherwise directed by the Municipal Engineer. Where dead ends exist, samples shall be taken at the end of the line. Approved bacteriological sample containers from the Provincial Laboratory of Public Health or the local Health Unit must be used.
- vi. The watermains shall not be commissioned and put into use until the bacteriological sample results are reviewed and approved by the Municipal Engineer. The disinfected watermain shall be flushed prior to being put into full active service. Dechlorination of the test water with neutralizing chemicals may be required prior to discharge to meet the regulatory requirements of Alberta Environment. Dechlorination activities shall be in accordance with the latest edition of AWWA standard C651. The chlorine residual and bacteriological test results must be reviewed and approved by the Municipal Engineer prior to the watermain being put into full active service.
- vii. The Developer shall be responsible for obtaining the necessary supply of test water for the watermain disinfection process as well as all associated costs.

D.15.4 Fire Hydrants Flow Test

- i. Prior to issuance of the Construction Completion Certificate, hydrants flow testing shall be conducted by the Developer's Consulting Engineer to verify that the flows and pressures identified in the design calculations are being provided in the field. The Developer's Consulting Engineer shall coordinate the testing with the Municipality representative to ensure he is present for all testing. Results of the testing shall be compiled by the Developer's Consulting Engineer and submitted to the Municipality representative with a comparison of the actual flows and design flows for the same hydrant.
- ii. Where the actual flows do not meet the minimum fire and service requirements all hydrants in the project must be tested and the Developer must advise the corrective action he shall be taking to provide the necessary service level. The location and extent of initial testing shall be as required by the Municipality representative.

D.16 WATER STORAGE FACILITIES

- D.16.1** Municipal potable water reservoirs shall be designed and constructed as an underground concrete reservoir and sized to accommodate 2 times maximum daily demand when no fire storage is required.

D.16.2 When fire storage is required, potable water reservoirs shall be sized to accommodate the larger of:

$$S = (A + B + C)$$

Where: S = Total storage requirement (m³)

A = Fire storage (m³)

B = Equalization storage = 25 % of maximum daily demand (m³)

C = Emergency storage = Min. 15 % of average daily demand (m³)

Disinfection contact time storage required to meet Alberta Environment requirements or 2 times maximum daily demand.

D.16.3 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 only.

D.17 GUIDELINES FOR RURAL WATER DISTRIBUTION SYSTEM DESIGN

D.17.1 The guidelines developed by the Municipality are intended to be consistent with the Water Act, its regulations and any related guidelines developed by Alberta Environment. Where any discrepancy exists, Alberta Environment requirements shall govern. This section provides information on the use of groundwater for proposed subdivisions. It may not be feasible to connect a proposed residential subdivision to a waterworks system that supplies municipal standard water.

D.17.2 Groundwater and groundwater supply.

- i. There are two basic groundwater supply alternatives in rural areas of Alberta which include:
 - a. A private groundwater supply system based upon a central well with a piped water distribution system.
 - b. Use of privately owned household water supply systems where each lot has its own system.

For alternative (a) the Applicant must submit an application under the Water Act to the appropriate regional office of the Water Administration Branch of Alberta Environment. The direction and evaluation of aquifer testing for wells requiring a license under this Act will require the assistance of a person competent in groundwater evaluations and who is a member of the Association of Professional Engineers Geologists and Geophysicists of Alberta.

- ii. Alberta Environment, Standards and Guidelines Branch recommends that the groundwater potential be evaluated when:
 - a. The number of unserviced residential parcels per quarter section, or per river lot, both existing and proposed, using the underlying groundwater resource is six or more.
 - b. Whenever there is a possibility that each proposed parcel will not have access to an adequate long term supply of potable groundwater using a privately owned household well.
- iii. The evaluation report should be consistent with the “Interim Guidelines for the Evaluation of Groundwater Supply for Unserved Residential Subdivisions Using Privately Owned Household Water Wells”.
- iv. The Consultant shall state in the report whether the evaluation was performed in conformance with these guidelines. If the report does not contain a recommendation on the groundwater supply potential and/or statement of conformance to these guidelines the subdivision approving authority should identify this as a major deficiency and not proceed with the application until this has been remedied.
- v. Wells used for water supply must be drilled by Alberta licensed water well drillers.

D.17.3 The household groundwater supply potential should be evaluated by using the following five criteria:

- i. The potential of one or more aquifers, if present, to provide a sufficient supply of groundwater to meet the needs of any existing subdivision and proposed unserviced residential subdivision within a quarter section during peak demand periods and over the long term (an aquifer is a water bearing formation which is capable of transmitting and yielding water in usable quantities).
- ii. The extent to which each aquifer is continuous beneath the proposed subdivision area (if discontinuous, each proposed parcel may not be able to have a privately owned household well).
- iii. The potability of each aquifer’s water in its current state considering its natural quality and possible existing anthropogenic contamination (anthropogenic refers to the impact of man on nature; existing contamination may be from agricultural, industrial activities, etc.; refer to the Local Health Unit’s criteria for potable water).
- iv. Feasibility of treating groundwater if needed.

- v. The susceptibility of each aquifer to potential contamination taking into account aquifer depth, overlaying low permeability layers such as clay and shale, and the presence of fractures, fissures or cracks in these fine textured layers. Each parcel within an unserviced residential subdivision is serviced by on site private sewage disposal system, therefore, the potential for contamination by sewage effluent is of primary concern.

D.17.4 Quantity of Water

A central well should be capable of meeting the household requirements of all the existing and proposed lots within a quarter-section, calculated based on an average meter consumption of 1,250 m³/year/household (0.523 igpm/household). These requirements do not provide for fire protection, irrigation, livestock, or any other use.

D.17.5 Groundwater Supply Evaluation Report should include, but not be limited to, the following:

- i. **Collection and Summary of Existing local Groundwater Data** - The Groundwater Supply Evaluation Report shall be prepared by a groundwater geologist or hydrogeologist or Professional Engineer whose area of competence lies within the groundwater field, and who is a member in good standing with APEGGA. The Consultant shall collect and summarize in the report existing local groundwater data for an area termed the Evaluation Area which includes the proposed subdivision and surrounding land within a minimum of 3.2 km from the proposed subdivision boundary.
- ii. **Sources of Data** - the Groundwater Information Center (GIC) maintains a provincial groundwater data archive of Water Well Driller's Reports, aquifer tests, chemical analysis, provincial observation, well hydrograph data, electric logs, records on flowing shot holes from seismic exploration, groundwater consultant's reports and most of the hydrogeological reports from the Alberta Geological Survey Information Sales (formerly Alberta Research Council).
- iii. **Assessment of Existing Information** - Using the information collected, the Consultant shall assess with respect to each of the groundwater supply evaluation criteria, whether there is sufficient existing hydrogeological information to confidently estimate the groundwater supply potential in the vicinity of the proposed subdivision.
- iv. **Aquifer Testing if Existing Information Insufficient** - Any testing of aquifer capacity shall be carried out in strict accordance with AEP guidelines, with the Developer held responsible for all necessary licensing.
- v. **Determination of the Adequacy of the Groundwater Supply** - Using the above information in the groundwater supply evaluation criteria, the Consultant shall determine whether the groundwater supply is adequate to meet the needs of the proposed subdivision.

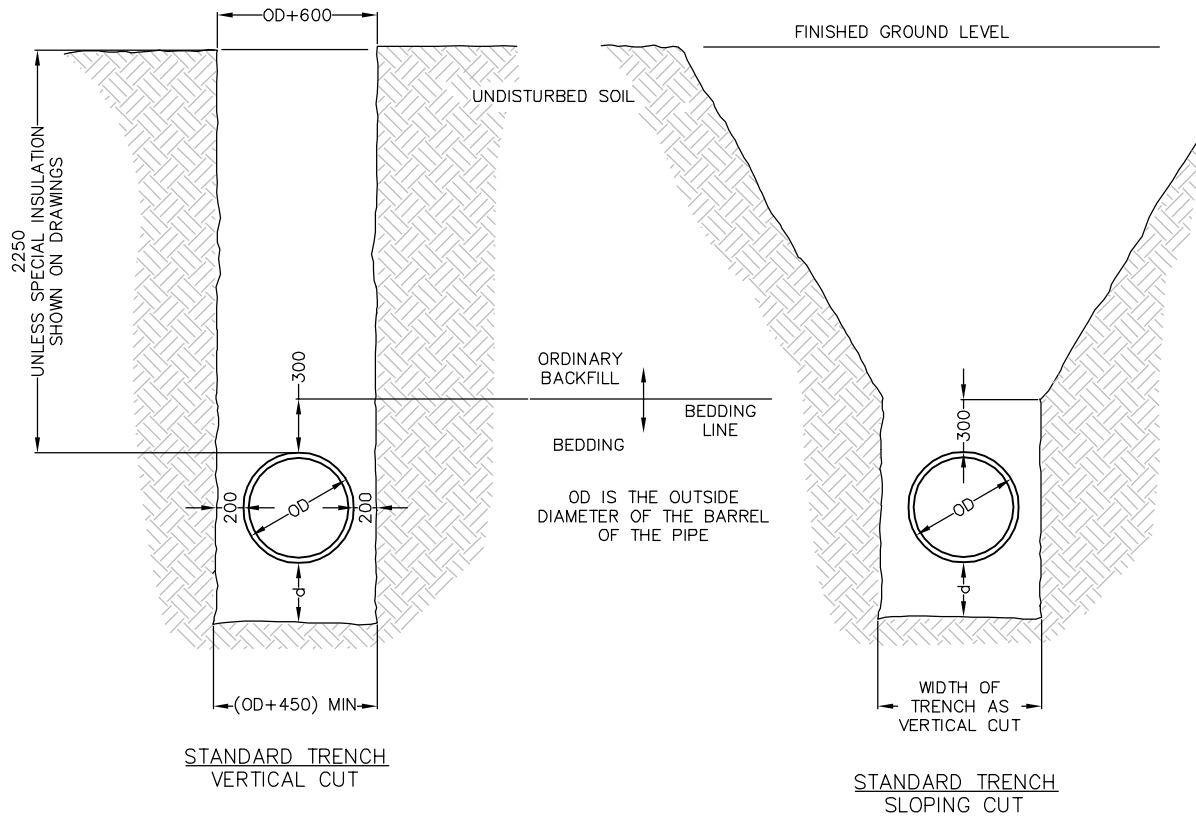
- vi. **Conclusion** - In the conclusion of the report, the Consultant shall clearly state:
 - a. Whether there is an adequate groundwater supply potential to meet the needs of the proposed subdivision.
 - b. Whether the evaluation was performed in conformance with these guidelines. If the report does not contain a recommendation on the groundwater supply potential and/or statement of conformance to these guidelines the development approving authority will identify this as a major deficiency and not proceed with the application until this has been remedied.
- vii. **Recommendations** - The Consultant shall recommend appropriate ongoing monitoring and well maintenance schedules, any water servicing devices or any other means to protect the ground water source. Copies of the report should be submitted to the Municipality and the Local Health Unit, and sent to the Groundwater Information Centre.

D.18 LIST OF DRAWINGS

D-01	Standard Trench Dimensions for Circular Pipe
D-02	Standard Trench Bedding for Circular Pipes
D-03	Bedding Detail
D-04	Typical Casing Pipe with Insulator
D-05	Insulation Requirements for Water Mains / Services
D-06	Single Low Pressure Sanitary Service
D-07	Typical Single Service
D-08	Typical Dual Service
D-10	Thrust Block Details
D-11	Type 'A' – Valve Casing Detail
D-12	Typical Shoulder Widening for Fire Hydrant – Rural Standard
D-13	Hydrant Connection
D-14	Typical Hydrant Connection
D-15	Flush Point Detail
D-16	Service Box Detail for 50mm & Smaller Water Service
D-17	Typical 50mm & Smaller Water Service for 300mm & Smaller Water Mains
D-18	Anode Installation on 50mm & Smaller Copper Water Service
D-19	Typical Anode Installation at Steel or Iron Fittings used with PVC Watermains
D-20	Anode Installation for Steel and Iron Water Mains
D-21	Anode Installation at Hydrant
D-22	Automatic Air Valve Chamber Detail (Plan)
D-23	Automatic Air Valve Chamber Detail (Profile)
D-24	Valve Chamber Detail (Plan)
D-25	Valve Chamber Detail (Profile)

END OF SECTION

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(EXCAVATION TO BE SHORED AS PER OCCUPATIONAL HEALTH AND SAFETY STANDARDS)

(EXCAVATION TO BE SLOPED AS PER OCCUPATIONAL HEALTH AND SAFETY STANDARDS)

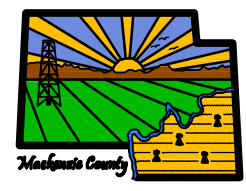
MAXIMUM TRENCH WIDTHS FOR SINGLE PIPES
 -UP TO AND INCLUDING 400mm ϕ - 1000mm
 -450mm ϕ AND ABOVE - OD + 600mm

DEPTH OF BEDDING BELOW PIPE BARREL (d)
 -100mm MIN.

NOTE:
 ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

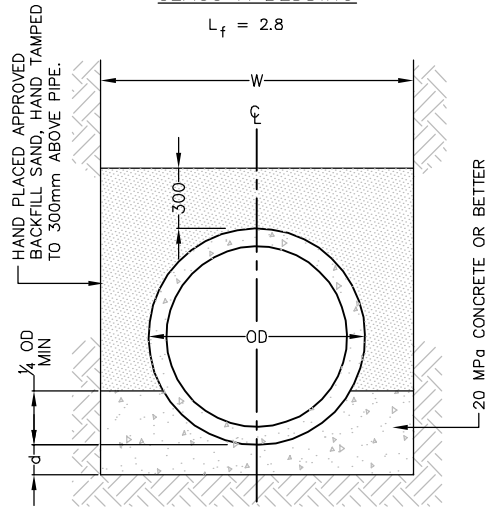
General Municipal Improvements Standards



Rev.		STANDARD TRENCH DIMENSIONS FOR CIRCULAR PIPE		Approved:	Figure D-01
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure D-01	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

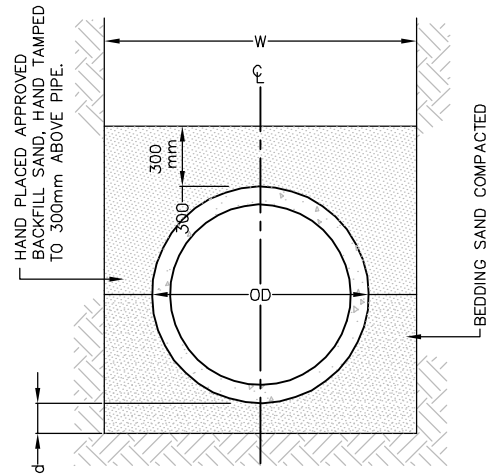
CLASS A BEDDING

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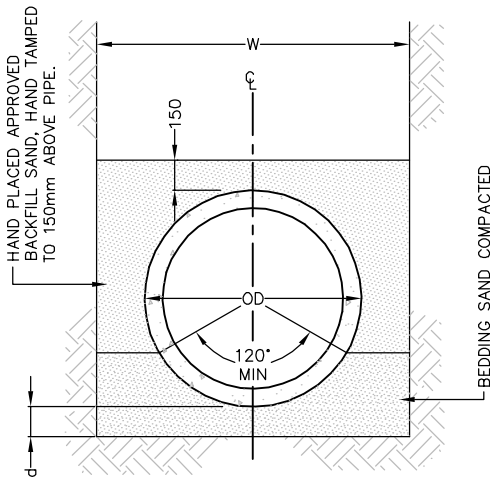
CLASS B BEDDING

$L_f = 1.9$



CLASS C BEDDING

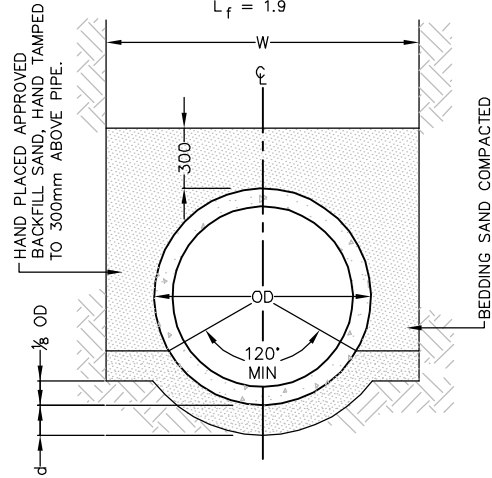
$L_f = 1.5$



CLASS B BEDDING

ALTERNATE - 375mm I.D. & UNDER

$L_f = 1.9$

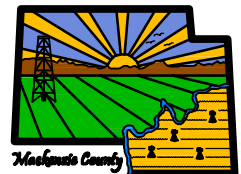


NOTES:

1. W = TRENCH WIDTH - O.D. + 450mm (MINIMUM).
 - 1000mm max. FOR PIPES UP TO AND INCLUDING 400mm DIAMETER.
 - O.D. + 600mm max. FOR PIPE DIAMETERS 450mm AND ABOVE.
2. O.D. = OUTSIDE PIPE DIAMETER.
3. I.D. = INSIDE PIPE DIAMETER.
4. L_f = LOAD FACTOR.
5. d = DEPTH OF BEDDING BELOW PIPE = 150mm (MIN).
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
7. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

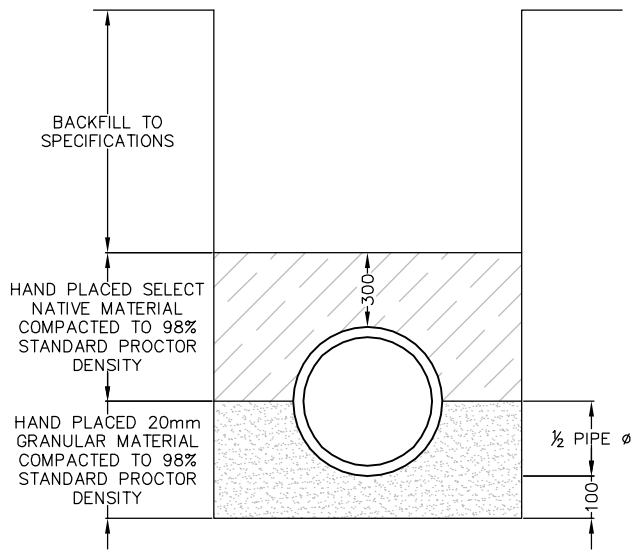
MACKENZIE COUNTY

General Municipal Improvements Standards

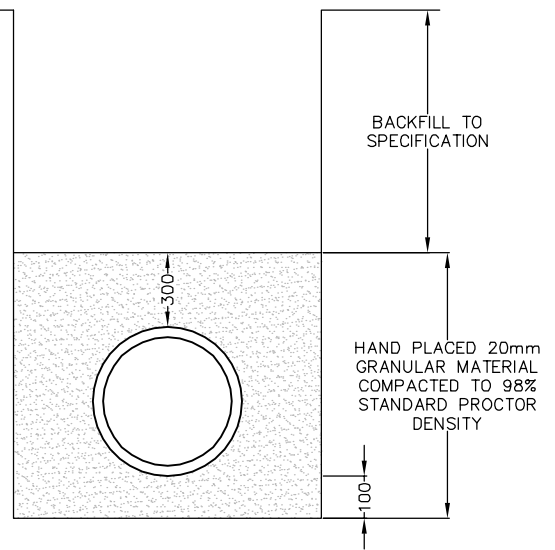


STANDARD TRENCH BEDDING FOR CIRCULAR PIPES

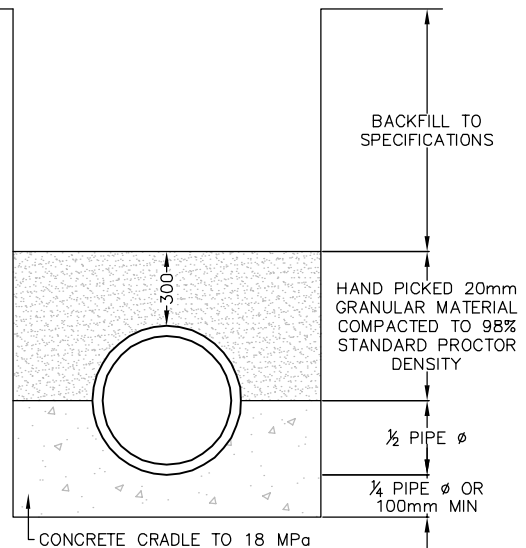
Rev.				Approved:	Figure D-02
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:		Approved:	Figure D-02
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



CLASS B



CLASS B-1



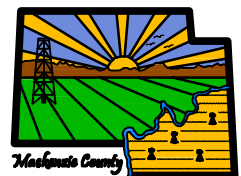
CLASS A-1

NOTES:

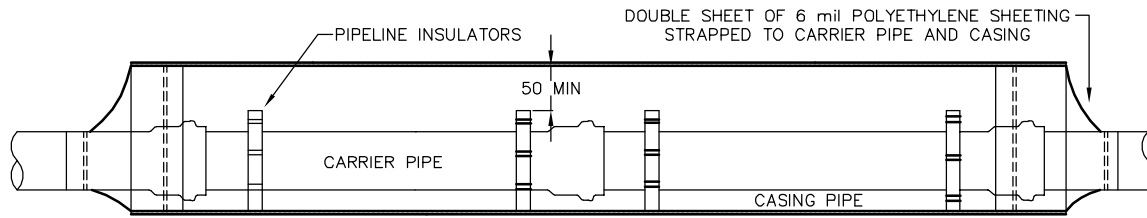
1. SAND MAY BE ALLOWED ON PIPE SIZES LESS OR EQUAL TO 375mm DIAMETER.
2. WITHIN THE PIPE ZONE:
MINIMUM TRENCH WIDTH - PIPE DIAMETER + 450mm.
MAXIMUM TRENCH WIDTH - PIPE DIAMETER + 600mm.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4

MACKENZIE COUNTY

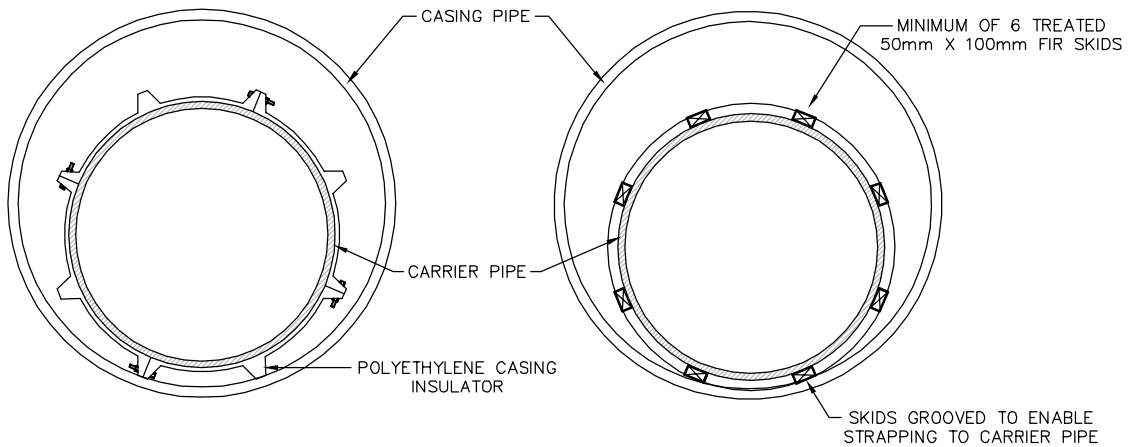
General Municipal Improvements Standards



Rev.		<p style="text-align: center;">BEDDING DETAIL</p>		<p style="text-align: right;">Figure D-03</p>
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		



ELEVATION



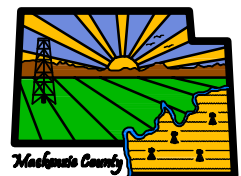
SECTION

NOTES:

1. CASING MATERIAL AND THICKNESS TO BE AS SPECIFIED ON CONSTRUCTION DRAWINGS.
2. INSULATOR SPACING TO BE DETERMINED BY THE MATERIAL AND JOINT TYPE OF CARRIER PIPE BEING USED.
3. CASING COATING AND CATHODIC PROTECTION REQUIREMENTS TO BE AS SPECIFIED ON CONSTRUCTION DRAWINGS.
4. MINIMUM SPACING OF 50mm IS REQUIRED BETWEEN SPACER AND CARRIER PIPE. MAXIMUM SPACE WILL DEPEND ON THE CARRIER PIPE DIAMETER, TYPE OF SPACERS USED CASING PIPE DIAMETER. OVERALL THE MAXIMUM SPACING SHOULD BE NO MORE THAN 200mm.
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

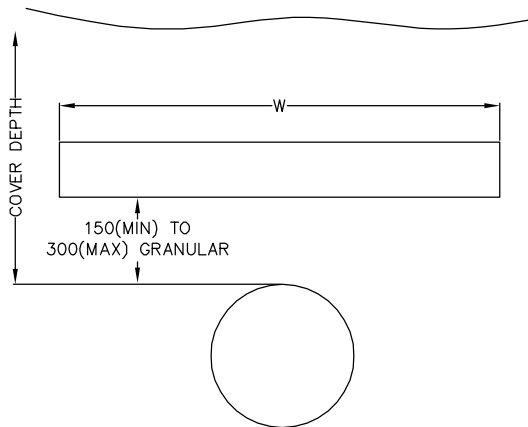
General Municipal Improvements Standards



Rev.				TYPICAL CASING PIPE WITH INSULATOR	
Rev.					
Rev.					
Rev. 2012-JAN-25	File No.: GP60.33682	Design:	Approved:	Figure D-04	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

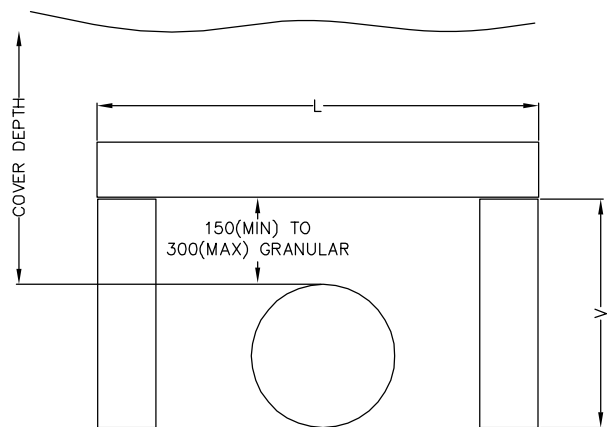
COVER DEPTH m	THICKNESS mm (IN)	WIDTH (W) m
1.1 – 1.4	90 (3.5)	3.4
1.4 – 1.7	75 (3.0)	2.8
1.7 – 2.0	75 (3.0)	2.2
2.0 – 2.3	50 (2.0)	1.6
2.3 – 2.6	40 (1.5)	1.0
2.6 – 2.9	40 (1.5)	0.4
BELOW 2.9	-	-

* USING DOW HI-40 STYROFOAM BOARD AND FILLCRETE OR GRANULAR BACKFILL



HORIZONTAL

OR



INVERTED U

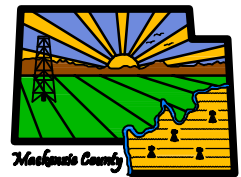
$$W = L + 2V$$

V TO BE LESS THAN OR EQUAL TO L

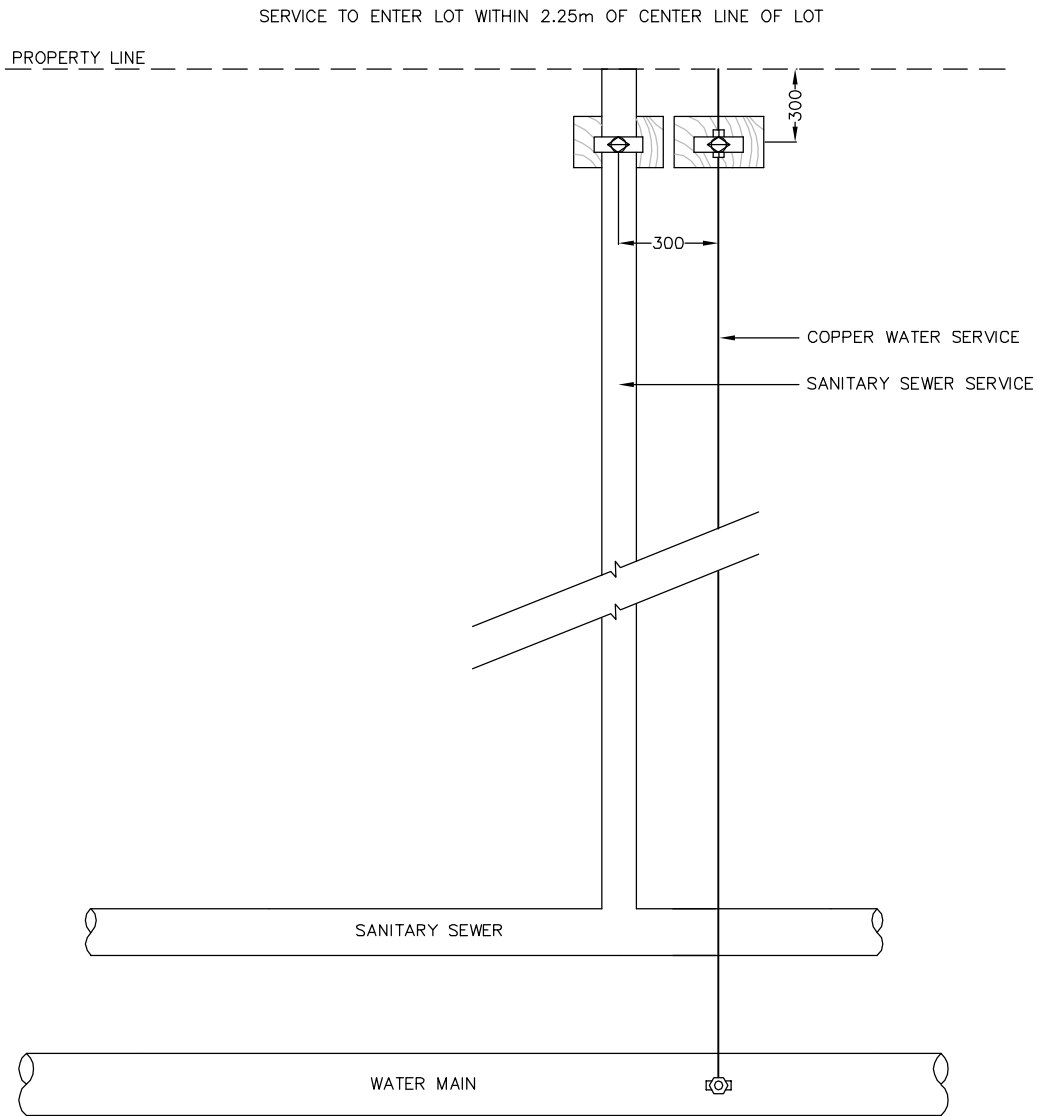
NOTE:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		INSULATION REQUIREMENTS FOR WATER MAINS/SERVICES		Approved:	Figure D-05
Rev.					
Rev.		File No.: GP60.33682	Design:		
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

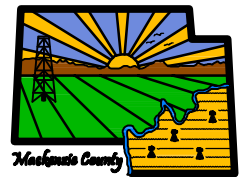


NOTES:

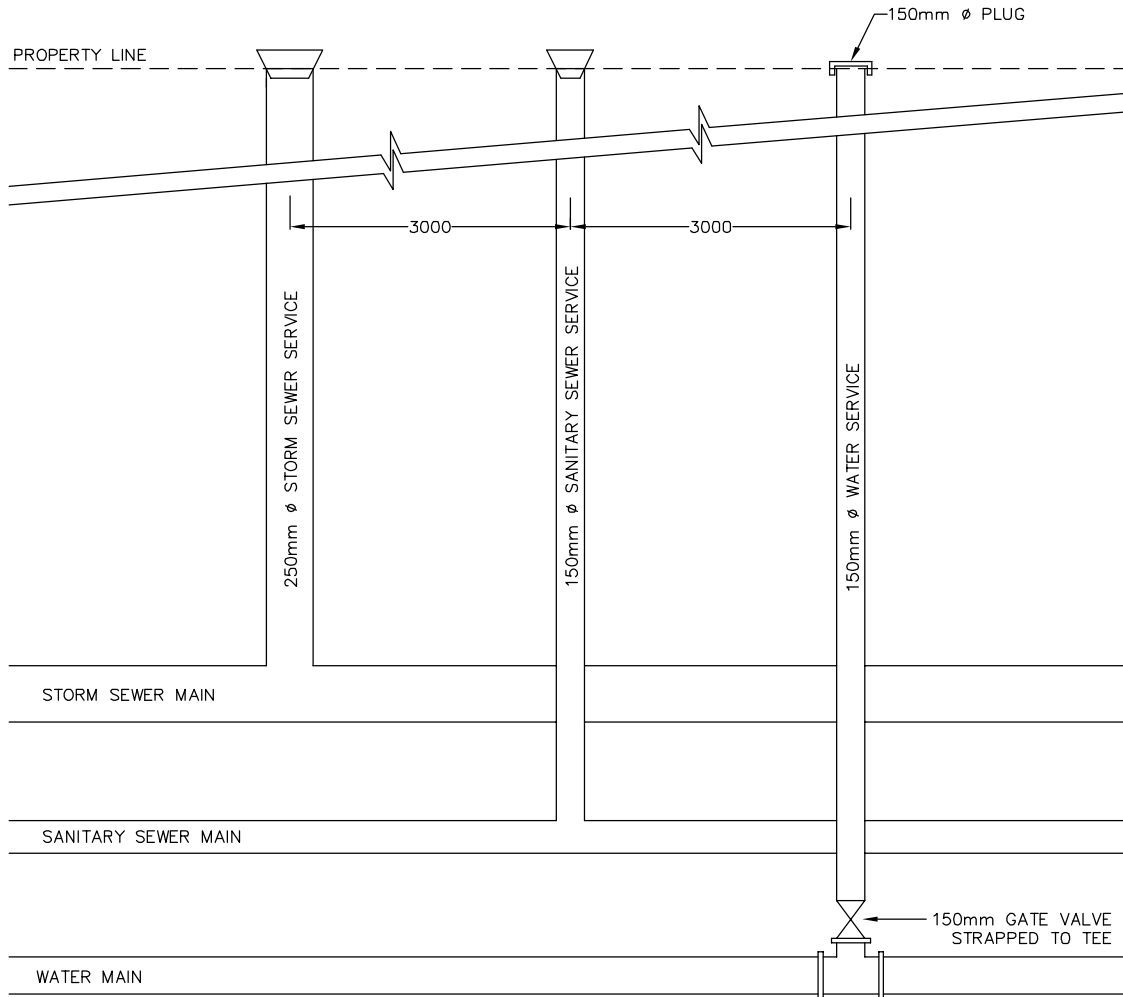
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. SERVICES MAY BE EXTENDED INTO PRIVATE PROPERTY TO EDGE OF GAS EASEMENT IN LANELESS SUBDIVISIONS.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	<b style="font-size: 1.2em;">Stewart Weir <small>Naturally Resourceful</small>	SINGLE LOW PRESSURE SANITARY SERVICE		Figure D-06	
Rev.					
Rev.		File No.: GP60.33682	Design:		Approved:
Date: 2010-AUG-31		Drawn: K.P.L	Scale: N.T.S		



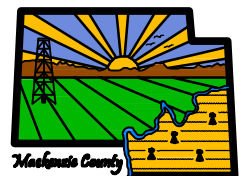
PLAN VIEW

NOTES:

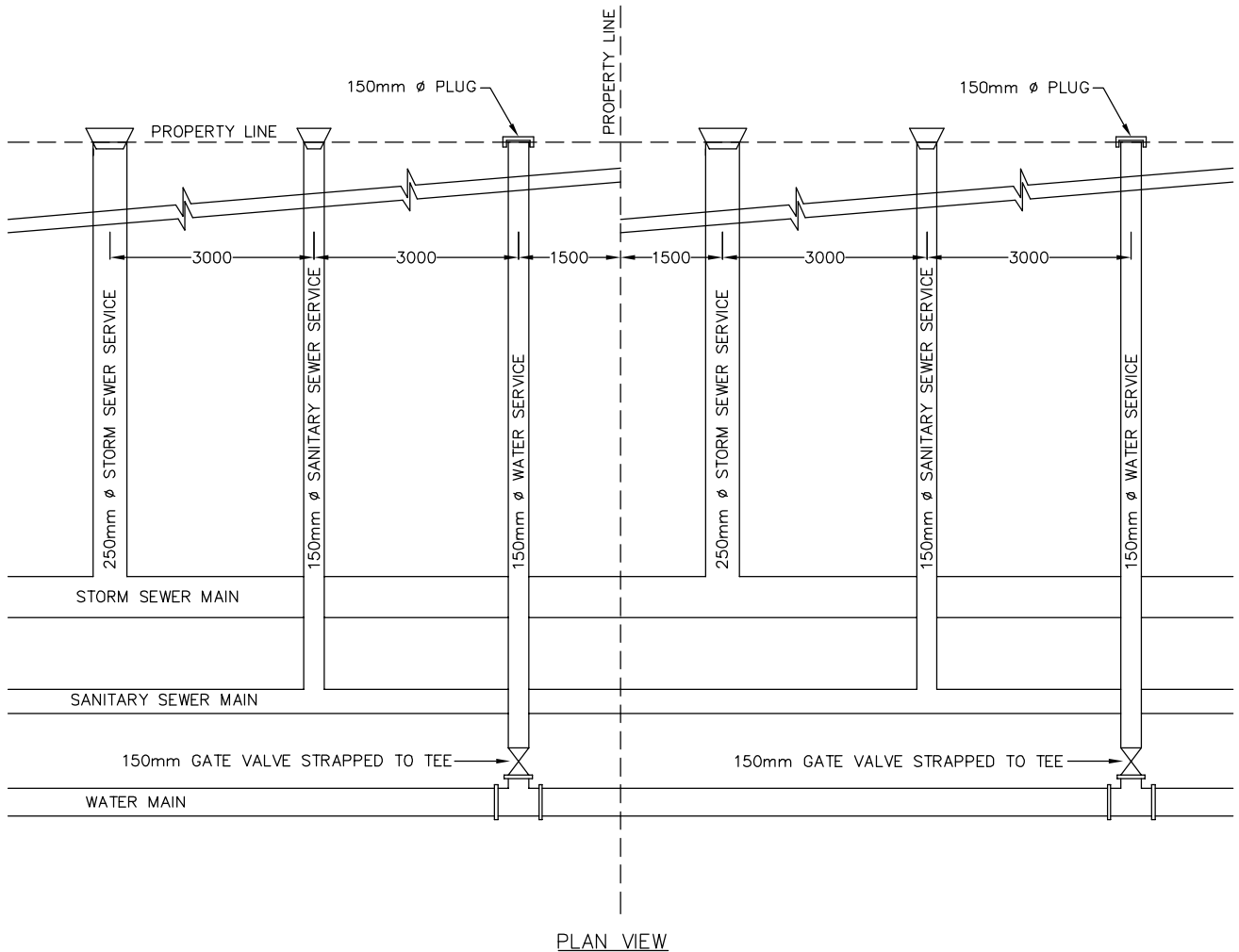
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. SERVICES MAY BE EXTENDED INTO PRIVATE PROPERTY TO THE EDGE OF GAS EASEMENT.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	TYPICAL SINGLE SERVICE		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure D-07
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

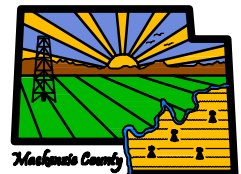


NOTES:

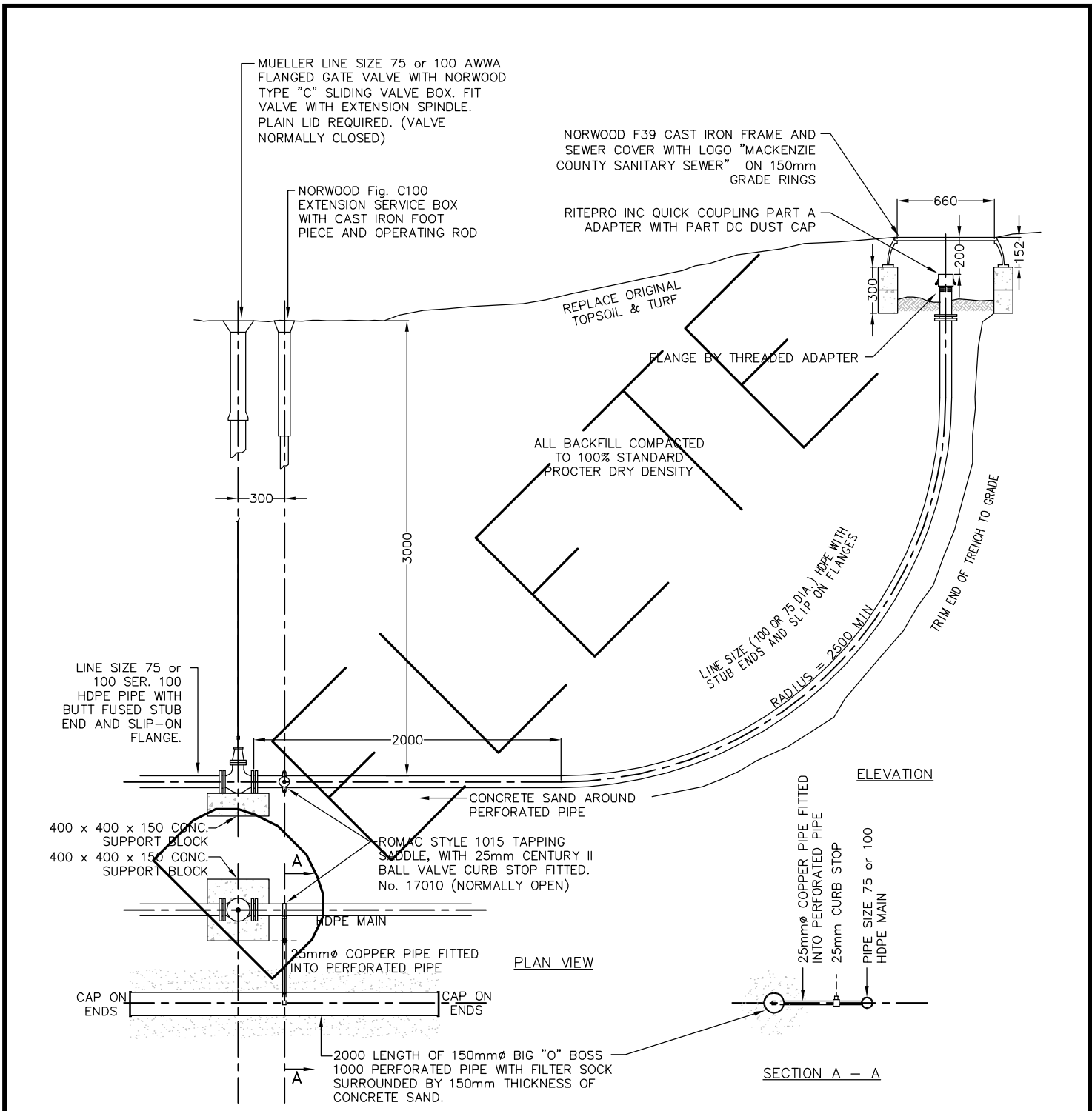
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. SERVICES MAY BE EXTENDED INTO PRIVATE PROPERTY TO THE EDGE OF GAS EASEMENT.

MACKENZIE COUNTY

General Municipal Improvements Standards



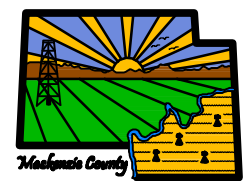
Rev. Rev. Rev.		TYPICAL DUAL SERVICE	
Rev. Date: 2010-AUG-31	File No.: GP60.33682 Drawn: K.P.L.	Design: Scale: N.T.S.	Approved: Figure D-08



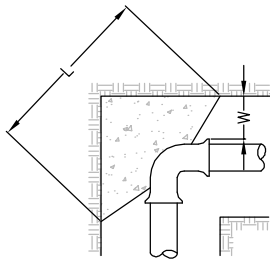
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

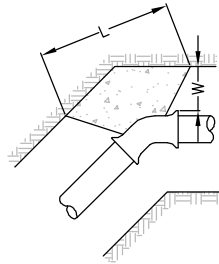
General Municipal Improvements Standards



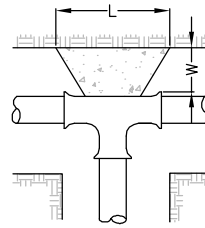
Rev.	Stewart Weir Naturally Resourceful	SANITARY CLEAN OUT DETAIL	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	Figure D-09



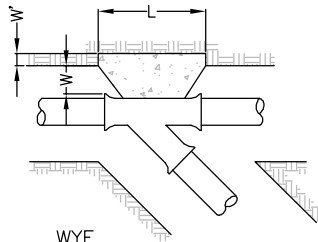
HORIZONTAL 90° BEND



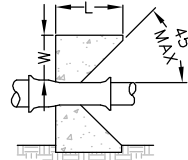
HORIZONTAL 45° BEND



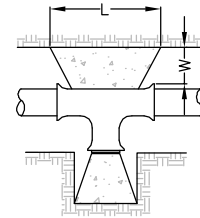
TEE



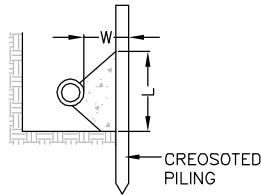
WYE



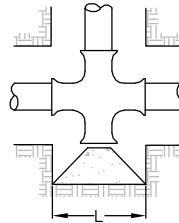
REDUCER



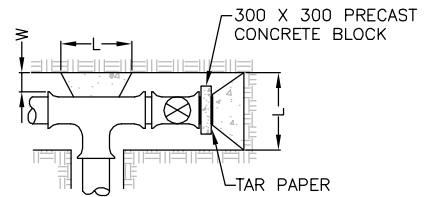
TEE WITH PLUG



CREOSOTED PILING



CROSS WITH PLUG



TEE WITH VALVE

MINIMUM THRUST AREAS FOR FITTINGS AT 1035 kPa PRESSURE AND FOR SOILS WITH MINIMUM BEARING OF 9765 kg/m (NOT TO BE USED FOR SOFT CLAY, MUCK, PEAT, etc.)

TYPE OF FITTING	FITTING SIZE		OUTSIDE OF FITTING TO BEARING FACE		RECESS IN TRENCH WALL		LENGTH	HEIGHT	TYPE OF FITTING	FITTING SIZE		OUTSIDE OF FITTING TO BEARING FACE		RECESS IN TRENCH WALL		LENGTH	HEIGHT
	D	W	W'	L	H	D				W	W'	L	H				
90° BEND	150	300		900	450	CROSS	150	300		600	450			600	450		
	200	350		1060	600		200	350		825	600						
	250	375		1445	750		250	375		975	825						
	300	400		1650	900		300	400		1200	900						
45° BEND	150	300		450	450	45° WYE	150	300	300	450	450			450	450		
	200	350		600	600		200	350	400	600	600						
	250	375		750	750		250	375	500	825	825						
	300	400		900	900		300	400	600	900	900						
22.5° BEND	150	300		450	230	REDUCER	150	300	150	450	450			450	450		
	200	350		600	300		200	350	200	600	600						
	250	375		750	450		250	375	250	825	825						
	300	400		900	450		300	400	300	900	900						
TEE	150	300		450	450	CAPS AND PLUGS (IF NOT BOLTED)	150	300		450	450			450	450		
	200	350		600	600		200	350		600	600						
	250	375		750	825		250	375		825	825						
	300	400		900	900		300	400		900	900						

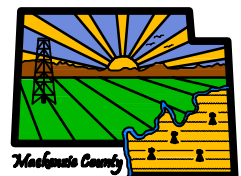
DIMENSIONS APPLY TO THE LARGER DIAMETER END OF FITTINGS

NOTES:

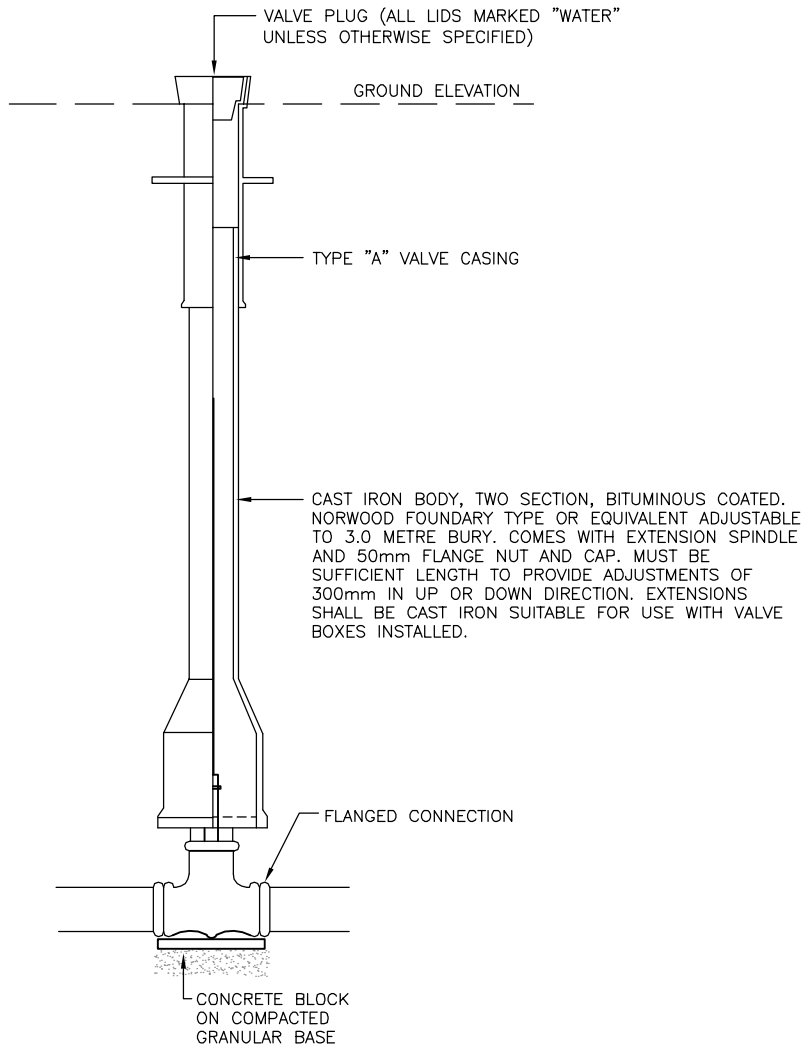
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>THRUST BLOCK DETAILS</p>		<p>Approved:</p>	<p>Figure D-10</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure D-10</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

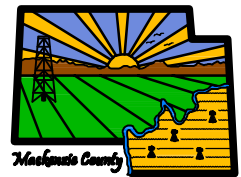


NOTES:

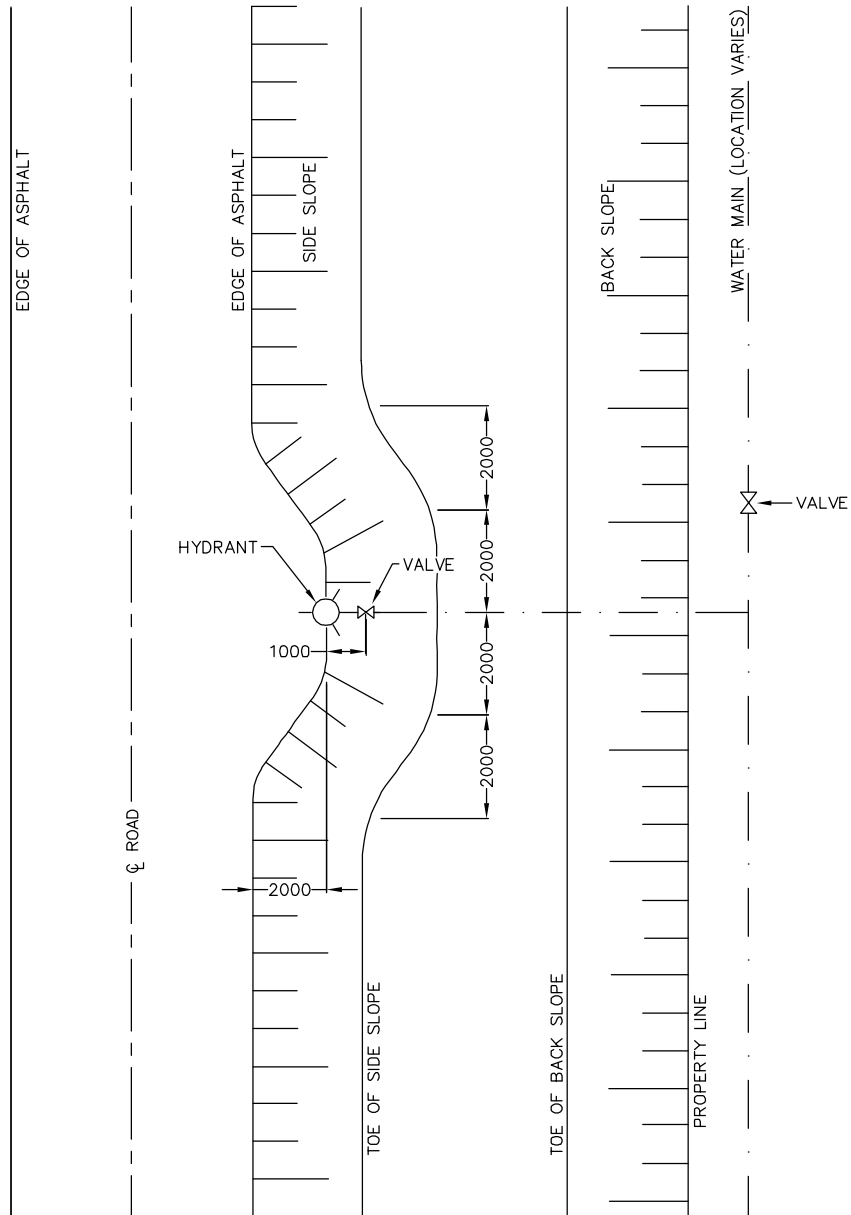
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPE 'A' – VALVE CASING DETAIL		Figure D-11
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure D-11
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

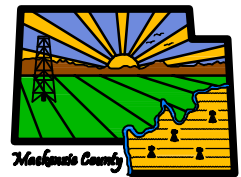


NOTES:

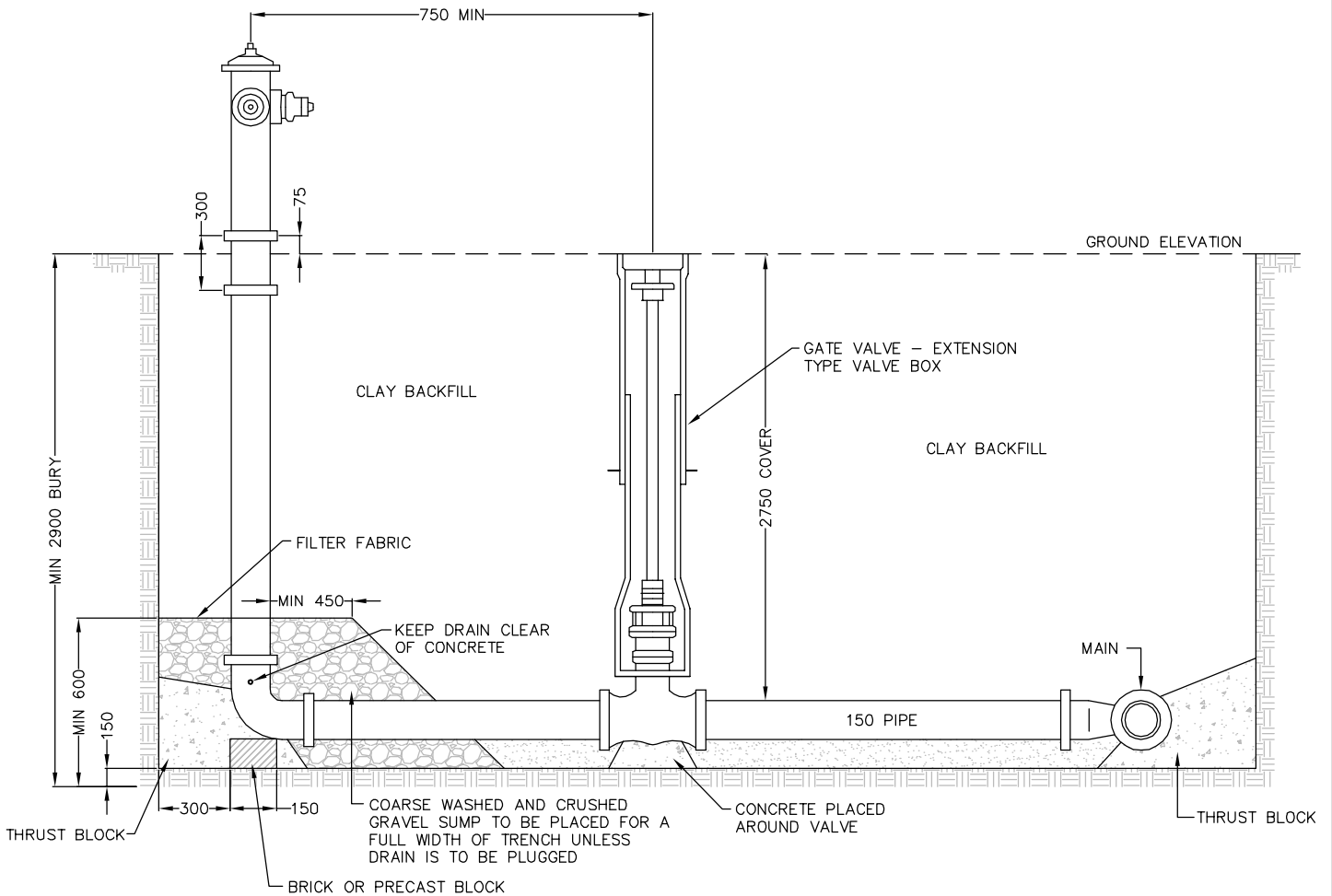
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. WATER MAIN AND HYDRANTS MAY BE LOCATED EITHER SIDE OF ROAD.
3. STREET LIGHTS TO BE OPPOSITE SIDE OF WATERMAIN.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>TYPICAL SHOULDER WIDENING FOR FIRE HYDRANT-RURAL STANDARD</p>		<p>Approved:</p>	<p>Figure D-12</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure D-12</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

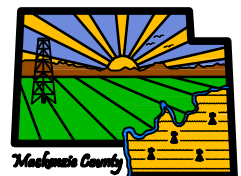


NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



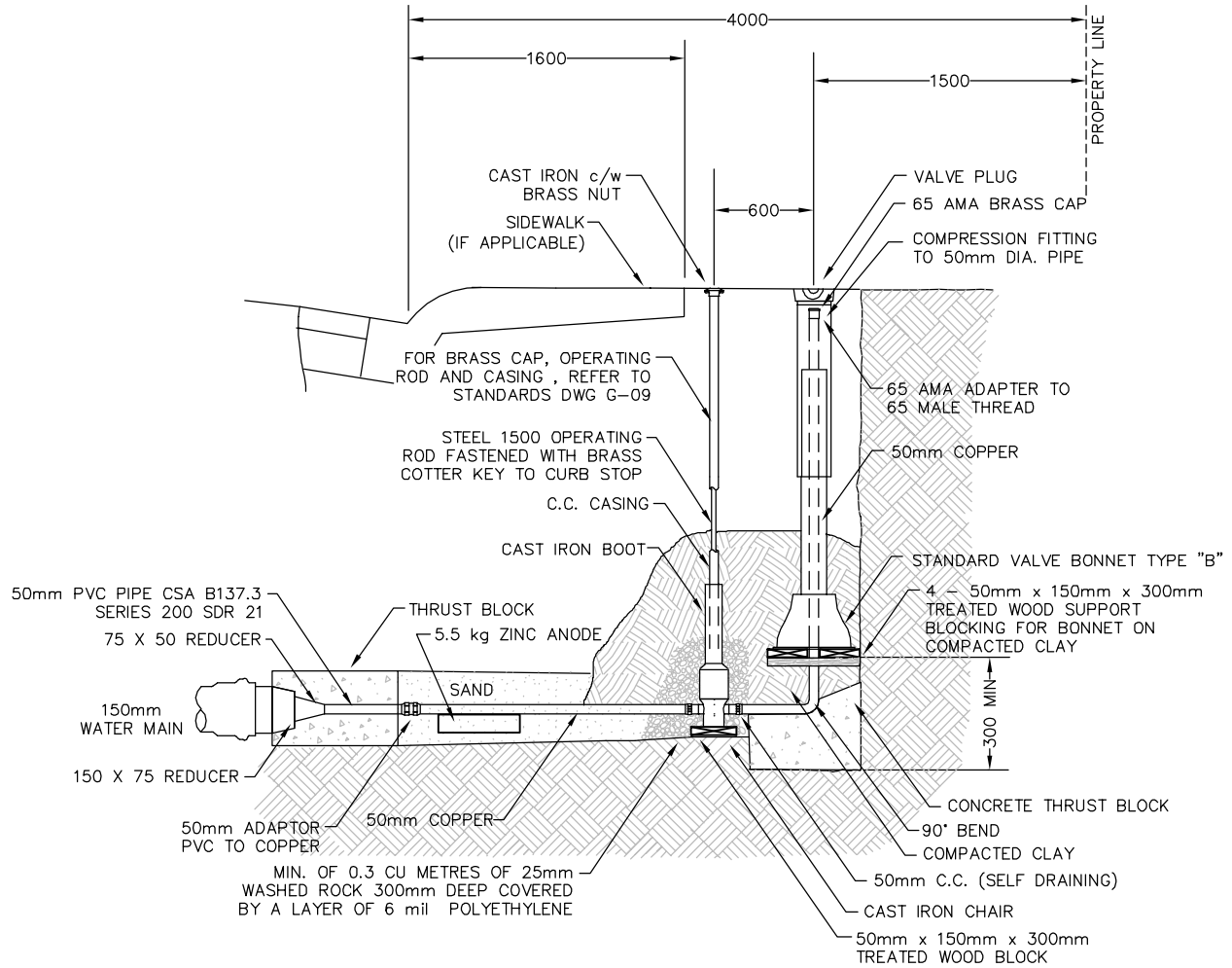
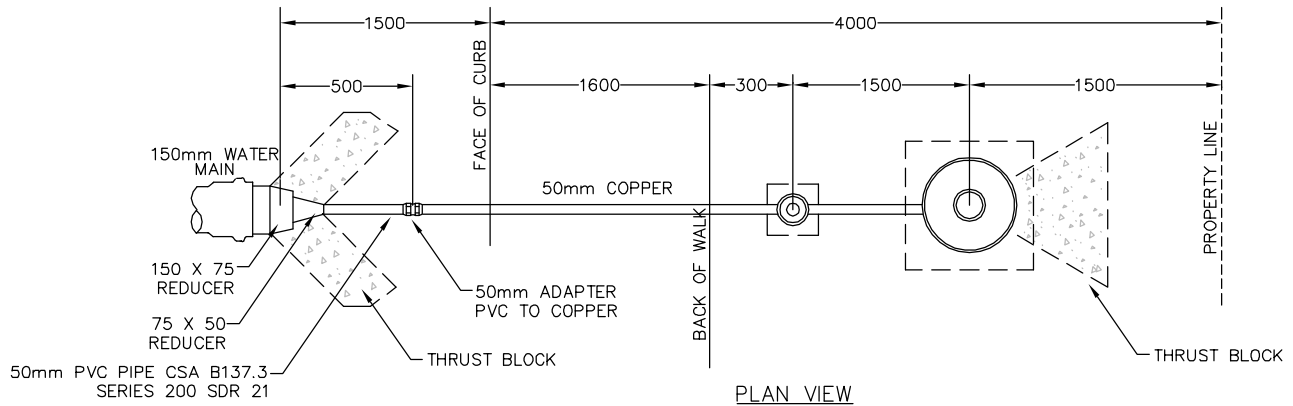
HYDRANT CONNECTION

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:	
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Figure	D-13
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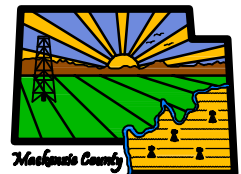


NOTES:

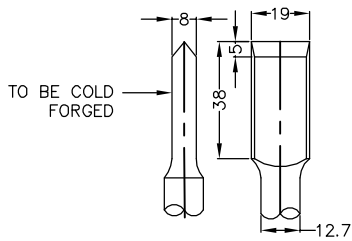
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

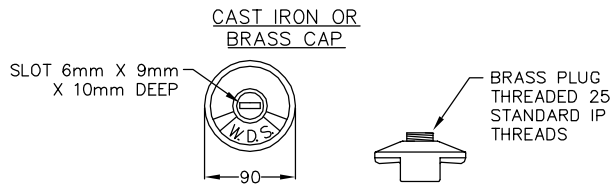
General Municipal Improvements Standards



Rev.		<p>FLUSH POINT DETAIL</p>		<p>Approved:</p>	<p>Figure D-15</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure D-15</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

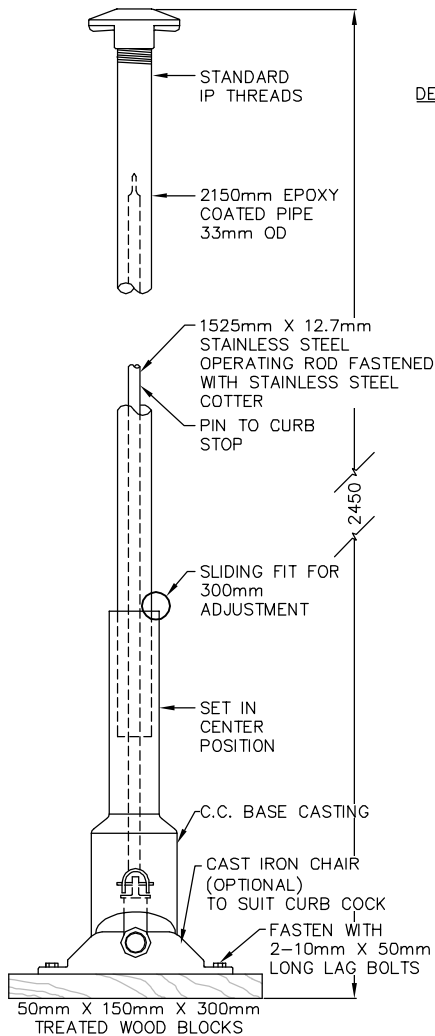


DETAIL A



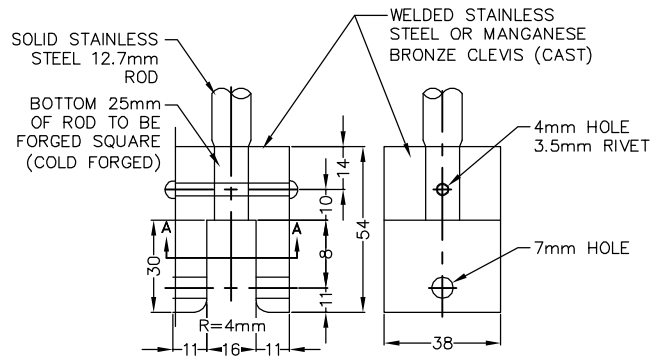
CAST IRON OR BRASS CAP

BRASS PLUG THREADED 25 STANDARD IP THREADS

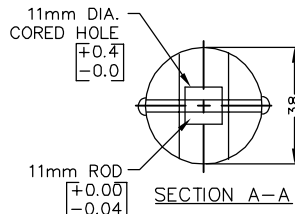


SEE
DETAIL A

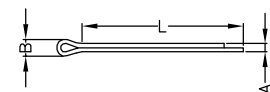
1525 ROD LENGTH



DETAIL B



SECTION A-A



BRASS COTTER PIN

COTTER PIN					
NOMINAL DIAMETER	DIAMETER A		OUTSIDE EYE DIAMETER B MINIMUM	HOLE SIZE RECOMMENDED	LENGTH L
	MAX.	MIN.			
6.35mm	5.7mm	5.6mm	12.7mm	6.7mm	55mm

WELDED STAINLESS STEEL OR MANGANESE BRONZE CLEVIS (SEE DETAIL B)

3.5mm RIVET

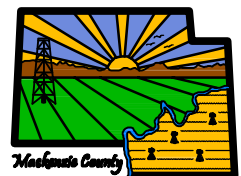
USE BRASS COTTER PIN

NOTES:

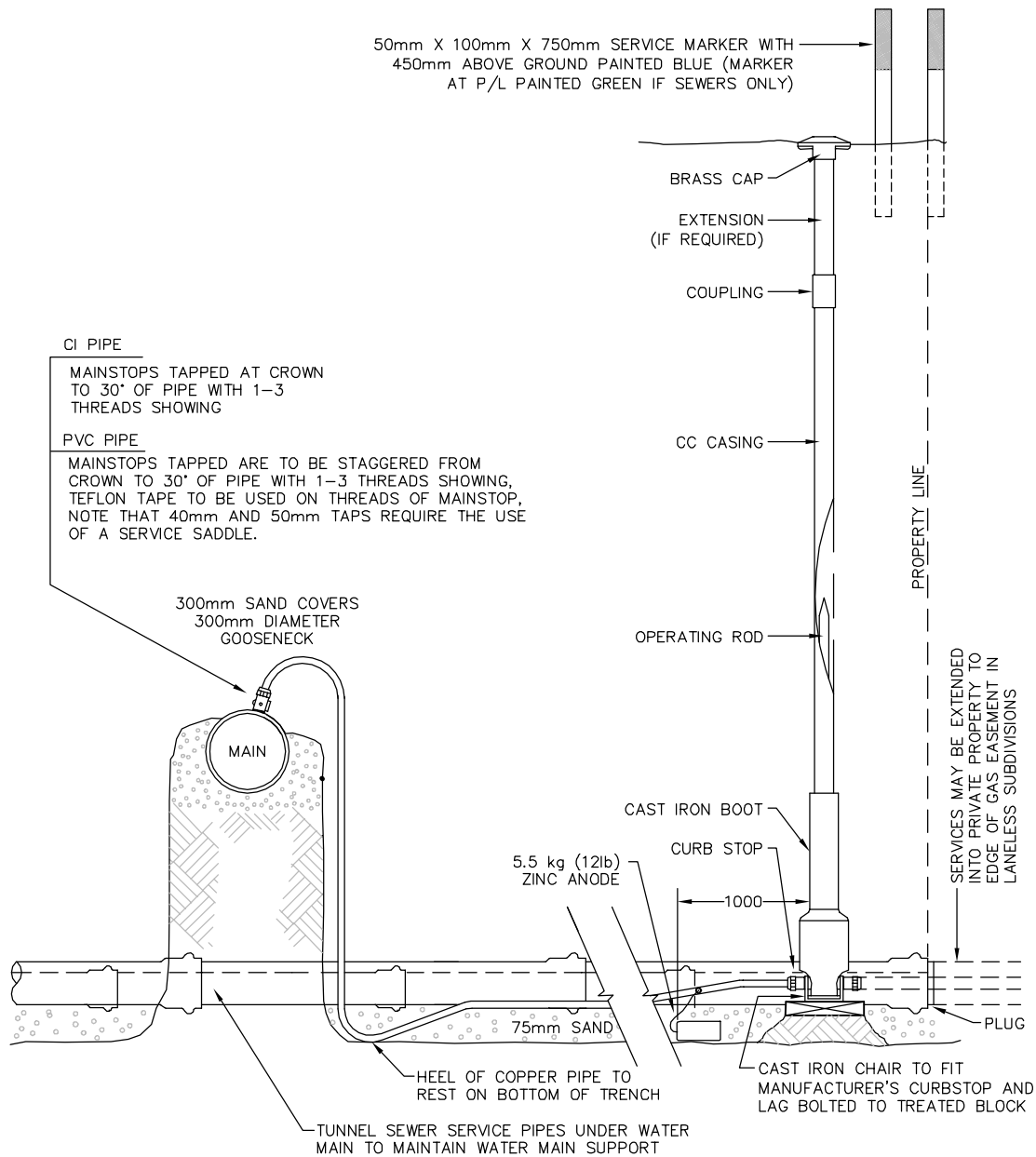
1. OPERATING ROD SHALL BE SUPPLIED AS A SINGLE UNIT COMPRISED OF A SOLID STAINLESS STEEL ROD (A.S.T.M. 8554 - 94), ATTACHED TO A WELDED STAINLESS STEEL OR MANGANESE BRONZE CLEVIS WITH A STAINLESS STEEL RIVET.
2. THE MANUFACTURER'S NAME SHALL BE EMBOSSED ONTO THE CLEVIS.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

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General Municipal Improvements Standards



Rev.		SERVICE BOX DETAIL FOR 50mm & SMALLER WATER SERVICE	
Rev.		Approved:	Figure D-16
Rev.		File No.: GP60.33682	Design:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	

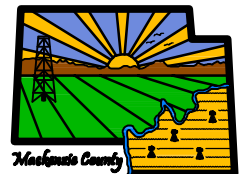


NOTES:

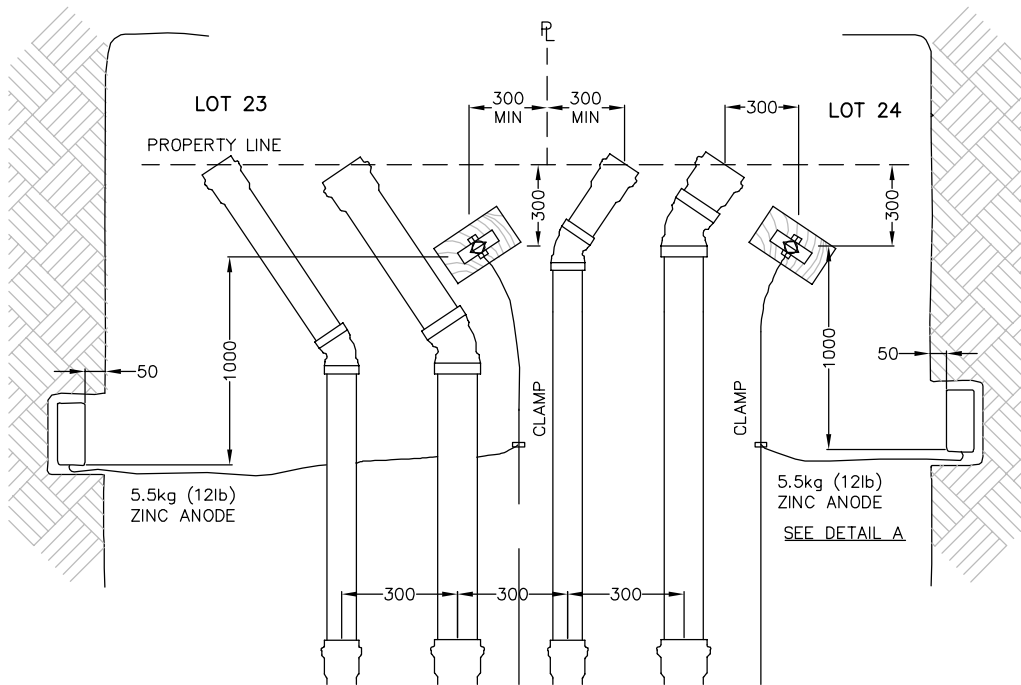
1. AN ADDITIONAL GOOSENECK IS REQUIRED AT EACH SEWER CROSSING.
2. MAINSTOP TAPS SHALL BE A MINIMUM OF 600mm APART, AND NO LESS THAN 300mm FROM A COUPLING OR COLLAR.
3. COPPER SERVICE PIPE SHALL BE ONE CONTINUOUS PIECE, SHOULD LENGTH EXCEED 20m, A DOUBLE UNION WILL BE ALLOWED. SIZE OF COPPER SERVICE MUST BE 25mm MIN. IF LENGTH OF SERVICE EXCEEDS 20m.
4. INVERT ELEV. OF WATER SERVICE PIPES AT P/L SHALL BE 2.59m BELOW ESTABLISHED FINISHED GRADE.
5. WHERE ENGINEER APPROVED COVER OVER WATER SERVICE TO BE LESS THAN 2.59m SERVICE IS TO BE INSULATED.
6. ZINC ANODE SHALL BE ATTACHED TO COPPER PIPE 1.0m FROM CC WITH AN ALL BRONZE (INCLUDING NUTS AND BOLTS) CLAMP OR APPROVED EQUIVALENT.
7. ZINC ANODE TO BE EMBEDDED INTO TRENCH WALL TO PROVIDE FOR MIN. 50mm OF NATIVE CLAY SURROUNDING ANODE.
8. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

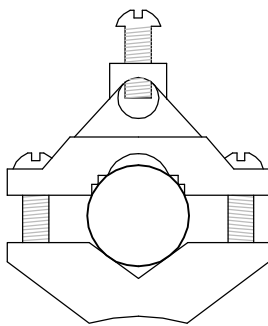
General Municipal Improvements Standards



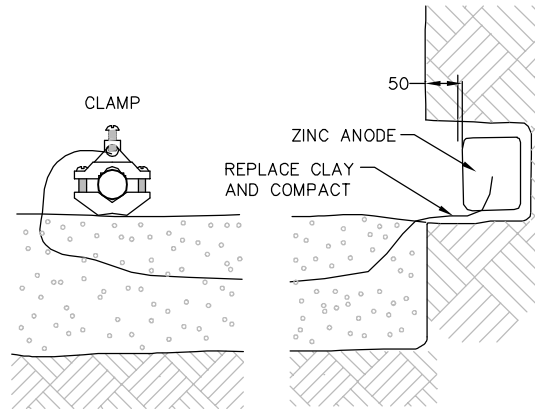
Rev.			TYPICAL 50mm & SMALLER WATER SERVICE FOR 300mm & SMALLER WATER MAINS	
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		D-17



PLAN VIEW



TYPICAL PIPE CLAMP



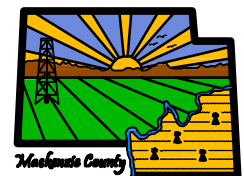
DETAIL A
TYPICAL

NOTES:

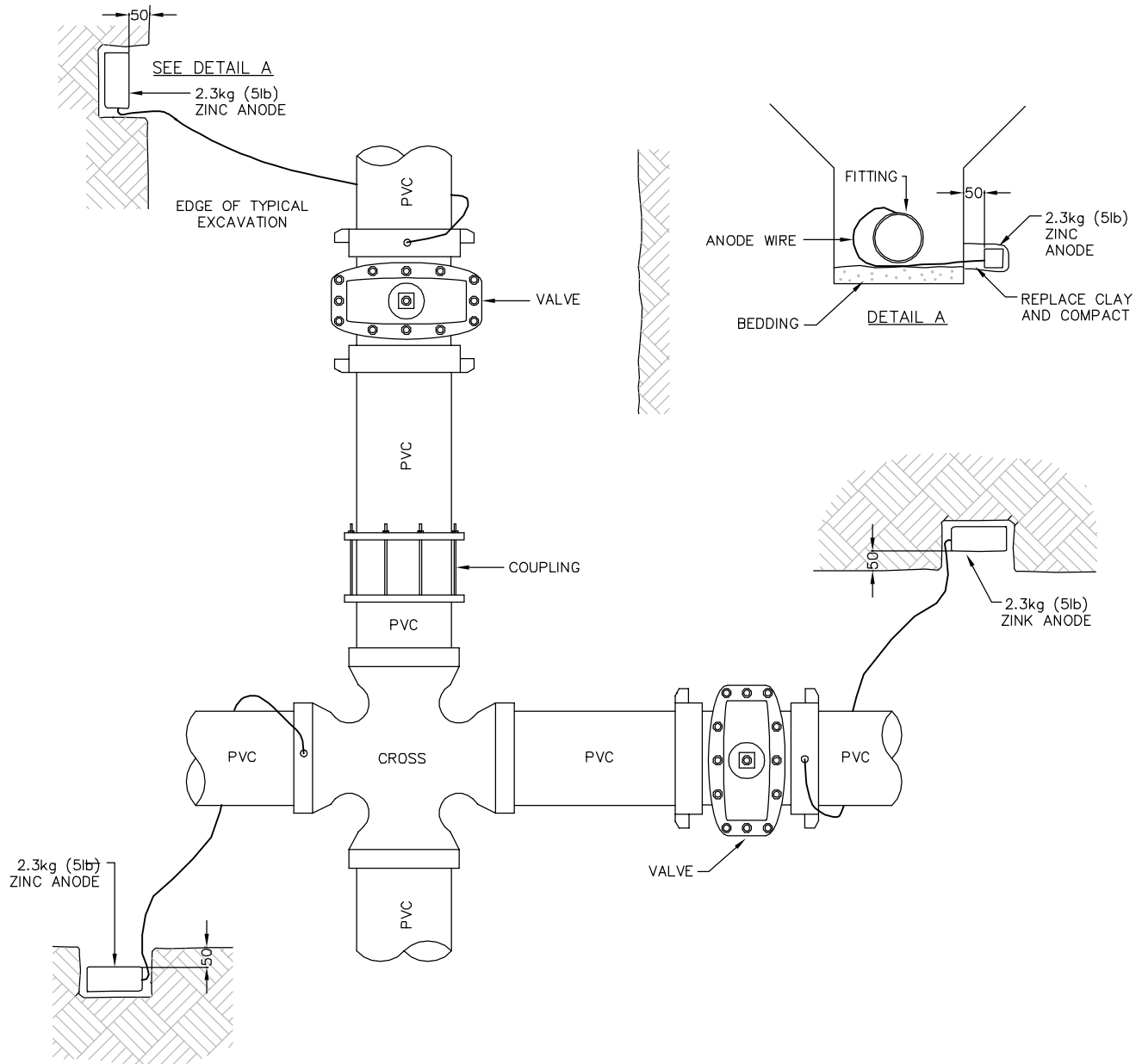
1. PIPE CLAMP TO BE ALL BRASS OR APPROVED EQUIVALENT.
2. ZINC ANODES TO BE EMBEDDED INTO TRENCH WALL TO PROVIDE FOR A MINIMUM OF 50mm OF NATIVE CLAY COMPACTED COMPLETELY SURROUNDING ANODES.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

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Rev.		ANODE INSTALLATION ON 50mm & SMALLER COPPER WATER SERVICE	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure D-18

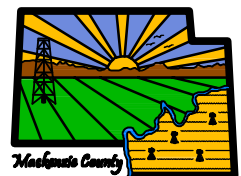


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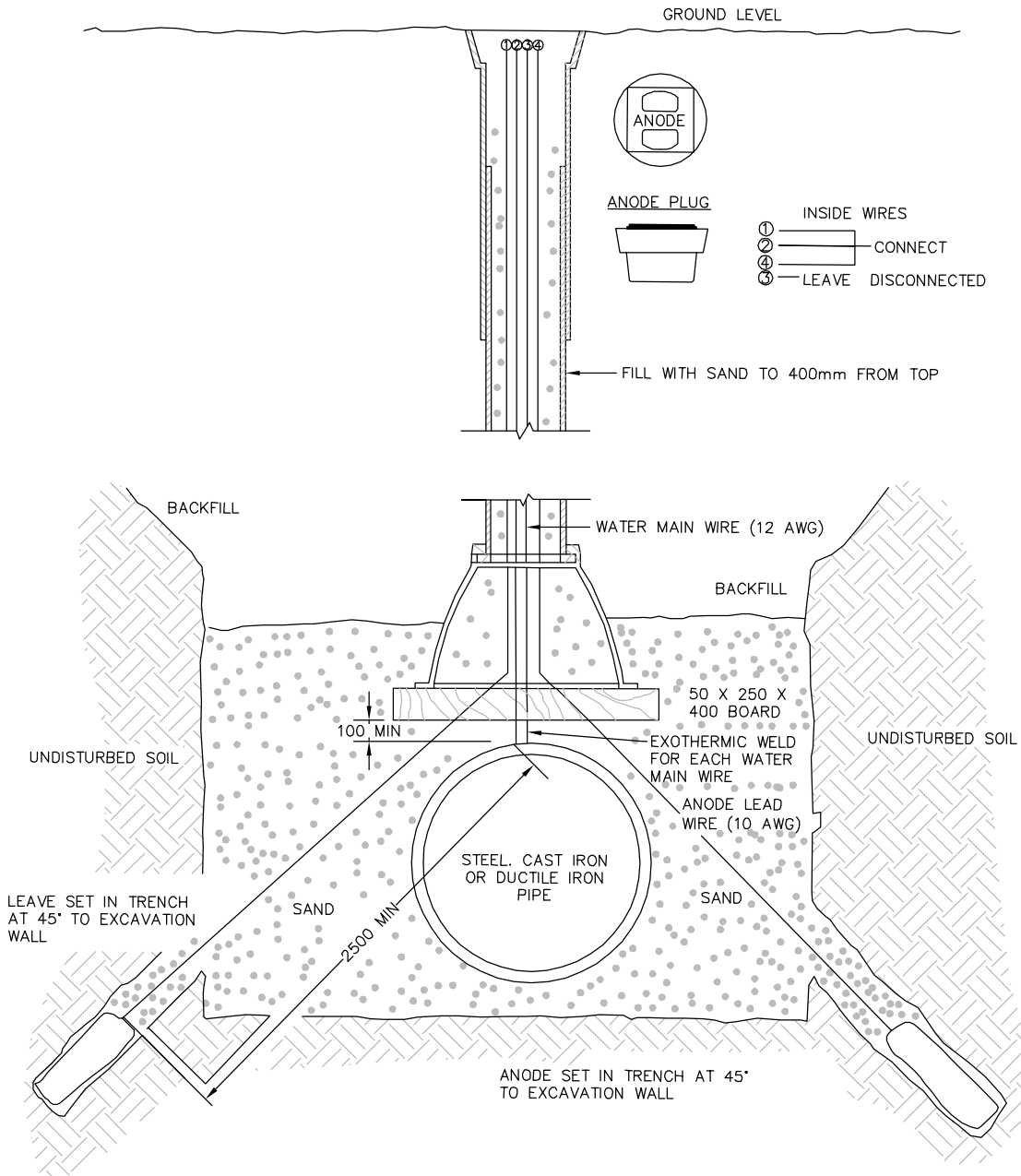
1. MINIMUM DISTANCE FROM ANODE TO PIPE, FITTING, VALVE OR HYDRANT IS 150mm.
2. INSTALL ANODE AT APPROX. PIPE DEPTH IN NATIVE SOIL.
3. ALL ZINC ANODES ON FITTINGS AND VALVES ARE 2.3kg (5lb).
4. ZINC ANODES TO BE EMBEDDED INTO TRENCH WALL TO PROVIDE FOR A MINIMUM OF 50mm OF NATIVE CLAY COMPLETELY SURROUNDING THE ANODE.
5. ANODES TO BE AT LEAST 300mm CLEAR OF THRUST BLOCK.
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

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Rev.		TYPICAL ANODE INSTALLATION AT STEEL OR IRON FITTINGS USED WITH PVC WATERMAINS		Figure D-19	
Rev.		File No.: GP60.33682	Design:		Approved:
Rev.		Drawn: K.P.L	Scale: N.T.S		
Date: 2010-AUG-31					

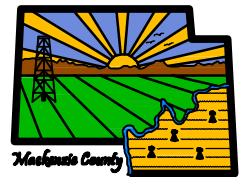


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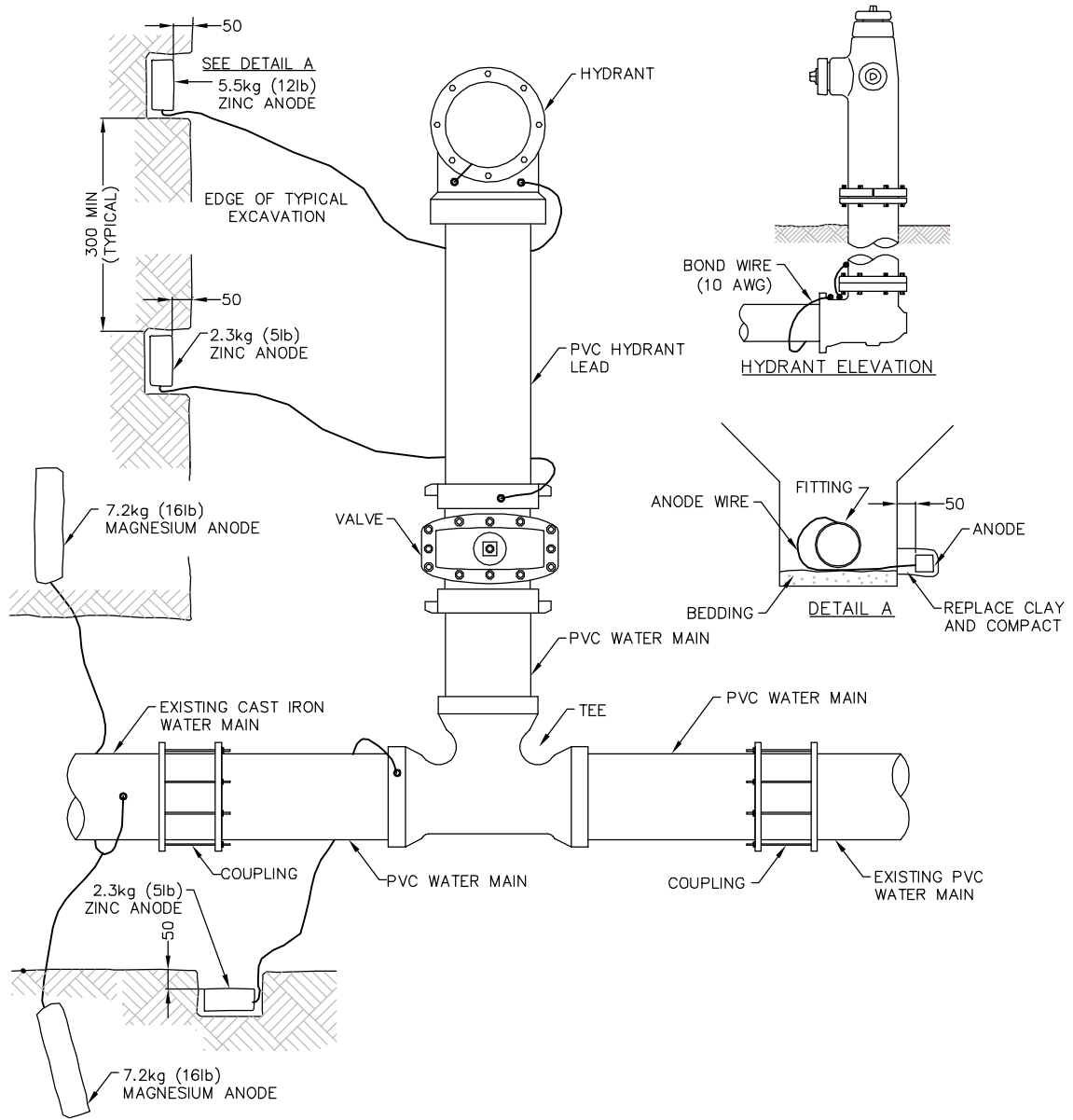
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. NEW STEEL MAINS—INSTALLATION OF A THIRD ANODE TO BE SET IN TRENCH AT 45° EXCAVATION WALL AND A MINIMUM 3.0m CLEARANCE BETWEEN ANODES.
3. NUMBER, SPACING, TYPE AND WEIGHT OF ANODES TO BE DETERMINED BY ENGINEER.

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Rev.	Stewart Weir Naturally Resourceful	ANODE INSTALLATION FOR STEEL AND IRON WATER MAINS	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure D-20

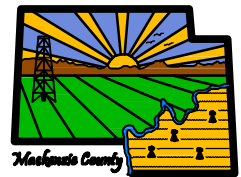


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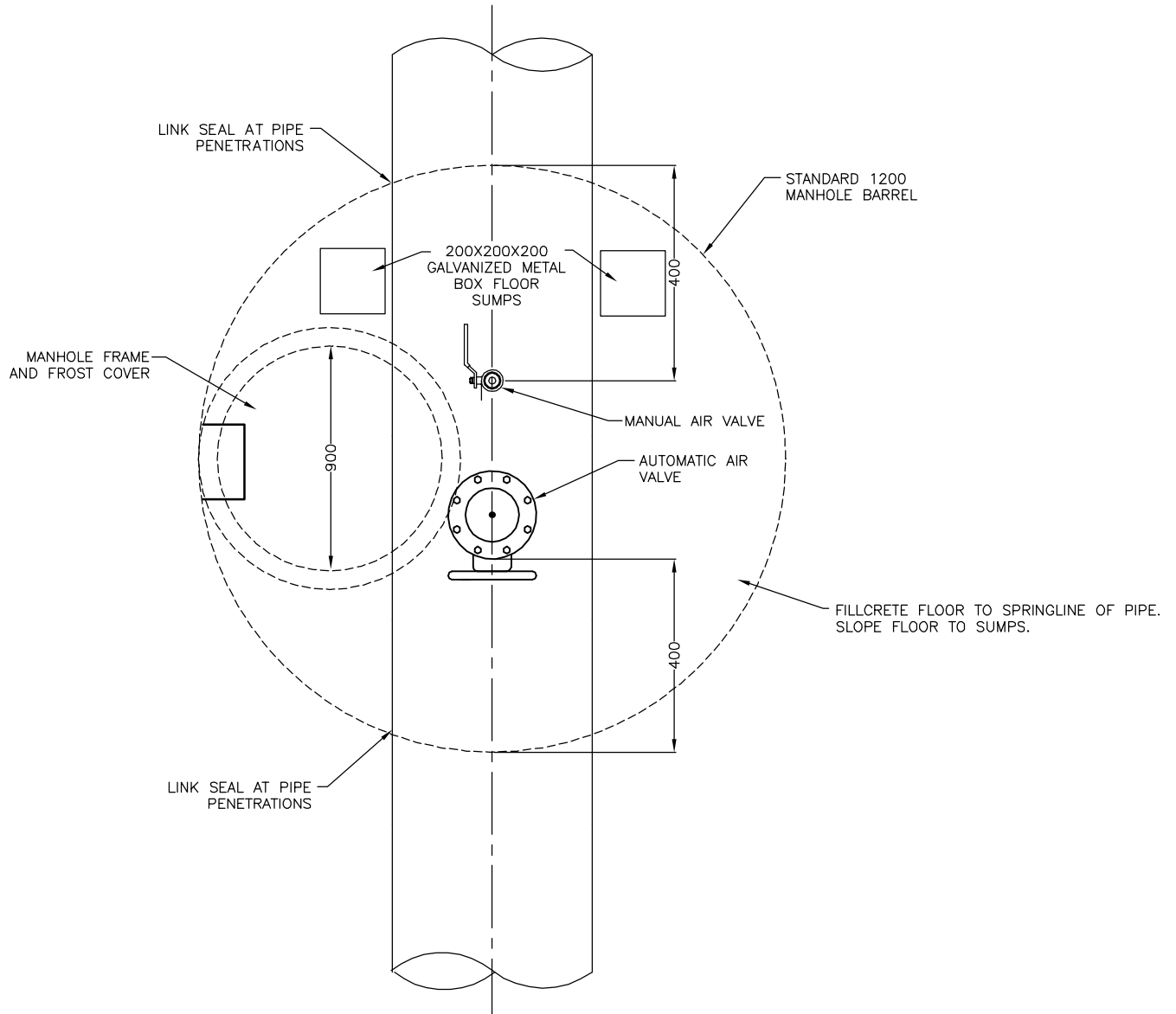
1. MIN. DISTANCE FROM ANODE TO PIPE IS 150mm.
2. INSTALL ANODE AT APPROX. PIPE DEPTH IN NATIVE SOIL.
3. ALL ZINC ANODES ON FITTINGS AND VALVES ARE 2.3kg (5lb).
4. ALL ZINC ANODES ON HYDRANTS ARE 5.5kg (12lb).
5. ZINC ANODES TO BE EMBEDDED INTO TRENCH WALL TO PROVIDE FOR A MINIMUM OF 50mm OF NATIVE CLAY COMPLETELY SURROUNDING THE ANODE.
6. ANODES TO BE AT LEAST 300mm CLEAR OF THRUST BLOCK.
7. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

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Rev.		ANODE INSTALLATION AT HYDRANT		Figure D-21
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure D-21
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

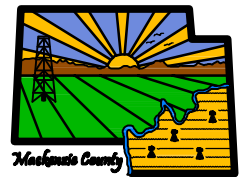


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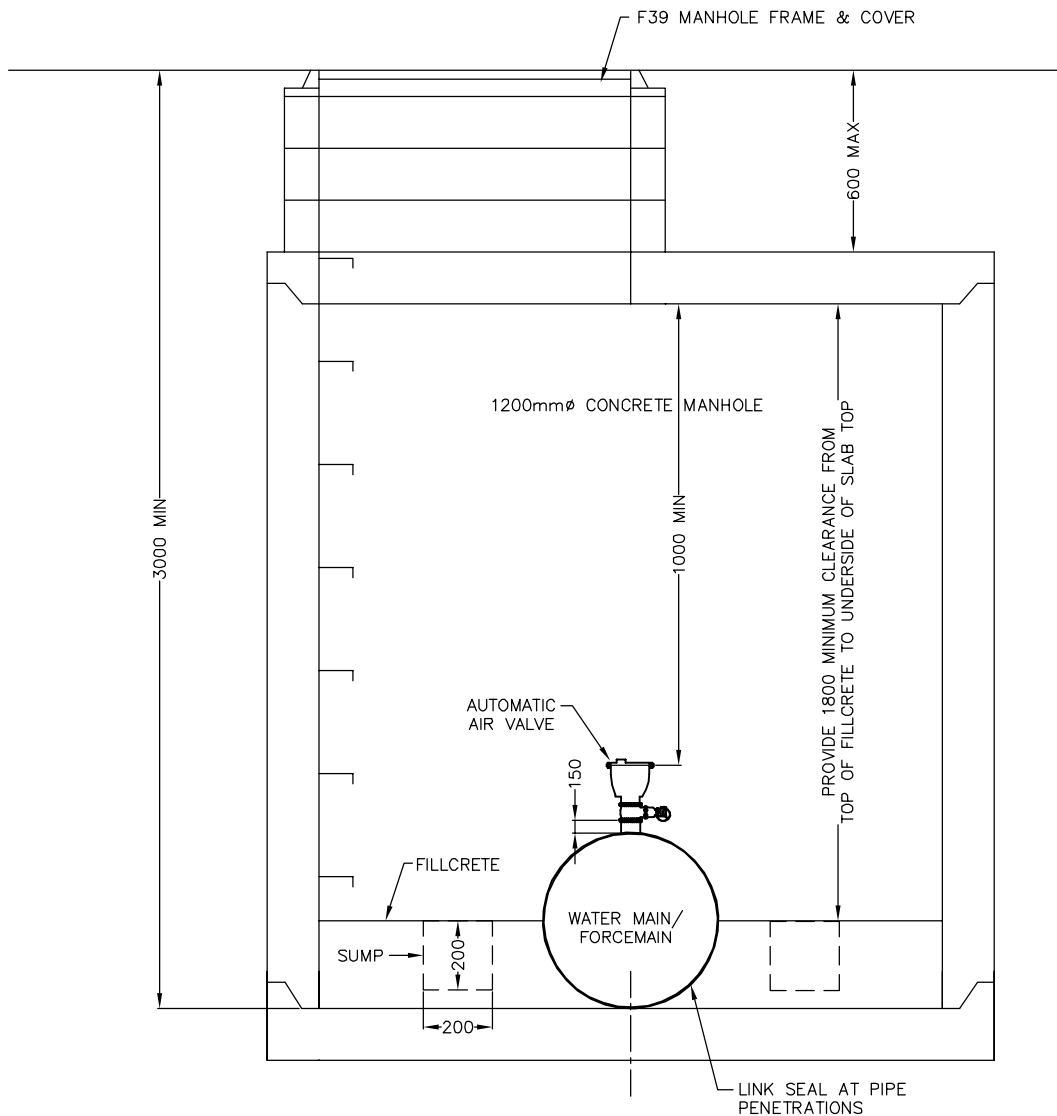
1. INSULATE EXTERIOR OF MANHOLE AND RISER WITH 100mm THICK POLYURETHANE FOAM INSULATION. TREAT WITH APPROVED WATERPROOFING COMPOUND.
2. FOR STEEL AND CONCRETE CYLINDER WATER MAINS, PROVIDE ELECTRICAL ACCESS WIRES WHEN DIRECTED BY THE ENGINEER.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

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Rev.		AUTOMATIC AIR VALVE CHAMBER DETAIL (PLAN)		Approved:	Figure D-22
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:		Figure D-22
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

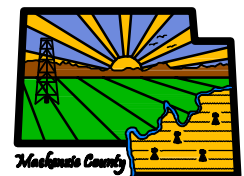


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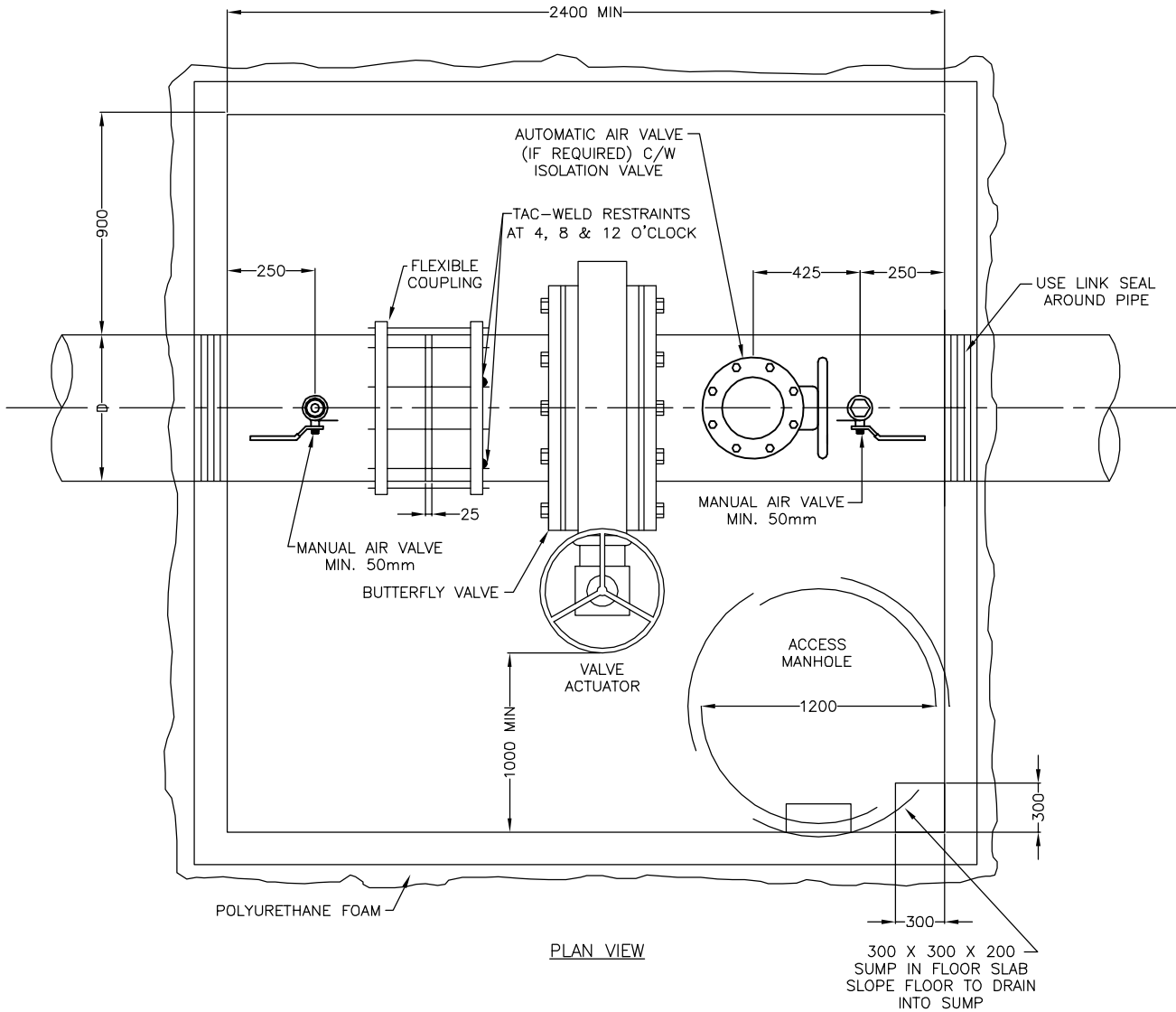
1. ALSO SEE FIGURE D-22.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

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General Municipal Improvements Standards



Rev.		<p style="text-align: center;">AUTOMATIC AIR VALVE CHAMBER DETAIL (PROFILE)</p>		<p style="text-align: right;">Figure D-23</p>
Rev.				
Rev.		Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S



PLAN VIEW

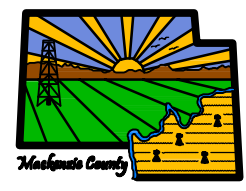
300 X 300 X 200
SUMP IN FLOOR SLAB
SLOPE FLOOR TO DRAIN
INTO SUMP

NOTES:

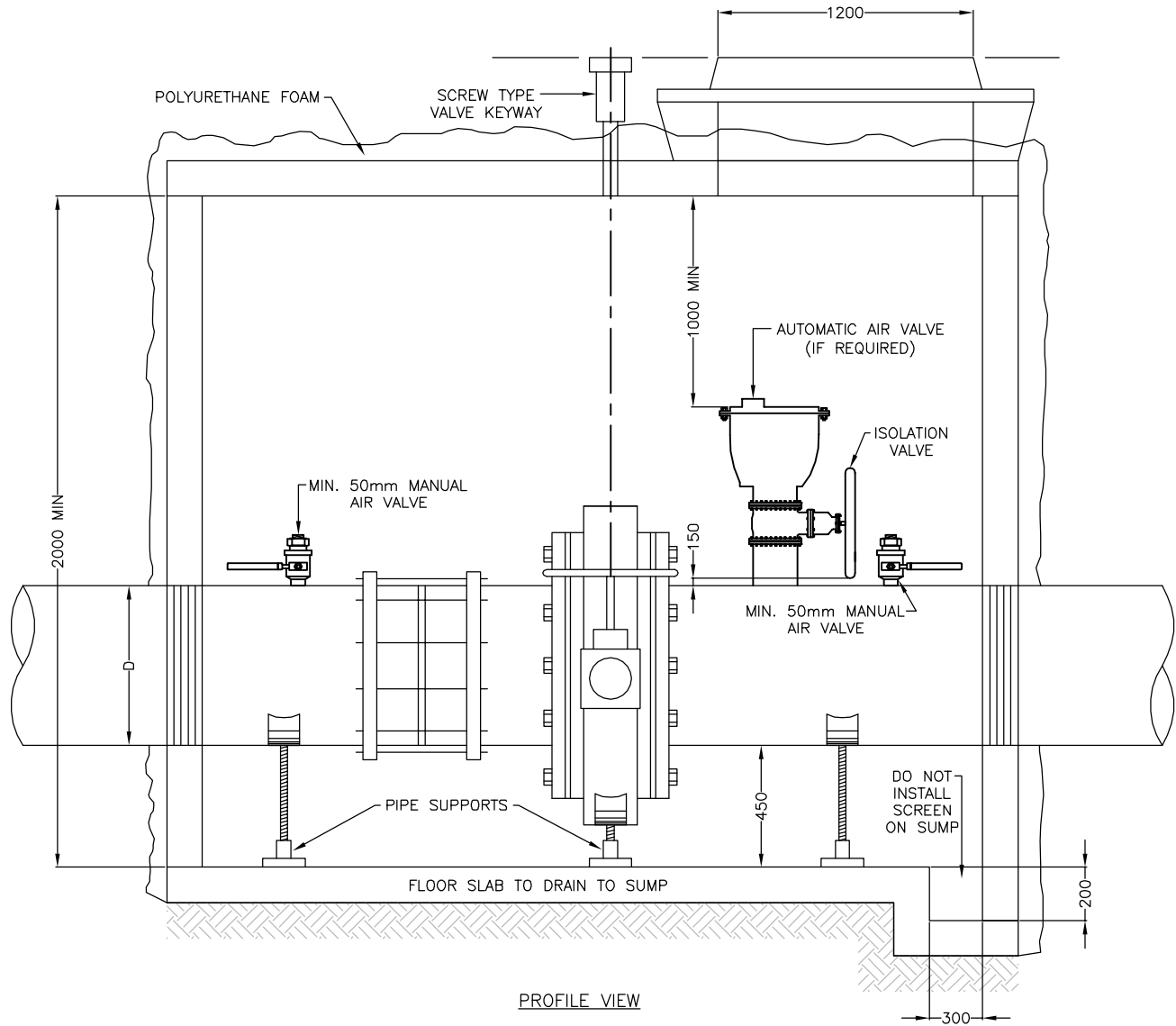
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROVIDE 100mm THICK POLYURETHANE FOAM INSULATION AROUND EXTERIOR OF CHAMBER WALLS, ROOF AND MANHOLE RISER FOR CHAMBERS UTILIZING AUTOMATIC AIR VALVES. PROVIDE A FROST COVER FOR MANHOLE FRAME. COVER ALL INSULATION WITH APPROVED WATERPROOFING COMPOUND.
3. ALSO SEE FIGURE D-25.
4. FOR STEEL AND CONCRETE CYLINDER WATER MAINS, PROVIDE AN ELECTRICAL CONTINUITY BOND ACROSS THE VALVE AND COUPLING WHEN DIRECTED BY THE ENGINEER.

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General Municipal Improvements Standards



Rev.		VALVE CHAMBER DETAIL (PLAN)		Approved:	Figure D-24
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure D-24
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



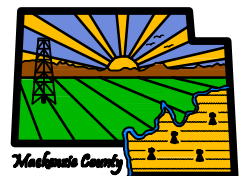
PROFILE VIEW

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALSO SEE FIGURE D-24.

MACKENZIE COUNTY

General Municipal Improvements Standards



VALVE CHAMBER DETAIL (PROFILE)

Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682	Design:
Drawn: K.P.L	Scale: N.T.S

Approved:

Figure D-25

SECTION E SANITARY SEWER SYSTEM

E.1 GENERAL

- E.1.1** The Developer and the Developer's Consulting 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 specifications to be prepared by the Developer's Consulting 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:
- ✓ ASTM - American Society for Testing and Materials
 - ✓ CSA - Canadian Standards Association
 - ✓ Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems
- E.1.3** The specific requirements of the sanitary sewer system will depend on whether the proposed subdivision is defined as a rural or urban subdivision. Regardless, the intent of the sanitary sewer system design is to properly convey sewage generated from the proposed subdivision to an appropriate treatment system. The conveyance and treatment systems are to be approved by the Municipality and must meet current design standards.
- E.1.4** The Developer is responsible to confirm adequate capacity in any existing downstream collection or treatment system, if such information is not readily available from the system owner.
- E.1.5** Generally, rural sanitary sewer system will involve individual disposal fields on each lot. The system must meet *Municipal Affairs* requirements. Site suitability for disposal fields is to be documented in the Geotechnical/Hydrogeological Report for the site. Private sanitary sewage disposal systems shall conform to the current edition of the Alberta Private Sewage Systems Standard of Practice.
- E.1.6** The requirements for urban sanitary sewer system shall be dependent upon the existing and proposed population numbers, the site suitability, the establishment of contributing sanitary basins or benefiting sanitary areas, existing system capacities and flows, and future growth areas. If these Standards do not cover an area of sanitary sewer system concern, the responsibility shall be upon the Developer to make recommendations and present alternative corrective measures based on sound economic, engineering, environmental, operational and maintenance criteria for approval by the Municipality. The system shall meet the recommended standards of Alberta Environment Standards and Guidelines for Municipal Water Supply, Wastewater & Storm Drainage Facilities.

- E.1.7** Connections to the Municipal system from weeping tile or storm run-off connections, or any storm water contribution, including roof drains, will not be permitted.

E.2 FLOW GENERATION RATES

- E.2.1** The proposed sanitary sewer system shall be designed to include all of the total tributary area intended to be serviced by the sewer main at any particular point, as well as the proposed subdivision area, in accordance with the Area Structure Plan engineering recommendation for that area.

- E.2.2** The sanitary system shall be of sufficient capacity to carry peak flows plus an inflow and infiltration allowance. The design flows and factors listed below shall be used as minimum requirements in the design of the sanitary sewer systems:

i. Residential subdivision.

- | | | |
|--|---|-------------------------------|
| a. Population density | - | 3.5 persons/residence |
| b. Infiltration | - | 17,000 L/ha/day |
| c. Average sewage flow | - | 350 L/person/day |
| d. Peak sewage flow | - | Average Flow x Peaking Factor |
| e. The Peak Flow for a residential subdivision may be determined by the following formula (if existing data is not available): | | |

$$Q_{PDW} = (G \times P \times Pf) / 86.4$$

Where: Q_{PDW} = peak dry weather flow rate (L/sec)

G = per capita average daily design flow (L/d)

P = design contributing population in thousands

Pf = peaking factor

f. Harmon's Peaking Factor (P.F.):

$$P.F. = 1 + 14 / (4 + P^{1/2})$$

Where: P = the contributing design population in 1000's.

The population density is to be determined on a subdivision-specific basis using area zoning and default subdivision plans.

The Peaking Factor shall be applied against all residential sanitary generations (excluding infiltration) to determine the peak flow. The minimum peak factor shall be 2.5, with a maximum of 5.

- ii. Industrial, commercial and institutional subdivision.
 - a. Infiltration - 17,000 L/ha/day
 - b. Average sewage flow - 17,280 L/ha/day
 - c. Peaking factor (P.F.):

$$\text{P.F.} = 10Q^{-0.45}$$

Where: Q is in L/sec.

The Peaking Factor shall be applied against all sanitary generations (excluding infiltration) to determine the peak flow. The minimum peak factor shall be 2.5, with a maximum of 5.

- E.2.3** 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.2.4** Infiltration into the sanitary sewer shall be addressed in design. Sanitary manholes should not be located in areas susceptible to ponding. In areas where there is the risk of surface water intrusion, the frames shall be waterproofed to prevent water infiltration into the sanitary system.
- E.2.5** These average rates may not be applied to high water consumption land uses, such as heavy industrial. Detailed analysis of the design requirements specific to each subdivision is required.

E.3 SEWER MAIN

E.3.1 Sewer Main Design

- i. The Manning Equation shall be used to size sanitary sewer mains. The equation is as follows (for System International units):

$$Q = (1/n)AR^{2/3}S^{1/2}$$

Where: Q = quantity of flow (m³/sec)

n = roughness coefficient; n=0.013 is commonly used for the roughness coefficient. Lower values may be used for PVC pipes based on manufacturer's recommendations.

A = cross sectional area of flow (m²)

R = hydraulic radius (m)

S = slope of energy grade line (m/m)

- ii. All sanitary sewers shall be PVC SDR 35. The size shall be based upon Manning's Formula to accommodate the calculated design flow under free flow conditions. The minimum Manning's "n" value shall be 0.013 for all pipes. Minimum diameter of sanitary sewer mains shall be 200 mm for residential areas and 250 mm for commercial and industrial areas.

- iii. All sanitary sewers shall be designed and constructed to achieve a minimum velocity of 0.6 m/sec, a maximum velocity of 3.0 m/sec and mean velocities when flowing full of not less than 0.75 m/sec. The minimum slope of the first upstream leg shall not be less than 1.0 %.

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	0.10
600	0.08

Sanitary sewer main inverts shall not deviate from the design grade by an amount equal to 3 mm plus 3 mm for each 300 mm of pipe diameter. It is recommended that all sanitary sewers be designed with a slope of 0.4% or greater, wherever possible. Minimum slopes shall be increased by 50% on all curved sections.

- iv. Sanitary sewer mains shall be designed to convey the design flow when flowing 80 % full by depth, with the hydraulic grade line at the pipe crown. All pipe crown elevations shall match at manhole junctions.
- v. The Developer is responsible for providing the engineering expertise relating to the structural design of sewers, providing all test results and the quality control of all materials proposed to be used. All sewers shall be designed to prevent damage from superimposed loads.
 - a. For rigid pipes a 0.025 cm crack shall be determined as exceeding the working strength and the pipe will be rejected. For flexible pipe, when deflection greater than seven and one-half percent (7.5 %) of the original diameter is reached, then the pipe shall be considered to have exceeded the limit of serviceability and shall be rejected.
 - b. Proper allowances shall be made with regard to the class of bedding and the trench dimensions when determining the loadings on pipes.
 - c. The "Marston Theory" is to be used in analyzing loadings in the single trench applications for rigid pipe. For flexible pipe, the modified IOWA formula shall be used.
 - d. Concrete pipe specified under ASTM C655 may have combinations of circular and elliptical reinforcement with minimum steel requirements at all outer and inner points as specified under ASTM C76. The Developer shall specify the horizontal and structural strength of all pipes.

E.3.2 Sewer Main Location and Installation

- i. Sanitary sewers shall be installed to provide sufficient thickness of cover to provide complete frost protection. A minimum thickness of ground cover of 3.0 m from the top of the pipe to the final finished grade shall be provided. If the minimum depth of cover cannot be provided, the sanitary sewer main shall be adequately insulated to the satisfaction of the Municipal Engineer.
- ii. Gravity mains shall have sufficient gradients to allow draining from all buildings to the sewer by gravity. Special consideration should be given when building floor elevations are lower than the adjacent roadway. Service lines shall have a minimum cover of 2.6 m from the finished lot surface to the top of pipe at the property line.
- iii. Under normal conditions, sewer mains shall cross below watermains with sufficient clearance to allow for proper bedding and structural support of the pipes. Pipe clearance when passing under watermain shall be a minimum of 300 mm separation between the top of the sewer pipe and the bottom of the watermain. Pipe clearance when passing over watermain shall be a minimum of 500 mm separation between the bottom of the sewer pipe and the top of the watermain. Efforts shall be made to pass under the watermain whenever possible.
- iv. It is recommended that sewers with the inside diameter of 600 mm or less be installed with straight alignment between manholes. Curved sewers will be permitted providing that the following requirements are met:
 - a. Curved sewers shall run parallel to the curb or roadway centerline.
 - b. Sanitary sewer main shall be installed as a simple curve with a radius equal to or greater than 90 m or the manufacturer's minimum recommended radius, whichever is larger.
 - c. Manholes shall be located at intervals not greater than 90 m along the length of the curve.
 - d. Permissible joint deflections shall be in accordance with the manufacture's guidelines.
 - e. Manholes are to be located at the beginning and end of curve.
 - f. The minimum grade for curved sewers shall be fifty percent (50 %) greater than the minimum grade required for straight sewers.
- v. Sewer mains shall be located within the roadway right-of-way and outside the carriageway.
- vi. Sanitary sewers shall be located a minimum of 3 m o/c from any watermain and 1.8 m o/c from any gas line or as required by the utility company.

- vii. Sanitary sewers shall be spaced at a minimum of 0.25 m between pipes (wall-to-wall) from any adjacent storm sewer.
- viii. Public Utility Lot (PUL) widths shall be at least 4 m for a single utility and 6 m for two utilities.

E.3.3 Sewer Main Materials

- i. The Developer shall supply only new materials for the sanitary system installation. All materials found to be defective or damaged shall be replaced at the cost of the Developer.
- ii. Where particular materials and products are specified, it is intended that available equivalents will be acceptable upon approval from the Municipality prior to installation.
- iii. PVC pipe and fittings shall conform to the following:
 - a. CSA B182.2, ASTM D3034, ASTM F679, NQ 3624-130 and NQ 3624-135 standards with minimum stiffness of 320 kPa. Service connections pipes shall have a minimum stiffness of 625 kPa.
 - b. Standard Dimension Ratio (SDR) 35 unless otherwise indicated on the drawings.
 - c. Sealing gaskets shall meet requirements of CSA B182.2 and ASTM F477.
 - d. 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. 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. Pipe and fittings shall be installed within two (2) years from the production date indicated on the manufacturer's certification.
- iv. Polyethylene pipe and fittings for low-pressure systems shall conform to the following:
 - a. Polyethylene pipe shall conform to CSA B137.1 and ASTM D3035, D3350.
 - b. Minimum pressure rating of 550 kPa (Series 80).
 - c. Moulded fittings shall conform to ASTM D2683 or D3261.
 - d. Fabricated fittings shall be manufactured from pipe of the same series as that used in the piping system.
 - e. Pipe shall be joined by thermal butt-fusion, electrofusion coupling, flange assemblies or compression type fittings.

- f. Flanges shall be stainless steel or epoxy coated ductile iron conforming to ASTM A536-80 with stainless steel nuts, bolts and washers.
 - g. Compression couplings shall be used with stainless steel inserts.
 - h. Service tapping saddles shall be Robar Type 2706 or approved equal with bronze body, 44 mm wide stainless steel straps with stainless steel nuts and bolts. Electrofusion saddles shall be allowed for services on HDPE pipe.
 - i. Valves shall be cast iron gates valves with flanged connections.
 - j. 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.
- v. All materials are to be approved by the Municipality in order to ensure consistency and compatibility with materials currently in use. Only approved materials are to be incorporated into the work. The Developer shall be responsible for all materials furnished for the proposed subdivision and shall provide necessary certification by an independent testing authority that the materials delivered conform to the applicable standards. Unapproved materials shall be removed and replaced with acceptable materials, all at the Developer's expense.
- vi. The pipe installation shall be in accordance with manufacturer's instructions and recommendations. When no pipe installation is occurring, the open end of the pipe is to be securely closed. No water shall be allowed to drain through a newly installed pipe. Upon completion, the sewer must be thoroughly cleaned and video inspected. One (1) copy of the video and report shall be forwarded to the Municipality.
- vii. All jointing shall be made between clean pipe ends, as recommended by the pipe manufacturer. Pipe shall not be deflected either vertically or horizontally in excess of that recommended by the manufacturer or as noted in these Standards.

E.4 MANHOLES

E.4.1 Manhole Location and Installation

- i. The maximum spacing of manholes shall be 120 m. Manholes shall be located at the upstream end of each line, at changes in pipe diameter, grade or alignment and at all junctions.

- ii. Inverts in manholes on straight sections of sanitary sewer mains shall have at least 30 mm of fall across the manhole. To maintain a continuous energy gradient through manholes, the obvert elevation of the lowest upstream sewer main shall be equal to or higher than the obvert of the downstream sewer main. The drop across manholes shall be of sufficient magnitude to account for any energy losses in the manhole:
 - b. Pipe deflections of less than 45° require a drop of at least 30 mm;
 - c. Pipe deflections of 45° to 90° require a drop of at least 50 mm.
- iii. Invert drops for pipes larger than 600 mm or for high flow situations shall be assessed on an individual basis. Interior drop manholes shall be considered whenever the invert elevations of the inlet and outlet sanitary sewer mains differ by more than 750 mm.
- iv. Manholes shall be a minimum of 1200 mm in diameter. Precast (Type 50) reinforced concrete manhole barrels conforming to ASTM C478 shall be used. The base shall be constructed of 30 MPa sulphate resistant (Type 50) concrete. Galvanized iron safety steps are required.
- v. Manholes shall be located at the extension of property lines whenever possible in order to avoid conflicts with driveways.
- vi. Manhole frames and covers shall be of cast iron. A Norwood NF-80 or NF-90 frame and cover, or an equivalent approved by the Municipality shall be used for sanitary and storm manholes located in roadways. An appropriate locking manhole frame and cover shall be used on manholes located in parkland areas. Castings shall be marked with series designation, foundry identification and date of casting. Manhole covers with the Municipality identification will be encouraged. Other municipal identification covers are not permitted within the Municipality.
- vii. All industrial, commercial and institutional subdivisions shall have an inspection manhole or chamber installed on their sanitary sewer service connection. Where possible, a service shall be connected to an existing or proposed manhole constructed on the sanitary sewer main alignment. Where a direct connection is made to the sanitary sewer main, an inspection manhole or chamber shall be installed. All inspection manholes or chambers are to be located at the property line or easement line on the sanitary service.

E.4.2 Manholes Materials

- i. Unless specified with better material accepted by the Municipal Engineer, all underground and water retaining structures 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. 30 MPa concrete shall be used and tested in accordance with CSA 23.2.
- ii. The design of foundation, footing, excavation, soil, rock and liquid retaining structure shall comply with the current National Building Code and Alberta Building Code. 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.
- iii. Concrete manholes, catchbasins shall be manufactured with pre-cast reinforced concrete components conform to ASTM C478. No corrugated steel pipe shall be allowed. Component joint shall be supplied with a pre-formed and sealed O-ring type rubber gasket, comply to ASTM C443 or current requirement.
- iv. Minimum of 100 mm thick bedding of granular material (no particles larger than 32 mm) shall be placed for levelling bed for the aforesaid structures.
- v. 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.
- vi. Manhole sections shall be pre-cast reinforced concrete conforming to ASTM C478 and CSA A257.4. The concrete shall achieve compression strength of 30 MPa at 28 days after placing. The maximum allowable slump shall be 75 mm. 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.
- vii. All manholes shall have an inside diameter of 1200 mm for pipe 900 mm and less. For pipes exceeding 900 mm in diameter, manhole diameters shall be pipe diameter plus 600 mm or a tee-riser shall be used. For pipe exceeding 900 mm diameter or manhole having multiple inlets, manhole sizing shall be subject to review by the Municipality. The Developer shall submit the specification for the Municipality for review and approval with their design submission.
- viii. The manhole shall be checked against floatation at HWL if the manholes are not using reinforced concrete.

- ix. 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.
- x. All pipe penetrations shall be sealed with rubber gaskets conforming to ASTM C443, all joints between grade rings, conical top, slab tops and frames will use bituminous type seals (i.e. Rubber Neck) to create a water proof joint.
- xi. Pre-benched manhole bases shall be used wherever possible with pre-cored connection holes and watertight Duraseal or G-Loc joints or approved equal.
- xii. Tee-riser manholes shall conform to CSA 257.2, ASTM C76 and CSA A257.4, ASTM C76.
- xiii. Safety platforms are not to be used in any manholes As per ASTM C478-07, Standard Specifications for Reinforced Concrete Manhole Sections, a personal fall protections/rescue harness system should be used.
- xiv. All pre-cast units shall be marked with manufacturer's identification, date of casting, type of cement and CSA standard.

E.5 LOW PRESSURE SEWER SYSTEM

E.5.1 Low pressure sanitary sewer collection systems are normally installed in situations where there is inadequate grade to economically install gravity collection systems. The requirements listed herein include components to be installed on private property and public rights-of-way. The limits of responsibility must be determined by the Developer at the commencement of the planning and design stage. Due to increased operation costs of low pressure sewer systems, gravity collection systems are strongly preferred as the sanitary sewer collection system of choice for the Municipality. Applications that include a low pressure system must be approved by the Municipal Engineer based on site specific conditions.

E.5.2 Low pressure sanitary sewer collection systems consist of two major components; the onsite pressurization facility and the pressurized sewer main. The pressurization facility may consist of a grinder pump system or a septic tank and effluent pumping system. Grinder pump systems have higher operational and maintenance costs. As a result, septic tank systems are the preferred option. The pressurized sewer mains normally range in size from 30 mm to 100 mm depending upon the number of residences connected to the system.

- E.5.3** It is the responsibility of the Developer's Consulting Engineer to determine the maximum number of pumps that will be pumping simultaneously and to size the main accordingly. These are the minimum design requirements:
- i. Minimum main pipe diameter - 50 mm
 - ii. Minimum service pipe diameter - 38 mm
 - iii. Minimum flow velocity - 0.6 m/sec
 - iv. Maximum flow velocity - 3.0 m/sec
 - v. Hazen Williams flow coefficient (C) - 150
- E.5.4** A two-compartment septic tank is required with a minimum total volume of 3,000 litres for a single-family dwelling. The use of a single chamber tank with a grinder pump is not permitted. Septic tanks shall provide effective solids settling and grease removal capabilities as well as providing adequate storage volumes to ensure reasonable pump cycle times.
- E.5.5** Sanitary sewer pumps shall have an open impeller design suitable for handling septic tank effluent. Pumps may either be submersible pumps installed in the second chamber (liquid chamber) of the septic tank or a centrifugal pump installed in the basement of the building with a suction line to the second chamber. All pump connections shall incorporate double check valves downstream of the pump discharge to prevent backflow into the septic tank.
- E.5.6** The maximum head for economical operation of low pressure sanitary sewer systems is 24 m (35 PSI). Pumps with higher discharge pressures should not be utilized unless detailed engineering design calculations recommend higher operating pressures. All pumps and collection mains within the system shall be designed to accommodate higher pressures if necessary. Small collection systems (40 residences or less) shall have all the discharge pumps designed for the same maximum discharge head.
- E.5.7** 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.5.8** A single pump intended to accommodate multiple services shall not be permitted unless the Developer's Consulting Engineer can demonstrate that the design will not be detrimental to the other system users.
- E.5.9** Sewer mains shall be either PVC pressure Class 150 or HDPE Series 100, and shall be capable of operating at a continuous pressure level of 875 kPa at 23°C. The minimum pipe size for sewer mains shall be 50 mm. Sewer mains shall not be oversized to reduce frictional head loss.

- E.5.10** Minimum depth of cover on sewer main shall be 3.0 m, measured from the top of the sewer to the final finished surface.
- E.5.11** Service pipes shall be 38 mm diameter Series 160 polyethylene or polybutylene tubing.
- E.5.12** PVC fittings for use with PVC pipe shall be a rubber gasket joint manufactured for the type of pipe used in the mains. Polyethylene pipe shall be joined by the butt fusion method and connected to fittings as recommended by the pipe manufacturer.
- E.5.13** Fittings shall PVC polyethylene or cast iron conforming to CAN3-B137.3, CAN-B137.1 or CAN3-B131.9 as appropriate. Fittings shall be designed for a working pressure of 900 kPa. Where flanged joints are used the bolts shall be manufactured from stainless steel.
- E.5.14** Service tees for use on 50 mm diameter mains shall be tapped to accept 37 mm or adapters. Only bronze reducing bushings shall be used to decrease the size of threaded opening in PVC tees down to 37 mm. Service tees on pipes 75 mm diameter or larger shall be made using Smith Blair Service Saddles as follows:
- i. Smith Blair Style 342 for 75 mm and 100 mm mains.
 - ii. Smith Blair Style 352 for 150 mm and larger mains.
- Only bronze reducing bushings shall be used to reduce the opening in the service saddle to 37 mm.
- E.5.15** Corporation stops for plastic service tubing shall have a compression joint. Stainless steel stiffeners of the correct size shall be used at all compression joints on polyethylene and polybutylene service tubing.
- E.5.16** Curb stops for plastic pipe shall have a compression type joint. The curb stop shall be of the ball valve type. Curb stops shall be equipped with an extension type valve box suitable for 3 m bury in the extended position. Stainless steel stiffeners of the correct size shall be used at all compression joints on polyethylene or polybutylene pipe.
- E.5.17** Ball valve curb stops shall be used as valves on 50 mm diameter pipe and shall be supplied with an extension type valve box suitable for 3 m bury. Valve boxes shall be protected against damage. Joints shall be of the compression type for both outlets.
- E.5.18** For 75 mm and larger pipe, valves shall be epoxy lined water works gate valves conforming to AWWA Specification C500.
- E.5.19** Valve boxes for 75 mm and larger valves shall be Norwood Foundry Type A or approved equivalent.
- E.5.20** The low pressure sewerage system shall be subjected to, and pass, a leakage test for one hour at 875 kPa pressure. The allowable leakage shall not exceed the pipe manufacturers recommended allowance.

E.5.21 The use of repair clamps will not be permitted when making repairs to the pipe of the low pressure sewerage system. Regardless of the pipe being used, the bedding shall be placed to provide a minimum of 150 mm of sand cover over the pipe.

E.6 SANITARY SERVICE CONNECTIONS

- E.6.1** Separate sanitary sewer connections to the property line shall be provided for each separately titled lot or unit of multi-family dwellings.
- E.6.2** The minimum diameter of a residential gravity sanitary sewer service from the main to the property line shall be 150 mm. The Municipality may approve 100 mm diameter services under special circumstances where the total service length from main to proposed building site is less than 20 m.
- E.6.3** The minimum diameter of a residential low-pressure sanitary sewer service shall be 38 mm.
- E.6.4** Non-residential service connections shall be sized according to anticipated user requirements.
- E.6.5** 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.6.6** Connections for all proposed residential lots shall be installed at the time of initial subdivision development.
- E.6.7** The grade(s) of any sewer is governed by the minimum velocity required (0.6 m/sec). If the design flow does not produce a minimum velocity of 0.6 m/sec, the minimum grade must be calculated using d/D of 0.35 and velocity of 0.6 m/sec. Upon this condition the minimum grades for pipes 400 mm and smaller shall be as shown in Table 6.7-1:

TABLE 6.7-1 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.6.8** Risers for service lines shall be required when sewer mains exceed 4 m in depth.
- E.6.9** Services shall be located such that they do not conflict with driveway locations.

E.6.10 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 sanitary service connections shall be extended to the edge of the easement furthest from the roadway.

E.6.11 Sanitary services shall always be installed to the right of the water service when facing the property line from the roadway.

E.6.12 Weeping tiles, roof leaders and other similar appurtenances handling storm or groundwater shall not be permitted to discharge into the sanitary sewer.

E.7 CONSTRUCTION

E.7.1 Trenching, Bedding and Backfilling

- i. All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.
- ii. 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.
- iii. Granular materials shall be well graded and approved by the Municipality before use. 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 100 mm below the pipe and shall extend up both sides to the trench wall and provide a minimum cover of 300 mm above the pipe. Where necessary, the Developer’s Consulting Engineer shall determine special pipe foundation measures for areas where unsuitable pipe foundation conditions exist. Bedding sand bedding sand must be clean and meet the following requirements:

Sieve Size Passing	% Passing, By Mass
2,500	100
630	60 or more
315	30 or less
160	20 or less

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

- v. Excavated material shall be stockpiled at a safe distance from the edge of the trench. Backfill material shall be the soil excavated from the trench although approved granular materials may be substituted for poor existing soils. All backfill material will be subject to approval by the Municipality. If possible, the excavated material shall be placed back in the trench in the vertical and horizontal order in which it was excavated. Backfill shall be placed in uniform lifts not exceeding 300 mm loose thickness. Where clay is used as backfill material, its moisture content shall not exceed the Plastic Limit by more than ten percent (10 %).
- vi. Within roadways, under no circumstances shall backfill material containing ice, snow, organic or any other deleterious material be used. Trench excavations shall be kept free of water.
- vii. Compaction and densities:
 - a. Prior to street construction: all excavations under proposed carriageways, sidewalks, street lights or other similar surface structures shall be backfilled in lifts with compacted thickness of 300 mm or less per lift and compacted to minimum density of not less than 98 % of the Maximum Standard Proctor Density or as otherwise approved by the Municipality. A minimum of two (2) density tests per 100 lineal meters of trench per 600 mm of compacted backfill thickness shall be taken. Additional tests may be called for as deemed necessary. Any free water in a trench shall be removed prior to placing additional lifts.
 - b. Under existing carriageways: all excavations under existing carriageways, sidewalks, lanes or other similar surface structures shall be backfilled to meet the following specifications:
 - 300 mm or more below final grade – backfill materials shall be compacted to minimum density of not less than 98 % of the Maximum Standard Proctor Density.
 - 0 - 300 mm below final grade – backfill materials shall be compacted to a minimum of 100 % of the Maximum Standard Proctor Density and based on a minimum of two (2) field tests per 100 lineal meters of trench of compacted backfill. Backfill shall be placed in uniform lifts not exceeding 150 mm compacted thickness.
 - c. Adjacent to existing carriageways: all material 300 mm below the finished grade shall be compacted to a density not less than 98 % of the maximum density of a five point Standard Proctor Compaction Test and based on a minimum of one (1) field test per 150 lineal meters of trench for each 600 mm of compacted vertical backfill.

- d. Sand or gravel backfill shall be compacted to meet the following density requirements:
 - 300 mm or more below grade - the minimum acceptable density shall be 98 % of the Maximum Standard Proctor Density.
 - 0 - 300 mm below grade - all sand or gravel in this zone shall compact to 100 % of the Maximum Standard Proctor Density.
- e. Compaction testing: for all density tests indicating insufficient compaction, two (2) more density tests, proportionately representative of the trench length tested shall be taken at that depth. If the average of the three (3) tests is below the required density, the area of deficient density shall be re-excavated and re-compacted to meet the specified density. Densities greater than 100 % shall be deemed to be at 100 % for calculating the average of the three tests.
- f. Sub-grade and base course compaction for roadway construction shall be as specified in the applicable sections of these Standards.
- viii. The Developer's Consulting Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.
- ix. If the above standards cannot be achieved due to a large variation in soil types throughout the subdivision, 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 Consulting Engineer justifying the required changes to the compaction standards.
- x. If the established 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 shall not be permitted as an alternate testing procedure due to wet soil conditions. The Developer's Consulting Engineer shall be required to suggest appropriate measures such as drying in-situ material or importing suitable material in order to meet the required minimum densities.
- xi. All landscaping, pavement structures, sidewalks, curb and gutter, and any other existing structures and facilities damaged or removed during trenching shall be restored or replaced at the Developer's expense.
- xii. All debris, surplus fill and unused materials must be removed from the site as directed by the Municipal Engineer.

E.7.2 Sewer Main Installation

- i. 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.
- ii. Pipe installation shall start at the outlet and work upstream.
- iii. Pipes shall be carefully aligned when jointing. Joints are to be kept free of mud, gravel and foreign material and shall be completed as outlined in the manufacturer's specifications. Each joint shall be completed before laying the next length of pipe. Deflections shall not exceed those permitted by the pipe manufacturer.
- iv. The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete. When pipe installation is not in progress, the open ends of installed pipe shall be closed with an approved plug or cap to prevent entrance of trench water and/or any foreign or other material into the line.
- v. Adequate backfill shall be placed on the pipe to prevent floating. Any pipe which has floated shall be removed from the trench and be re-installed as directed by the Municipality.
- vi. The alignment of pipes less than 900 mm in diameter shall not be more than 150 mm off the designated alignment. The alignment for pipes larger than 900 mm shall not deviate by more than 50 mm per 300 mm of pipe diameter.
- vii. The invert of the pipe shall not deviate from the design grade by more than 6 mm plus 20 mm per metre of pipe diameter.
- viii. Standard plugs shall be inserted into the bells of all dead end fittings and plain ends of pipe. A concrete thrust block shall then be placed behind this plug backing onto undisturbed material. A valve shall be placed within a distance of two full pipe lengths (12 m typical) from the end of the pipe or between the plug and fitting, as required.

E.7.3 Manholes Installation

- i. Manholes shall be installed as depicted on the detail drawings and in accordance with manufacturer's recommendations.
- ii. Use of specific structures such as pre-cast or cast in place manholes shall be determined by the Developer's Engineer depending on application and approved by the Municipality.
- iii. Backfill around manholes shall be compacted to a minimum of 98 % of Standard Maximum Proctor Density.
- iv. Tee riser manholes shall require Class A bedding placed from the bottom of the excavation to the pipe spring line.

- v. Pre-cast manhole bases shall be installed on a base of 100 mm to 300 mm of washed gravel.
- vi. Cast in place manhole bases approved by the Municipal Engineer shall be placed directly on undisturbed ground.
- vii. 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 300 mm. Steps shall be evenly spaced at a maximum of 410 mm to within 600 mm of the base of the manhole.
- viii. The manhole frame and cover shall be installed following manufacturer's recommendations.

E.8 INSPECTION AND TESTING

E.8.1 All material testing shall be performed by an accredited firm 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.8.2 Closed Circuit Television Inspection of Sewer Lines

E.8.2.1 General

This section of the Standards shall form a part of the Contract Documents and should be read in conjunction with them.

The work shall include television inspection of sewer mains between manholes including a digital or audio commentary on location and distance encoding, written report and still photographs of problem areas.

The equipment, materials and methods used must produce suitable video records and logs for the identification and categorization of deficiencies, as well as the determination of the location, extent and seriousness of each deficiency.

All sewer lines shall be flushed and cleaned prior to video inspection. Lines, including stubs must be inspected with either actual flow or simulated flow pronounced by adding water at an upstream manhole or riser pipe. The simulated flow must produce a visible, laminar flowing stream in the line for the full length of the line being inspected. Inspections will be rejected where the simulated flow exceeds one-third the diameter of the pipe.

E.8.2.2 Video Records and Index Plans

Video records are to be supplied by the Contractor and shall be in DVD format and in color. The Contractor shall set up the DVD's on a format where each section of pipe or services has a separate chapter number. All video inspections are to be done in color and with sufficient lighting to result in clear high quality picture. The Contractor must also provide an 11" x 17" plan with an Index of video runs to pipe element or manhole numbers. Manhole numbers shall be as prescribed by the Municipal Engineer and, in the absence of such, the manhole numbers on the Detailed Engineering Drawings shall be used. The manhole numbers from the Detailed Engineering Drawings shall be on a plan showing the location and the number of the manholes, and is to be bound in with the video and index sheet. There shall be separate video DVD's for sanitary mains and services. Separate logs shall be provided for each DVD.

E.8.2.3 General Operations

The entire length of each sewer shall be video inspected between manholes. In new subdivisions, terminating videos at the connection point to an existing stub will not be permitted. The camera unit shall, at no time, travel at a rate of speed greater than 6 m per minute. If for any reason, the video camera unit will not pass from one manhole to another then a reverse run shall be done at no extra cost. The video inspection shall take place during low flow conditions. At no time during video inspection shall the depth of flow exceed 1/3 of the pipe diameter. Camera travel shall be in the same direction as the flow, at all times, unless impractical or when a reverse run is necessary. Newly constructed pipes are to be video inspected with simulated flow by running water into an upstream manhole or clean-out.

The camera shall be positioned centrally in the pipe with a tolerance of +/- 10 %. If conditions within the pipe do not allow for this configuration, a greater tolerance may be allowed upon approval by appropriate Utility personnel and/or the Municipal Engineer. Chainages for the video inspection shall begin at the inside face of the starting manhole wall and terminate at the inside face of the end manhole wall.

E.8.2.4 Video Taping

The video inspection of each section of sewer line shall begin with a digital or audio commentary describing the following:

- i. Time and date
- ii. Weather conditions at the time of inspection
- iii. Subdivision description and/or phase
- iv. Location description in and on-from-to format as described on the list of lines to be inspected

- v. Manhole numbers as provided by the Developer
- vi. Size and use of sewer including pipe material
- vii. Direction of flow
- viii. Inspection technician
- ix. DVD identification number

This information shall also be written on the video report sheet.

E.8.2.5 Work Report

A television work report, in log form, shall be completed during the inspection. This log shall show the exact measured location of faults including, but not limited to:

- i. Open joints
- ii. Broken, cracked, collapsed or ovaled pipe
- iii. Accumulation of debris or obstructions
- iv. Root penetration and root rating (1 to 9 root rating system)
 - v. Infiltration and mineral deposits
 - vi. Water depth variation and sags
- vii. Protruding gaskets
- viii. Service connections and type (in-line or inserta-tee)

The reference location shall include the distance away from the reference manhole and also the position of the fault as referred to the crown of the pipe using the clock face notation. Significant faults are to warrant audio commentary on the video tape duplicating report information. The camera shall be stopped briefly at these locations. Color photographs shall be taken of all sewer defects. The photographs shall be coordinated with the written report by reference numbers. Photographs of all deficiencies are required. Additional photographs shall be taken as deemed necessary.

One (1) copy of the final typewritten report with corresponding photographs and one (1) copy of the video inspection DVD's shall be furnished to the Municipal Engineer within one (1) week after completion of the inspection.

All video inspection DVD's shall be numbered and cross indexed to the typewritten report. Reports shall be bound and if more than one report is submitted in one binding, then there shall be an index sheet provided with the binding indicating the contents. Separate reports shall be submitted for mains and for services.

- E.8.3** Sections requiring repair will be subject to re-inspection when repairs are complete. At the discretion of the Municipal Engineer, re-inspection by a camera may be required on selected areas prior to issuing of the Final Acceptance Certificate. All video inspection costs shall be borne by the Developer.
- E.8.4** At the Municipal Engineer's discretion, an infiltration and/or exfiltration tests (leakage test) may be required for any section showing deficiencies during the camera test. Tests procedure shall be as follows:
- i. 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 1 m to 3 m 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.
 - ii. The allowable leakages are as follows:
 - a. Infiltration test shall be performed when the groundwater is above the pipe crown for the entire test length. Allowable infiltration is 5.0 L/day/mm diam/km for PVC pipe and 20.0 L/day/mm diam/km for concrete pipe.
 - b. Exfiltration test shall be performed when the groundwater is below the pipe invert for the entire test length. Allowable exfiltration is 5.0 L/day/mm diam/km and 20.0 L/day/mm diam/km for concrete pipe.
- E.8.5** Each section of sanitary sewer main shall be subjected to a light test. A light shall be shone into the sewer main at the upstream manhole. To pass the test, the light must be fully visible when viewed from the downstream manhole. In the event of an unsuccessful light test, the sewer main section in question shall be subjected to a pill test where a ball, or similar object of a diameter that is 50 mm less than the inside diameter of the sewer main shall be successfully pulled through without encountering any obstructions.

E.9 SANITARY WASTEWATER PUMPING SYSTEMS

- E.9.1** 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 proposed subdivision design report taking the subdivision plans for the surrounding area into account.
- E.9.2** 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.9.3 General Requirements for location of the wastewater pumping systems are:

- i. The pumping station shall be located in such a manner as to minimize the impact to adjacent subdivisions in terms of visibility, odour and noise.
- ii. Pumping stations shall not be located in areas subject to flooding during a major rainfall event.
- iii. Pumping stations shall always be accessible by road.

E.9.4 System configuration shall be as follows:

- i. A wet well configuration with submersible pump or above ground suction head pump is preferred.
- ii. A wet well/dry well configuration may be considered for larger facilities.
- iii. A separate building may be required for the wet well/dry well pumping stations.
- iv. A collection manhole shall intercept flow from all incoming sewers before discharge to the pumping station. The pumping station shall receive flow from one inlet only.
- v. Provisions shall be made to shut off flow from the collection manhole if required.
- vi. Any pumping stations without a separate building shall be fenced with a lockable gate to prevent unauthorized access.
- vii. The Developer shall be responsible for 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.9.5 Requirements for force mains:

- i. Force mains shall be constructed of HDPE pipe unless otherwise approved by the Municipality. The minimum force main diameter shall be 100 mm.
- ii. A "system-head" curve shall be provided for each force main. Supplementary information to be provided with the curves will include but not be limited to, population estimates, area served, plan and profile of line, friction coefficients and line head losses.
- iii. The force main design pressure shall allow for the normal static and dynamic operating pressures including water hammer effects. The pressure rating of the pipe shall be twice the operating pressure or 690 kPa, whichever is greater. Surge pressures during starting and stopping of the pumps shall not exceed the safe operating capacity of the force main.
- iv. The velocity shall be within 0.6 m/sec to 3.5 m/sec. The minimum velocity for pipes larger than 300 mm shall be 1.1 m/sec. Special design provisions in order to stabilize the line shall be incorporated when design velocities exceed 3.0 m/sec.

- v. A series of 45° bends shall be used in lieu of 90° bends.
- vi. Air release valves shall be installed in concrete access chambers at all relative high points. Force main grades should be designed in order to avoid the requirement for an air release valve wherever possible.
- vii. Blow-off valves shall be provided at all low points.
- viii. Vacuum relief valves shall be installed wherever necessary in lines designed to drain by gravity between pumping cycles.
- ix. Provide stainless steel bolts on all valves.
 - x. Provide operating nuts located between 2 m and 3 m below ground surface without rock shields on all valves.
 - xi. The force main invert at the receiving manhole shall be a maximum of 300 mm above the highest invert. The outlet invert of a lagoon inlet manhole shall always be above the high water level.
 - xii. When force main length exceeds 1,000 m, cleanouts should be installed in concrete access chambers complete with isolation valves and adaptor coupling for line flushing.
- xiii. A two hour pressure test shall be conducted for all new force mains.
- xiv. Isolation and check valves shall be provided and housed in an accessible valve chamber with removable hatch for facilitating the maintenance work.
- xv. If necessary, the force main shall be oversized to serve areas outside the proposed subdivision area. A gate valve shall be provided at both ends of the sewage force main.

E.9.6 Requirements for the pumping stations:

- i. The pumps shall be sized to accommodate the maximum expected flow as determined by accepted best engineering practice.
- ii. 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. Pump starts shall alternate between pumps.
- iii. Pumps shall be provided by an industry recognized manufacturer with a local repair service depot. The design and installation shall meet pump manufacturer's specifications.
- iv. Submersible pumps shall have a non-clog impeller design and flush valves.
- v. 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.

- vi. Dead storage shall be minimized while meeting minimum depth requirements specified by the pump manufacturer.
- vii. 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.
- viii. Wet wells shall be sized and equipped to accommodate operator access, maintenance and safety requirements.
- ix. Pipes and valves:
 - a. The minimum diameter for all pump suction and discharge piping shall be 100 mm.
 - b. Pipe sizing shall allow for minimum and maximum flow velocities of 0.75 m/sec to 3.5 m/sec respectively within the pumping station.
 - c. The minimum pressure rating of piping within the pumping station shall be determined based on calculated operating pressures but shall not be less than 900 kPa.
 - d. Pumps shall be connected in parallel to a common discharge header located within the pumping station. Check valves and isolation valves shall be installed on the discharge line between each pump and the discharge header.
 - e. A forcemain isolation valve shall be installed on the main discharge pipe outside the wet well.
- x. Water supply:
 - a. Water supply must be provided to the facility for washing and cleaning purposes.
 - b. 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 Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems for Water Supply and Wastewater Facilities published by Alberta Environment.
 - c. Where a potable water supply is to be used for washing and cleaning purposes, a break tank, a pressure pump and a 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 150 mm above the maximum flood line or the spill line of the tank.
- xi. Alarms and emergency backup:
 - a. The Developer shall make provisions to mitigate environmental or property damage caused by facility failure.

- b. Pumping stations shall be equipped with a feature for future connection of remote sensing and telemetry equipment enabling operators to monitor the system status.
 - c. 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.
 - d. Special considerations shall be made to control any possible overflow in a manner acceptable to the Municipality and according to the current requirements of Alberta Environment.
- xii. Access and maintenance:
- a. Permanent hoist equipment and access hatches of sufficient size and capacity shall be provided for removal of the pumping station equipment.
 - b. All access points shall have locking devices.
 - c. Ladders shall be non-skid and shall comply with Occupational Health and Safety requirements.
 - d. Pumping stations shall have adequate interior and exterior lighting.
 - e. 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 and 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 Construction Completion Certificate.
- xiii. Ventilation and heating:
- a. Forced mechanical ventilation is required for dry wells below ground level and for wet wells containing screens or mechanical equipment requiring maintenance or inspection.
 - b. Equipment shall be able to provide at least six (6) air changes per hour. Provisions shall be made for ventilation of the wells with portable equipment in case of system failure. Ventilation failure alarms shall be required.
 - c. There shall be no interconnection between wet well and dry well ventilation systems.
 - d. Multiple air inlets and outlets are recommended for dry wells over 5 m 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. Air shall be forced into the dry well at a point 150 mm above the pump floor and into the wet well at a point 150 mm above the high water level.
 - f. Automatic heating and dehumidification equipment shall be provided in all dry wells.
- xiv. Building requirements:
- a. All pumping stations shall be provided with a building to house all electrical and control equipment and to provide a workspace for pump maintenance.
 - b. Buildings shall be of an adequate size to allow for the required access hatches, hoist equipment, ventilation and control equipment.
 - c. Access to the wet well shall not be from within the building.
 - d. Building layout and access shall be designed to facilitate the removal of any equipment that may require off-site maintenance.
 - e. Structural members shall be masonry, concrete or structural steel. Wood frame buildings are not permitted. Buildings shall comply with the current Alberta Building Code.
 - f. The design shall incorporate measures to reduce the noise and odour impact on the surrounding areas.
 - g. Buildings shall be designed to blend architecturally with the surrounding subdivisions.
 - h. Windows shall not be permitted in pumping station buildings.

E.10 PRIVATE (RURAL) SYSTEM CONSIDERATIONS

E.10.1 These Standards specify general requirements that shall be adhered to for proposed subdivisions utilizing these disposal systems within the Municipality. Private sanitary sewage disposal systems shall conform to the Alberta Private Sewage Systems Standard of Practice.

E.10.2 Treatment mounds shall not be located within:

- i. 3 m of a property line,
- ii. 15m of a water source,
- iii. 15 m of a water course,
- iv. 3 m of a septic tank,
- v. 9 m of a basement, cellar, or crawl space, or
- vi. 3 m of a building that does not have a basement, cellar or crawl space.

All measurements are to be taken from the point where the side slope of the mound intersects with the natural soil contour.

E.10.3 Septic fields, measured from any part of a weeping lateral trench shall not be located within:

- i. 1.5 m from a property line,
- ii. 15 m from a water source,
- iii. 15 m from a water course,
- iv. 9 m from a basement, cellar or crawl space,

Note: the minimum requirement of 9 m clearance from a cellar, basement or crawl space is intended to protect excavations below grade from accumulating migrating effluent. A crawl space that is not below grade, or where the level of the ground surface at the disposal area is below the level of the crawl space, would not require 9 m clearance and could be treated as a building without a basement.

- v. 1 m from a building that does not have a basement, cellar or crawl space, and
- vi. 1 m from a septic tank or packaged sewage treatment plant.

E.10.4 Septic tanks, sewage holding tanks or sewage effluent tanks shall not be located within:

- i. 1m from a property line,
- ii. 9m from a water source,
- iii. 9m from a water course, and
- iv. 1m from a building.

Please also refer to Alberta Private Sewage Systems Standard of Practice Handbook Page 32 for details.

E.10.5 Percolation Testing and Methods

- i. The percolation testing shall be performed as stated in the Interim Guidelines for the Water Table Conditions and Soil Percolation Rate for Un-serviced Residential Subdivisions published by Alberta Environment. Percolation testing shall not be done without first determining the depth to the shallow water table.
- ii. Caution shall be taken when interpreting percolation results performed in fine grained soils. Evaluation of the suitability of the soils for on-site sewage disposal may require assistance of a Professional Engineer.

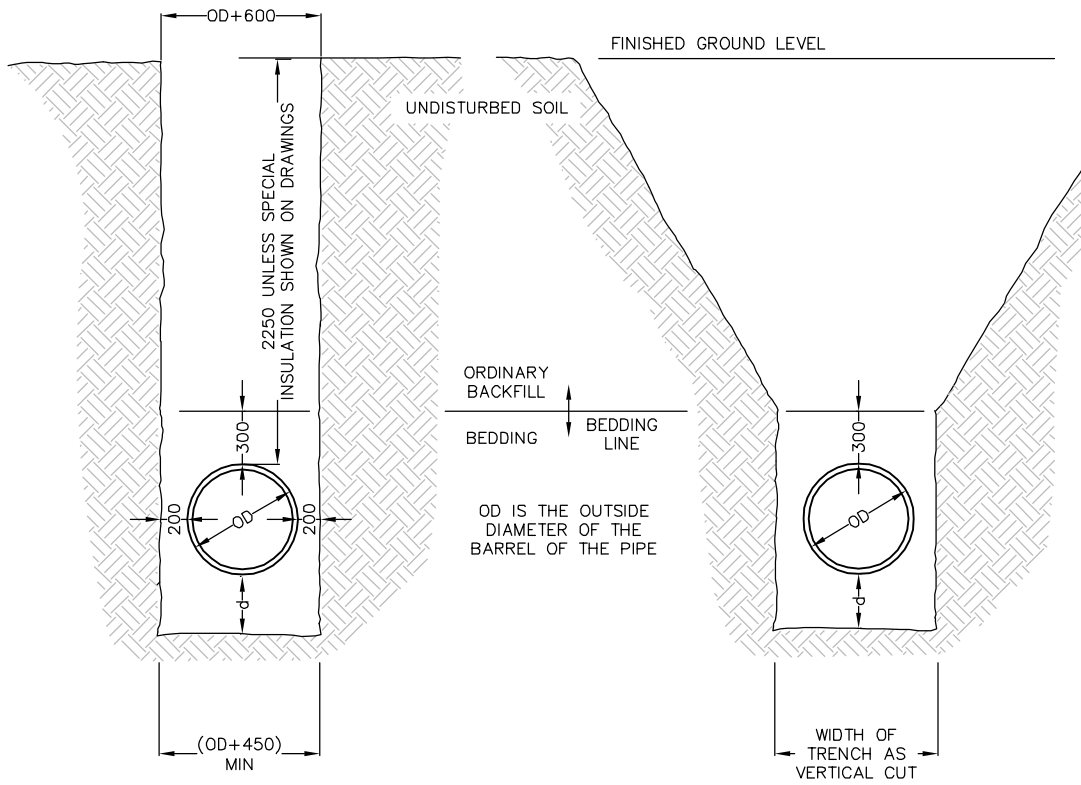
- iii. If a proposed subdivision is not to be served by a municipal wastewater system, then according to subsection 4(5)(c) and (e) of the Subdivision and Development Regulation, the Municipal Government Act, the Developer may be required to submit:
 - a. An assessment of subsurface characteristics of the land that is to be subdivided, including but not limited to, susceptibility to slumping or subsidence, depth to water table and suitability for any proposed on-site sewage disposal system.
 - b. A report prepared by a qualified Professional Engineer respecting the intended methods of providing sewage disposal facilities to each lot in the proposed subdivision. The report shall include all pertinent information and recommendations of a qualified Professional Engineer. This report will contain:
 - Proposed septic field sites.
 - Accurate location of the above.
 - Location of any existing septic fields.
 - Any water wells and their locations.
 - Methodology.
 - Results.
 - Conclusions and recommendations.
 - Sealed sewer holding tanks are not accepted unless in extra ordinary circumstances and the system is approved.

E.11 LIST OF DRAWINGS

E-01	Standard Trench Dimensions for Circular Pipe
E-02	Standard Trench Bedding for Circular Pipes
E-03	Typical Service Connections
E-04	Single Low Pressure Sanitary Service
E-05	Typical Services (Single & Dual)
E-06	Sanitary Cleanout Detail
E-07	Sanitary Service Connection Manufactured Home
E-08	Standard 1200mm Manhole
E-09	Neck Section Details for Standard 1200mm Manhole
E-10	635 Neck Ring
E-11	Safety Steps for Manholes
E-12	Dumping Truck Hauled Sewage Manhole
E-13	Dumping Truck Hauled Sewage Manhole
E-14	Plan View of Truck Hauled Sewage Dumping Station
E-16	Screen
E-17	Pigg Port / Cleanout
E-18	Low Pressure Septic Tank Installation
E-19	Floating Manhole Frame and Cover Type NF-80 and NF-90
E-20	Type 6A Cover and Frame
E-21	Manhole Cover – Sanitary Sewer
E-22	Manhole Plug
E-23	Guard Posts
E-24	Emergency Discharge Overflow Manhole Details
E-25	Discharge Overflow Structure from Storage Cell to Outfall Ditch
E-27	Overflow Structure from Anaerobic Cell to Facultative Cell
E-28	Control and Overflow Structure from Facultative Cell to Storage Cell
E-29	HDPE Pipe Penetration with Flange Plate
E-30	V-Type Anchor Trench
E-31	Standard Anchor Trench
E-32	Inlet Manhole Details
E-33	Discharge Control Details
E-34	Concrete Splash Pad Details
E-35	Frost Box Detail

END OF SECTION

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STANDARD TRENCH
VERTICAL CUT

(TO BE SHORED AS PER
OCCUPATIONAL HEALTH
AND SAFETY STANDARDS)

STANDARD TRENCH
SLOPING CUT

(TO BE SLOPED AS PER
OCCUPATIONAL HEALTH
AND SAFETY STANDARDS)

MAXIMUM TRENCH WIDTHS FOR SINGLE PIPES
 -UP TO AND INCLUDING 400mm DIAMETER - 1000mm
 -450mm DIAMETER AND ABOVE - OD + 600mm

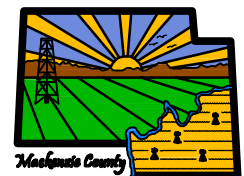
DEPTH OF BEDDING BELOW PIPE BARREL (d)
 -100mm MIN

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards

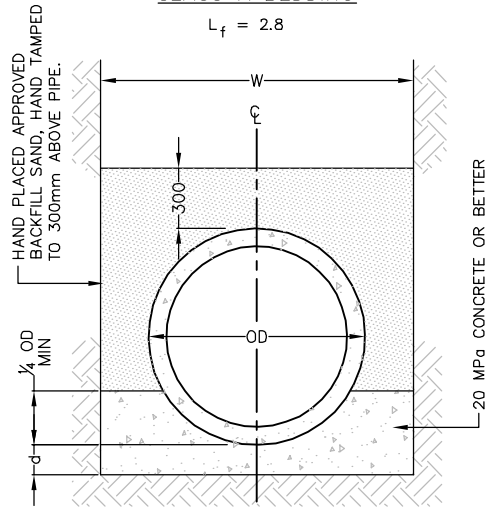


STANDARD TRENCH DIMENSIONS FOR CIRCULAR PIPE

Rev.					
Rev.					
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Rev.	File No.: GP60.33682	Design:	Approved:	Figure	E-01
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

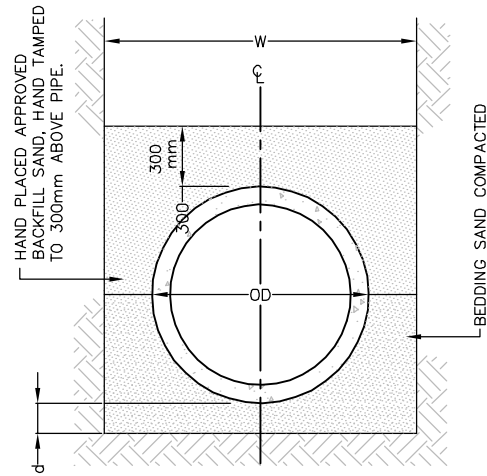
CLASS A BEDDING

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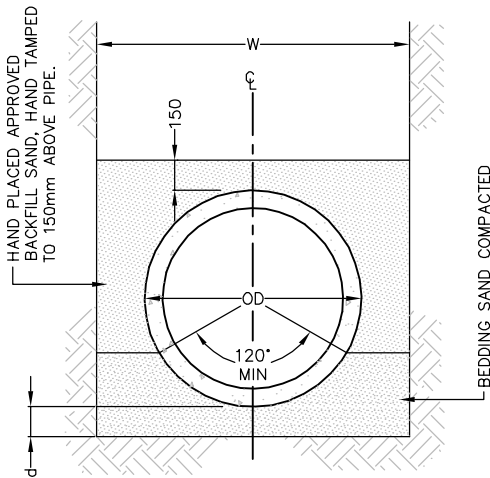
CLASS B BEDDING

$L_f = 1.9$



CLASS C BEDDING

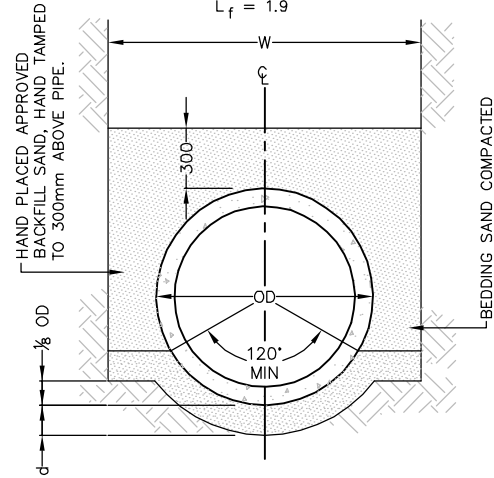
$L_f = 1.5$



CLASS B BEDDING

ALTERNATE - 375mm I.D. & UNDER

$L_f = 1.9$

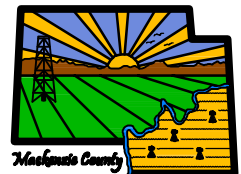


NOTES:

1. W = TRENCH WIDTH - O.D. + 450mm (MINIMUM).
 - 1000mm max. FOR PIPES UP TO AND INCLUDING 400mm DIAMETER.
 - O.D. + 600mm max. FOR PIPE DIAMETERS 450mm AND ABOVE.
2. O.D. = OUTSIDE PIPE DIAMETER.
3. I.D. = INSIDE PIPE DIAMETER.
4. L_f = LOAD FACTOR.
5. d = DEPTH OF BEDDING BELOW PIPE = 150mm (MIN).
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
7. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

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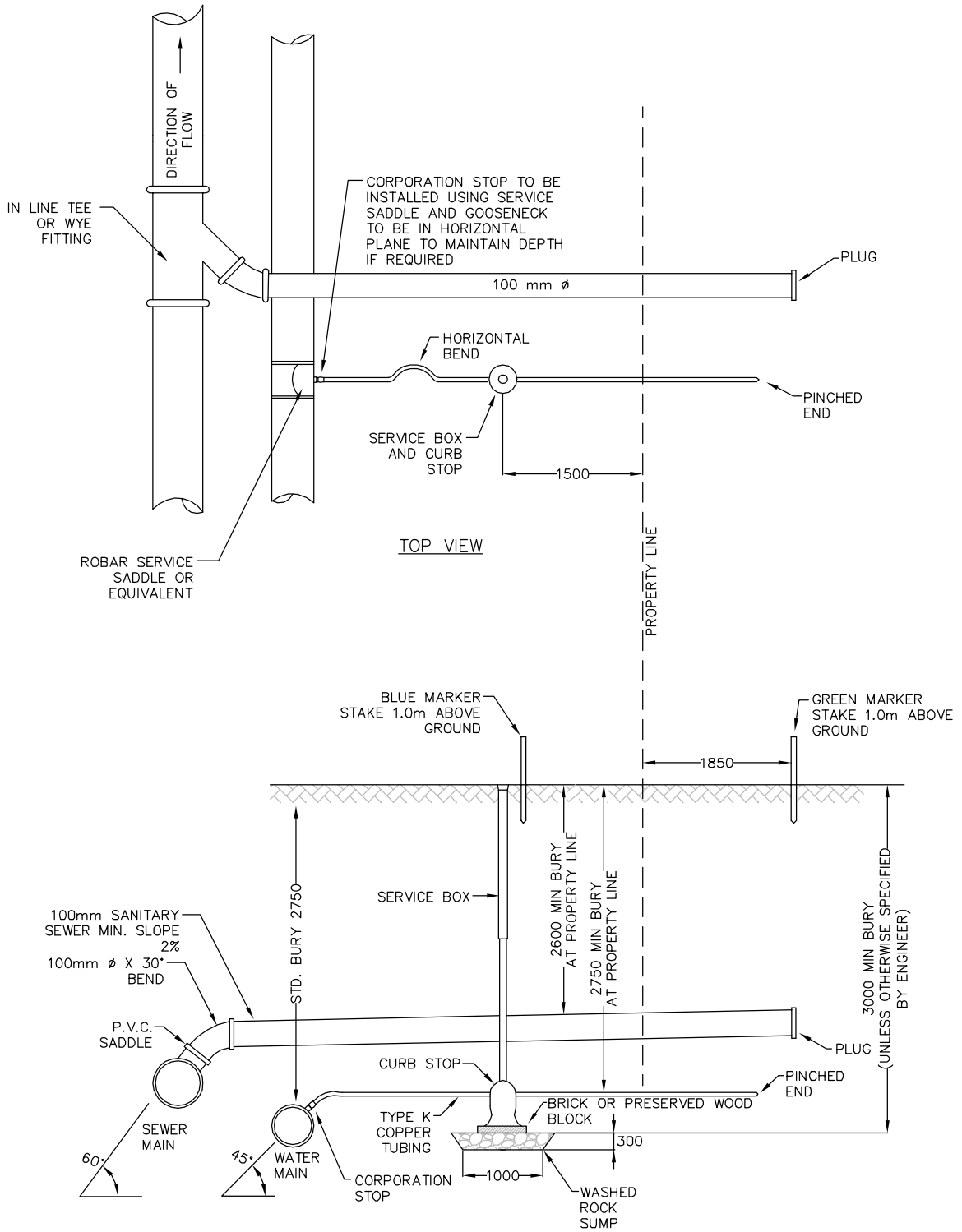
STANDARD TRENCH BEDDING FOR CIRCULAR PIPES

Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682	Design:
Drawn: K.P.L	Scale: N.T.S

Approved:

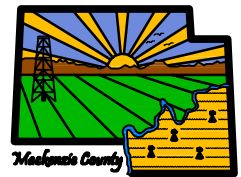
Figure E-02



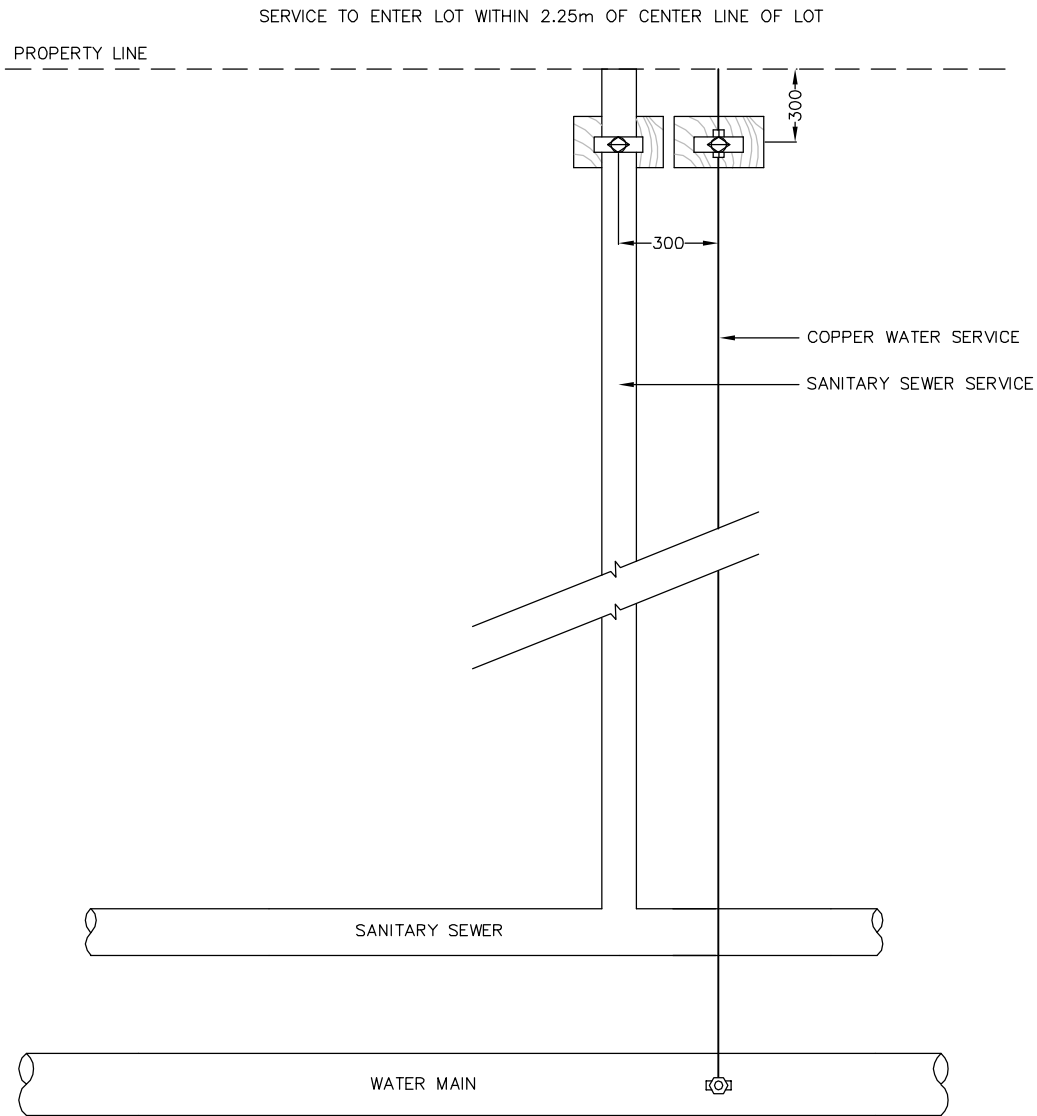
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

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General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	TYPICAL SERVICE CONNECTIONS		Figure E-03
Rev.				
Rev.		Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S

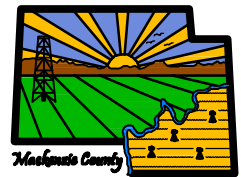


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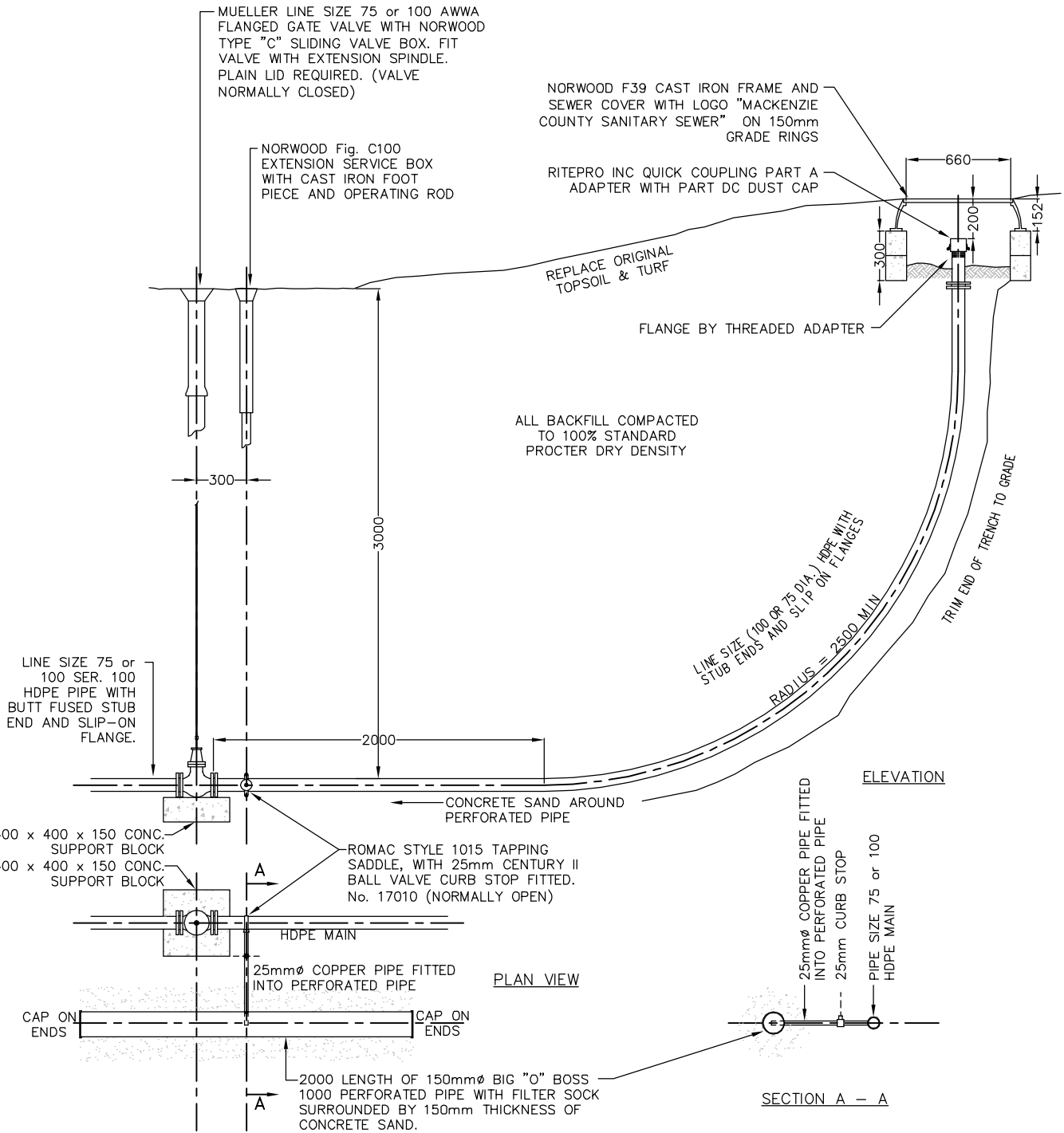
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. SERVICES MAY BE EXTENDED INTO PRIVATE PROPERTY TO EDGE OF GAS EASEMENT IN LANELESS SUBDIVISIONS.

MACKENZIE COUNTY

General Municipal Improvements Standards



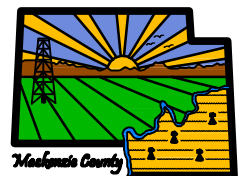
Rev. Rev. Rev. Rev. Date: 2010-AUG-31		SINGLE LOW PRESSURE SANITARY SERVICE	Approved: _____ Figure E-04
File No.: GP60.33682 Drawn: K.P.L.	Design: Scale: N.T.S.		



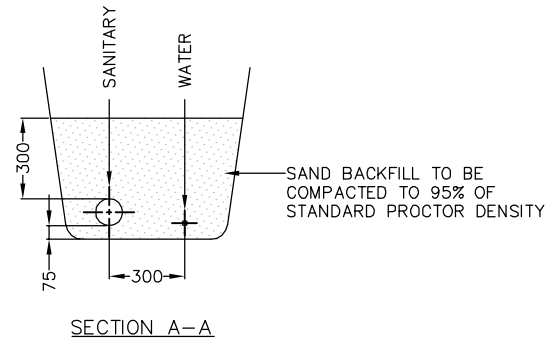
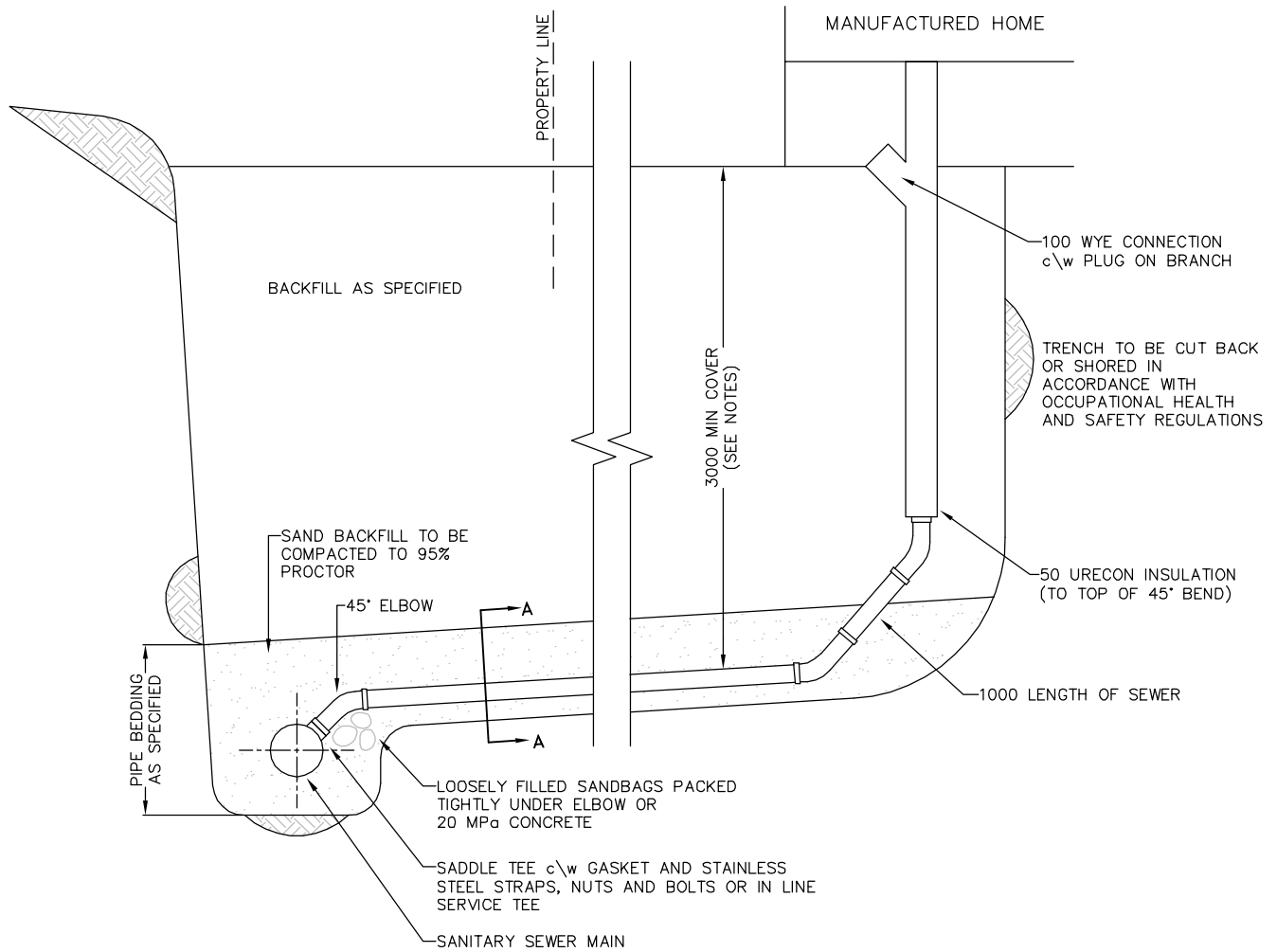
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	SANITARY CLEAN OUT DETAIL		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		E-06

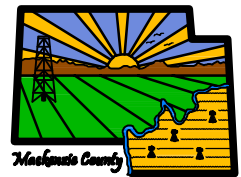


NOTES:

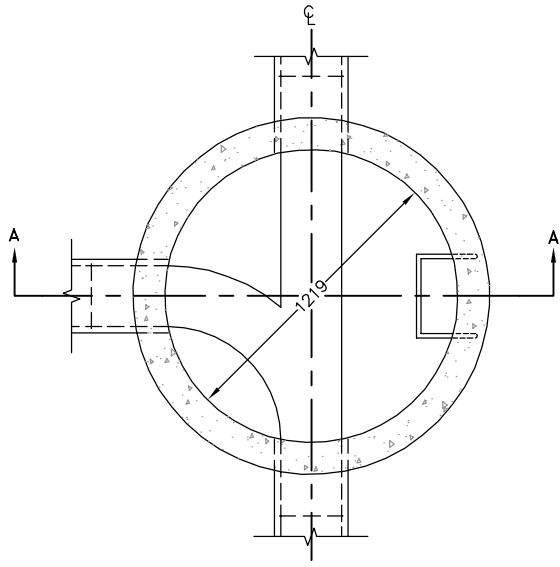
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. MIN SLOPE FOR 100 mm DIA. PIPE IS 2%
3. SERVICE CONNECTIONS SHALL BE 100mm UNLESS SPECIFICALLY SHOWN ON THE DRAWINGS.
4. 50mm URECON INSULATION WILL BE REQUIRED.
5. TRENCH TO BE CUT BACK OR SHORED IN ACCORDANCE WITH OCCUPATIONAL HEALTH AND SAFETY REGULATIONS.

MACKENZIE COUNTY

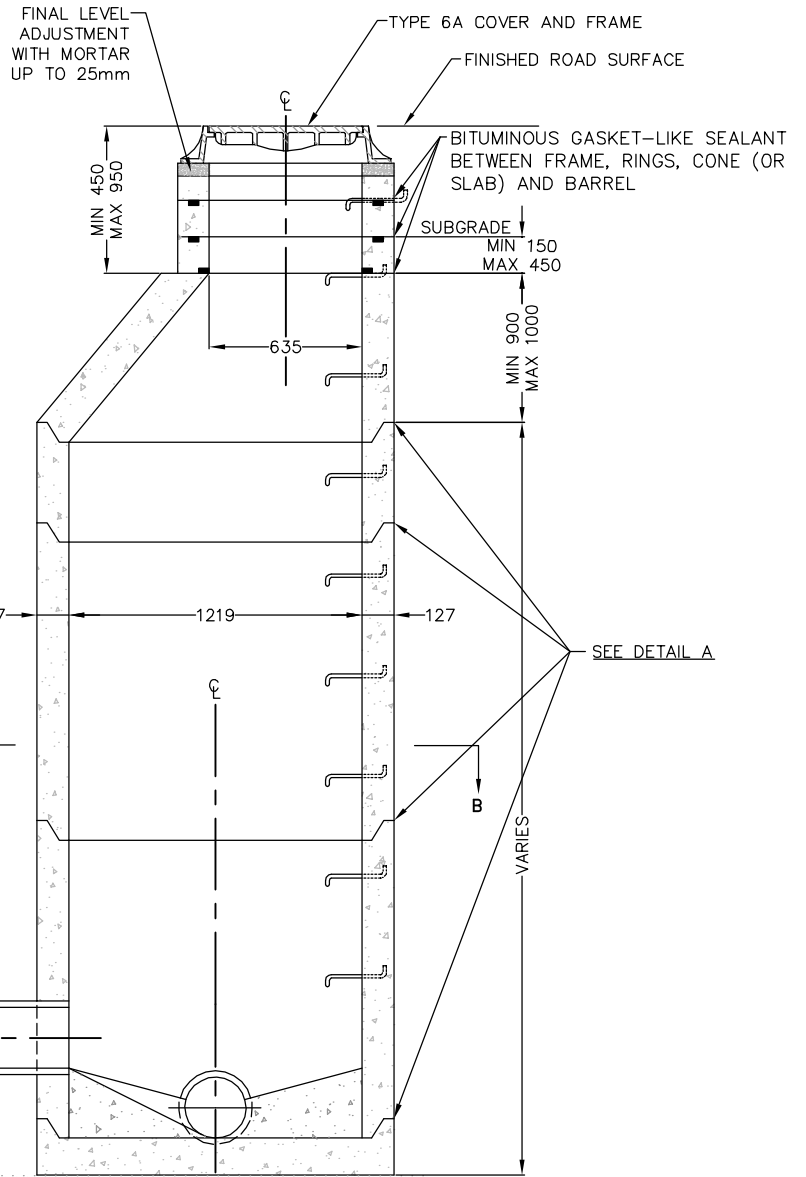
General Municipal Improvements Standards



Rev.		SANITARY SERVICE CONNECTION MANUFACTURED HOME		Approved:	Figure E-07
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure E-07
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			



SECTION B-B

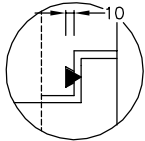


SECTION A-A

NOTES:

1. THIS STANDARD APPLIES TO MANHOLES ON PIPING OF MAXIMUM DIAMETER 600mm AND MINIMUM DEFLECTION ANGLE OF 120'.
2. 1500mm MANHOLE SHALL BE USED ON PIPING DIAMETER 750mm, 900mm AND 1050mm. FOR PIPE DIAMETER 1200mm AND LARGER, MANHOLE TEE RISERS SHALL BE USED.
3. PREBENCHED MANHOLE BASE UNITS WITH INTEGRAL GASKETS SHALL BE USED.
4. THE SEWER PIPING IS AN EXAMPLE ONLY, REFER TO PROJECT DRAWINGS FOR LAYOUT AND ELEVATIONS.
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
6. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

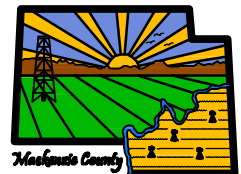
DETAIL A (TYP)



GRADE RINGS (c/w GASKET NOTCH) AS ALTERNATE, RUBBER GRADE RINGS MAY BE ACCEPTED BY MUNICIPAL ENGINEER

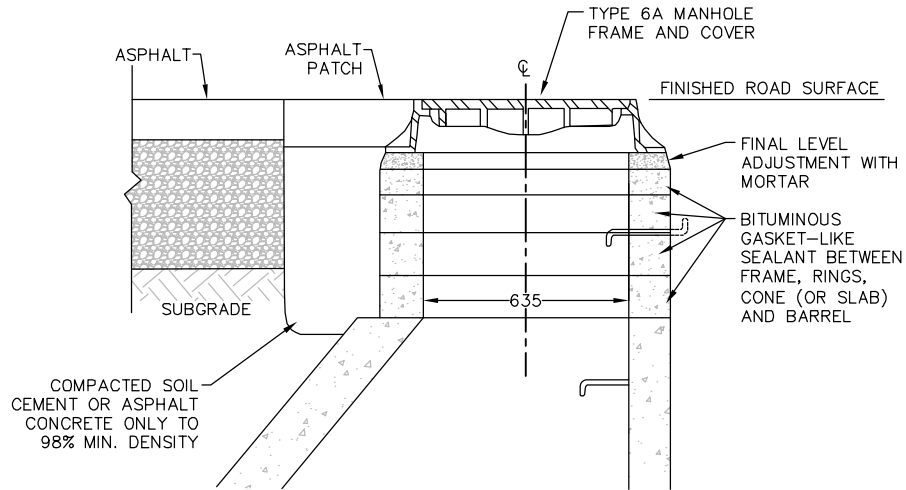
MACKENZIE COUNTY

General Municipal Improvements Standards



STANDARD 1200mm MANHOLE

Rev.				
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-08
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

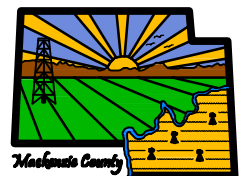


NOTES:

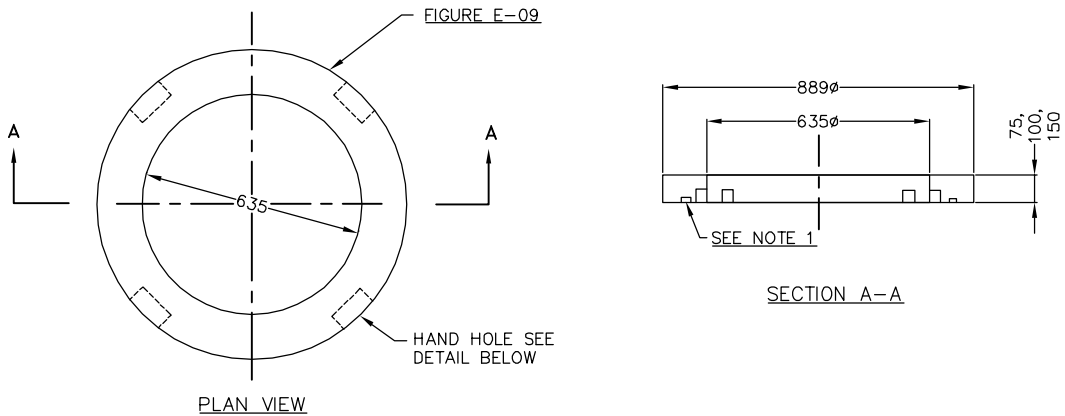
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards

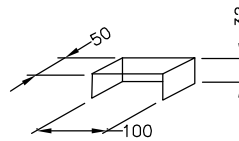


Rev.	Stewart Weir Naturally Resourceful	NECK SECTION DETAILS FOR STANDARD 1200 MANHOLE		Approved:	Figure E-09
Rev.					
Rev.		Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	



635 RING

(NECK RING FOR USE WITH TYPES 4A, 6, 6A, 8, NF-80, NF-90 FRAMES AND COVERS/GRATINGS)



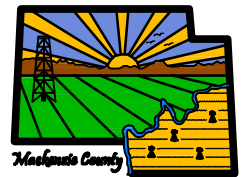
HAND HOLE DETAIL

NOTES:

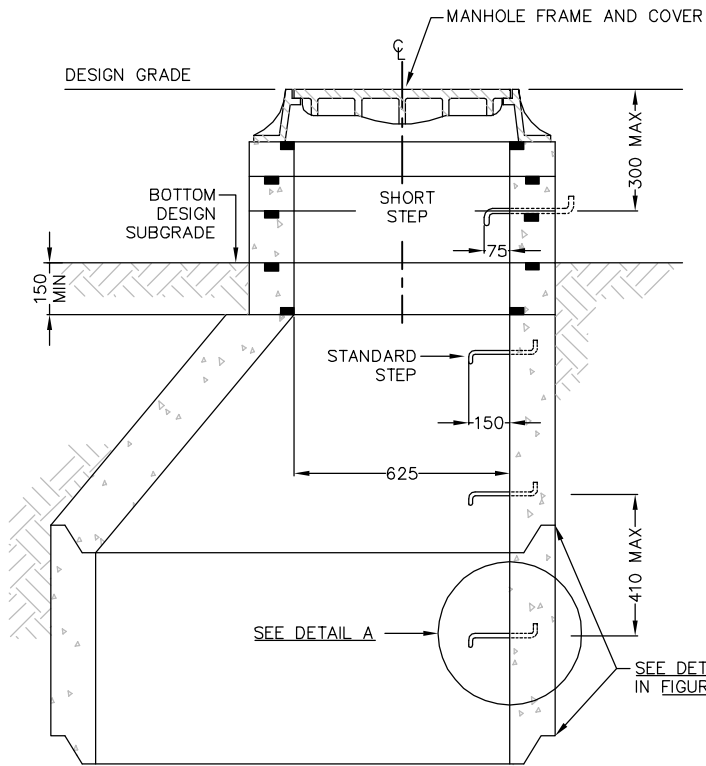
1. A CONCENTRIC GROOVE LOCATED AT MID CROSS SECTION, SUITABLE FOR SEALANT IS REQUIRED FOR NECK RINGS AND EXTENSION RINGS.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

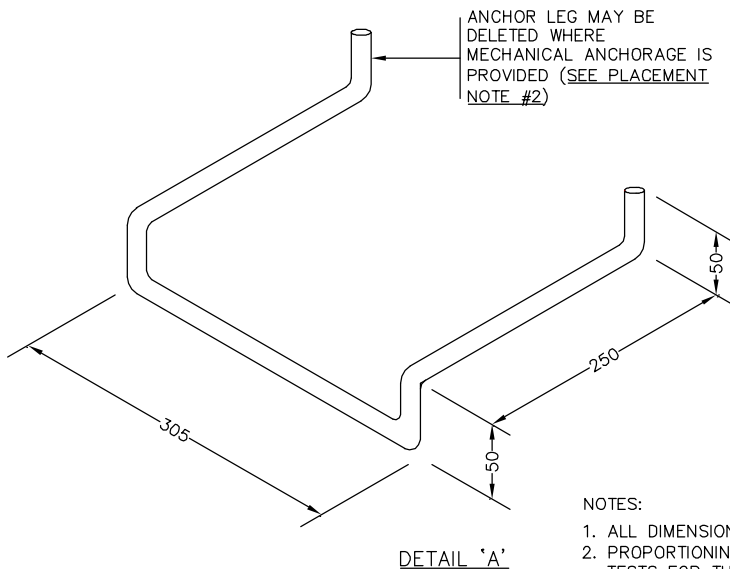
General Municipal Improvements Standards



Rev.		635 NECK RING		Approved:	Figure E-10
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-10	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



TYPICAL MANHOLE SECTION



NOTES:

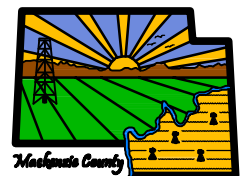
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

PLACEMENT:

1. EXCEPT WHERE SPECIFIED OTHERWISE, SAFETY STEPS SHALL BE INSTALLED IN ALL PRECAST MANHOLE SECTIONS & CONES, IN THE GRADE ADJUSTMENT SECTIONS AND IN CAST IN PLACE SECTIONS SO THAT WHEN THE VARIOUS SECTIONS ARE ASSEMBLED IN ANY COMBINATION THEY WILL FORM A CONTINUOUS VERTICAL LADDER WITH RUNGS EQUALLY SPACED AT A MAXIMUM OF 410mm TO WITHIN 300mm BELOW THE COVER AND TO WITHIN 600mm OF THE BASE OR BENCHING.
2. STEPS SHALL BE CAST FIRMLY IN PLACE OR SECURED WITH A SUITABLE MECHANICAL ANCHORAGE TO PREVENT PULLOUT, AND MAINTAIN WATER TIGHTNESS.
3. "STANDARD STEPS" SHALL PROJECT A DISTANCE OF 150mm MEASURED AT THE POINT OF EMBEDMENT.
4. A "SHORT STEP" WITH A PROJECTION OF 75mm SHALL BE INSTALLED WITHIN THE GRADE ADJUSTMENT SECTION, CAST INTO THE NECK OR FIRMLY MORTARED IN PLACE BETWEEN THE NECK RINGS, WITH THE ANCHOR LEGS OUTSIDE OF THE NECK RING.
5. EXCEPT AS SPECIFIED ABOVE, DESIGN AND INSTALLATION OF SAFETY STEPS SHALL CONFORM TO A.S.T.M. C478.
6. SAFETY STEPS SHALL BE ALIGNED ON CENTER LINE PERPENDICULAR TO THE MAIN FLOW CHANNEL. WHENEVER POSSIBLE, THE STEPS SHALL BE ALIGNED SO THAT A PERSON EXITING THE MANHOLE WOULD FACE ONCOMING TRAFFIC IF NOT CONFLICTING WITH THE PREVIOUS REQUIREMENT.

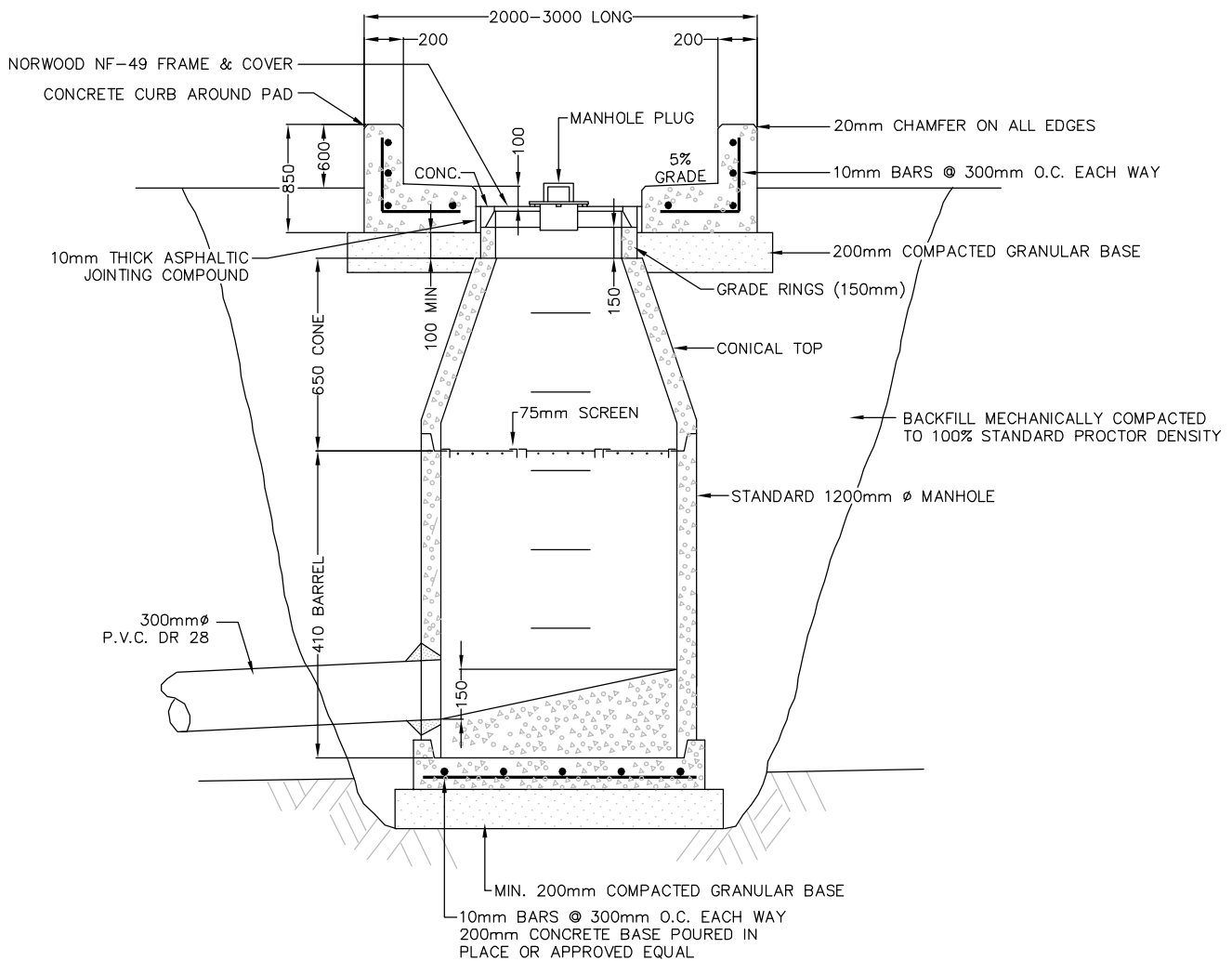
MACKENZIE COUNTY

General Municipal Improvements Standards



SAFETY STEPS FOR MANHOLES

Rev.			Approved:	Figure E-11
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:		
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

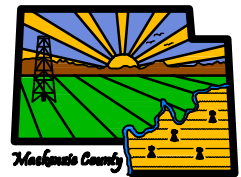


NOTES:

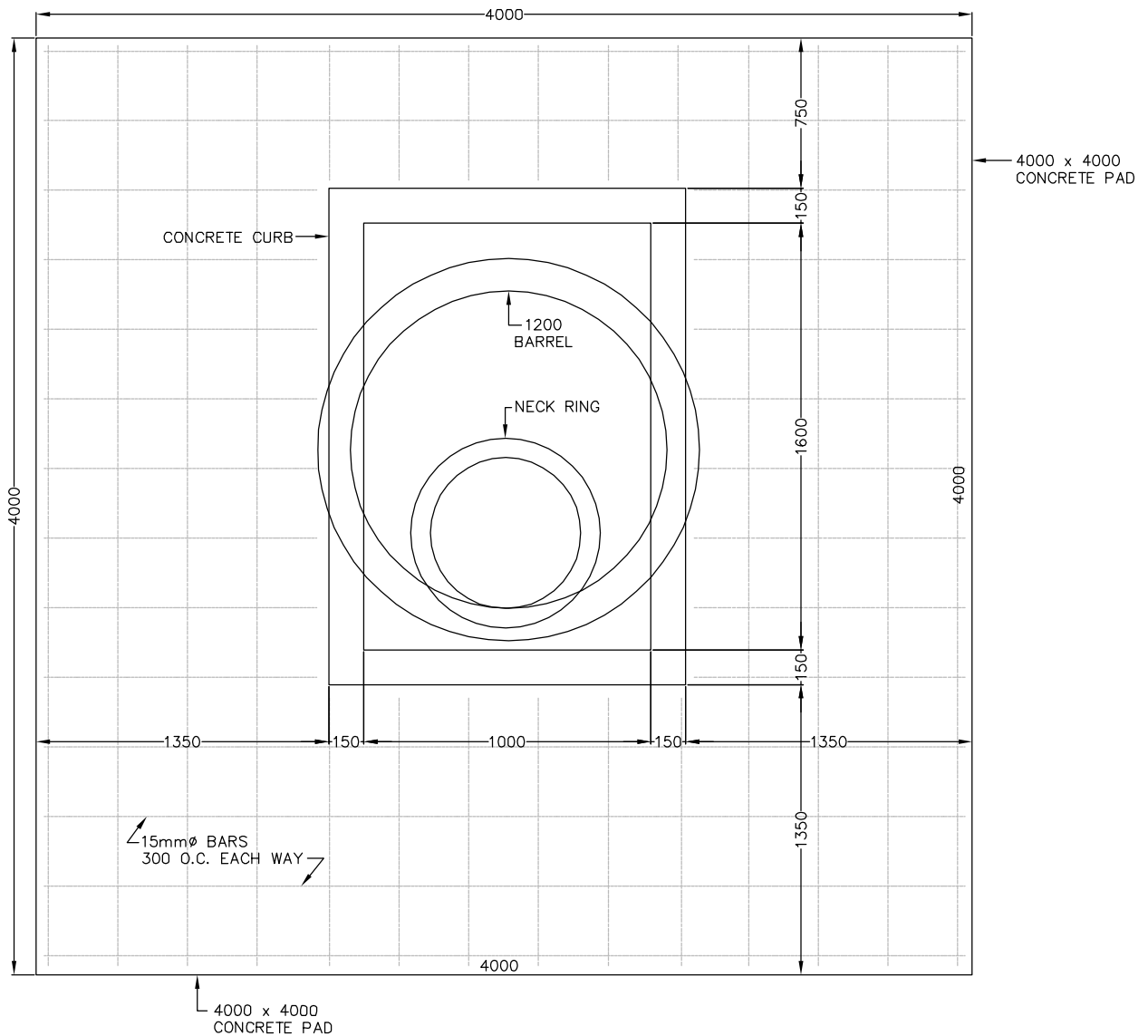
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

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Rev.		<p>DUMPING TRUCK HAULED SEWAGE MANHOLE</p>		<p>Approved:</p>	<p>Figure E-13</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>		<p>Figure E-13</p>
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

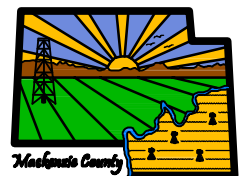


NOTES:

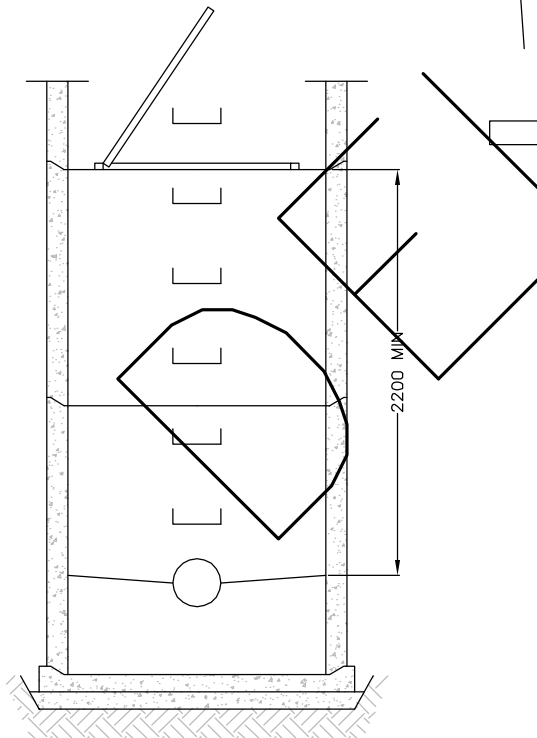
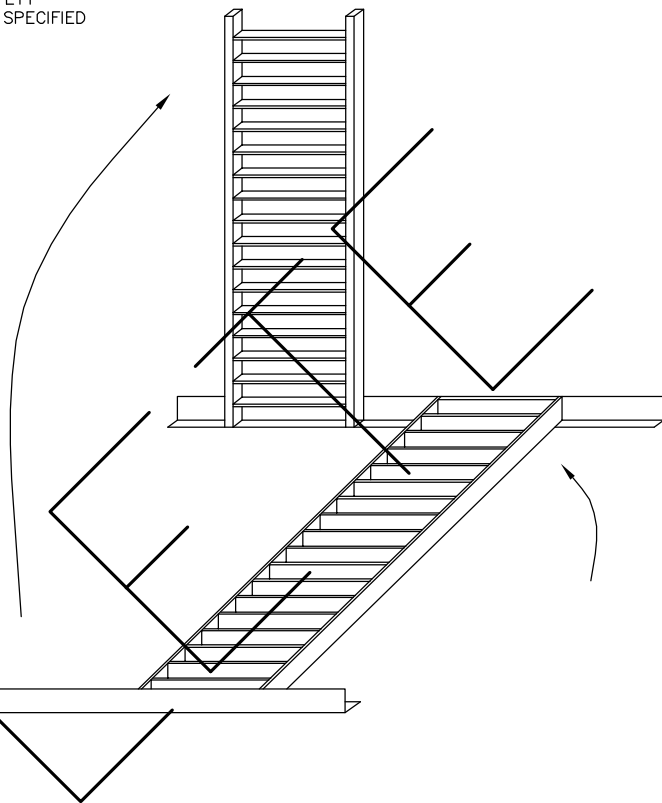
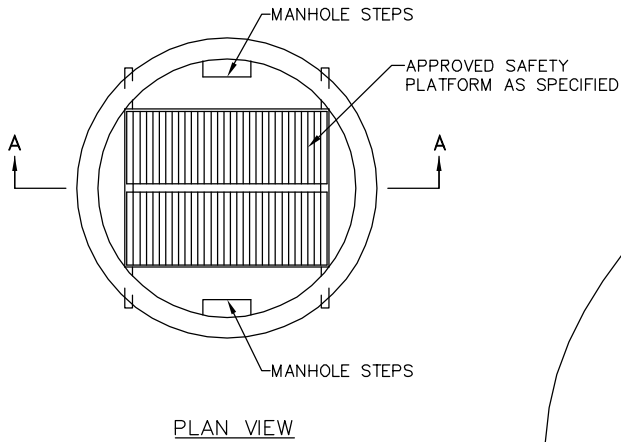
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>PLAN VIEW OF TRUCK HAULED SEWAGE DUMPING STATION</p>		<p>Approved:</p>	<p>Figure E-14</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-14	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



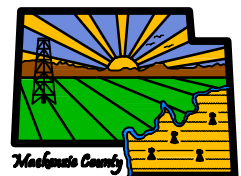
SECTION A-A

NOTES:

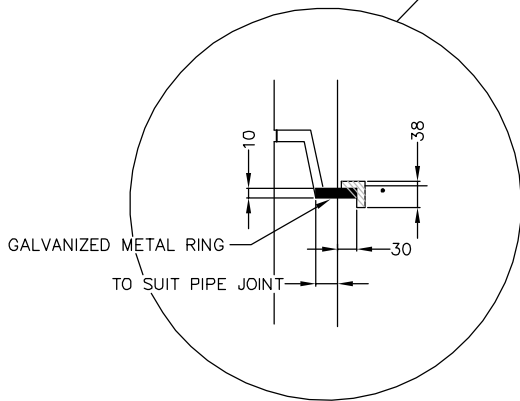
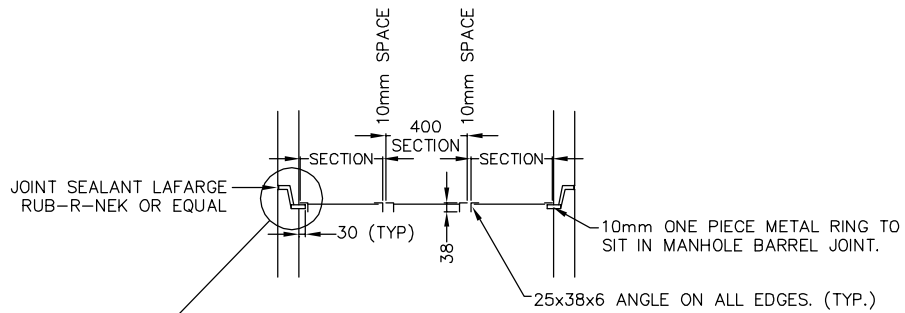
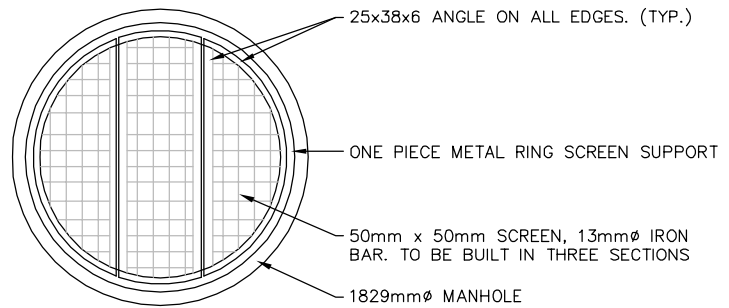
1. TO BE INSTALLED ON MANHOLES GREATER THAN 5.0m DEEP.
2. MAXIMUM SPACING BETWEEN PLATFORMS TO BE 5.0m.
3. ALUMINUM GRATES TO BE MSU MISSISSAUGA OR APPROVED EQUAL.
4. TO BE INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	MANHOLE SAFETY PLATFORM		Approved:	Figure E-15
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-15	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

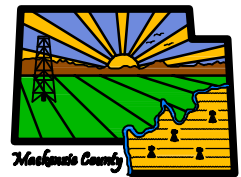


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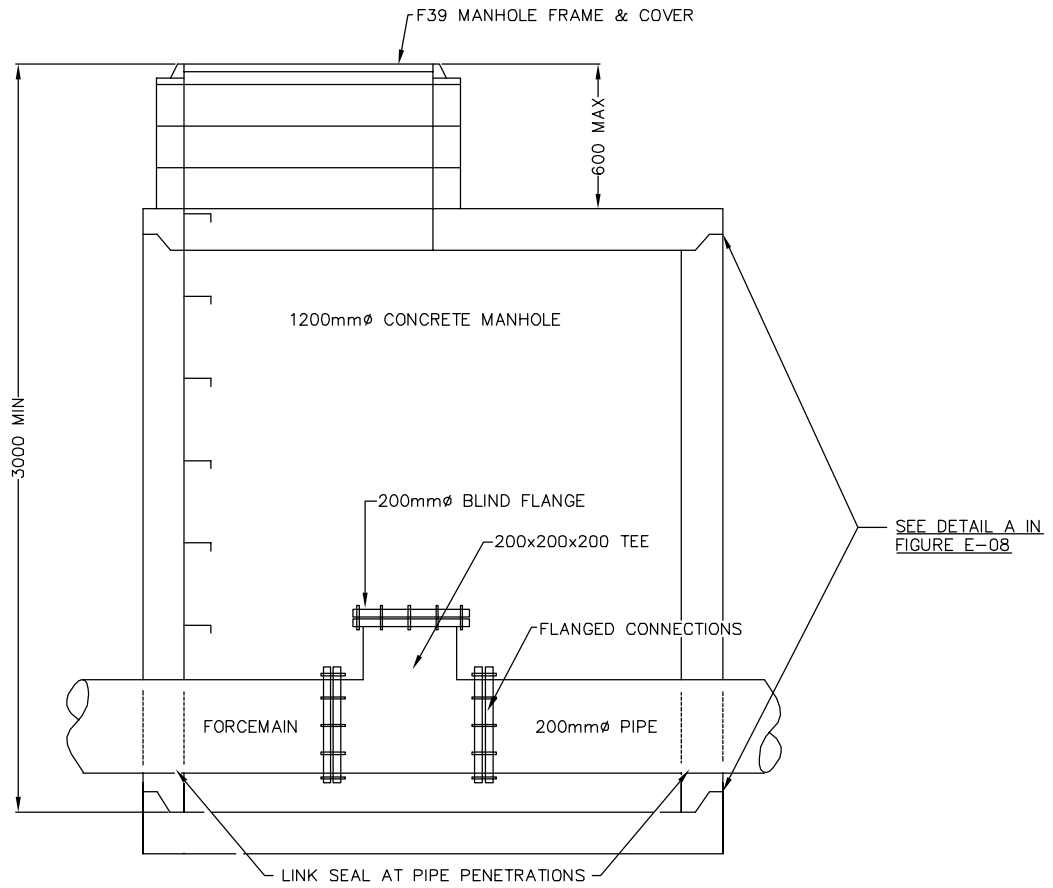
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL STEEL WORK TO BE HOT DIPPED GALVANIZED AFTER FABRICATION.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	SCREEN	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	

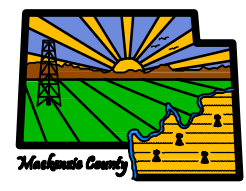


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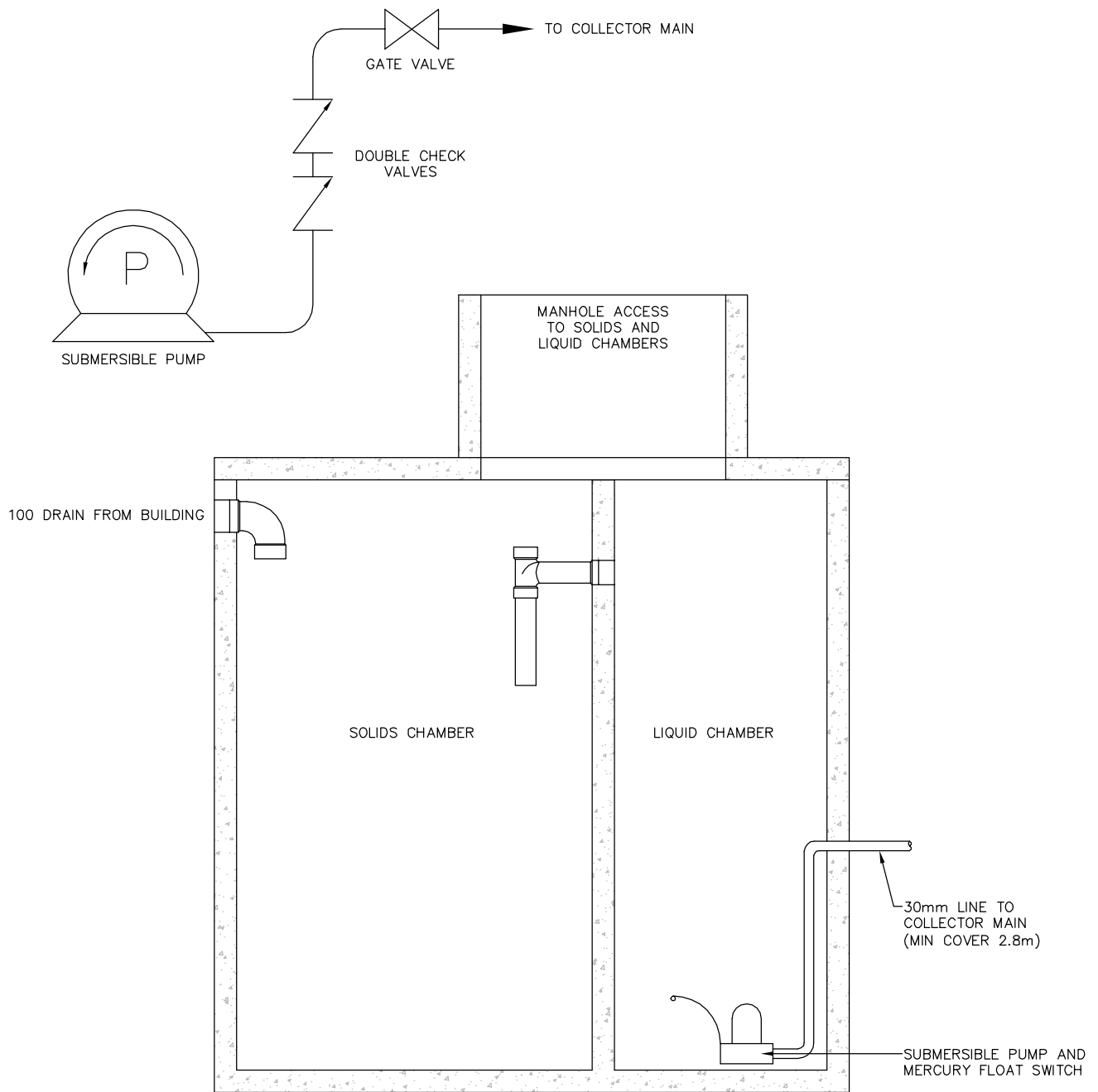
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards

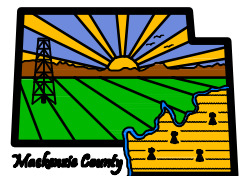


Rev.	Stewart Weir Naturally Resourceful	PIGG PORT / CLEANOUT		Approved:	Figure E-17
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-17	
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			

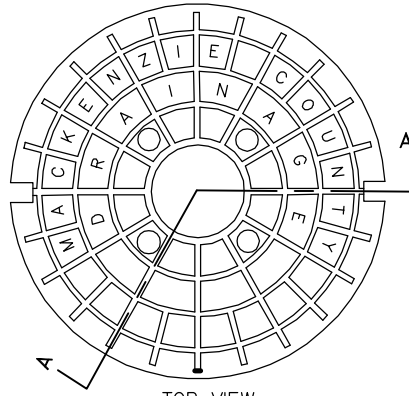


MACKENZIE COUNTY

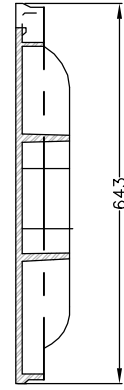
General Municipal Improvements Standards



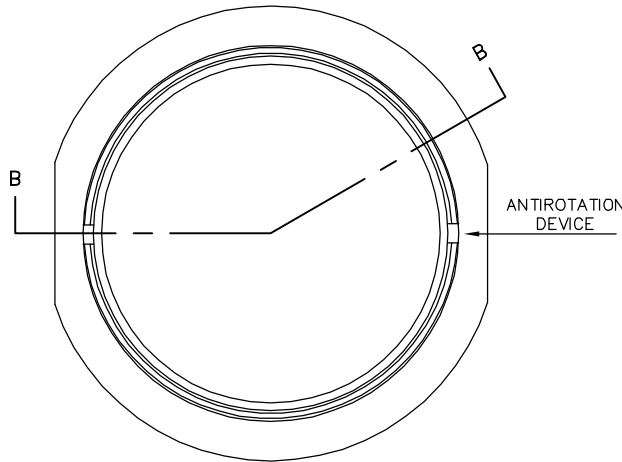
Rev.			LOW PRESSURE SEPTIC TANK INSTALLATION	
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		E-18



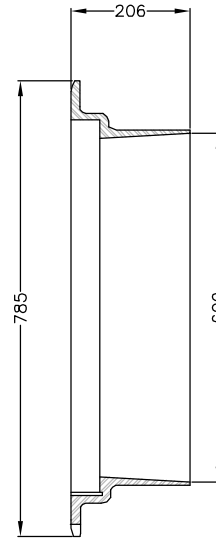
TOP VIEW
MANHOLE COVER
WITH 4 VENTHOLES



SECTION A-A



PLAN VIEW



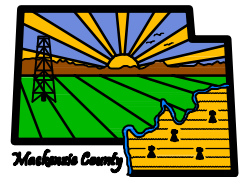
SECTION B-B

NOTES:

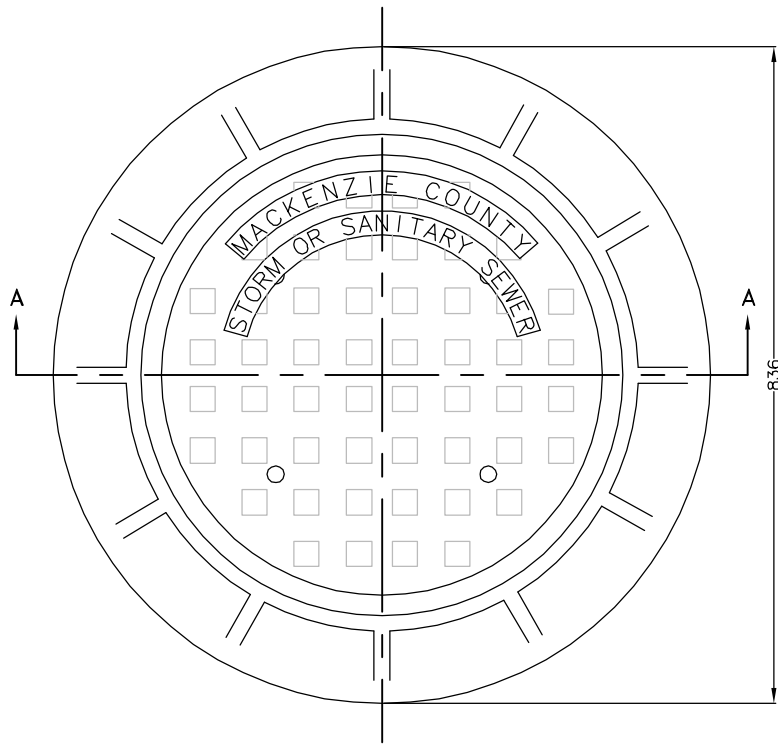
1. MATERIAL SPECIFICATION:
DUCTILE IRON TO CONFORM TO A.S.T.M. A536 (LATEST EDITION) GRADE 80-60-03.
2. NF-90 FRAME AND COVER IS WATERTIGHT VARIATION OF NF-80.
THERE ARE NO VENTING HOLES IN NF-90 COVER AND A GASKET IS PLACED BETWEEN THE FRAME AND COVER.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

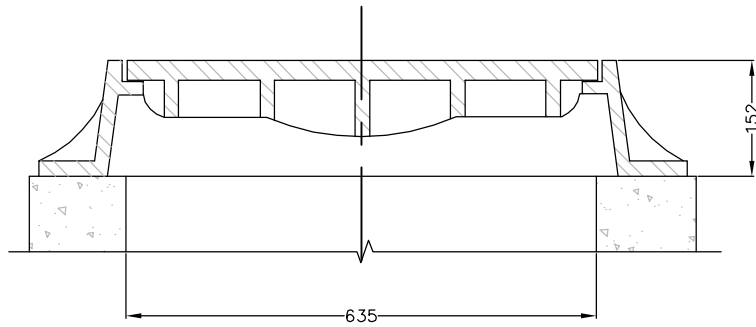
General Municipal Improvements Standards



Rev.		FLOATING MANHOLE FRAME AND COVER TYPE NF-80 AND NF-90		Approved:	Figure E-19
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure E-19
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.	Approved:	Figure E-19	



PLAN VIEW



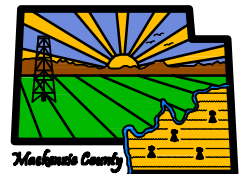
SECTION A-A

NOTES:

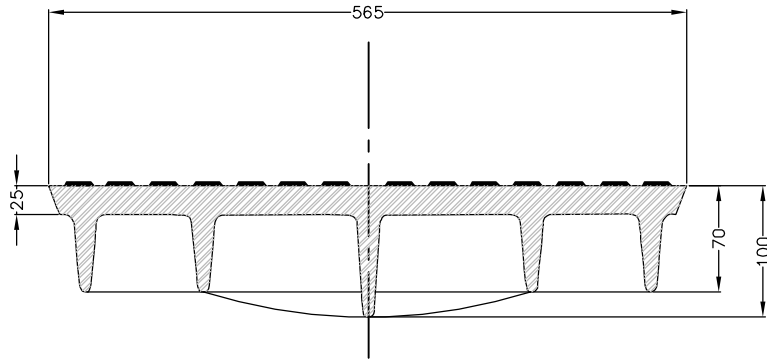
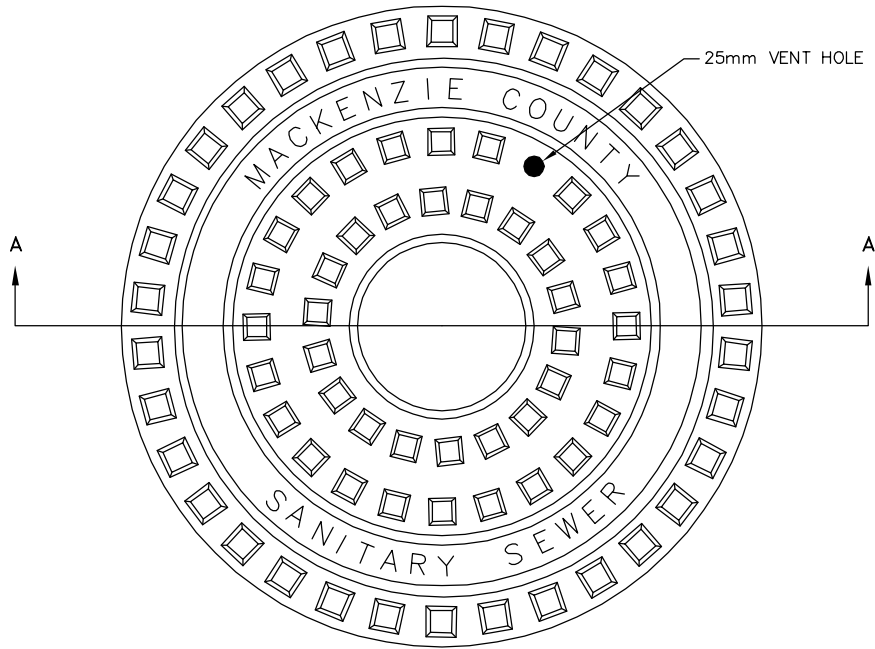
1. MATERIALS:
 FRAME: GRAY IRON CLASS 20B.
 COVER: GRAY IRON CLASS 20B.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPE 6A COVER AND FRAME		Figure E-20
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

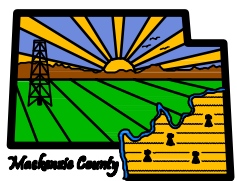


SECTION A-A

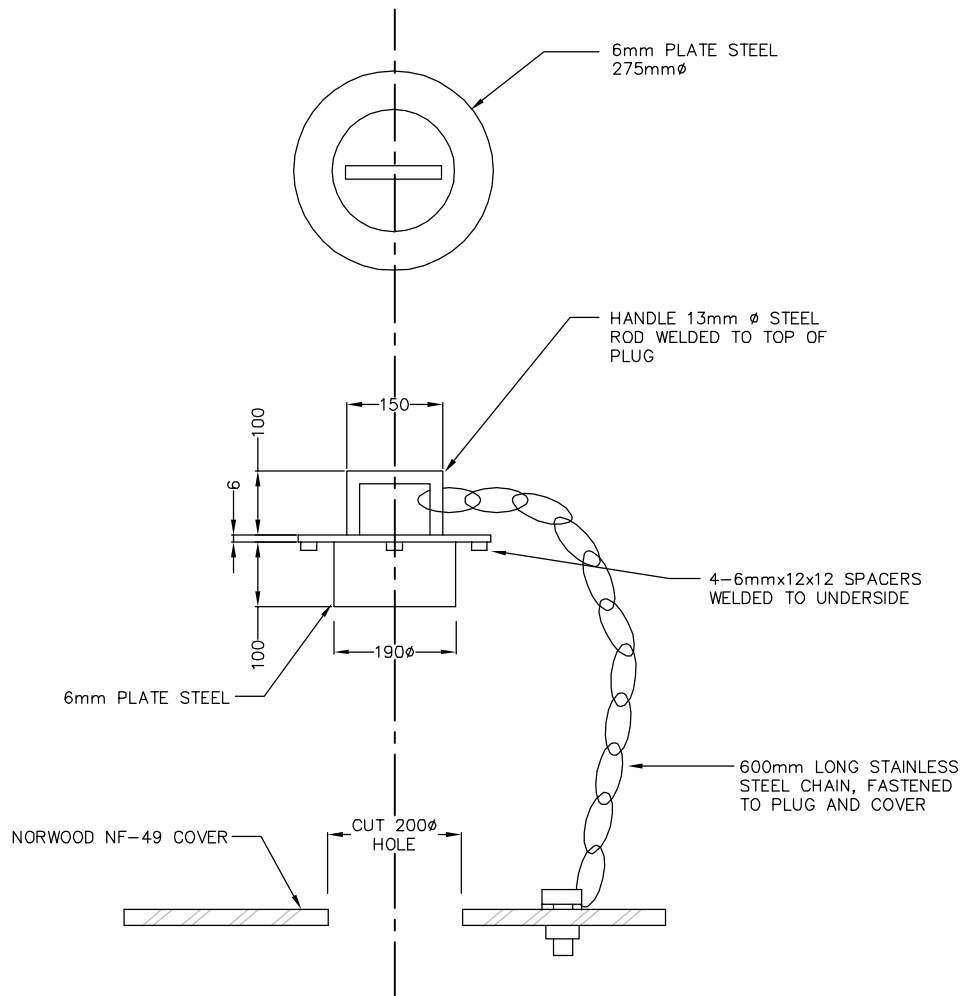
NOTES:
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



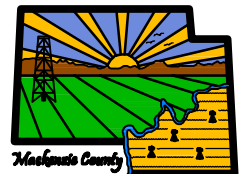
Rev.	Stewart Weir Naturally Resourceful	MANHOLE COVER – SANITARY SEWER	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure E-21



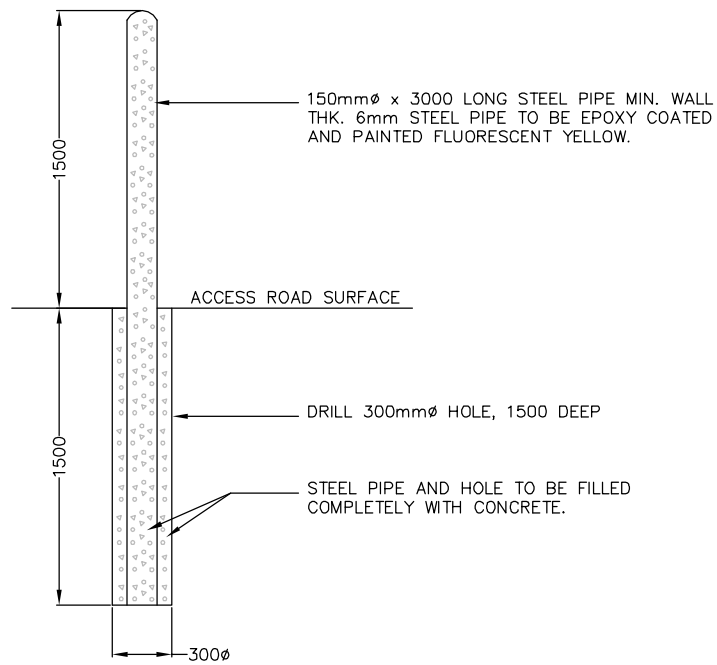
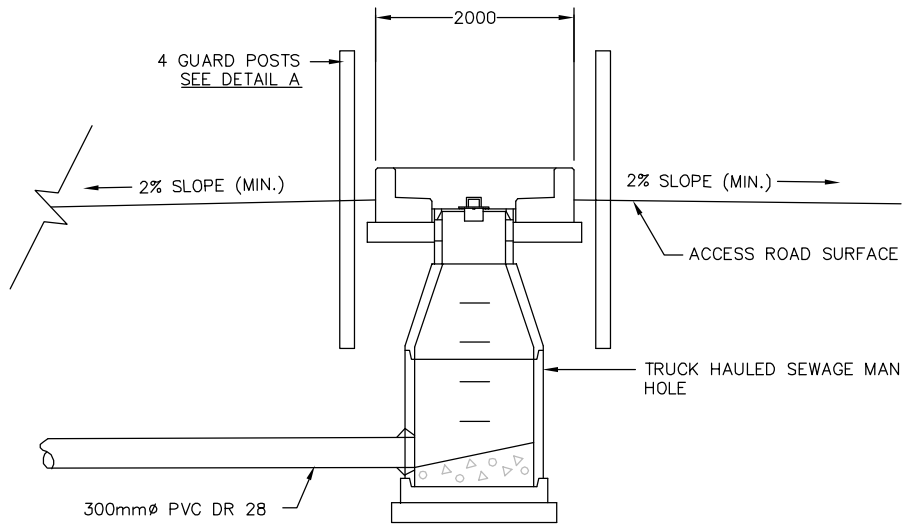
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		MANHOLE PLUG		Approved:	Figure E-22
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-22	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



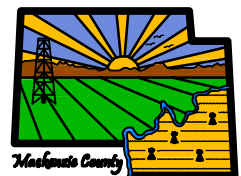
DETAIL A - GUARD POST

NOTES:

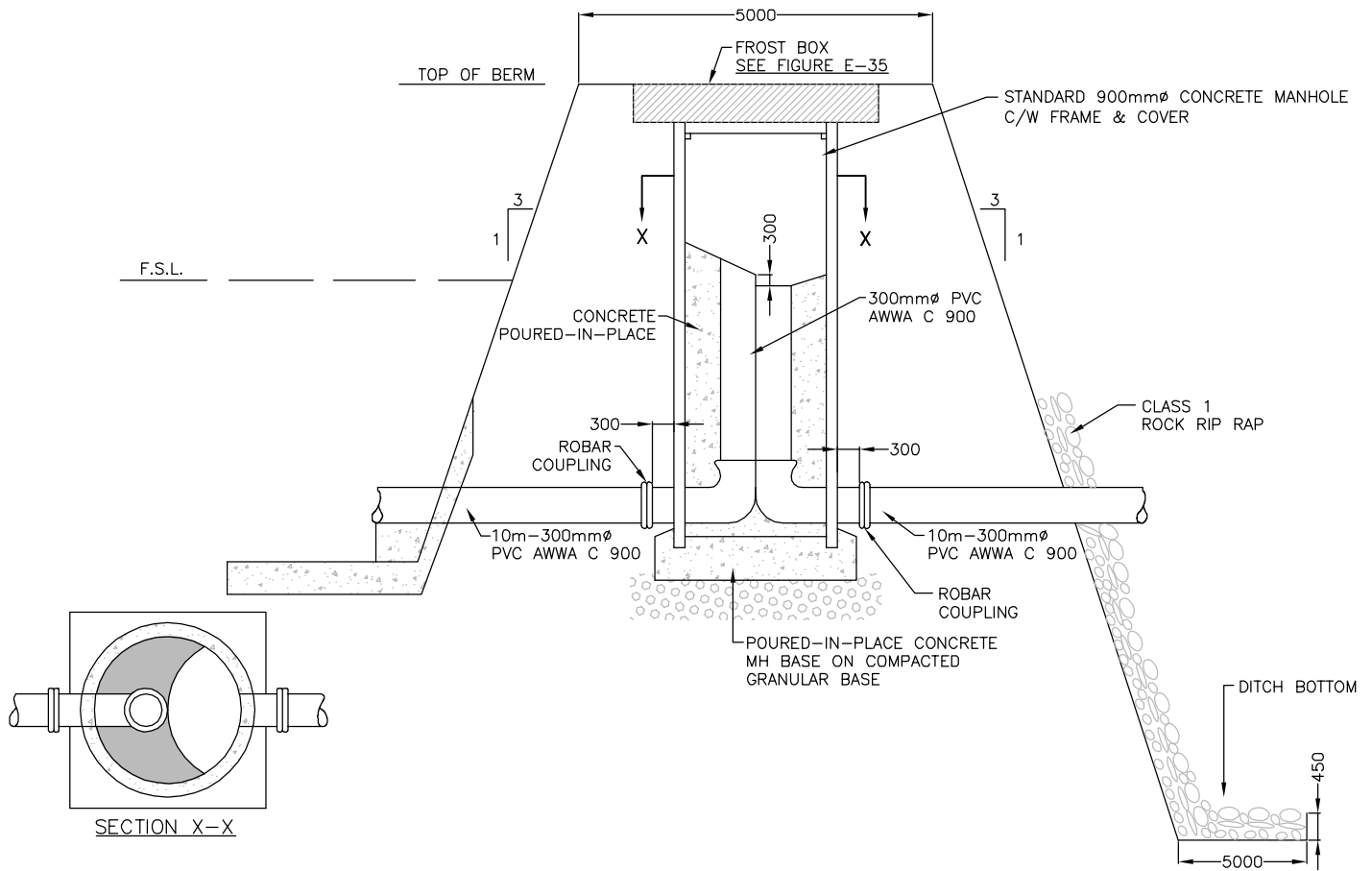
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p style="text-align: center;">GUARD POSTS</p>		<p style="text-align: right;">Figure E-23</p>
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-23
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

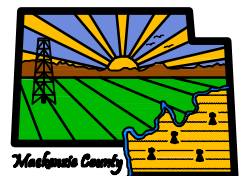


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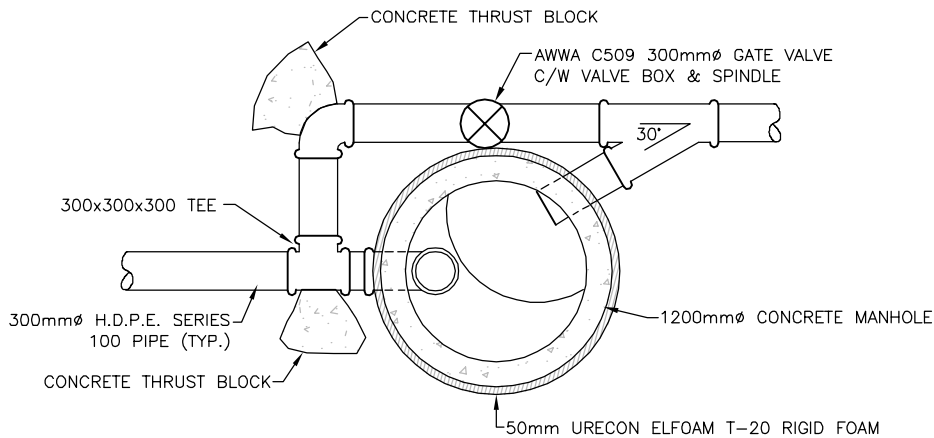
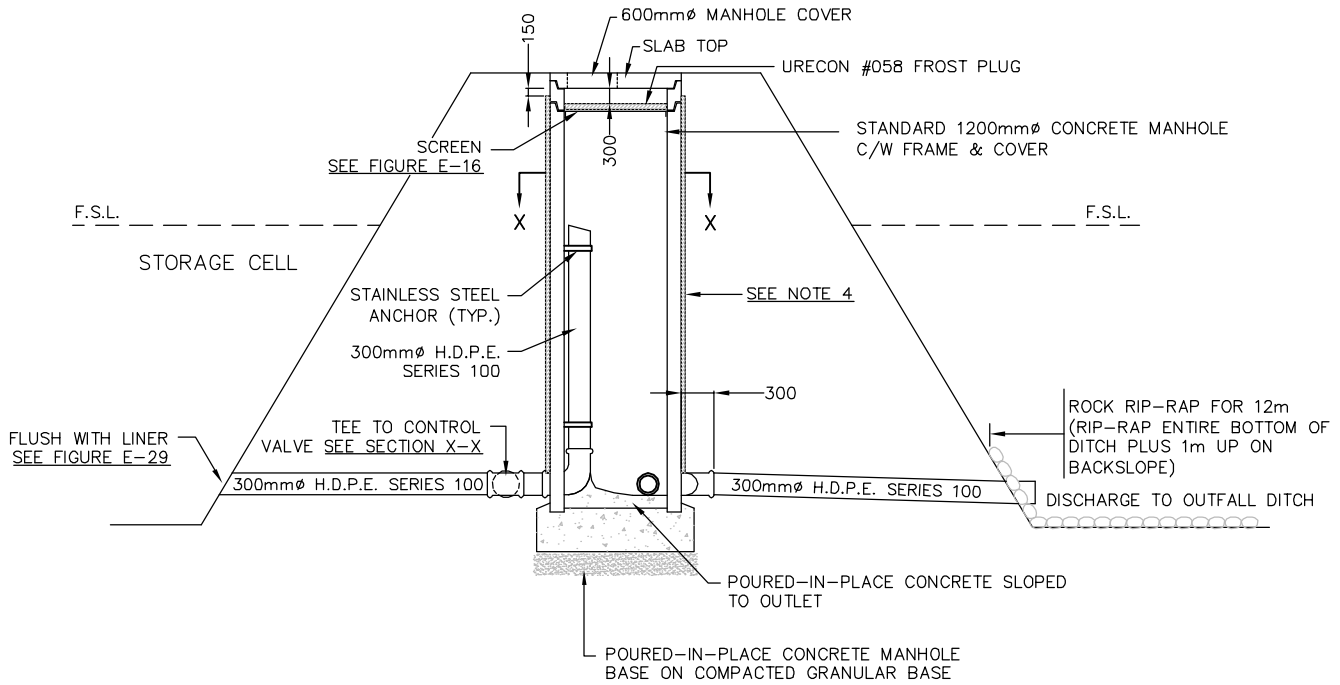
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.			EMERGENCY DISCHARGE OVERFLOW MANHOLE DETAILS	
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		E-24



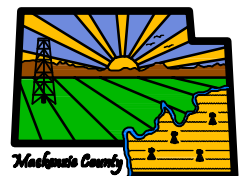
SECTION X-X

NOTES:

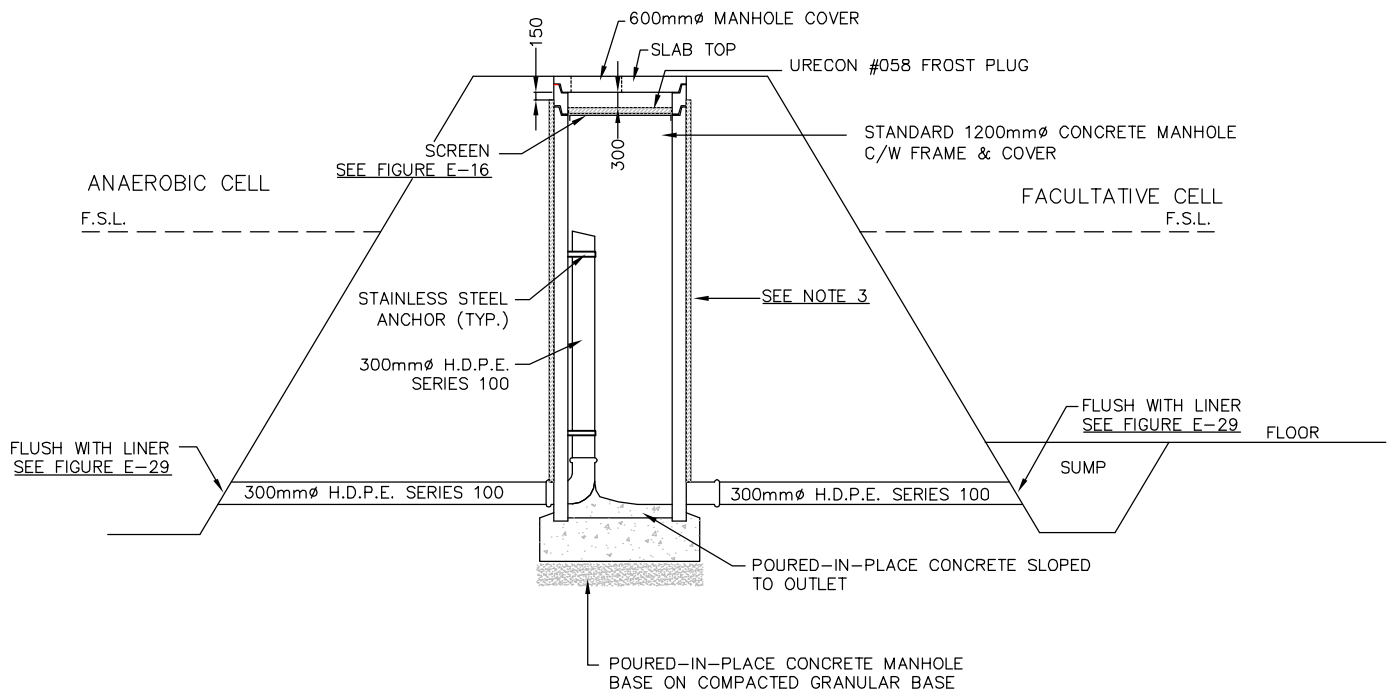
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.
3. URECON ELFOAM T-20 RIGID FOAM BOARD, WRAP TWO 25mm THICK LAYERS AROUND MANHOLE. 13mm NYLON BANDING STRAPS SPACED 400mm MAX. APART TO HOLD ELFOAM IN PLACE ON MANHOLE ALL JOINTS BETWEEN LAYERS TO BE STAGGERED. SEAL SEAMS WITH PORTAFOAM (URETHANE SPRAY) FOLLOWED BY APPLICATION OF BAKOR 110-14 WATERPROOFING MASTIC AND WRAPPED WITH 0.127mm POLYETHYLENE SHEET.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		DISCHARGE OVERFLOW STRUCTURE FROM STORAGE CELL TO OUTFALL DITCH		Approved:	Figure E-25
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-25	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

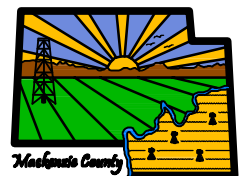


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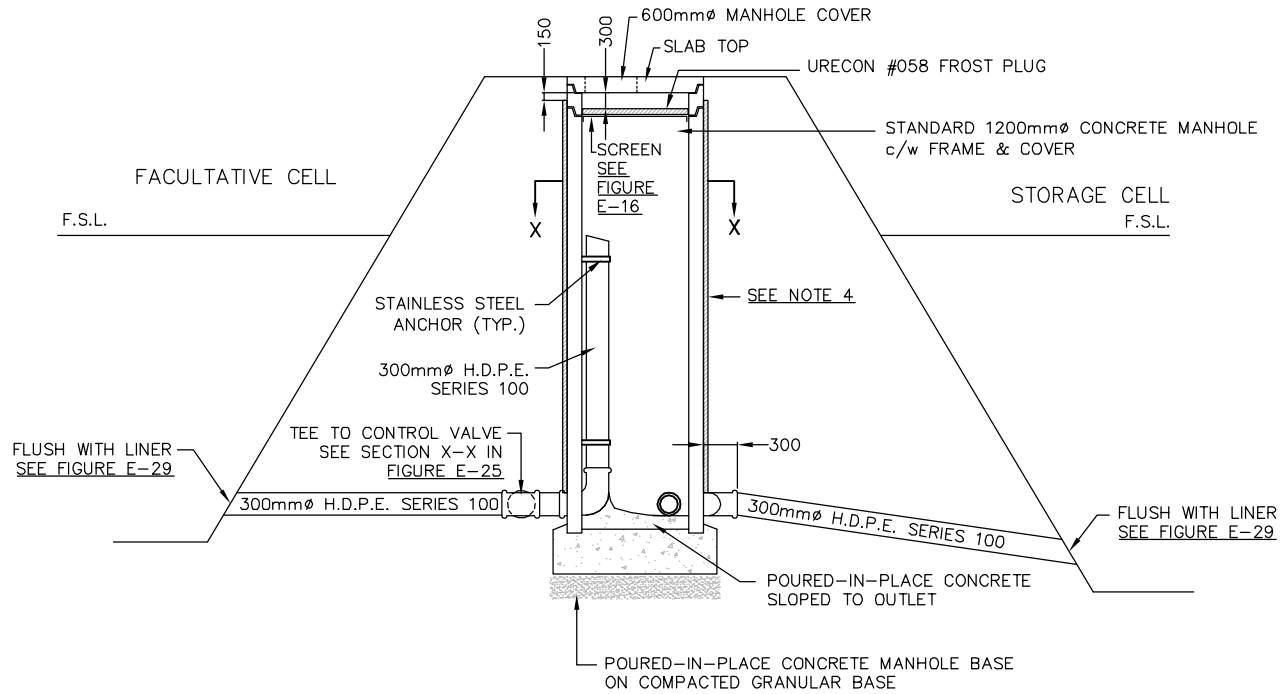
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.
3. URECON ELFOAM T-20 RIGID FOAM BOARD, WRAP TWO 25mm THICK LAYERS AROUND MANHOLE. 13mm NYLON BANDING STRAPS SPACED 400mm MAX. APART TO HOLD ELFOAM IN PLACE ON MANHOLE ALL JOINTS BETWEEN LAYERS TO BE STAGGERED. SEAL SEAMS WITH PORTAFOAM (URETHANE SPRAY) FOLLOWED BY APPLICATION OF BAKOR 110-14 WATERPROOFING MASTIC AND WRAPPED WITH 0.127mm POLYETHYLENE SHEET.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		OVERFLOW STRUCTURE FROM ANAEROBIC CELL TO FACULTATIVE CELL		Approved:	Figure E-27
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-27	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

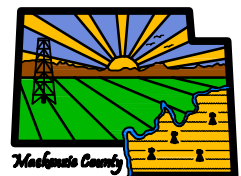


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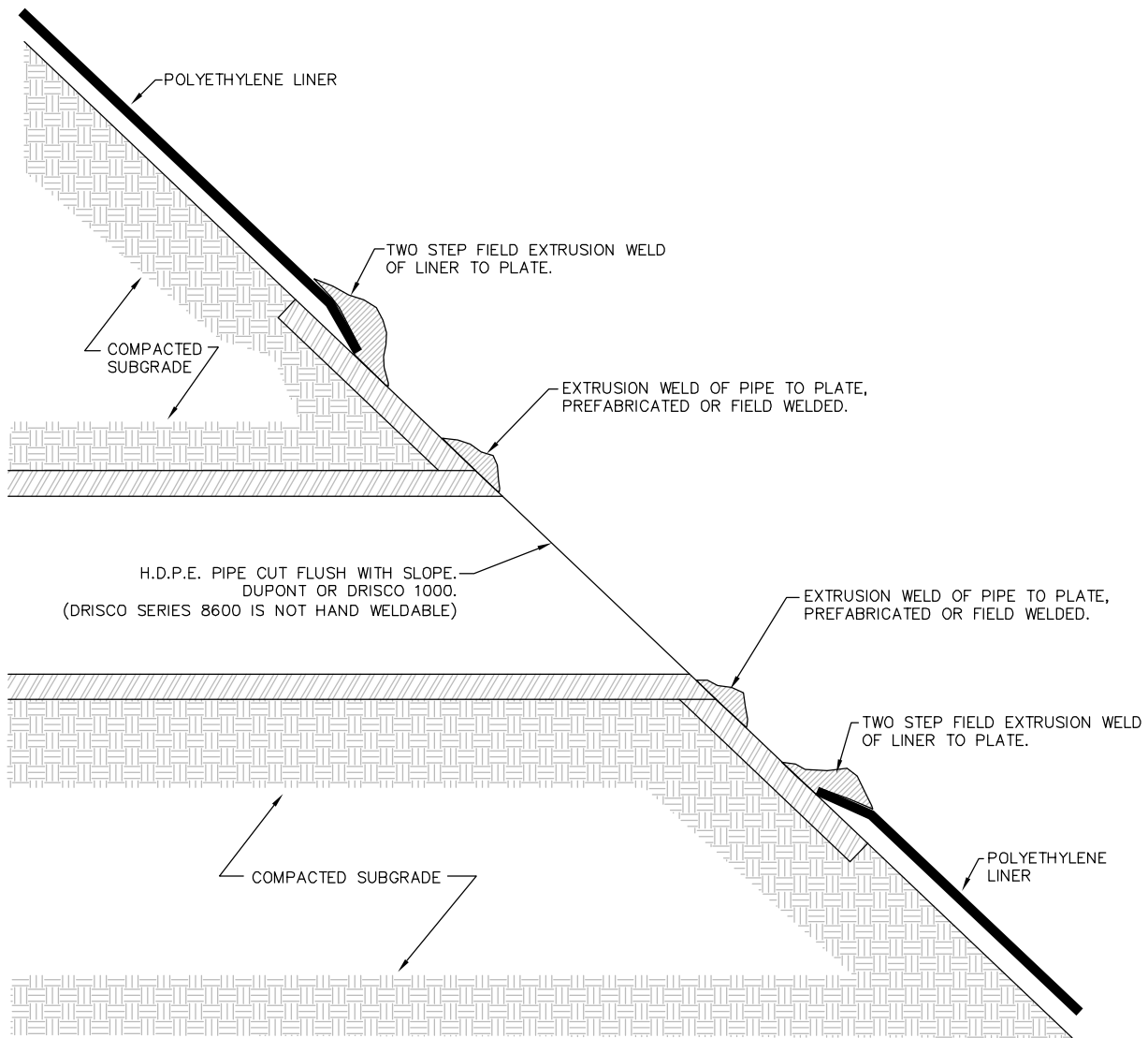
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.
3. SECTION X-X - SEE FIGURE ON E-25.
4. URECON ELFOAM T-20 RIGID FOAM BOARD, WRAP TWO 25mm THICK LAYERS AROUND MANHOLE. 13mm NYLON BANDING STRAPS SPACED 400mm MAX. APART TO HOLD ELFOAM IN PLACE ON MANHOLE ALL JOINTS BETWEEN LAYERS TO BE STAGGERED. SEAL SEAMS WITH PORTAFOAM (URETHANE SPRAY) FOLLOWED BY APPLICATION OF BAKOR 110-14 WATERPROOFING MASTIC AND WRAPPED WITH 0.127mm POLYETHYLENE SHEET

MACKENZIE COUNTY

General Municipal Improvements Standards

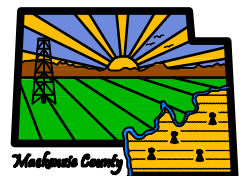


Rev.		CONTROL AND OVERFLOW STRUCTURE FROM FACULTATIVE CELL TO STORAGE CELL		Approved:	Figure E-28
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

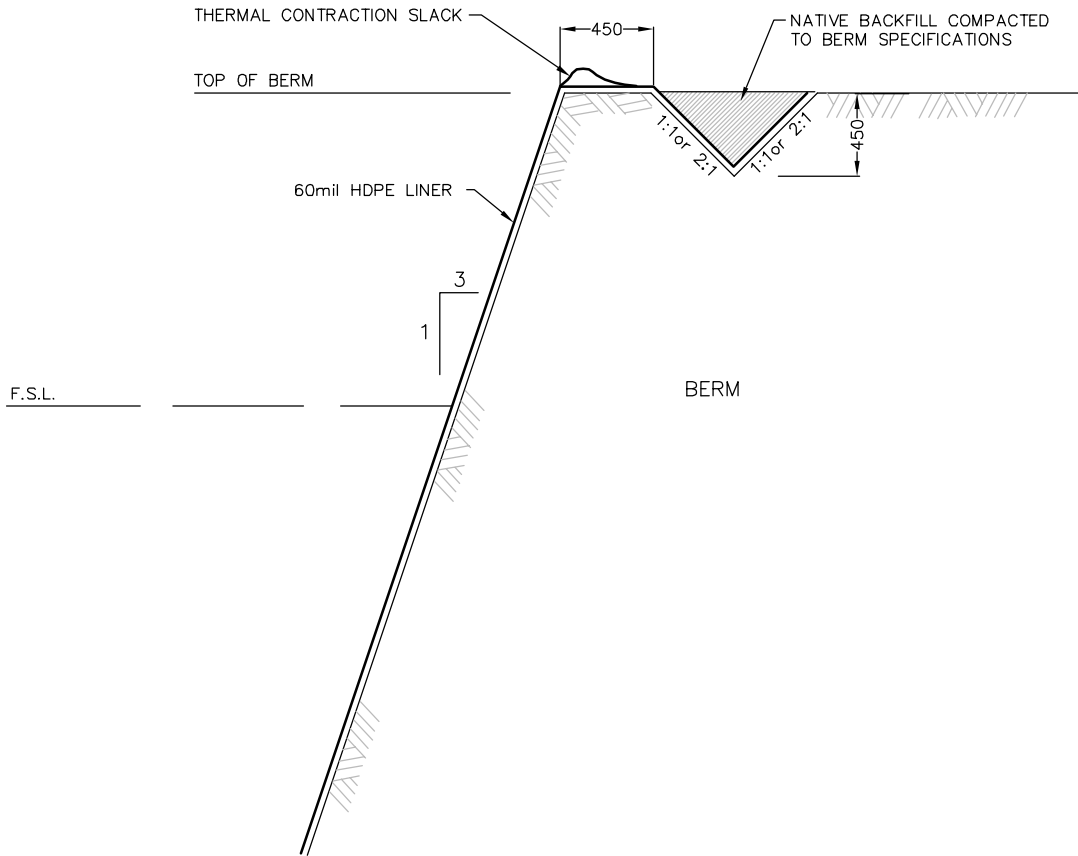


MACKENZIE COUNTY

General Municipal Improvements Standards



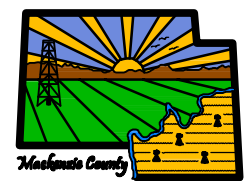
Rev.		H.D.P.E. PIPE PENETRATION WITH FLANGE PLATE		Approved:	Figure E-29
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure E-29
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



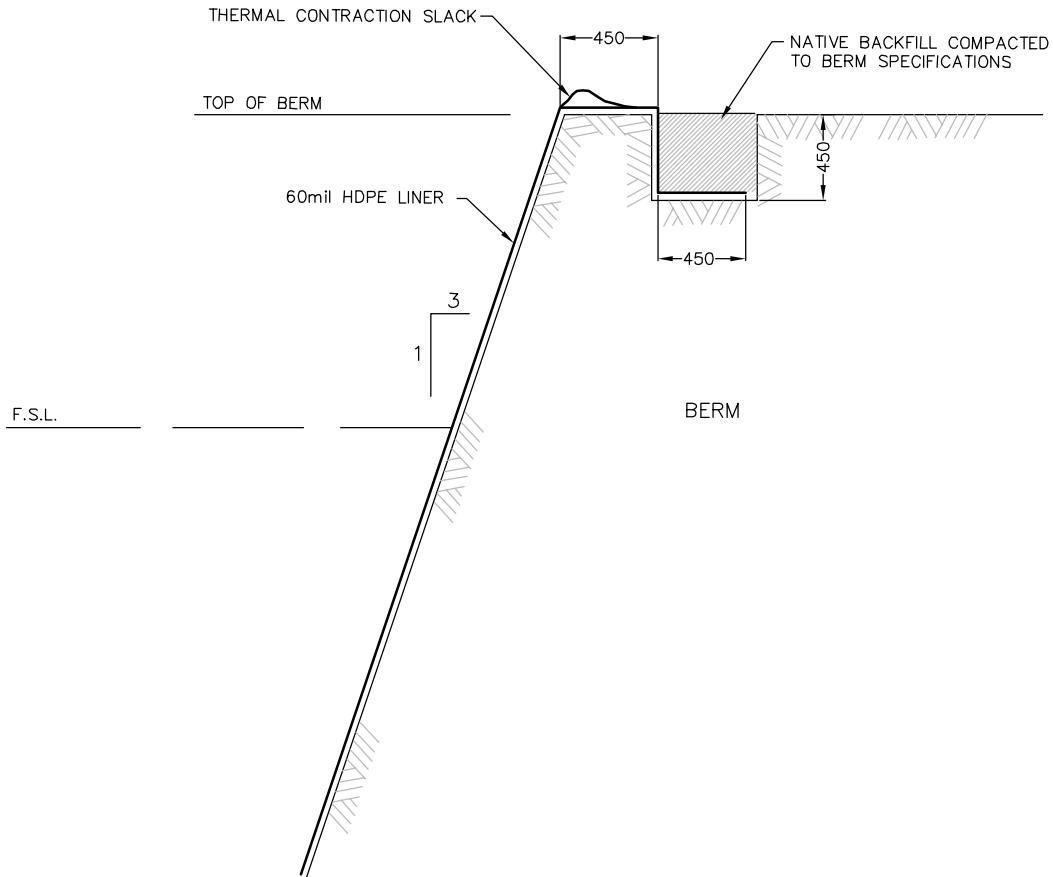
NOTES:
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



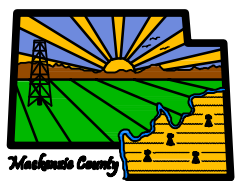
Rev.		V-TYPE ANCHOR TRENCH		Figure E-30
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		



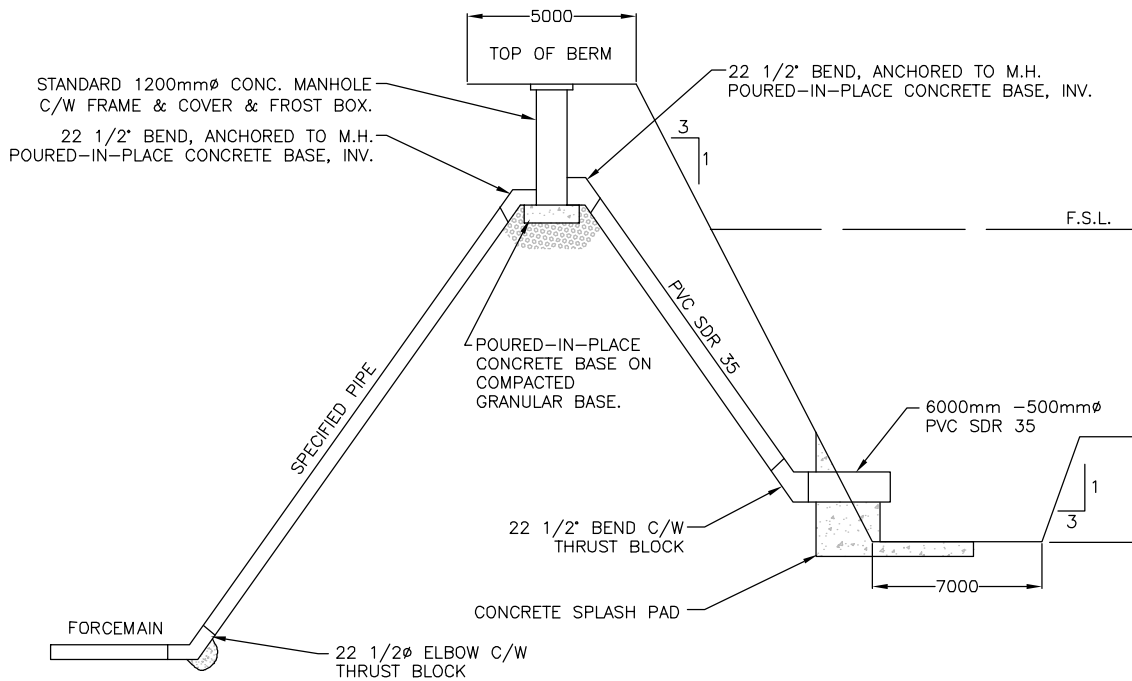
NOTES:
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		STANDARD ANCHOR TRENCH		Figure E-31
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

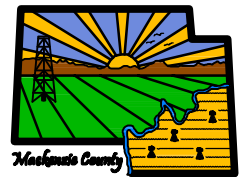


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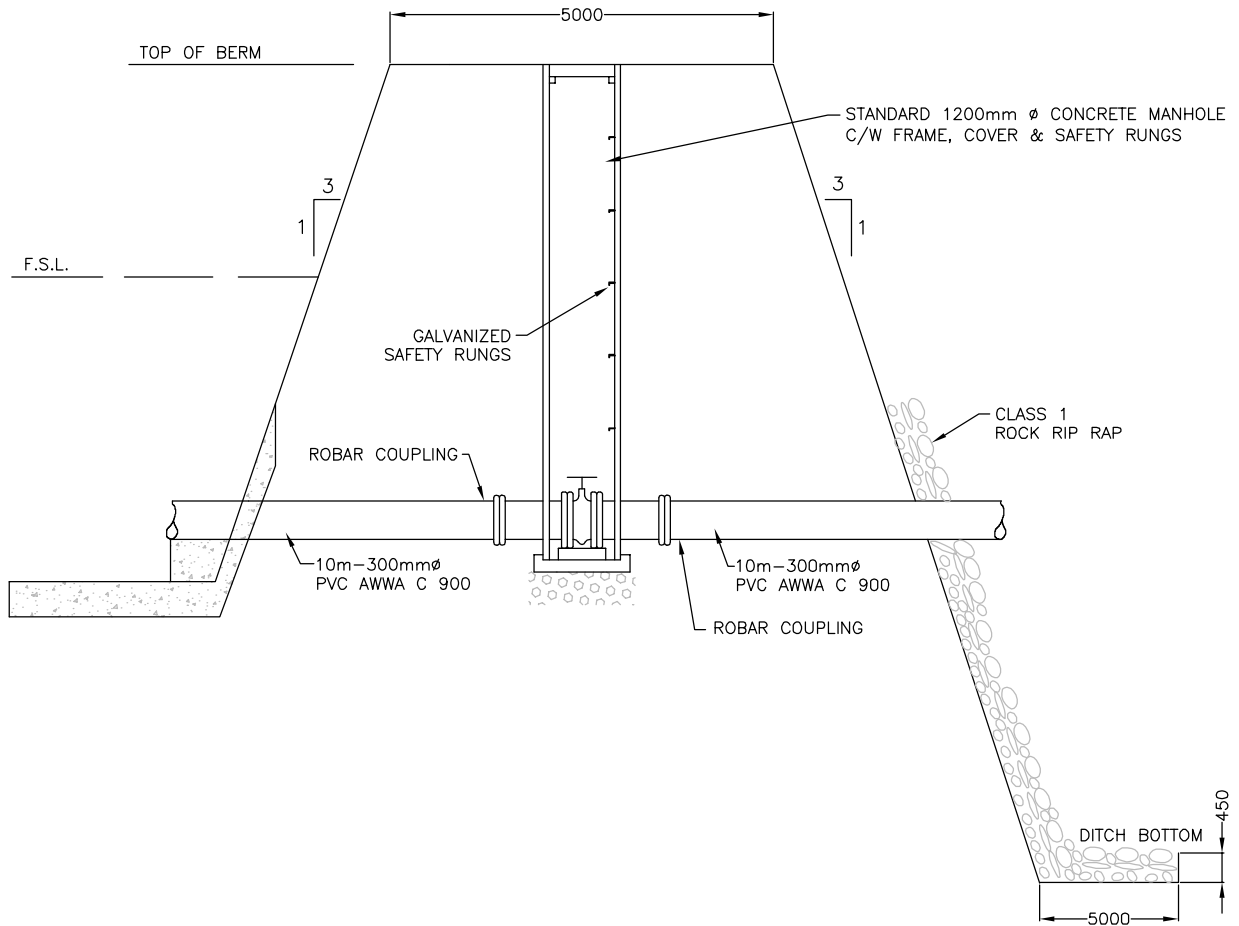
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p style="text-align: center;">INLET MANHOLE DETAILS</p>		<p style="text-align: right;">Figure E-32</p>
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-32
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

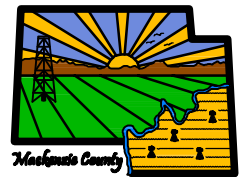


NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

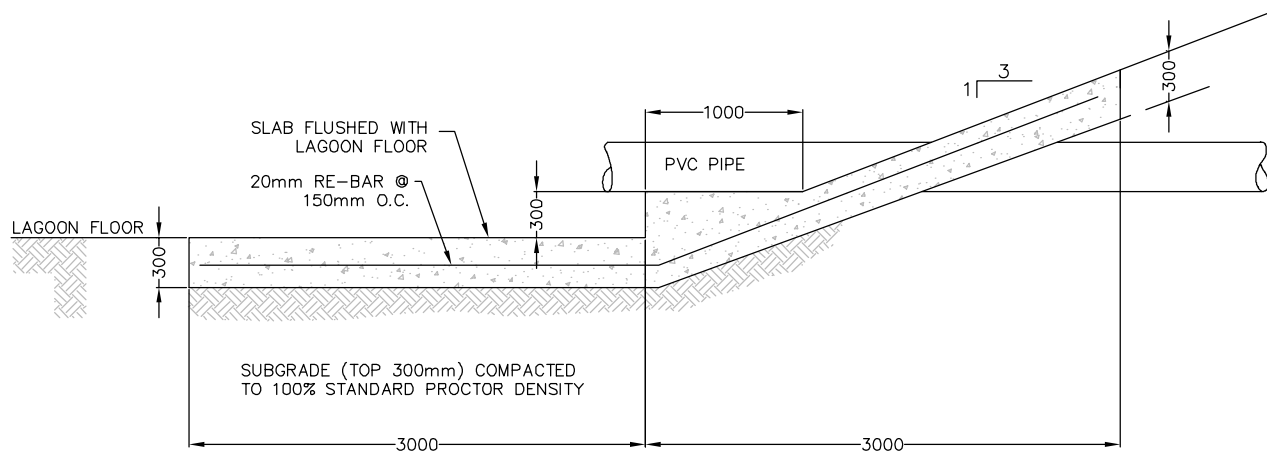
MACKENZIE COUNTY

General Municipal Improvements Standards



DISCHARGE CONTROL DETAILS

Rev.			Approved:	Figure E-33
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:		
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

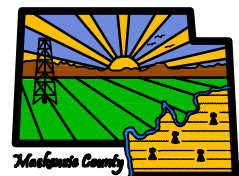


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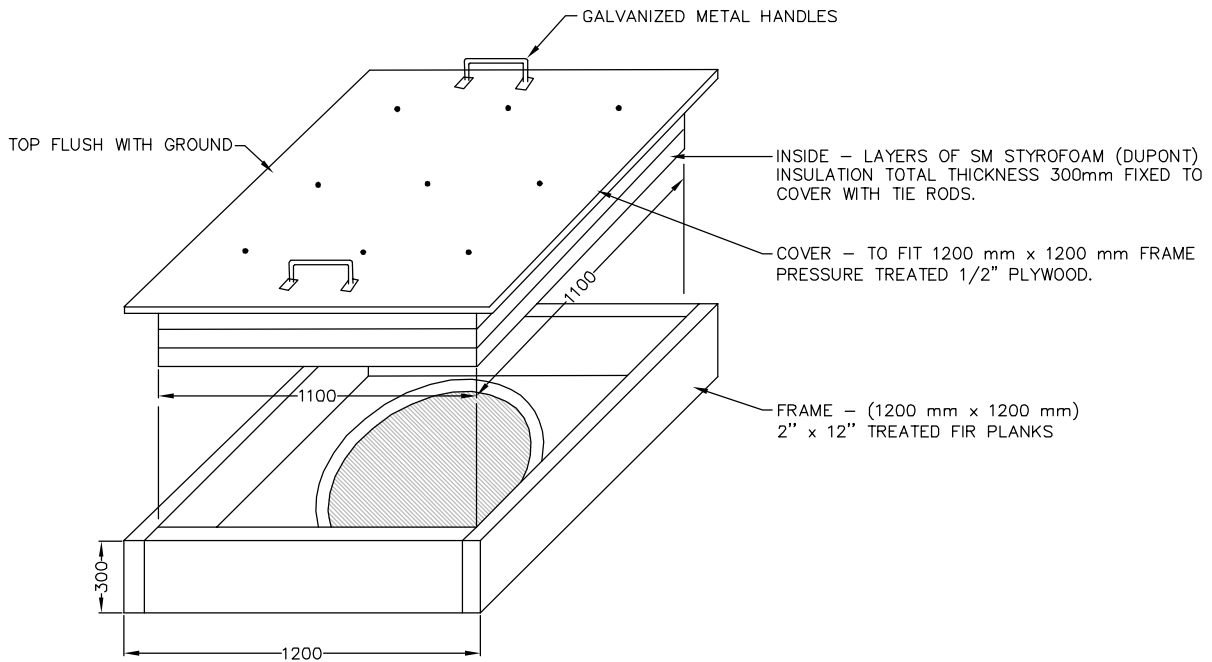
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.
3. CONCRETE THICKNESS 300mm UNLESS OTHERWISE STATED.
4. CONCRETE COMPRESSIVE STRENGTH MINIMUM 30 MPa @ 28 DAYS.

MACKENZIE COUNTY

General Municipal Improvements Standards



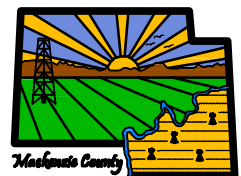
Rev.		<p>CONCRETE SPLASH PAD DETAILS</p>		<p>Approved:</p>	<p>Figure E-34</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure E-34	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



NOTES:
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>FROST BOX DETAIL</p>		<p>Approved:</p>	<p>Figure E-35</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure E-35</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

SECTION F STORM WATER MANAGEMENT SYSTEM

F.1 GENERAL

- F.1.1** The Developer and the Developer's Consulting Engineer are responsible to ensure that the storm water management system is designed and constructed according to accepted engineering practice. These Standards are intended as a guide only and shall not be considered as a substitute for a detailed material and construction specifications to be prepared by the Developer's Consulting Engineer.
- F.1.2** The current Standards and Specifications issued by the following organizations shall be implemented during design and construction of the storm water management 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.1.3** The specific requirements of the storm water management system will depend on whether the proposed subdivision is defined as a rural or urban subdivision. In either case, the intent of the storm water management system is to prevent any negative effects as a result of the subdivision.
- F.1.4** Detailed design of the storm water management system shall be consistent with the storm water management plan previously submitted by the Developer and approved by the Municipality. Deviation from the intent of the storm water management plan must be approved by the Municipality and supported by engineering analysis.
- F.1.5** For both rural and urban subdivision, the storm water management system shall be designed based upon a "net-zero" impact (runoff rates for a 24 hour duration, 1:100 year post subdivision design storm will not exceed rates for the same design storm under pre-subdivision conditions).
- F.1.6** If these Standards do not cover an area of drainage concern, the responsibility shall be upon the Developer to present alternative corrective measures and recommend proposed drainage standards to be used, based on sound economic, engineering, environmental, maintenance and operational criteria for approval by the Municipality. The system shall meet current standards and recommendations of Alberta Environment.
- F.1.7** The Developer shall provide rights-of-way or easements for drainage and have them registered in the name of the Municipality so that future maintenance may be provided.

- F.1.8** The Developer shall be responsible not only for the drainage within his subdivision, but also for drainage in the adjoining properties that would be affected by his subdivision.
- F.1.9** Drainage diversions (ditches, berms, ditch checks, installations of culverts, rip-rap) and other means of erosion control shall be approved and licensed by Alberta Environment as applicable.
- F.1.10** Storm sewer pipe shall be manufactured in conformity with the latest standard by the American Society for Testing Materials (ASTM) and the Canadian Standard Association (CSA).
- F.1.11** An urban storm management system shall be designed as a separate system. Pipes and their appurtenances (manholes, catch basins, outfall structures, etc.) shall comprise the minor system. This system shall convey runoff from snow melt and rainfall events without sustaining any surface ponding or excessive surface flows from a 1:5 year event. The road system, detention and retention facilities, parkland and other land shall comprise the major system. The major system shall convey runoff from up to a 1:100 year event and shall be sufficient to prevent any significant property damage (e.g., flooding of buildings).
- F.1.12** For a rural storm management system, both the minor and major systems consist of roadside ditches and swales, culverts and storage facilities. It is expected that the rural system will be comprised primarily of swales, ditches, culverts and similar open flow components. The system shall convey runoff from snowmelt and rainfall events consistent with the storm water management plan. The system will be considered the major system, and shall convey runoff for the design storm sufficient to prevent property damage.
- F.1.13** The design of both the major and minor systems must meet the current requirements outlined in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems published by Alberta Environment.
- F.1.14** Wastewater from residential, industrial, agricultural or commercial operations shall not discharge into the storm water management system.
- F.1.15** Foundation drain (weeping tile) sump pumps shall discharge collected water onto the ground surface for overland flow.
- F.1.16** Roof drainage downspouts from residential buildings shall not be directly connected to the storm sewer system. Roof drainage downspouts from single and dual family dwellings shall be discharged to grassed or pervious areas. The point of discharge shall be a minimum of 1 m away from the building to ensure positive drainage. Roof drainage downspouts from multi-family buildings, commercial areas, and industrial areas may be allowed to directly discharge to the storm sewer collection system subject to approval in writing by the Municipal Engineer.

- F.1.17** On-site detention strategies that utilize building roofs, parking lots, or landscaped areas to attenuate peak rainfall runoff rates must be approved by the Municipality.
- F.1.18** Properly graded and surfaced roads and lanes, landscaping and sediment control structures at storage facility inlets and outlets shall be used to minimize sediment discharge into the storm water collection system and receiving water body.
- F.1.19** Post-subdivision runoff rates shall not exceed the pre-subdivision runoff rates for a given contributing area in any event. A lower rate of post-subdivision runoff will be applied when pre-subdivision runoff rates are considered to be excessive. A maximum allowable runoff rate acceptable to both the Municipality and Alberta Environment will be established on an individual case basis.
- F.1.20** The Developer shall provide all detailed design calculations concerning the storm water management system to the Municipality for approval.

F.2 MINOR STORM MANAGEMENT SYSTEM

F.2.1 Design Criteria

- i. 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.
- ii. 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.
- iii. Storm sewer mains shall be designed to flow full when conveying the required design flows. The hydraulic grade line shall be located at the crown of the sewer main. Storm sewer main crown elevations shall match at manhole junctions.
- iv. Roof leaders shall be discharged onto the ground and drain away from the buildings, water supply wells and septic beds. 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 to prevent erosion and/or property damage.
- v. 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 5 m from the building foundation and located to ensure that drainage flows away from the building.

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

$$Q = CIA / 360$$

Where: Q = the design peak flow rate (m³/sec)

I = the intensity of rainfall (mm/hour)

A = the contributing area (ha)

C = the runoff coefficient

- vii. Rainfall intensity “I” shall be determined using appropriate Intensity Duration Frequency (IDF) or rainfall data within the Municipality. The maximum inlet time shall be 15 minutes unless approved otherwise by the Municipality. Rainfall intensity data can be obtained from Atmospheric Environment Services, Environment Canada, at 4905 Dufferin Street, Downsview, Ontario M3H 5T4.
- viii. The runoff coefficient “C” shall be consistent with the following guidelines and based on sound engineering and best management practice:

Land Use / Surface Characteristics	Runoff Coefficient, C	
	1:2 Years Rain	1:100 Years Rain
Undeveloped Farm Land	0.10	0.20
Lawns, Parks, Playgrounds	0.20	0.30
Urban – Residential	0.35	0.60
Urban – Commercial	0.60	0.80
Urban - Apartments	0.70	0.80
Paved Surfaces	0.90	0.95
Gravel Surfaces	0.30	0.70

These values may be further modified based upon the specifics of the proposed subdivision. In rural subdivisions or where a mixture of land uses or surface characteristics are proposed, the weighted average of pervious and impervious area runoff coefficients shall be used.

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

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

- x. 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.
- xi. For areas larger than 65 hectares, the Developer must submit an acceptable computer generated model of the area for review.
- xii. Weeping tile flows must be presented in a detailed Geotechnical Hydrogeological Investigation prepared by a qualified Geotechnical Engineer or Hydrogeologist. The report shall outline expected weeping tile flows and any design and construction procedures required for foundation installation.
- xiii. Effluent from sanitary sewers and any drainage from industrial, agricultural or commercial operations that may potentially be contaminated shall not be discharged into the storm sewer system, and connections of weeping tile drainage to the storm sewer shall not be considered.
- xiv. Roof drainage from one-family and two-family dwellings shall be discharged to grassed or pervious areas. The point of discharge shall be at a sufficient distance to ensure the water flows away from the building. Roof drainage from apartment buildings, commercial areas and industrial areas shall also be discharged to the surface drainage system.
- xv. Best management practices shall be provided to minimize sediment discharge to the storm sewers. This shall be in the form of properly graded and surfaced streets and lanes, landscaping, catch basin sumps, sediment control structures at pond and lake inlets, or other means where appropriate.

F.2.2 Pipe Sizing

Storm sewer pipe shall be designed to convey the design flow when flowing full with the hydraulic grade line at the pipe crown. All pipe crown elevations shall match at manhole junctions. The following design factors shall be used in determining the storm sewer pipe sizes:

- i. Minimum pipe diameter for storm sewer main - 300 mm
- ii. Minimum pipe diameter for foundation drains (accommodating flow from weeping tiles only) - 150 mm
- iii. Minimum pipe size for catch basin leads - 250 mm
- iv. Manning’s Formula “n” - 0.013
- v. Minimum flow velocity when flowing full - 0.6 m/sec
- vi. Maximum flow velocity - 3.0 m/sec
- vii. 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

- viii. 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

- ix. The minimum grade for catch basin leads shall not be less than 1 %.
- x. The minimum grade of the first upstream leg shall not be less than 0.5 %.

F.2.3 General Material Requirements

- i. Unless specified with better material accepted by the Municipality, 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.
- ii. Storm sewers 900 mm diameter and smaller shall be PVC SDR 35 or Ultra Rib PVC storm sewer pipe, provided that manufacturer's recommended pipe loadings are not exceeded. Storm sewers greater than 900 mm diameter shall be of concrete pipe unless approved otherwise by the Municipality.
- iii. The design of foundation, footing, excavation, soil, rock and liquid retaining structure shall comply with the current National Building Code of Canada and Alberta Building Code. A surface investigation, including ground water condition, shall be carried out by a qualified Professional Engineer.
- iv. Concrete manholes and catchbasins shall be manufactured with pre-cast reinforced concrete components conform to ASTM C478. Concrete pipe shall be of sulphate resistant concrete with a gasketed jointing system. No corrugated steel pipe shall be used. On steep slopes, welded steel pipe or another rigid piping system shall be constructed as approved by the Municipality. Component joint shall be supplied with a pre-formed and sealed O-ring type rubber gasket, comply to ASTM C443 or current requirement.
- v. Minimum of 100 mm thick pipe granular bedding with no particles larger than 32 mm shall be required.
- vi. The Developer is responsible for providing the engineering expertise relating to the structural design of storm sewers, providing all test results and the quality control of all materials proposed to be used. All storm sewers shall be designed to prevent damage from superimposed loads. Notwithstanding information contained herein, all materials and loading calculation shall be consistent with current ASTM and CSA standards.
 - a. For rigid pipes a 0.025 cm crack shall be determined as exceeding the working strength and the pipe rejected. For flexible pipe, when deflection greater than seven and one-half percent (7.5 %) of the original diameter is reached, then the pipe shall be considered to have exceeded the limit of serviceability and shall be rejected.
 - b. Proper allowances shall be made with regard to the class of bedding and the trench dimensions (width, depth) when determining the loadings on pipes.

- c. The minimum depth of cover to pipe crown shall be 1.8 m, or 2.6 m to invert, whichever is greater.
- d. "Marston Theory" is to be used in analyzing loadings in the single trench applications for rigid pipe. For flexible pipe, the modified IOWA formula shall be used.
- e. Concrete pipe specified under ASTM C655 may have combinations of circular and elliptical reinforcement with minimum steel requirements at all outer and inner points as specified under ASTM C76. The Developer shall specify the horizontal and structural strength of all pipes.

F.2.4 Storm Sewer Alignment and Location

- i. Storm sewer mains shall be located within the road right-of-way and outside the carriageway.
- ii. Storm sewers shall be located a minimum of 3.0 m o/c from any watermain and 1.8 m o/c from any gas line or as required by the utility company.
- iii. Storm sewers shall be spaced at a minimum of 0.25 m between pipe walls from any adjacent sanitary sewer.
- iv. Public Utility Lot (PUL) widths shall be at least 4 m for a single utility and 6 m for two utilities.
- v. For storm sewer pipes greater than 600 mm in diameter, change in flow direction at manholes should not exceed 45°. This limit may be exceeded if care is taken to design a proper transition manhole.
- vi. It is recommended that storm sewers 600 mm inside diameter or less be installed with straight alignment between manholes. Curved sewers will be permitted providing that the following requirements are met:
 - a. Permissible joint deflections shall be in accordance with the manufacturer's guidelines.
 - b. Manholes are to be located at the beginning and end of curve.
 - c. The curve shall run parallel to the roadway centerline.
 - d. The minimum grade for curved sewers shall be fifty percent (50 %) greater than the minimum grade required for straight runs.
 - e. Storm sewer main shall be laid as a simple curve with a radius equal to or greater than 90 m or the manufacturer's minimum recommended radius, whichever is larger.
 - f. Manholes shall be located at intervals not greater than 90 m along the length of the curve.

- vii. Storm sewers and catch basin leads shall be installed at a sufficient depth to meet the following requirements:
 - a. The storm sewer shall have sufficient depth of cover to provide complete frost protection. The storm sewer main shall have a minimum depth of cover of 1.8 m measured from finished grade to the top of the pipe.
 - b. The storm sewer main shall have sufficient depth to allow all required building foundations to drain by gravity to the sewer. Special consideration shall be given when building floor elevations are lower than the roadway. Service lines shall have a minimum cover of 2 m from the finished lot surface to the top of pipe at the property line.
 - c. The catch basin leads shall have a minimum of 1.5 m of cover measured from the finished surface to the top of pipe.
 - d. Pipe clearance when passing under any watermain shall be a minimum of 300 mm separation between the top of the storm sewer pipe and the bottom of the watermain. Pipe clearance when passing over any watermain shall be a minimum of 300 mm separation between the bottom of the storm sewer pipe and the top of the watermain.

F.2.5 Storm Sewer Materials

- i. The Developer shall supply only new materials. All materials found to be defective or damaged shall be replaced at the cost of the Developer.
- ii. Where particular materials and products are specified, it is intended that approved equals are also acceptable. Approval must be obtained from the Municipality prior to installation.
- iii. Polyvinyl chloride (PVC) pipe shall conform to the ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings, CAN 3–B182.1 and CAN 3–B182.2 - minimum Class SDR 35, separate gasket and intergraded bell system. Joints shall meet the ASTM D3212 Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals. Pipe may be any colour except blue. Minimum stiffness of the pipe shall be 320 kPa. Service lines shall have minimum stiffness of 625 kPa. 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.
- iv. PVC 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. Pipe and fittings shall be installed within two (2) years from the production date indicated on the certification.
- v. Ultra-rib PVC pipe shall conform to ASTM F794 and Uni-bell B-9, and fittings shall conform to CSA B182.4 with a minimum stiffness of 320 kPa. Pipe may be any colour except blue.

- vi. The non-reinforced concrete pipe shall conform to the ASTM C14 Non-Reinforced Concrete Sewer, designed for flexible rubber gasket joints to ASTM C443. Sulfate resistant cement shall be used. Reinforced concrete pipe shall conform to the ASTM C76 Reinforced Concrete Sewer-Storm Drain and Culvert Pipe, designed for flexible rubber gasket joints to ASTM C443. Sulfate resistant cement shall be used. Flexible rubber gasket joints shall conform to CSA 257.3 and ASTM C443.
- vii. 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. Each concrete pipe shall be marked with the manufacturer's name, date of casting and quality testing passing stamp.

F.2.6 Manhole Design and Location

- i. Manholes shall be located at the end of each line, at all changes in pipe diameter, grade or alignment, and at all junctions. Manholes shall be located at the extension of property lines whenever possible in order to avoid conflicts with driveways.
- ii. The maximum spacing between manholes shall not exceed:
 - a. 120 m for storm sewers less than 1200 mm in diameter.
 - b. 500 m for storm sewers 1200 mm to 1650 mm in diameter.
 - c. 800 m for storm sewers larger than 1650 mm in diameter.
- iii. Manholes shall be 1200 mm minimum inside diameter. Precast (Type 50) reinforced concrete manhole barrels conforming to ASTM C478 shall be used. The base shall be constructed of 30 MPa sulphate resistant (Type 50) concrete.
- iv. The drop across manholes should be of sufficient magnitude to account for any energy losses in the manhole:
 - a. Pipe deflections of less than 45° require a drop of at least 30 mm.
 - b. Pipe deflections of 45° to 90° require a drop of at least 60 mm.
- v. Pipe deflections in manholes shall not be greater than 90°.
- vi. Invert drops for pipes larger than 600 mm or for high flow situations shall be assessed on an individual basis.
- vii. The obvert elevation of a sewer entering a manhole shall not be lower than the obvert elevation of the outlet pipe.
- viii. Interior drop manholes shall be used whenever the invert elevations of the inlet and outlet mains differ by more than 750 mm.

F.2.7 Manhole Materials

- i. Manhole sections shall be pre-cast reinforced concrete conforming to ASTM C478 and CSA A257.4. 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 Municipality for acceptance.
- ii. CSP manholes will not be allowed.
- iii. All manholes shall have an inside diameter of 1,200 mm for pipe 900 mm and less. For pipe exceeding 900 mm or manhole having multiple inlets, manhole sizing shall be subject to review by the Municipal Engineer. All cones shall be eccentric. Reducing rings or slabs may be used.
- iv. Manhole frames and covers shall be of cast iron conforming to Class 20, ASTM C48 and have at least 4 lift holes. Grated or standard manhole covers shall be used as required. A Norwood NF-80 or approved equal frame and cover shall be used on manholes located in carriageways and an appropriate locking manhole frame and cover shall be used on manholes located in parkland areas. Manhole covers with the Municipality identification will be encouraged. The use of manhole covers marked with names of other municipalities shall not be permitted.
- v. 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.
- vi. All joints shall be sealed with rubber gaskets conforming to ASTM C443, all joints between grade rings, conical top, slab tops and frames will use bituminous type seals (i.e. Rubber Neck) to create a water proof joint.
- vii. Manhole bases shall be reinforced precast slabs, vault or precast tees (reinforced). The concrete base is to be of a minimum of 150 mm in thickness constructed on compacted granular material or undisturbed native material. Perched manhole bases shall be a minimum of 200 mm in thickness. Pre-benched manhole bases shall be used wherever possible with pre-cored connection holes and watertight Duraseal or G-Loc joints or approved equal.
- viii. Tee-riser manholes shall conform to CSA 257.2, ASTM C76 and CSA A257.4, ASTM C76.
- ix. All pre-cast units shall be marked with manufacturer's identification, date of casting, type of cement and applicable standards.

F.2.8 Storm Services and Foundation Drains

- i. 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.
- ii. 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.
- iii. When required, separate storm sewer or foundations drain service connections shall be provided for each separately titled lot.
- iv. The minimum diameter of a residential storm sewer or foundation drain service shall be 100 mm. Non-residential service connections shall be sized according to anticipated flow.
- v. Connections for all proposed residential lots requiring storm sewer or foundation drain services shall be installed at the time of initial subdivision development.
- vi. The minimum grade for a storm sewer or foundation drain service line shall be 2 %.
- vii. Services shall be located such that they do not conflict with driveway locations.
- viii. 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.2.9 Catch Basins and Leads

- i. For urban design, surface water shall not be permitted to run a distance greater than 300 m along roadways without provision for interception by a catch basin, except in lanes or walkways where 200 m in either direction may be permitted.
- ii. Surface water shall be intercepted with a number of catch basins such that the combined inlet capacity is sufficient to receive the design storm water flow. At sag locations, the determination of the required capacity must account for flow that may bypass inlets at upstream gutter locations.
- iii. Gutter flow shall be intercepted by a catch basin prior to crossing a walkway wherever possible. The depth of flow in gutters shall not exceed the top of curb at any point. Minimum gutter grade shall be 0.5 % except in cul-de-sacs and around curb returns where minimum gutter grade shall be 0.8 %.

- iv. Catch basins shall be located at the beginning of the curve or at the end of the curve of any curb return. Catch basins and leads shall not be placed beyond the public right-of-way. Lots must be graded to ensure that all runoff drains to an existing approved drainage system.
- v. All catch basin bodies shall be 900 mm pre-cast sulphate resistant concrete sections. The body will be constructed to provide a minimum 600 mm sump unless otherwise approved. The minimum inside diameter for a pre-cast catch basin shall be 610 mm. The minimum sump depth in catch basins shall be 500 mm.
- vi. The minimum catch basin lead diameter shall be 250 mm with a minimum slope of 1 % and a maximum length of 30 m. If the length must exceed 30 m, a catch basin manhole must be installed on the upstream end. For leads of greater length or for those from a CBMH to a manhole the minimum lead size shall be 300 mm. All leads shall be connected to a manhole or catch basin manhole at the downstream end.

F.2.10 Catch Basins Materials

- i. Catch basins shall conform to the ASTM C478. Catch basin barrels shall be manufactured using sulphate resistant Type 50 cement.
- ii. The catch basin grates, leads and spacing shall be designed such that there will be no ponding during a 1:2 year rainfall event. Catch basin frames and covers shall be combination precast iron inlet type. Norwood F41 & F51, Trojan K2 or approved equal shall be used with 900 mm concrete sections. Catch basin frames and grates shall be cast iron conforming to Class 20 ASTM A48 and ASTM A536. Any other types must be approved by the Municipal Engineer. Castings shall be marked with series designation, foundry identification and date of casting.
- iii. Catch basin leads shall be Poly Vinyl Chloride (PVC) pipe conforming to CSA B182.2 – M1983 and ASTM D 3034, SDR 35. Jointing shall be bell and spigot type with rubber gaskets conforming to ASTM D 3212. As an alternative, Profile Wall (ribbed) PVC pipe may be used. The pipe and fittings shall adhere to CSA B182.4, jointing shall bell and spigot type with rubber gaskets as above.
- iv. If required, catch basin 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.
- v. All pre-cast units shall be marked with manufacturer's identification, date of casting, type of cement and applicable standards.
- vi. Corrugated steel pipe (CSP) material will not be allowed.

F.3 CONSTRUCTION

F.3.1 Trenching, Bedding and Backfill

- i. All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.
- ii. 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.
- iii. Granular materials shall be well graded and approved by the Municipality before use. 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 100 mm below the pipe and shall extend up both sides to the trench wall and provide a minimum cover of 300 mm above the pipe. Where necessary, the Developer’s Consulting Engineer shall determine special pipe foundation measures for areas where unsuitable pipe foundation conditions exist. Bedding sand must be clean and meet the following requirements:

Sieve Size Passing	% Passing, By Mass
2500	100
630	60 or more
315	30 or more
160	20 or less

- iv. Mortar sand shall be clean and shall contain no deleterious material and conform to CAN 3-AS-M, sulphate resistant (type 50).
- v. Washed rock shall contain no deleterious materials or other impurities and shall meet the following grading requirements:

Sieve Size Passing	% Passing, By Mass
25,000	100
5,000	60 or more
80	30 or less

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

- vii. Excavated material shall be stockpiled at a safe distance from the edge of the trench. Backfill material shall be the soil excavated from the trench although approved granular materials may be substituted for poor existing soils. All backfill material will be subject to approval by the Municipality. If possible, the excavated material shall be placed back in the trench in the vertical and horizontal order in which it was excavated. Backfill shall be placed in uniform lifts not exceeding 300 mm loose thickness. Where clay is used as backfill material, its moisture content shall not exceed the Plastic Limit by more than ten percent (10 %).
- viii. Within roadways, under no circumstances shall backfill material containing ice, snow, organic or any other deleterious material be used. Trench excavations shall be kept free of water.
- ix. Compaction and densities:
 - a. Prior to street construction: all excavations under proposed carriageways, sidewalks, street lights or other similar surface structures shall be backfilled in lifts with compacted thickness of 300 mm or less per lift and compacted to minimum density of not less than 98 % of the Maximum Standard Proctor Density or as otherwise approved by the Municipality. A minimum of two (2) density tests per 100 lineal meters of trench per 600 mm of compacted backfill thickness shall be taken. Additional tests may be called for as deemed necessary. Any free water in a trench shall be removed prior to placing additional lifts.
 - b. Under existing carriageways: all excavations under existing carriageways, sidewalks, lanes or other similar surface structures shall be backfilled to meet the following specifications:
 - 300 mm or more below final grade – backfill materials shall be compacted to minimum density of not less than 98 % of the Maximum Standard Proctor Density.
 - 0 - 300 mm below final grade – backfill materials shall be compacted to a minimum of 100 % of the Maximum Standard Proctor Density and based on a minimum of two (2) field tests per 100 lineal meters of trench per 600 mm of compacted backfill. Backfill shall be placed in uniform lifts not exceeding 150 mm compacted thickness.
 - c. Adjacent to existing carriageways: all material 300 mm below the finished grade shall be compacted to a density not less than 98 % of the maximum density of a five point Standard Proctor Compaction Test and based on a minimum of one (1) field test per 150 lineal meters of trench for each 600 mm of compacted vertical backfill.
 - d. Sand or gravel backfill shall be compacted to meet the following density requirements:

- 300 mm or more below grade - the minimum acceptable density shall be 98 % of the Maximum Standard Proctor Density.
 - 0 - 300 mm below grade - all sand or gravel in this zone shall compact to 100 % of the Maximum Standard Proctor Density.
- e. Compaction testing: for all density tests indicating insufficient compaction, two (2) more density tests, proportionately representative of the trench tested length shall be taken at that depth. If the average of the three (3) tests is below the required density, the area of deficient density shall be re-excavated and re-compacted to meet the specified density. Densities greater than 100 % shall be deemed to be at 100 % for calculating the average of the three tests.
- f. Sub grade and base course compaction for roadway construction shall be as specified in the appropriate section of these Standards.
- x. 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.
- xi. All debris, surplus fill and unused materials must be removed from the site as directed by the Municipal Engineer.

F.3.2 Bedding

The pipe shall be installed in the class of bedding shown on the plans as specified herein:

- i. Class A: method of bedding on which the lower part of the pipe exterior is set in concrete of suitable thickness to encase at least one-quarter of the pipe diameter for the full trench width. Compacted sand shall be placed to a minimum depth of 300 mm above the top of the pipe.
- ii. Class B: method of bedding in which the pipe is set in compacted sand or gravel, as specified, on a trench bottom shaped to fit the pipe. The pipe is entirely encased with sand to a minimum of 300 mm above its top in layers not exceeding 150 mm in thickness. Depth of bedding below the pipe to be a minimum of 75 mm for 675 mm diameter pipe or smaller at 100 mm for pipe 750 mm diameter or greater.
- iii. Class C: method of bedding in which the pipe is placed on an earth foundation shaped to fit the lower part of the pipe. The remainder of the pipe is encased in sand compacted to a height of at least 150 mm above the top of pipe.
- iv. Class D: method of bedding in which the foundation is not shaped to fit the lower part of the pipe but the pipe must be evenly supported throughout its length (except for the pipe bells).

F.3.3 Storm Sewer Installation

- i. Pipe shall not be deflected either vertically or horizontally in excess of that recommended by the manufacturer.
- ii. Pipe installation shall start at the outlet and work upstream.
- iii. The pipe and gasket installation shall be conducted in compliance with the pipe manufacturer's specifications.
- iv. Installation of PVC pipe and fittings shall conform to AWWA M23.
 - v. Installation of concrete steel cylinder pipe shall conform to AWWA M9.
- vi. Field welding procedures shall be in accordance with CSA Z662. Welders shall be qualified as B pressure welders.
- vii. The trench shall be kept dry during pipe installation and no water shall be allowed to drain through the newly installed pipe for at least two hours where mortar joints have been used. No pipe shall be installed in wet trench conditions that preclude proper bedding or on frozen trench bottom or when, in the opinion of the Municipal Engineer, the trench conditions or the weather are unsuitable for proper installation.
- viii. Pipes shall be carefully aligned when jointing. Joints are to be kept free of mud, gravel and foreign material and shall be completed as outlined in the manufacturer's specifications. Each joint shall be completed before laying the next length of pipe. Deflections shall not exceed those permitted by the pipe manufacturer.
- ix. The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete. When pipe installation is not in progress, the open ends of installed pipe shall be closed with an approved plug or cap to prevent entrance of trench water and/or any foreign or other material into the line.
- x. Adequate backfill shall be placed on the pipe to prevent floating. Any pipe which has floated shall be removed from the trench and be re-installed as directed by the Municipality.
- xi. The alignment of pipes less than 900 mm in diameter shall not be more than 150 mm off the designated alignment. The alignment for pipes larger than 900 mm shall not deviate by more than 50 mm per each 300 mm of diameter.
- xii. The invert of the pipe shall not deviate from the design grade by more than 6 mm plus 20 mm per metre of diameter of sewer pipe.
- xiii. Each valve and fitting shall be permanently supported independently of the pipe with 30 MPa concrete.

- xiv. The cutting of pipe for closure to fittings, valves and other reasons shall be done in a neat and workmanlike manner, without damage to the pipe and so as to leave a smooth edge at right angles to the axis of the pipe. Pipe cutting for valves and fittings shall be done accurately so as to bring all valves and fittings to their correct positions. Cut standard pipe used with rubber gasket joints shall be field machined and chamfered as required by the manufacturer's instructions.
- xv. Standard plugs shall be inserted at all dead ends of pipe. A concrete thrust block shall then be placed behind this plug backing onto undisturbed material. A valve shall be placed within a distance of two full pipe lengths (12 m typical) from the end of the pipe or between the plug and fitting, as required.

F.3.4 Manhole Installation

- i. Manholes shall be installed as depicted on the detail drawings and in accordance with manufacturer's recommendations.
- ii. Backfill around manholes shall be compacted to a minimum of 98 % of Standard Proctor Density.
- iii. Tee-riser manholes shall require Class A bedding to the elevation of the spring line.
- iv. Pre-cast manhole bases shall be installed on a base of 100 mm to 300 mm of washed gravel.
- v. Cast in place manhole bases approved by the Municipal Engineer shall be placed directly on undisturbed ground.
- vi. 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 300 mm. Steps shall be evenly spaced at a maximum of 410 mm to within 600 mm of the base of the manhole. Refer to Drawing F-14 for details.
- vii. The frame and cover shall be installed following manufacturer's recommendations.

F.3.5 Riprap

- i. When required by the plans, or as ordered by the Municipal Engineer, embankments, the ends of culverts and ditch bottoms shall be protected by riprap as directed. This item consists of supplying materials and constructing a protective covering of approved stone or sacked concrete on an earth bed, granular filter blanket or filter fabric in accordance with these Standards. Riprap shall be constructed at the locations and in conformity with the lines and grades shown on the plans or as designated by the Municipal Engineer.

- ii. The Developer shall supply all riprap materials for the proposed subdivision. The materials supplied will be subject to the approval of the Municipality.
- iii. The Municipality reserves the right to select an independent testing firm to conduct inspections and testing of riprap, and compile its own data during or after the construction period. Any costs associated with inspections and testing conducted by the Municipality for areas that fail initial testing shall be borne by the Developer and taken from the security held by the Municipality. These results will be made available to the Developer and their Consulting Engineer. This quality assurance testing program does not relieve the Developer of their responsibility to conduct their own quality control testing program.
- iv. Stone riprap: materials shall consist of sound, hard and dense stones, boulders or quarry rocks resistant to the action of air and water and free from seams, cracks or other structural defects. The particles shall be generally of equal dimensions in all directions, with a minimum of flat and/or elongated particles. Types of stone riprap:
 - a. Normal stone riprap - used for corrugated steel pipe culverts, ditch checks and ditch blocks. Shall consist of particles having dimensions of not less than 150 mm in any one direction.
 - b. Heavy stone riprap - used for corrugated structural plate pipe culverts, bridges, and major stream bank protection.

Weight of stones (kg)	Percentage
400 – 600	40 - 60
200 – 400	20 - 40
25 – 200	10 - 30
Under 25	0

- c. Armour stone riprap:

Weight of stones (kg)	Percentage
600 – 900	60 - 70
300 - 600	20 - 30
100 - 200	10 - 20
Under 100	0

- d. Hand laid riprap - hand laid riprap shall be sound, durable stones and in no case measure less than 150 mm. The stones shall be placed with their beds at right angles to the slope, with larger stones used in the bottom courses, and the smaller stones at the top. They shall be laid in close contact so as to break joints, and in such manner that the weight of the stone is carried by the earth and not by the adjacent stones. The spaces between the larger stones shall be filled with spalls, securely rammed into place. The finished work shall present an even, tight, and reasonably plain surface, varying not more than 75 mm from the required contour.
 - e. Random riprap - random riprap, graded so that the smaller stone is uniformly distributed throughout the mass, shall be dumped randomly over the areas until the required depth is attained. The occasional manual handling of rocks or stones shall in no manner be construed to transform the classification of random riprap into that of hand laid riprap.
 - f. Sacked concrete riprap - granular material used for the concrete and consists of well graded gravel with a maximum particle size of 75 mm. Sacks shall be manufactured from burlap and shall have a capacity of approximately 0.03 m³. The cement shall be Portland cement conforming to the latest CSA Specifications A5, Type 1.
- v. Construction:
- a. Preparation of foundation: aprons and slopes to be rip rapped shall be excavated as shown on the plans or as specified by the Municipal Engineer. The foundation bed shall be fine graded to form a uniform and even surface. Granular filter blankets or filter fabrics when required shall be placed as specified by the Municipal Engineer. A thin layer of fine grained material shall be placed over filter fabric to prevent damage to the fabric by the stones.
 - b. Hand placed riprap: the stones, boulders or quarry rocks shall be placed by hand to conform to the lines and grades as shown on the plans or as specified by the Municipal Engineer. The stones shall be firmly bedded into the bed and against adjoining stones and smaller stones used to fill in the voids. Hand placing will generally be designated for normal stone riprap.
 - c. Machine placed riprap: the stones, boulders or quarry rocks shall be sorted and placed by machine to produce a uniform blanket or riprap conforming to the lines and grades shown on the plans or as specified by the Municipal Engineer. The equipment used shall be capable of handling and positioning individual riprap particles. Machine placing will generally be designated for heavy stone riprap and armour stone riprap.

- d. Random riprap: the stones, boulders or quarry rock shall be placed onto the surface to be rip rapped and sufficient hand and/or machine work shall be done to produce a uniform mat conforming to the lines and grades shown on the plans or as specified by the Municipal Engineer. Random placing may be designated for all types of stone riprap.
- e. Sacked concrete rip-rap: the Municipal Engineer will establish the mix design for the concrete to be used and it will be based on a minimum compressive strength of 14 MPa after 28 days. Each burlap sack shall be filled with at least 40 kg of concrete and securely stapled or tied with wire ties. Within one half hour after mixing of the concrete, the filled sacks shall be placed in their final position on the prepared base and packed into conformance with the base and the adjacent sacks already in place. The pattern to which the sacks are laid shall be as required by the plans or as specified by the Municipal Engineer. Following placing, the sacked concrete riprap shall be kept moist for 24 hours by sprinkling water or by covering with at least 100 mm thick of moistened earth.

F.4 INSPECTION AND TESTING

- i. During construction, all excavating, installation, joining of pipes, backfilling and completion of all works shall be subject to inspection by the Municipality's authorized representatives. Unsatisfactory conditions shall be remedied at the Developer's expense. All equipment, tools and labor for testing shall also be provided by the Developer at his expense.
- ii. Prior to issuance of the Construction Completion Certificate and Final Acceptance Certificate, all sewer installations shall be subject to inspections and testing.
- iii. All material testing 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.
- iv. Where deemed necessary by the Municipal Engineer an infiltration and/or exfiltration test (leakage test) shall be conducted for each section of the storm sewer:
 - b. 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.
 - c. The allowable leakages are as follows:

- Infiltration test shall be performed when the groundwater is above the pipe crown for the entire test length. Allowable infiltration is 5.0 L/day/mm diam/km for PVC pipe and 20.0 L/day/mm diam/km for concrete pipe.
- Exfiltration test shall be performed when the groundwater is below the pipe invert for the entire test length. Allowable exfiltration is 5.0 L/day/mm diam/km and 20.0 L/day/mm diam/km for concrete pipe.

v. Light and pill tests:

Each section of storm sewer main shall be subjected to a light test. A light shall be shone into the sewer main at the upstream manhole. To pass the test, the light must be fully visible when viewed from the downstream manhole. In the event of an unsuccessful light test, the sewer main section in question shall be subjected to a pill test where a ball, or similar object of a diameter that is 50 mm less than the inside diameter of the sewer main shall be successfully pulled through without encountering any obstructions.

F.4.1 Closed Circuit Television Inspection of Sewer Lines

F.4.1.1 General

- i. This section of the Standards shall form a part of the Contract Documents and should be read in conjunction with them.
- ii. The work shall include television inspection of sewer mains between manholes including a digital or audio commentary on location and distance encoding, written report and still photographs of problem areas.
- iii. The equipment, materials and methods used must produce suitable video records and logs for the identification and categorization of deficiencies, as well as the determination of the location, extent and seriousness of each deficiency.
- iv. All sewer lines shall be flushed and cleaned prior to video inspection. Lines, including stubs must be inspected with either actual flow or simulated flow pronounced by adding water at an upstream manhole or riser pipe. The simulated flow must produce a visible, laminar flowing stream in the line for the full length of the line being inspected. Inspections will be rejected where the simulated flow exceeds one-third the diameter of the pipe.

F.4.1.2 Video Records and Index Plans

- i. Video records are to be supplied by the Contractor and shall be in DVD format and in color. The Contractor shall set up the DVD's on a format where each section of pipe or services has a separate chapter number. All video inspections are to be done in colour and with sufficient lighting to result in clear high quality picture.

- ii. The Contractor must also provide an 11" x 17" (279 mm x 432 mm) plan with an Index of video runs to pipe element or manhole numbers. Manhole numbers shall be as prescribed by the Municipal Engineer and, in the absence of such, the manhole numbers on the Detailed Engineering Drawings shall be used. The manhole numbers from the Detailed Engineering Drawings shall be on a plan showing the location and the number of the manholes, and is to be bound in with the video and index sheet.
- iii. There shall be separate video DVD's for storm mains and services. Separate logs shall be provided for each DVD.

F.4.1.3 General Operations

- i. The entire length of each sewer shall be video inspected between manholes. In new subdivisions, terminating videos at the connection point to an existing stub shall not be permitted. The camera unit shall, at no time, travel at a rate of speed greater than 6 m per minute. If for any reason, the video camera unit will not pass from one manhole to another then a reverse run shall be done at no extra cost to the Municipality.
- ii. The video inspection shall take place during low flow conditions. At no time during video inspection shall the depth of flow exceed 1/3 of the pipe diameter. At all times camera travel shall be in the same direction as the flow unless impractical or when a reverse run is necessary. Newly constructed pipes are to be video inspected with simulated flow by running water into an upstream manhole or clean-out.
- iii. The camera shall be positioned centrally in the pipe with a tolerance of +/- 10 %. If conditions within the pipe do not allow for this configuration, a greater tolerance may be allowed upon approval by the Municipal Engineer. Chainages for the video inspection shall begin at the inside face of the starting manhole wall and terminate at the inside face of the end manhole wall.

F.4.1.4 Video Taping

The video inspection of each section of sewer line shall begin with a digital or audio commentary describing the following:

- i. Time and date
- ii. Weather
- iii. Subdivision description and/or phase
- iv. Location description in and on-from-to format as described on the list of lines to be inspected
- v. Manhole numbers as provided by the Developer
- vi. Size and use of sewer including pipe material

- vii. Direction of flow
- viii. Inspection technician
- ix. DVD identification number

This information shall also be written on the video report sheet.

F.4.1.5 Work Report

- i. A television work report, in log form, shall be completed during the inspection. This log shall show the exact measured location of faults including, but not limited to:
 - Open joints
 - Broken, cracked, collapsed or ovaled pipe
 - Accumulation of debris or obstructions
 - Root penetration and root rating (1 to 9 root rating system)
 - Infiltration and mineral deposits
 - Water depth variation and sags
 - Protruding gaskets
 - Service connections and type (in-line or inserta-tee)
- ii. The reference location shall include the distance away from the reference manhole and also the position of the fault as referred to the crown of the pipe using the clock face notation. Significant faults are to warrant audio commentary on the video tape duplicating report information. The camera shall be stopped briefly at these locations. Color photographs shall be taken of all sewer defects. The photographs shall be coordinated with the written report by reference numbers. Photographs of all deficiencies are required. Additional photographs shall be taken as deemed necessary.
- iii. One (1) copy of the final typewritten report with corresponding photographs and one (1) copy of the video inspection DVD's shall be furnished to the Municipal Engineer within one (1) week after completion of the inspection.
- iv. All video inspection DVD's shall be numbered and cross indexed to the typewritten report. Reports shall be bound and if more than one report is submitted in one binding, then there shall be an index sheet provided with the biding indicating the contents. Separate reports shall be submitted for mains and for services.

F.4.2 Sections requiring repair will be subject to re-inspection when repairs are complete. At the discretion of the Municipal Engineer, re-inspection by a camera may be required on selected areas prior to issuing of the Final Acceptance Certificate. All video inspection costs shall be borne by the Developer.

- F.4.3** At the Municipal Engineer's discretion, an infiltration and/or exfiltration tests (leakage test) may be required for any section showing deficiencies during the camera test.

F.5 MAJOR SYSTEM

F.5.1 General

- i. 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 shall not be limited to the immediate subdivision area but must consider overland flows that may enter the area from adjacent land as well as downstream effects on adjacent subdivision and receiving water bodies.
- ii. The Rational Method shall not be used to design the storm water management system for areas greater than 65 ha. Computer models shall be used to determine design flows and to properly size storm water management facilities. The selection of an appropriate computer model shall be based on a solid understanding of the principles, assumptions, and limitations of each model and methodology in relation to the system being designed. Acceptable computer models are SWMM and OTTHYMO. Wherever possible, the computer model shall be calibrated. In all analyses, the parameters used, the drainage boundaries and the storm sewer collection network shall be clearly identified on an overall drawing. Computer printouts and a design summary report shall be provided to the Municipal Engineer for review.
- iii. For storm water management systems that consist of sewers only, the design storm duration to be used shall be 1 hour. For storm water management systems requiring storage facilities, the design storm duration to be used shall be at minimum of 12 hours. Longer design storm duration shall be used, if necessary, to properly assess the post-event drainage/discharge of the storage facility.
- iv. Overland flows shall not be permitted to travel a distance greater than 250 m along local roadways without provision for interception by catch basins. Overland flows on collector and arterial roadways shall not travel a distance greater than 120 m without interception by catch basins. Overland flows shall be intercepted with a sufficient number of catch basins such that the total inlet capacity provided is sufficient enough to receive the design storm water flow rates.
- v. The minimum slope of roadway gutters shall be 0.5 % in the longitudinal direction. For cul-de-sacs and curb returns, the minimum slope of the gutter shall be 0.8 % in the longitudinal direction.

F.5.2 Lot Grading

- i. The intent of the lot grading shall be to ensure that water flows away from the buildings, water supply wells, and septic beds, and in no case shall ponding levels come within 150 mm from the finished ground elevations around the buildings during a 1:100 year rainfall event. Site grading shall be done to ensure proper drainage of private property and to establish an adequate drainage system for the entire subdivision.
- ii. 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 subdivisions and existing topography.
- iii. 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 rights-of-way are in place to accommodate drainage directly from the lot without crossing adjacent lots. Split drainage or front-to-back drainage may be allowed when a road, lane or public right-of-way exists at both the front and back of the lot, or as approved otherwise by the Municipality.
- iv. Back-to-front drainage shall be the standard practice. They shall be graded to achieve a minimum slope of 2 % or greater away from buildings and along the lot boundaries. Provisions shall be made to keep the runoff at least 3 m away from buildings where practical. An initial grade of 10 % sloping away from the building for a distance of 2 m shall be required on all sides. The slope shall continue at a minimum grade of 2 % or greater to the property boundary. Larger slopes are desirable if topography allows to a maximum of 10 %.
- v. Reverse (back sloped) driveways shall not be permitted.
- vi. Reserves and public lands shall be graded to drain towards developed roadway, lanes and/or the storm drainage system according to a specific landscape or site plan submitted by the Developer and approved by the Municipality.
- vii. The construction of all overland drainage control shall be completed to the satisfaction of the Municipality, in accordance with approved plans, prior to the issuance of the Construction Completion Certificate for storm sewer mains.

F.5.3 Roadways

Grading of streets comprising the major drainage system shall follow the guidelines listed below:

- i. Continuity of overland flow routes between adjacent subdivisions shall be maintained.
- ii. Collector roadways shall have at least one lane that is not inundated.

- iii. Local roads should not have a depth of water more than 50 mm above the crown of the road.
- iv. The depth of water at the curb shall be less than 500 mm for all roadways.

F.6 STORM WATER MANAGEMENT FACILITIES

F.6.1 General

- i. Storm water management facilities shall be designed as an integral part of both the minor and major storm water management systems. These facilities shall attenuate the peak post-subdivision runoff flow hydrograph for the 1:100 year return period storm event to the peak flow calculated under pre-subdivision conditions for the same contributing area.
- ii. All storm water management facilities, and the entire area of land inundated by flood waters during the 1:100 year event, shall become property of the Municipality.
- iii. In assessing the need for a storm water management facility to be included as part of a proposed subdivision, the Developer shall consider the impacts of uncontrolled storm water drainage on the subdivision itself and the surrounding environment, as well as any potential impacts on receiving water bodies. The type of facility to be used shall be based on the principles of Best Management Practices for end of pipe treatment of storm water runoff and shall be subject to approval by the Municipality.
- iv. Soils investigations, specific to the type of storm water management facility being considered, shall be undertaken to determine the appropriate design factors and field conditions. If a storm water management facility is to be located above a shallow aquifer, the potential for groundwater contamination must be considered and the necessary measures shall be taken to minimize the potential impacts.
- v. The design of any storm water management facility shall consider the aesthetic implications of shape, size, grading, and required landscape features.
- vi. High water level elevations in the storm water management facilities shall be considered in the design of both the minor storm water management system and lot grading. Hydraulic grade line elevations for the minor storm water management system shall be based on the maximum water level elevation calculated for the 1:5 year storm event. Whenever feasible, obvert elevations of the minor system pipes located in the first manhole upstream of a storm water management facility shall be at, or above, the maximum water level elevation achieved in the storage facility during the 1:5 year storm event.

- vii. Outlet capacity shall be of sufficient size so that 90 % of the active storage volume is recovered after 96 hours. This time requirement is based on the flood waters reaching the high water levels during the 1:100 year design storm event. Private property lines and building openings shall be at an elevation equal to, or above, the elevation achieved at the top of the freeboard depth.
- viii. Emergency overflow provisions (overflow channels and overland drainage route) shall be provided, where feasible, for storm water management facilities. If emergency overflow means cannot be provided, the freeboard depth shall be increased (subject to approval by the Municipality).

F.6.2 Swales

- i. Drainage swales on municipal or private property shall be constructed prior to any development of subdivision lots. Drainage swales located between adjacent lots shall be concrete. Completion of the swales construction shall be a prerequisite to the issuance of the Construction Completion Certificate.
- ii. All surface runoff drainage swales shall be contained within Public Utility Lots and shall become the property of the Municipality. Detailed drainage swale calculations and designs shall be submitted to the Municipality for approval.
- iii. Drainage swales located on private property shall be covered by an easement in favour of the Municipality. A minimum clearance of 200 mm shall be provided between the edge of the swale and the property line. Major rainfall event flows shall be contained within the easement.
- iv. Drainage swales crossing several properties for the collection of runoff shall not be permitted unless special circumstances warrant.
- v. Bottom and side slopes of the earthen swales shall be protected from erosion by grass cover, appropriate ground cover or geotextile fabric, as specified by the Municipality and shown on the approved drawings.
- vi. The minimum design slope for concrete swales on private property is 0.75 %, on public property is 0.5 % or as required to provide adequate hydraulic capacity, and for swales without a concrete gutter is 1.5 %.

F.6.3 Channels and Ditches

- i. Side slopes and back slopes of channels or ditches shall be at 3:1 minimum.
- ii. For a flat bottom ditch, the minimum width shall be 1 m for local and collector roads and a minimum of 3 m for arterials, unless otherwise approved by the Municipality.
- iii. Minimum depth of ditch shall be 1 m.
- iv. Bottom and side slopes of channels and ditches shall be protected from erosion by grass cover, appropriate ground cover or geotextile fabric, as specified by the Municipality and shown on the approved drawings.

- v. Ditch checks:
 - a. Ditch checks shall be required for any ditch that has 4 % or greater grade. The ditch check shall be considered as part of the design of the proposed subdivision and addressed in the storm water management plan.
 - b. Ditch checks shall be of a permanent nature and shall be maintained by the Developer until final acceptance of the completed subdivision by the Municipality. The distance between ditch checks shall be a minimum of 5 m from any culvert invert; and have a maximum spacing of 20 m, or as specified by the Municipality.
 - c. Ditches with grades exceeding 3 % shall include permanent erosion control measures.

F.6.4 Outfalls

- i. Proper outfall structures shall be placed at the end of all storm water outfall pipes that discharge to open channels or receiving water bodies. The outfall structures shall provide a means for reducing the velocity of the discharge flow and dissipating the associated energy. As well, these structures shall incorporate the necessary design features to prevent erosion of the surrounding environment.
- ii. Outfall structures must receive written approval from the following federal and provincial regulatory authorities (the Developer shall obtain all necessary regulatory approvals and permits at their own expense):
 - a. Federal
 - b. Transport Canada (Coast Guard) - Navigable Waters Protection Act
 - c. Department of Fisheries and Oceans – Fisheries Act
 - d. Provincial
 - e. Alberta Environment – Water Act
 - f. Sustainable Resource Development – Public Lands Act
- iii. Outfall structures may be a chute, spillway, stilling basin, or plunge pool with headwall. Cut off walls are required at the end of the outfall apron to prevent undermining support structure.
- iv. Outfall structure aprons shall be 150 mm to 225 mm above the invert of the receiving water body to prevent the collection of debris on the apron. Weeping tile shall be placed under the structure to reduce the effects of water pressure on the headwall of the outfall structure. Safety railings and trash screens shall be installed in the outfall structure.

- v. Obverts of outfall pipes shall be at least 150 mm above the 1:5 year flood level in the receiving watercourse. Inverts of outfall pipes shall be above the winter ice level to prevent the pipes submerge below the bottom of ice level. Outfalls shall be protected against damage from moving ice during spring break-up.
- vi. Drop structures, slope protection material (riprap, filter fabric, etc.) and energy dissipaters shall be used where necessary to prevent erosion. Outfall structures shall be properly landscaped and finished so that they may blend in with the existing topography as much as possible. Facilities shall be provided with removable gates to discourage unauthorized access.

F.6.5 Receiving Water Bodies

- i. Necessary engineering measures shall be incorporated in the design of the proposed subdivisions to prevent any increase in the amount of downstream erosion experienced by receiving water bodies as a result of the subdivision.
- ii. If a development causes downstream erosion despite the use of on-site peak runoff rate controls, appropriate mitigating measures shall be taken in the downstream areas.
- iii. Preservation of watercourse aesthetics and wildlife habitat shall be considered a high priority for all erosion protection and bank stability work.

F.6.6 Culverts

- i. Culverts shall be placed so that the minimum distance from the top of the finished grade of the roadway to the top of the culvert pipe shall be not less than one-half the diameter of the pipe or a minimum of 300 mm, whichever is greater, unless approved otherwise by the Municipality.
- ii. If proposed culverts cross existing water bodies, the design shall incorporate allowances for backwater effects over a range of flows. The design of culverts shall require an assessment of both the nominal design capacity and the performance of the structure during 1:100 year flood events. Design calculations shall be performed by qualified Structural and Hydrological Engineers and submitted to the Municipality for approval.
- iii. A trench shall be excavated to the specified depth and grade with the bottom shaped to conform to the bottom of the pipe to afford a firm and uniform bearing over the entire length of the culvert. If the material in the bottom of the excavation is unsuitable, the trench shall be sub-excavated 100 mm below the grade as ordered, and backfilled with approved granular material and thoroughly compacted to ensure an unyielding foundation for the culvert.
- iv. Where the trench is in solid rock or other hard material, it shall be excavated to a depth of at least 100 mm below the design grade of the bottom of the pipe, and backfilled with suitable material in such manner as to ensure a uniform bearing for the length of the culvert.

- v. Selected backfilling material, free from stones, frozen lumps, and other deleterious material, shall be placed under and around the pipe and thoroughly compacted in place. The trench shall be completely filled and the pipe cover at least 300 mm thick with hand placed and properly compacted material before the construction of the embankment over the culvert proceeds.
- vi. If a trench is not required, the culvert pipe shall be installed true to line and grade on a bed that is uniformly firm throughout its entire length, and the backfilling shall be completed to form a minimum 100 mm thick granular cover over the top of the pipe.
- vii. When using corrugated pipe, the pipe shall be installed in the trench with the separate sections firmly joined together and with outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Corrugated pipe shall be so handled as to prevent bruising and scaling. In no case shall culvert pipe be dragged on the ground.
- viii. Where necessary, the Developer shall carefully remove existing culverts and other structures and dispose off or place the materials as directed by the Municipal Engineer.
- ix. All drainage culverts shall have riprap placed as specified at both inlet and outlet. The size and type of riprap shall conform to these Standards requirements.
- x. Minimum diameter of roadway culvert shall be 600 mm. Minimum diameter of entrance culvert shall be 500 mm. Minimum wall thickness shall be 1.6 mm or as required by the design criteria.

F.6.7 Storm Water Storage Facilities

- i. This section identifies the general design parameters for the planning and design of storm water storage facilities.
- ii. A drainage master plan must be prepared by the Developer providing a detailed description of the subdivision area including overland flow, catchment areas, natural storage and planned storage.
- iii. Several different storage methods may be employed for a storm water storage facility such as:
 - a. Retention storage (wet pond) – collects and stores runoff for a period of time and releases it after the inflow has ceased. Retention storage also includes constructed wetland.
 - b. Detention storage (dry pond) – 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.

- c. Channel storage – channel constructed with wide bottoms and small grades will provide a type of storage as the channel fills with water.
- iv. The design of the storage facility shall be based on a 1:100 year rainfall event. The Developer's Consulting 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.
- v. These Standards are not intended to restrict developers from formulating innovative storm water management processes intended to protect the environment and improve the storm water quality prior to release. All storm water management plans must be submitted to the Municipality for review and approval.

F.6.8 Storm Water Ponds

- i. Storm water ponds are considered as detention facilities which shall be designed as part of both the minor and the major drainage systems. They must control the peak runoff conditions for events up to the 1:100 year return period. Storm water ponds become municipal property.
- ii. The need for a specific storm water detention facility shall require the approval of the Municipality. In assessing the need for specific detention facilities, the Developer's Consulting Engineer shall consider the impacts of uncontrolled drainage.
- iii. The ratio of land area for open space use around the pond shall be twice the area of the water surface for the 1:100 year runoff event, unless approved otherwise.
- iv. Soils investigations specific to the detention facility shall be undertaken to determine appropriate design factors. Where the facility is situated above a shallow aquifer or high water table, the potential for groundwater contamination must be minimized.
- v. Wet pond detention facilities should be constructed in impervious soils to minimize water losses during dry weather periods. Intruding silt, sand or gravel seams shall be sealed off.
- vi. Where a detention facility is to have multiple functions, its design shall consider the aesthetic implications of shape, grading, landscape features and use.
- vii. An emergency overflow system shall drain to a receiving watercourse, or outlet acceptable to the Municipality, for storms greater than the 1:100 year event.
- viii. The effects of the maximum pond water levels shall be considered in the design of the minor system and lot grading. The crown elevations of the pipes in the first manhole upstream of a facility shall be at or above the maximum detention pond level during the 1:5 year storm event.

- ix. The maximum water level fluctuations for detention ponds in residential areas during the 1:100 year storm event shall be 2 m. All inhabited building space, including basements, shall be constructed above the 100 year flood level.
- x. Design standards for wet ponds:
 - a. 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). Private property subject to potential flooding shall be covered by an easement in the favour of the Municipality.
 - b. The pond shall be located at local low points or adjacent to an existing water course. A restrictive covenant shall be placed on the lots abutting the facility as required to control development that will restrict the capacity of the pond.
 - c. The design shall incorporate a semi-annual turnover at average annual precipitation. Minimum detention time shall be 24 hours.
 - d. The pond shall have a minimum depth of 2 m at NWL. The high water level (HWL) shall be at least 300 mm below the lowest building opening on adjacent lots.
 - e. The minimum surface area at normal water level shall be 2 ha in order to discourage a large number of small facilities.
 - f. The pond shall have side slopes no steeper than 3:1 from the bottom of the pond to 1 m below NWL. From there to 5 m (horizontal) beyond the 100 year flood level the side slopes shall be no steeper than 7:1. A 4:1 slope shall be considered if appropriate slope protection is proposed as part of the design. These slopes may be revised in confined spaces or areas with extreme topography at the discretion of the Municipal Engineer.
 - g. The minimum depth from the NWL to the lake bottom shall be 2.5 m in order to discourage growth of vegetation.
 - h. Where the ground water level is below the NWL, the pond bottom shall be of impervious material. Where the ground water level is near or above the NWL, the pond bottom may be made of a pervious material based on geotechnical investigation.
 - i. Inlets and outlets are to be placed in order to maximize detention time and water circulation thereby avoiding dead bay areas.
 - j. Inlet and outlet pipes are to be fully submerged and at least 200 mm above the pond bottom and 1 m below the NWL. Inlets and outlets shall be submerged below ice level and above the level of anticipated sediment accumulation.

- k. Invert of the upstream minor system pipe in the inlet manhole of the wet pond and the invert of the downstream pipe in the outlet manhole of the wet pond shall be at, or above, the NWL elevation to ensure that the NWL elevation can be maintained.
 - l. Provision shall be made in order to drain the pond completely by gravity or portable pump system, and for sediment accumulation at the points of inflow, and for the later removal of the sediment. Sediment traps, pre-treatment sumps, or fore-bays shall be provided at each inlet.
 - m. An overflow channel and overland drainage route must be provided at the high water level.
 - n. Edge treatment is required for erosion protection due to wave action from 0.3 m below the NWL to 0.3 m above the NWL. The edge treatment shall be compatible with adjacent land use and consider safety, maintenance, access and erosion reduction.
 - o. All weather vehicle access must be provided to all control works. Access to the lake for launching boats shall also be made available. Fencing, signage and lighting approved by the Municipality shall be installed where necessary for safety purposes.
 - p. An inspection manhole shall be located no greater than 18 m from shore on both the inlet and outlet lines.
- xi. Design standards for dry ponds:
- a. 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). Private property subject to potential flooding shall be covered by an easement in the favour of the Municipality.
 - b. 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. Storm water flow bypass provisions shall be provided for minor storm events that are less than the 1:5 year storm event. Minimum detention time shall be 24 hours.
 - c. A restrictive covenant shall be placed on the lots abutting the facility as required to control development that will restrict the capacity of the pond.
 - d. Maximum storage depth shall be 1.5 m measured from the invert of the outlet pipe. A freeboard depth shall be 0.3 m.
 - e. The pond shall be designed to drain completely after excess flow has dissipated. The pond bottom shall have a minimum slope of 2 % towards the outlet. French drains (pond under drain system) shall be provided in the pond bottom where longitudinal slopes are less than 2 %.

- f. Sediment traps, or hard bottom pre-treatment sumps, shall be provided at each inlet.
- g. Side slopes shall not be sloped steeper than 7:1 within private property and 5:1 within public property.
- h. Grass cover shall be established after completion of construction. Slope erosion protection measures shall be used when required by the County Engineer.
- i. All inlets and outlets shall have grates with a maximum bar spacing of 150 mm over their openings in order to prevent unauthorised access.
- j. The possibility of plugging shall be considered when determining the diameter of the outlet pipe. Maximum flow through the grating shall be 1 m³/sec.
- k. Inlets and outlets shall utilize trash racks and proper security measures to limit human access into the structures.

F.6.10 Alternative Storm Water Management Facilities

- i. Underground storm water storage tanks may be used when designs that involve the use of wet ponds or dry ponds as storage facilities are not feasible.
- ii. Parking lot and rooftop storage of storm water may be permitted in certain instances but must be approved by the Municipality.
- iii. Infiltration and evaporation detention facilities may be used in subdivisions where a suitable receiving water body cannot be found or the location of the water body makes construction of a proper outfall improbable. These types of facilities require detailed field investigations that involve site specific measurements of infiltration rates and a solid understanding of the local groundwater hydrology and what effects the detention facility would have on existing condition.

F.7 STORM WATER QUALITY AND BEST MANAGEMENT PRACTICES

- F.7.1** The design of all storm water management systems shall adequately address the issue of storm water quality. Specifically, Best Management Practices for storm water management shall be followed as described in Section 8.3 of the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems as published by Alberta Environmental (December, 1997).
- F.7.2** The use of constructed wetlands for further water quality enhancement is encouraged prior to discharge to a receiving water body.

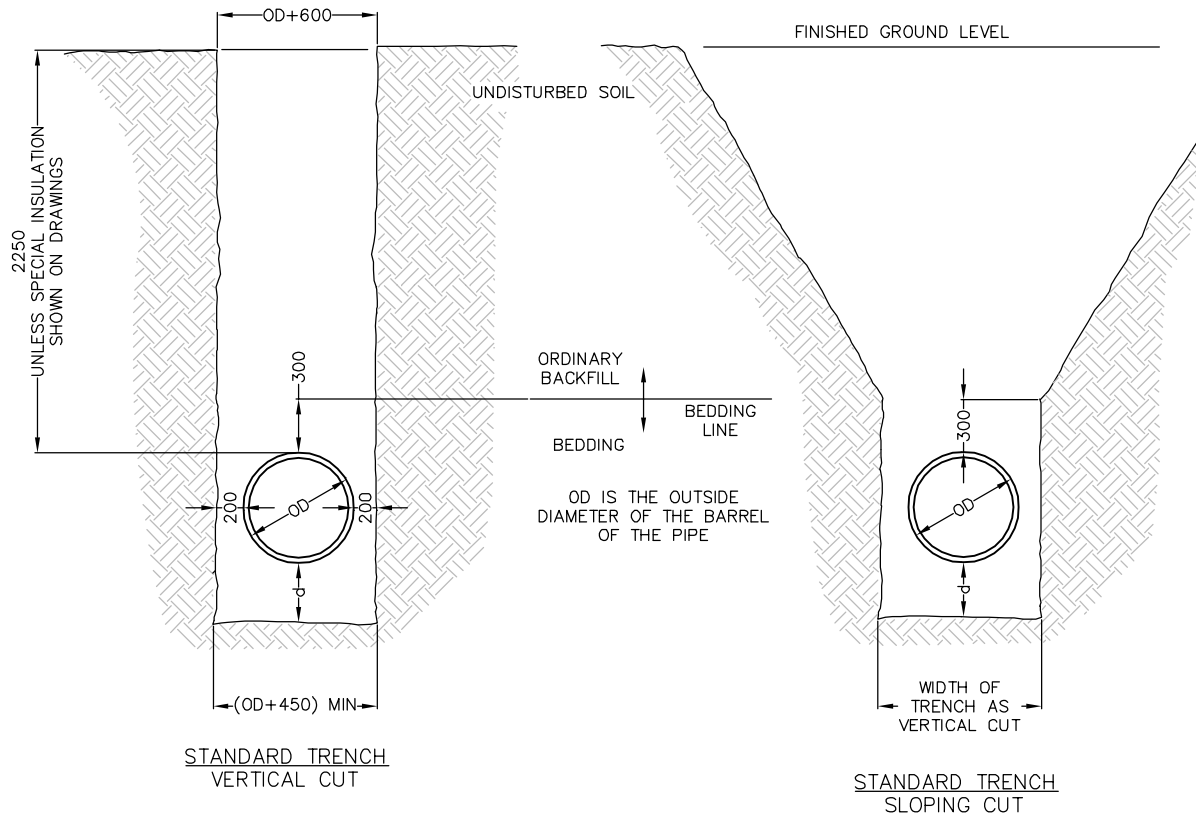
F.7.3 Dry ponds are utilized as a means of attenuating the peak storm water runoff rates that are experienced in the collection system immediately after a rainfall event. Dry ponds do not address the quality of the storm water runoff. Best Management Practices shall be used downstream of all dry ponds to properly address the quality of the storm water being produced by the storm water management system.

F.8 LIST OF DRAWINGS

F-01	Standard Trench Dimensions for Circular Pipe
F-02	Standard Trench Bedding for Circular Pipes
F-03	Typical Services (Single & Dual)
F-05	Standard 1200mm Manhole
F-06	Precast Drop Manhole
F-07	Neck Section Details for Standard 1200mm Manhole
F-08	Neck Rings
F-09	K-7 DF&G Shoulder Ring
F-11	Trash Guard for Manhole Assembly
F-12	Steel Plate Top System
F-13	Standard 1200mm CB Manhole
F-14	Safety Steps for Manholes
F-15	Precast 610mm Catchbasin
F-16	Standard 900mm Catchbasin with Type DK-7 Grating & Frame
F-17	Standard 900mm Precast CB c/w K7 Double Frame & Grate
F-18	Steel Plate Top System
F-19	Slabtops for Standard 900mm Catch Basin
F-20	Two Piece Type 4A Grating & Frame
F-21	Frame & Grating Type 6 and 8
F-22	Type 6A Cover and Frame
F-23	Round Top Catch Basin and Manhole
F-24	Frame & Grating Type K-7
F-25	K-7 DF&G Catch Basin
F-26	K-7 DF&G Shoulder Ring
F-27	K-7 SF&G Shoulder
F-28	K-7 DF&G Neck Ring
F-29	K-7 SF&G Neck Ring
F-30	Typical Catch Basin Installation 150 Curb & 250 Gutter
F-31	Storm Pond Outlet Structure
F-32	Storm Pond Outlet Control
F-33	Swale Inlet Structure
F-34	Swale Inlet Structure
F-35	Concrete Culvert Flared End Detail
F-36	Gabion Basket Detail Storm Sewer Outlet
F-37	Pipe Grate Detail Storm Sewer Outlet
F-38	1000mm Concrete Swale
F-39	Guard Posts
F-53	Frost Box Detail
F-54	Typical Dry Pond Section
F-55	Typical Wet Pond Section

END OF SECTION

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(EXCAVATION TO BE SHORED AS PER OCCUPATIONAL HEALTH AND SAFETY STANDARDS)

(EXCAVATION TO BE SLOPED AS PER OCCUPATIONAL HEALTH AND SAFETY STANDARDS)

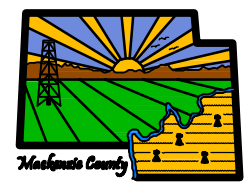
MAXIMUM TRENCH WIDTHS FOR SINGLE PIPES
 -UP TO AND INCLUDING 400mm ϕ - 1000mm
 -450mm ϕ AND ABOVE - OD + 600mm

DEPTH OF BEDDING BELOW PIPE BARREL (d)
 -100mm MIN.

NOTE:
 ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

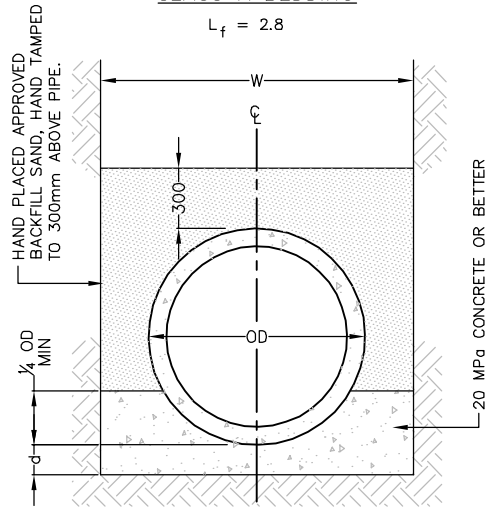
General Municipal Improvements Standards



Rev.		STANDARD TRENCH DIMENSIONS FOR CIRCULAR PIPE		Approved:	Figure F-01
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-01	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

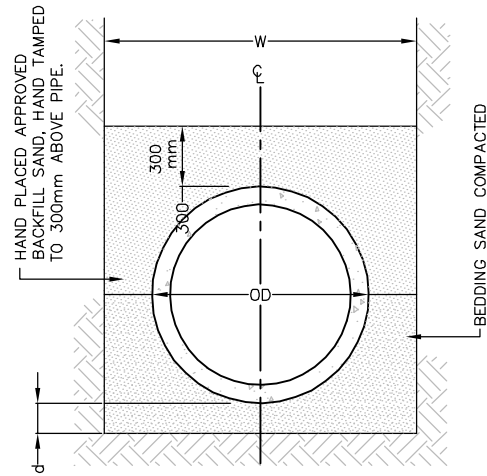
CLASS A BEDDING

$L_f = 2.8$



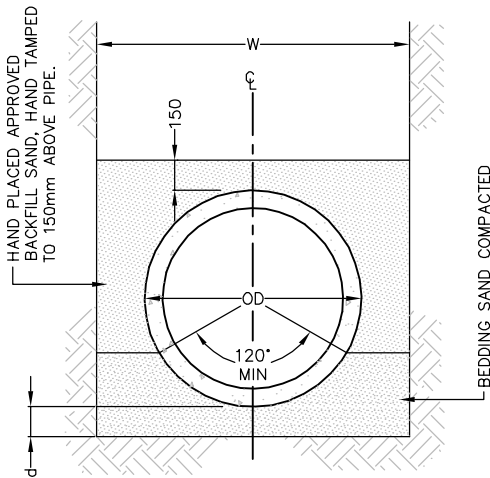
CLASS B BEDDING

$L_f = 1.9$



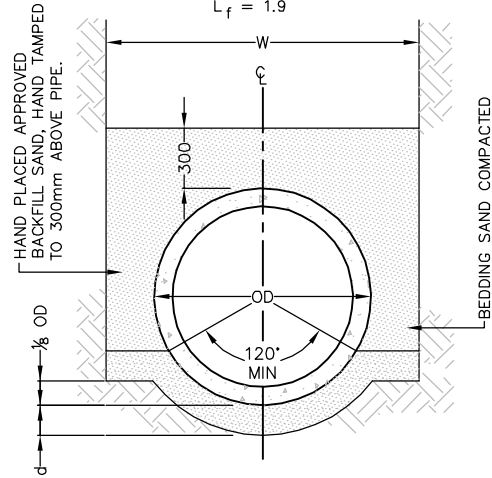
CLASS C BEDDING

$L_f = 1.5$



CLASS B BEDDING

ALTERNATE - 375mm I.D. & UNDER
 $L_f = 1.9$

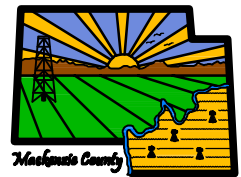


NOTES:

1. W = TRENCH WIDTH - O.D. + 450mm (MINIMUM).
- 1000mm max. FOR PIPES UP TO AND INCLUDING 400mm DIAMETER.
- O.D. + 600mm max. FOR PIPE DIAMETERS 450mm AND ABOVE.
2. O.D. = OUTSIDE PIPE DIAMETER.
3. I.D. = INSIDE PIPE DIAMETER.
4. L_f = LOAD FACTOR.
5. d = DEPTH OF BEDDING BELOW PIPE = 150mm (MIN).
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
7. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



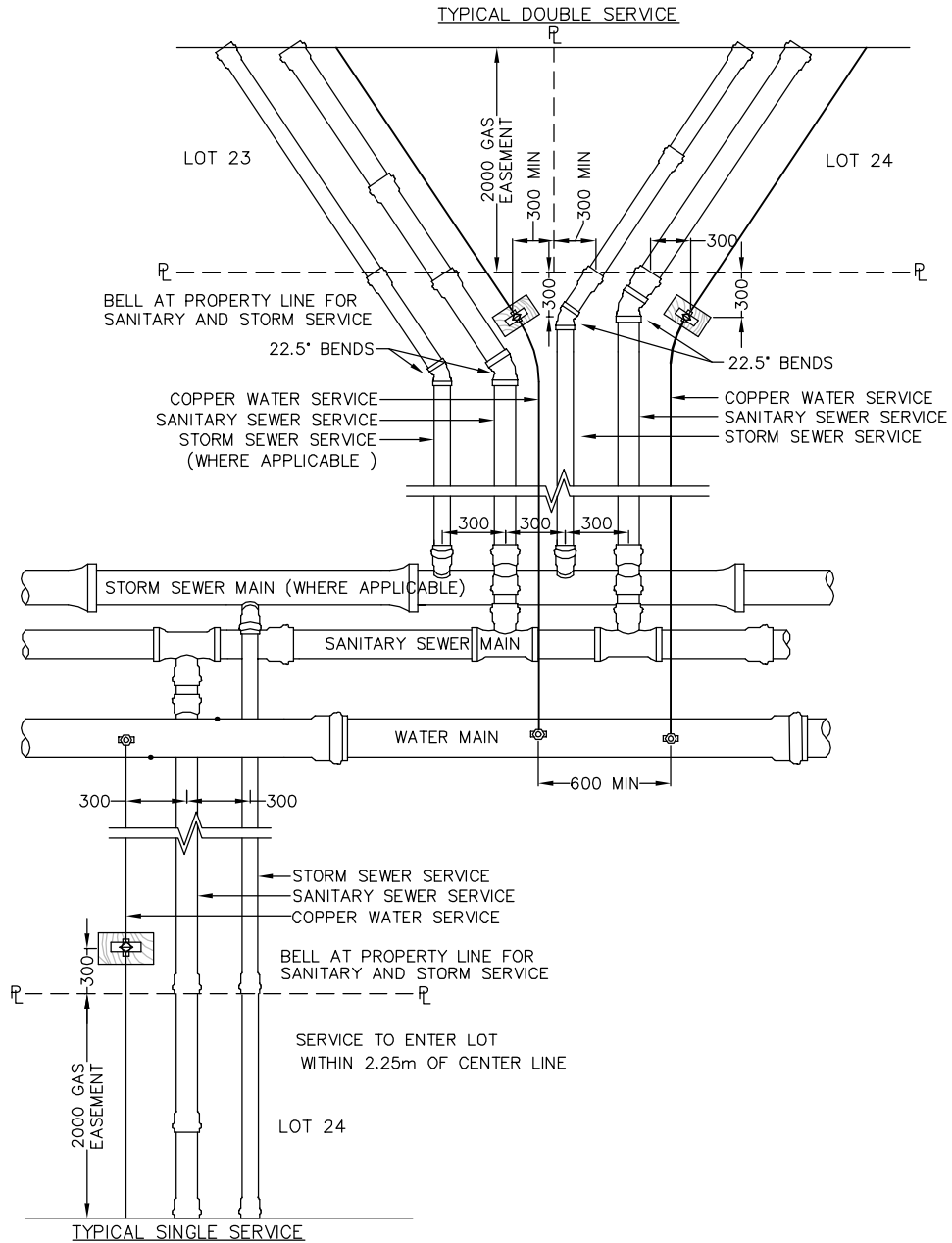
STANDARD TRENCH BEDDING FOR CIRCULAR PIPES

Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682	Design:
Drawn: K.P.L	Scale: N.T.S

Approved:

Figure **F-02**

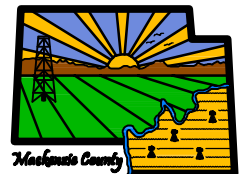


NOTES:

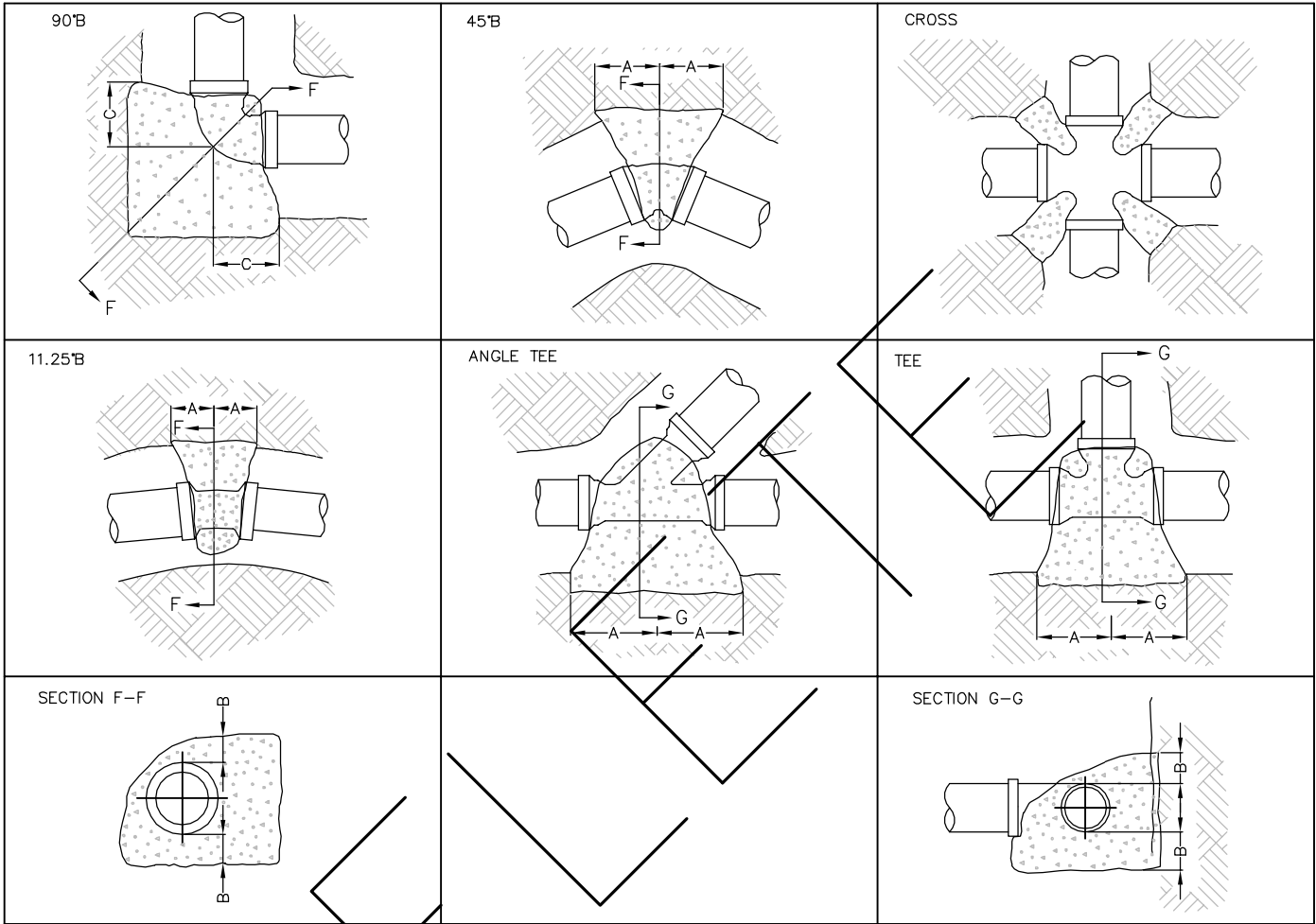
1. WATER AND SEWER SERVICES MAY BE EXTENDED TO EDGE OF 2.0m GAS EASEMENT.
2. THE COUNTY ACCEPTS NO RESPONSIBILITY FOR THE CONSTRUCTION OR MAINTENANCE OF SERVICES INSTALLED WITHIN THE EASEMENT.
3. MARK ENDS OF SERVICES AT EDGE OF GAS EASEMENT WITH A 50mm X 100mm X 750mm STAKE PROTRUDING 450mm ABOVE GROUND AND PAINTED BLUE. MARK THE CURB CONTROL VALVE WITH A SIMILAR STAKE PAINTED RED.
4. THE END OF COPPER WATER SERVICE PIPING SHOULD NOT BE CRIMPED CLOSED, PERMEABLE FILTER CLOTH MAY BE USED TO PREVENT INTRUSION OF DEBRIS AND TO ALLOW TESTING FLOW OF CURBSTOP.
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	<b style="font-size: 1.2em;">Stewart Weir <small>Naturally Resourceful</small>	TYPICAL SERVICES (SINGLE & DUAL)		Figure F-03	
Rev.		File No.: GP60.33682	Design:		Approved:
Rev.		Drawn: K.P.L	Scale: N.T.S		
Date: 2010-AUG-31					



NOTES:

REQUIRED BEARING AREA

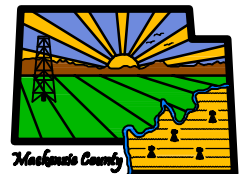
DIA (mm)	TEE BRANCH & DEAD END					22.5° & 11.25° BENDS					45° BENDS					90° BENDS				
	300	250	200	150	100	300	250	200	150	100	300	250	200	150	100	300	250	200	150	100
A (mm)	975	775	550	375	250	300	225	200	150	100	550	450	375	300	200					
B (mm)	75	75	75	75	75	150	125	100	75	75	150	125	100	75	75	525	350	300	200	150
C (mm)																450	400	350	300	200
AREA(m ²)	1.025	0.750	0.475	0.275	0.125	0.50	0.275	0.200	0.150	0.05	0.800	0.550	0.375	0.225	0.100	1.475	1.025	0.700	0.400	0.175

NOTES:

- DESIGN BASIS:
 - HYDRAULIC PRESSURE 1035 kPa.
 - SOIL BEARING CAPACITY 72kPa (MEDIUM SOFT CLAY).
- TEMPORARY BLOCKING MUST BE APPROVED BY THE ENGINEER.
- CONCRETE STRENGTH SHALL BE 30MPa AT 28 DAYS.
- CONCRETE TO BE CLEAR OF BELLS AND PIPE AND UNDER ALL FITTINGS.
- ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
- PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



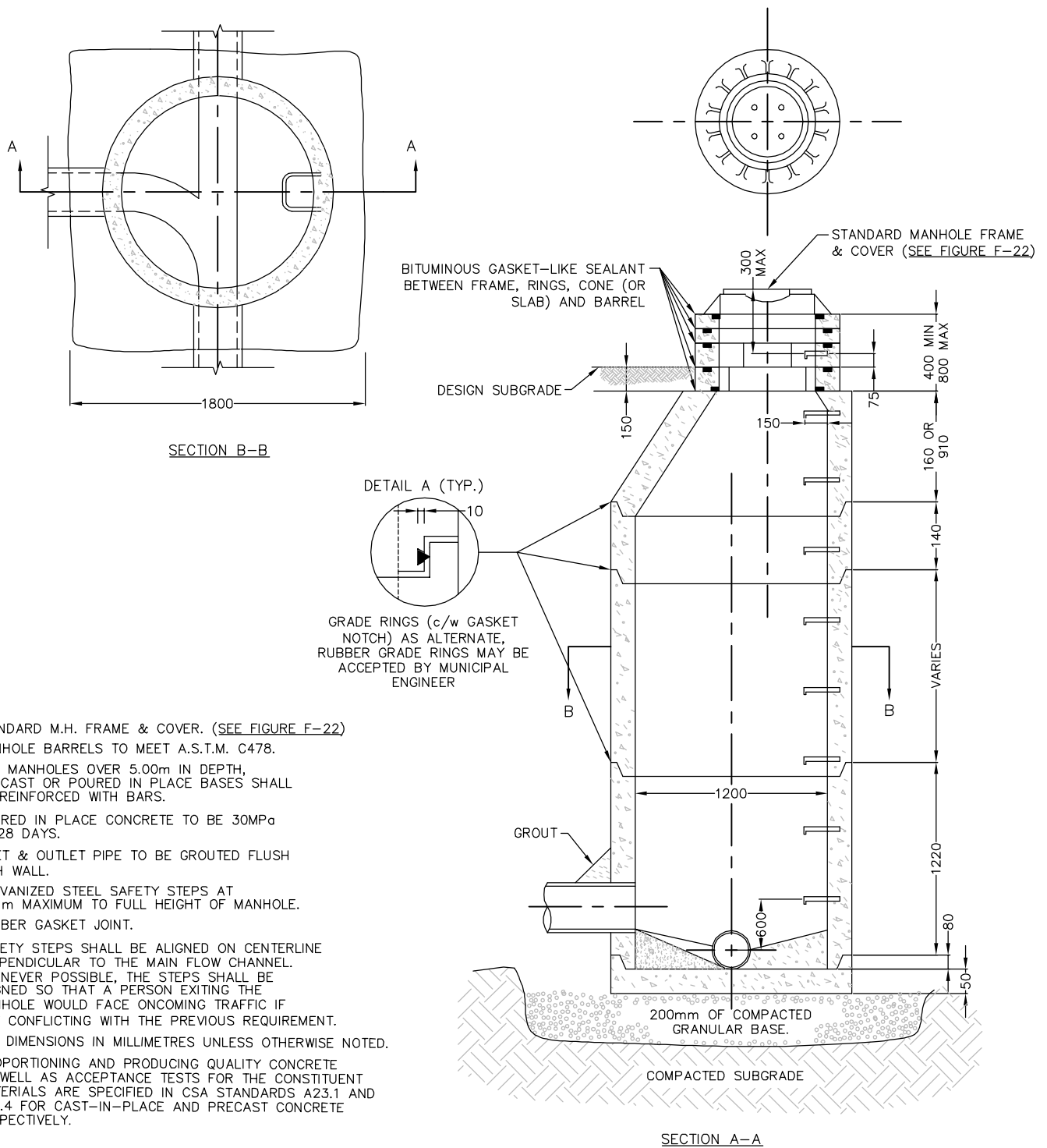
HORIZONTAL CONCRETE THRUST BLOCK DETAILS

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:

Figure F-04

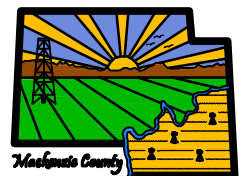


NOTES:

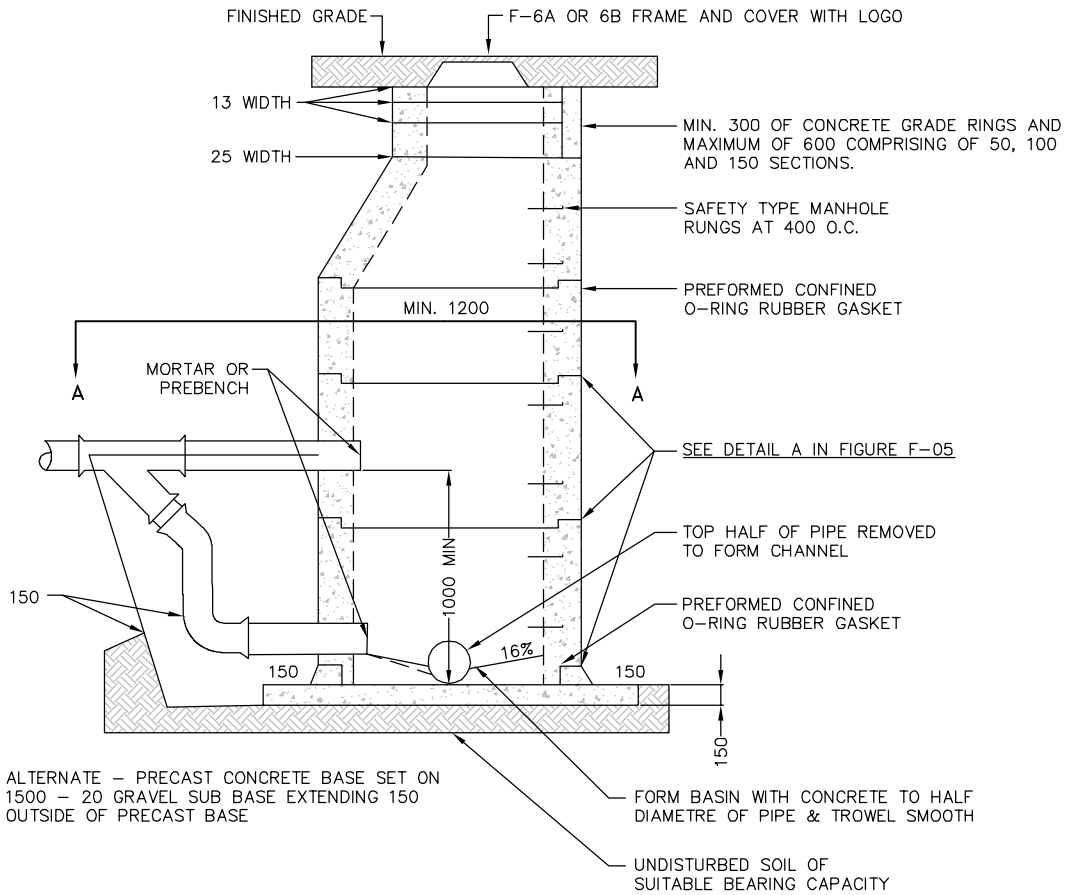
1. STANDARD M.H. FRAME & COVER. (SEE FIGURE F-22)
2. MANHOLE BARRELS TO MEET A.S.T.M. C478.
3. FOR MANHOLES OVER 5.00m IN DEPTH, PRECAST OR POURED IN PLACE BASES SHALL BE REINFORCED WITH BARS.
4. POURED IN PLACE CONCRETE TO BE 30MP_a AT 28 DAYS.
5. INLET & OUTLET PIPE TO BE GROUTED FLUSH WITH WALL.
6. GALVANIZED STEEL SAFETY STEPS AT 0.41m MAXIMUM TO FULL HEIGHT OF MANHOLE.
7. RUBBER GASKET JOINT.
8. SAFETY STEPS SHALL BE ALIGNED ON CENTERLINE PERPENDICULAR TO THE MAIN FLOW CHANNEL. WHENEVER POSSIBLE, THE STEPS SHALL BE ALIGNED SO THAT A PERSON EXITING THE MANHOLE WOULD FACE ONCOMING TRAFFIC IF NOT CONFLICTING WITH THE PREVIOUS REQUIREMENT.
9. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
10. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



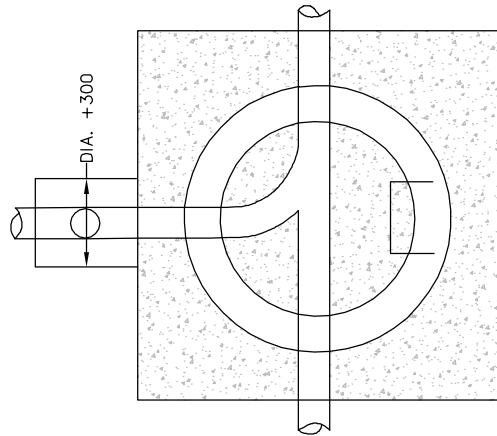
Rev.		STANDARD 1200mm MANHOLE		Approved:	Figure F-05
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-05	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



ALTERNATE - PRECAST CONCRETE BASE SET ON 150 - 20 GRAVEL SUB BASE EXTENDING 150 OUTSIDE OF PRECAST BASE

FORM BASIN WITH CONCRETE TO HALF DIAMETRE OF PIPE & TROWEL SMOOTH

UNDISTURBED SOIL OF SUITABLE BEARING CAPACITY



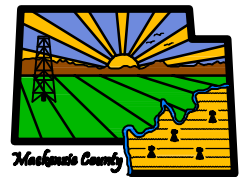
SECTION A-A
N.T.S.

NOTES:

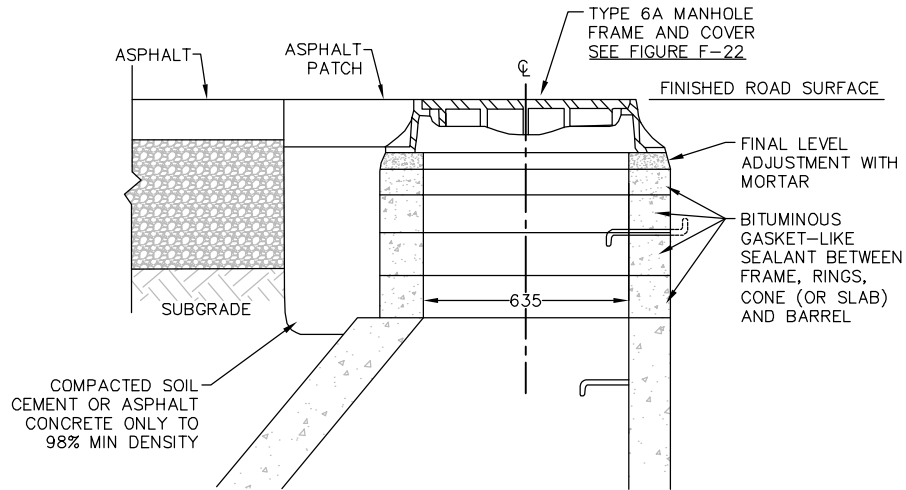
1. ALL PRECAST MANHOLES MUST CONFORM TO A.S.T.M. SPECIFICATIONS C478.
2. POURED IN PLACE CONCRETE SHALL HAVE 28 DAYS COMPRESSIVE STRENGTH OF 30 MPa.
3. FORM FLOW THROUGH IN PARTIALLY SET CONCRETE AND TROWEL SMOOTH.
4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
5. MAX DIST. FROM RIM TO TOP RUNG IS 800mm.
6. BACKFILL MANHOLE WITH SELECT NATIVE MATERIAL.
7. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>PRECAST DROP MANHOLE</p>		<p>Approved:</p>	<p>Figure F-06</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>		<p>Figure F-06</p>
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

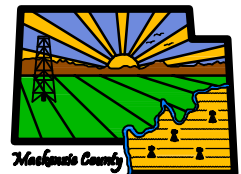


NOTES:

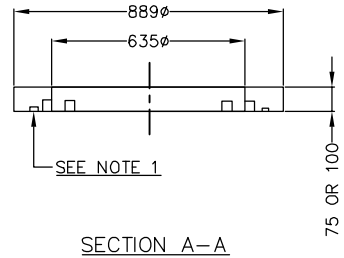
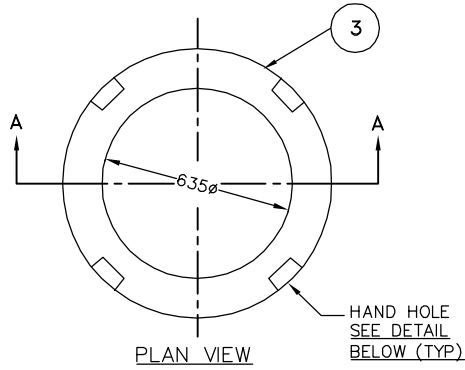
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

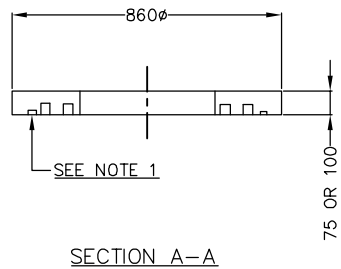
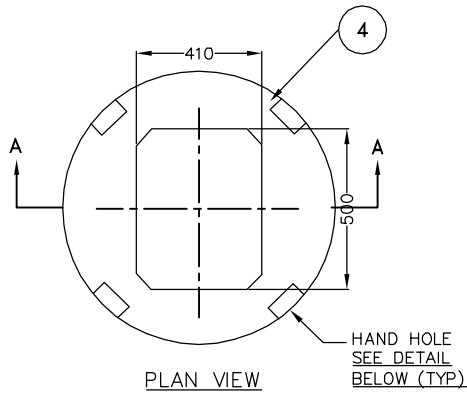
General Municipal Improvements Standards



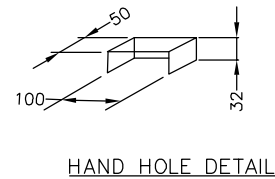
Rev.	Stewart Weir Naturally Resourceful	NECK SECTION DETAILS FOR STANDARD 1200mm MANHOLE		Approved:	Figure F-07
Rev.					
Rev.		Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	



635 RING
(NECK RING FOR USE WITH TYPES 4A,6,6A,8,NF-80,NF-90 FRAMES AND COVERS/GRATINGS)



K-7 RING
(NECK RING FOR USE WITH TYPE K-7 OR F-5I WITHOUT SIDE INLET FRAMES AND GRATINGS)

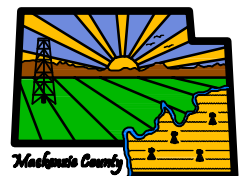


NOTES:

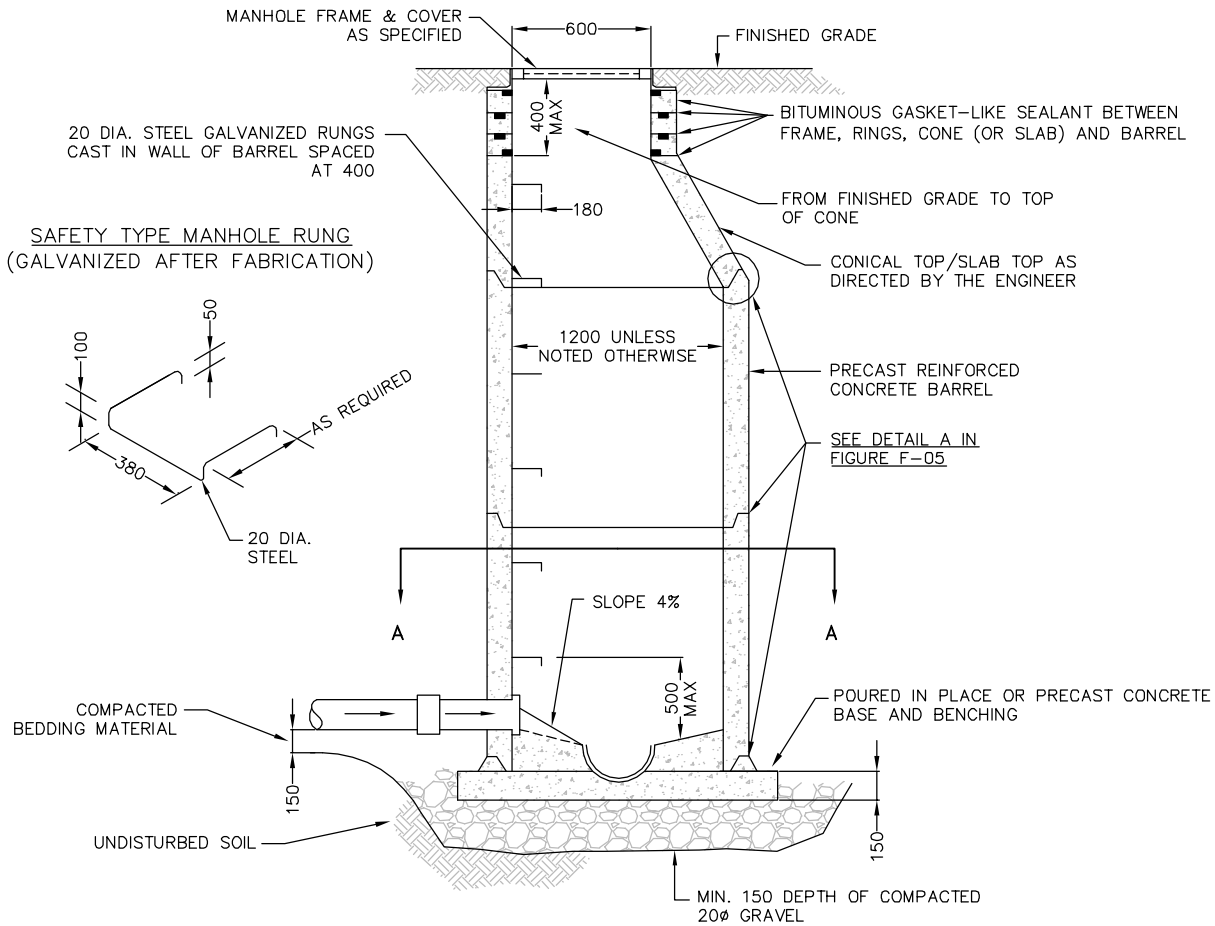
1. A CONCENTRIC GROOVE LOCATED AT MID CROSS SECTION, SUITABLE FOR SEALANT IS REQUIRED FOR NECK RINGS AND EXTENSION RINGS.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

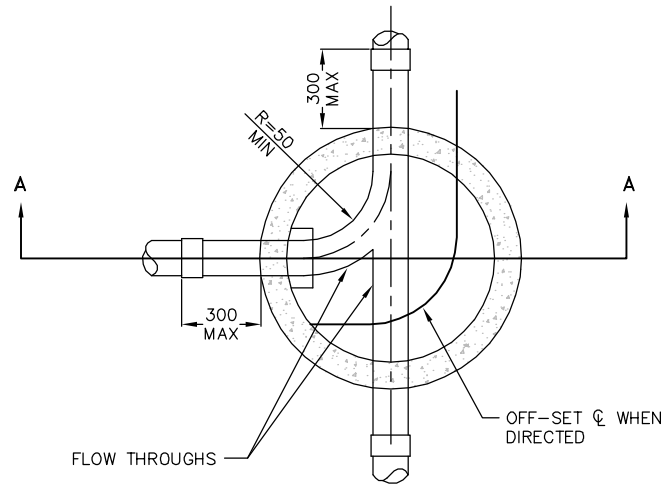
General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	NECK RINGS		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-08
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		



SECTION A-A



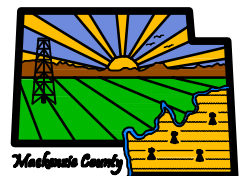
MANHOLE DETAIL

NOTES:

1. ALL PRECAST MANHOLES MUST CONFORM TO A.S.T.M. SPECIFICATIONS C478.
2. POURED IN PLACE CONCRETE SHALL HAVE 28 DAYS COMPRESSIVE STRENGTH OF 30 MPa.
3. ALL JOINTS MORTARED INSIDE & OUT.
4. FORM FLOW THROUGH IN PARTIALLY SET CONCRETE AND TROWEL SMOOTH.
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
6. MAX DIST. FROM RIM TO TOP RUNG IS 800mm.
7. BACKFILL MANHOLE WITH SELECT NATIVE MATERIAL.
8. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



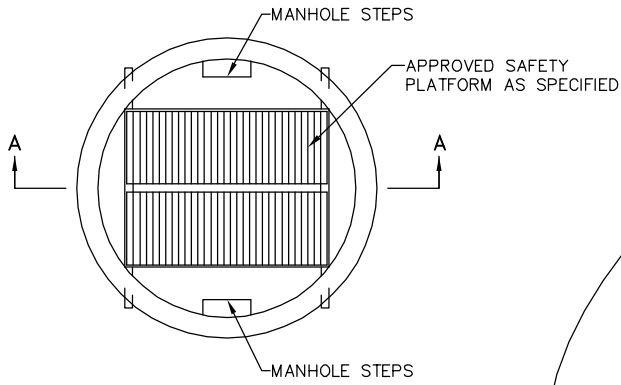
K-7 DF&G SHOULDER RING

Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

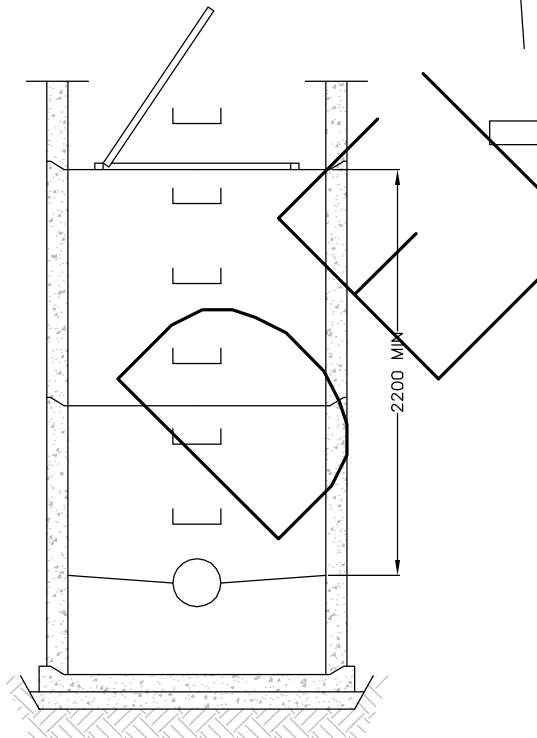
File No.: GP60.33682	Design:
Drawn: K.P.L	Scale: N.T.S

Approved:

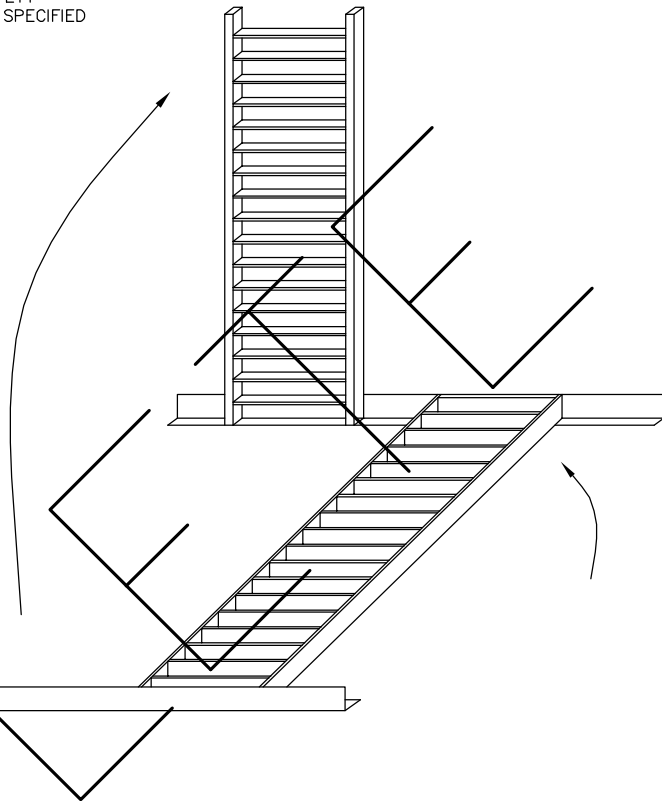
Figure F-09



PLAN VIEW



SECTION A-A

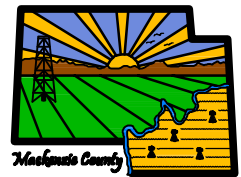


NOTES:

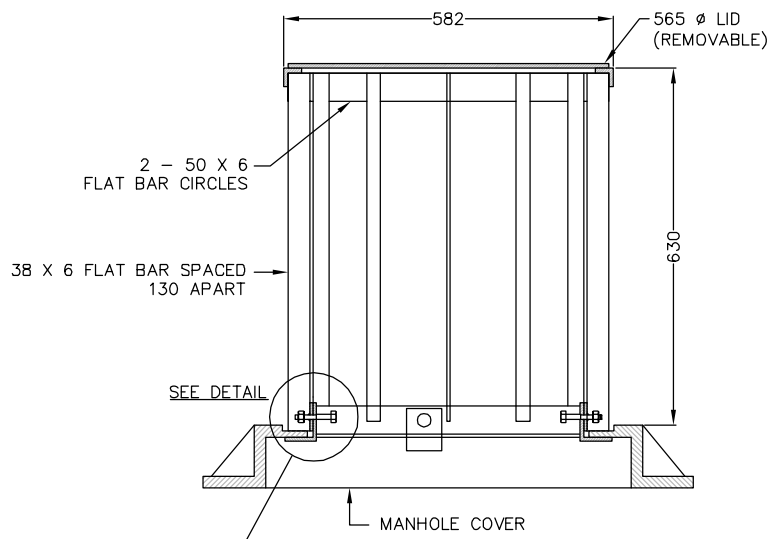
1. TO BE INSTALLED ON MANHOLES GREATER THAN 5.0m DEEP.
2. MAXIMUM SPACING BETWEEN PLATFORMS TO BE 5.0m.
3. ALUMINUM GRATES TO BE MSU MISSISSAUGA OR APPROVED EQUAL.
4. TO BE INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

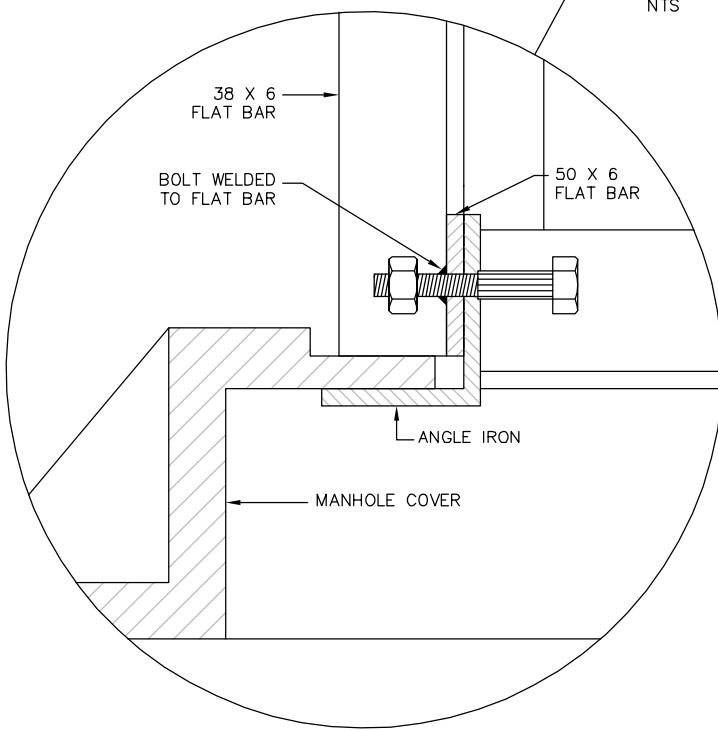
General Municipal Improvements Standards



Rev.		MANHOLE SAFETY PLATFORM		Approved:	Figure F-10
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-10	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



SECTION/ELEVATION VIEW
N.T.S

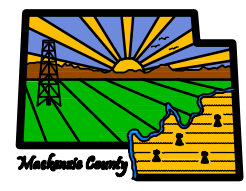


CLAMP ASSEMBLY DETAIL
N.T.S

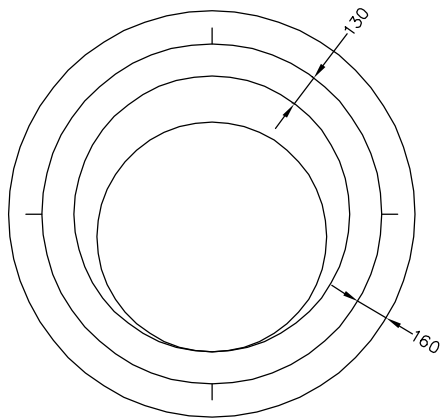
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

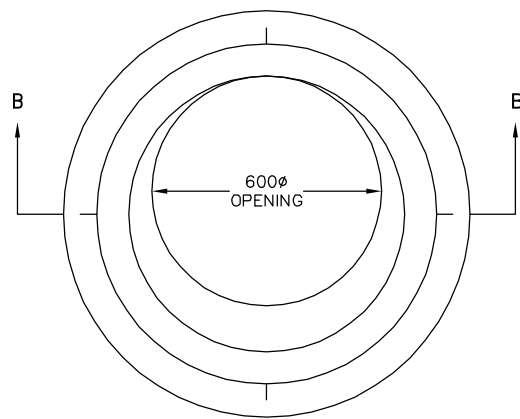
General Municipal Improvements Standards



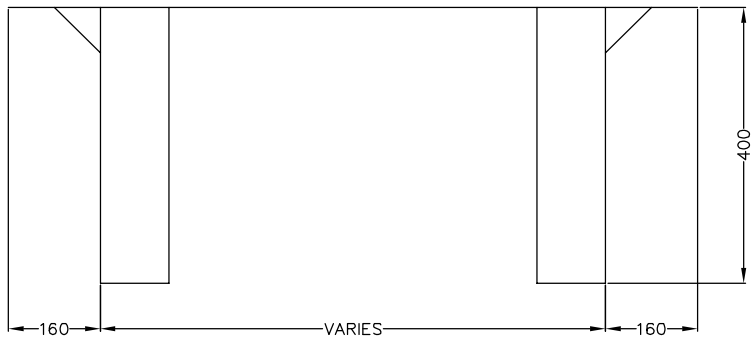
Rev.		<p>TRASH GUARD FOR MANHOLE ASSEMBLY</p>		<p>Approved:</p>	<p>Figure F-11</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure F-11</p>	
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S			



BOTTOM VIEW



TOP VIEW

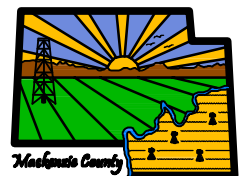


SECTION B-B

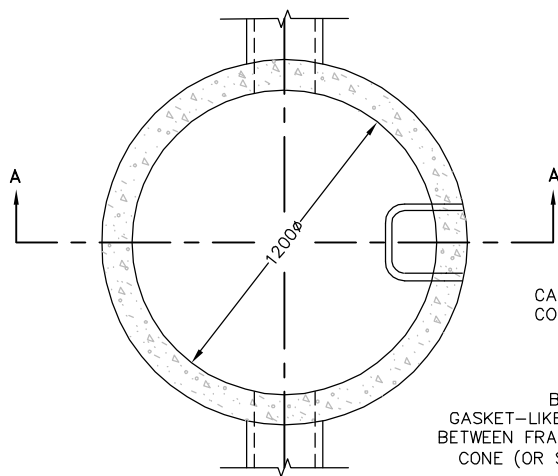
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



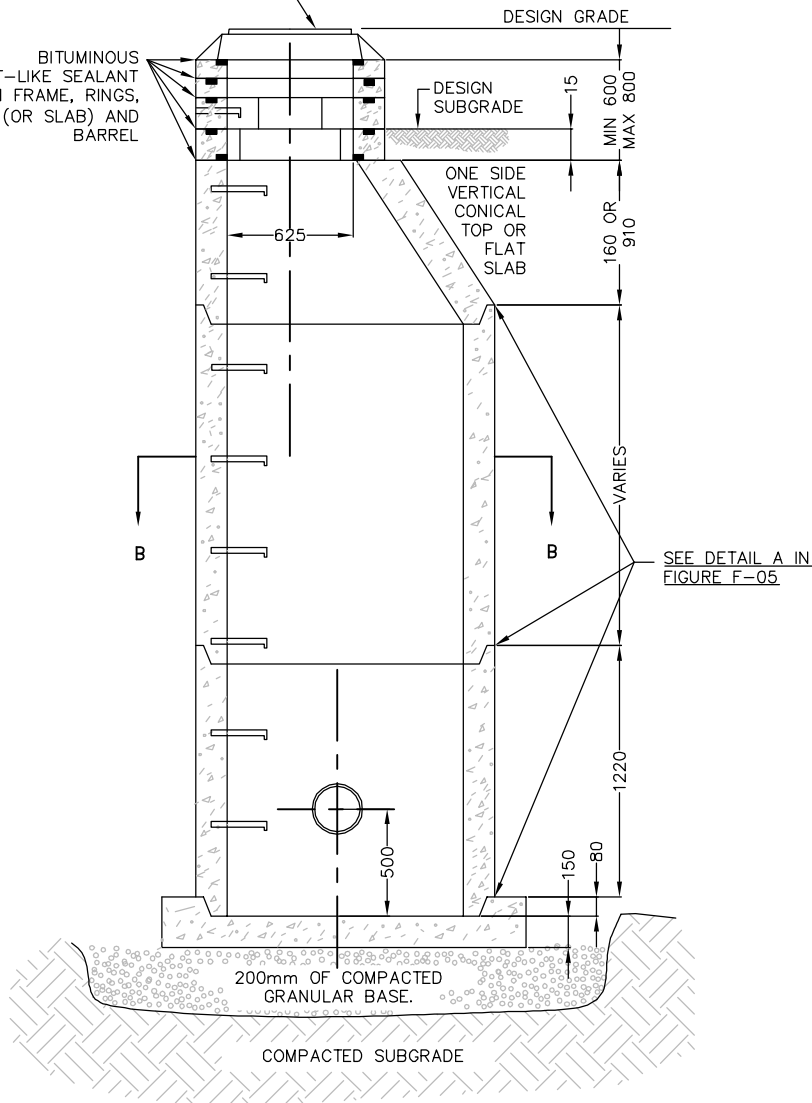
Rev.	Stewart Weir Naturally Resourceful	STEEL PLATE TOP SYSTEM		Approved:	Figure F-12
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure F-12
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



SECTION B-B

CATCH BASIN FRAME AND COVER AS SPECIFIED

BITUMINOUS GASKET-LIKE SEALANT BETWEEN FRAME, RINGS, CONE (OR SLAB) AND BARREL



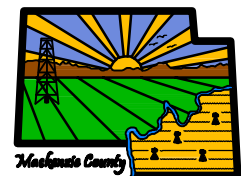
SECTION A-A

NOTES:

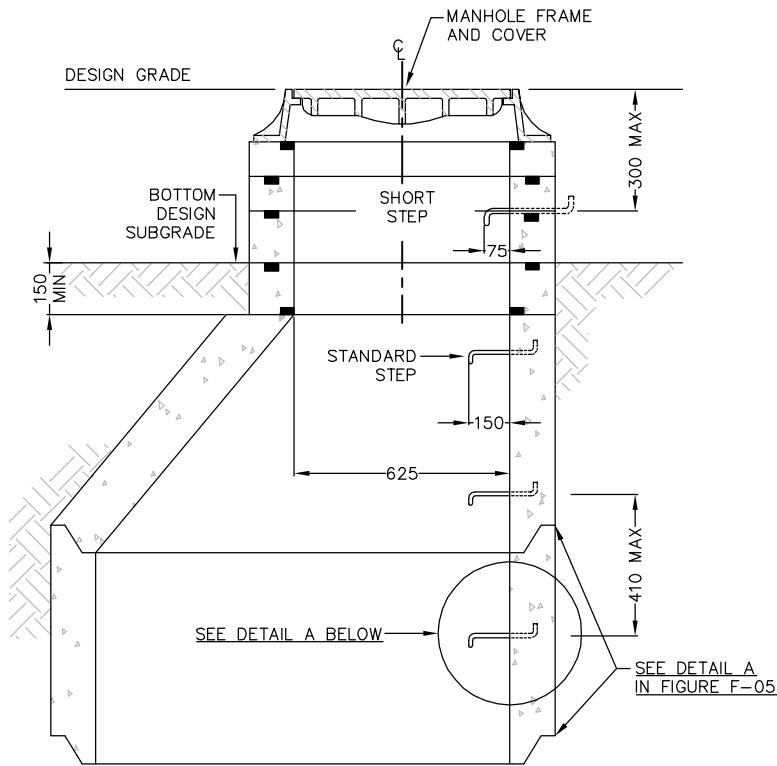
1. MANHOLE BARRELS TO MEET ASTM, C478.
2. POURED IN PLACE CONCRETE BASES MAY BE USED.
3. FOR CBMH. OVER 5.0m IN DEPTH, PRECAST OR POURED IN PLACE BASES SHALL BE REINFORCED WITH BARS.
4. POURED IN PLACE CONCRETE TO BE 30MPa AT 28 DAYS.
5. INLET & OUTLET PIPE TO BE GROUTED FLUSH WITH WALL.
6. GALVANIZED STEEL SAFETY STEPS AT 0.41m MAXIMUM TO FULL HEIGHT OF M.H.
7. RUBBER GASKET JOINTS.
8. SAFETY STEPS SHALL BE ALIGNED ON CENTERLINE PERPENDICULAR TO THE MAIN FLOW CHANNEL. WHENEVER POSSIBLE, THE STEPS SHALL BE ALIGNED SO THAT A PERSON EXITING THE MANHOLE WOULD FACE ONCOMING TRAFFIC IF NOT CONFLICTING WITH THE PREVIOUS REQUIREMENT.
9. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
10. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



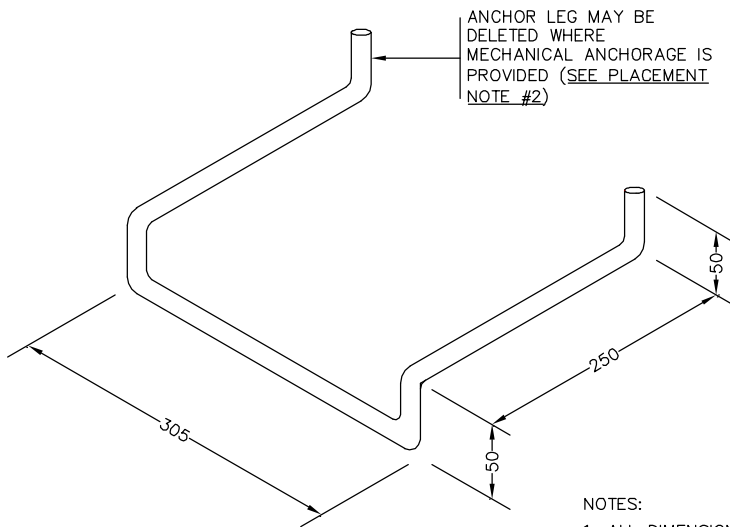
Rev.		STANDARD 1200mm C.B. MANHOLE	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure F-13



TYPICAL MANHOLE SECTION

PLACEMENT:

1. EXCEPT WHERE SPECIFIED OTHERWISE, SAFETY STEPS SHALL BE INSTALLED IN ALL PRECAST MANHOLE SECTIONS & CONES, IN THE GRADE ADJUSTMENT SECTIONS AND IN CAST IN PLACE SECTIONS SO THAT WHEN THE VARIOUS SECTIONS ARE ASSEMBLED IN ANY COMBINATION THEY WILL FORM A CONTINUOUS VERTICAL LADDER WITH RUNGS EQUALLY SPACED AT A MAXIMUM OF 410mm TO WITHIN 300mm BELOW THE COVER AND TO WITHIN 600mm OF THE BASE OR BENCHING.
2. STEPS SHALL BE CAST FIRMLY IN PLACE OR SECURED WITH A SUITABLE MECHANICAL ANCHORAGE TO PREVENT PULLOUT, AND MAINTAIN WATER TIGHTNESS.
3. "STANDARD STEPS" SHALL PROJECT A DISTANCE OF 150mm MEASURED AT THE POINT OF EMBEDMENT.
4. A "SHORT STEP" WITH A PROJECTION OF 75mm SHALL BE INSTALLED WITHIN THE GRADE ADJUSTMENT SECTION, CAST INTO THE NECK OR FIRMLY MORTARED IN PLACE BETWEEN THE NECK RINGS, WITH THE ANCHOR LEGS OUTSIDE OF THE NECK RING.
5. EXCEPT AS SPECIFIED ABOVE, DESIGN AND INSTALLATION OF SAFETY STEPS SHALL CONFORM TO A.S.T.M. C478.
6. SAFETY STEPS SHALL BE ALIGNED ON CENTER LINE PERPENDICULAR TO THE MAIN FLOW CHANNEL. WHENEVER POSSIBLE, THE STEPS SHALL BE ALIGNED SO THAT A PERSON EXITING THE MANHOLE WOULD FACE ONCOMING TRAFFIC IF NOT CONFLICTING WITH THE PREVIOUS REQUIREMENT.



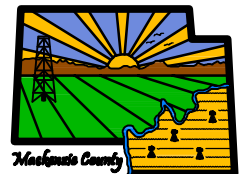
DETAIL A

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



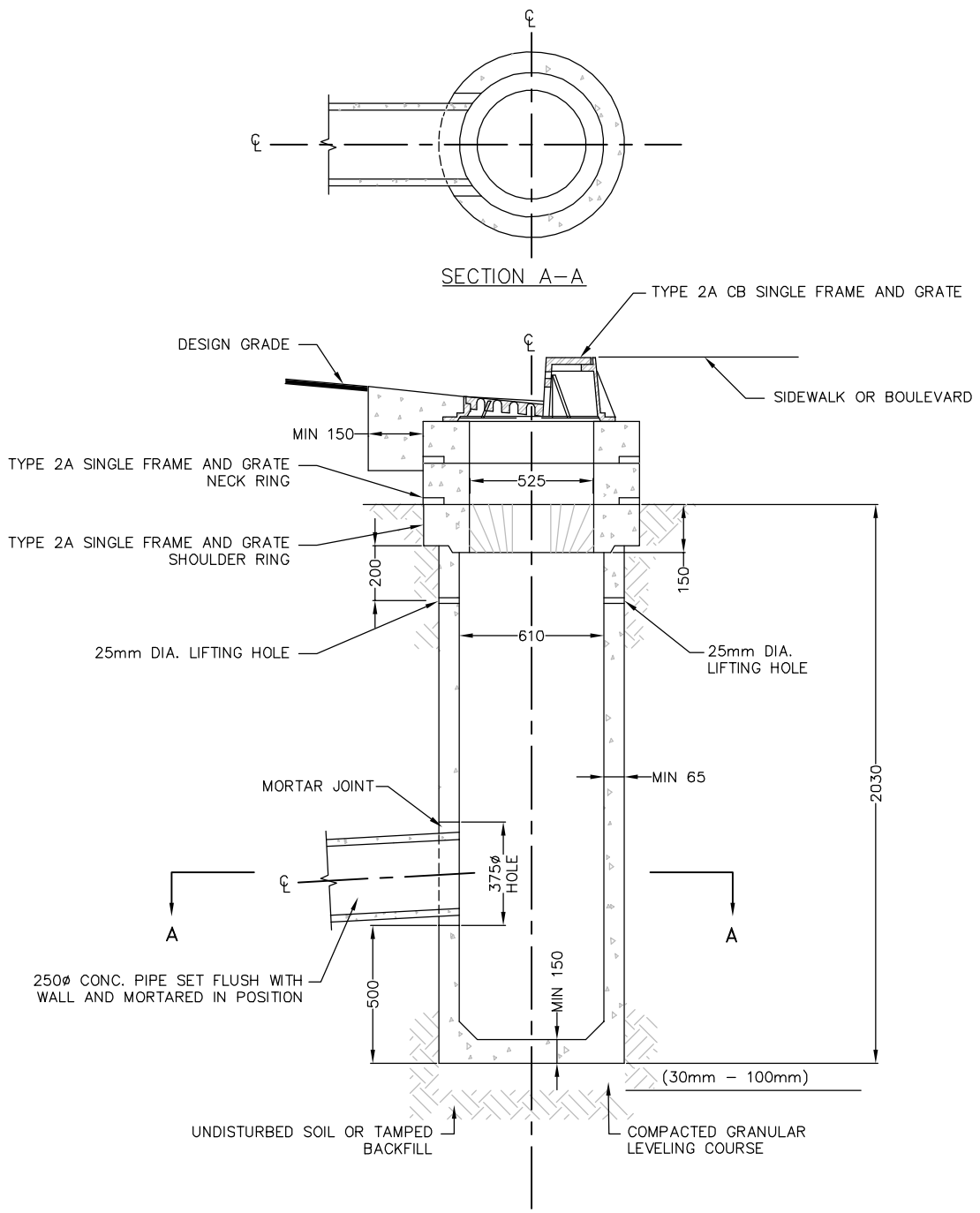
SAFETY STEPS FOR MANHOLES

Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682	Design:
Drawn: K.P.L	Scale: N.T.S

Approved:

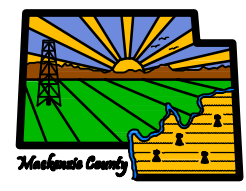
Figure F-14



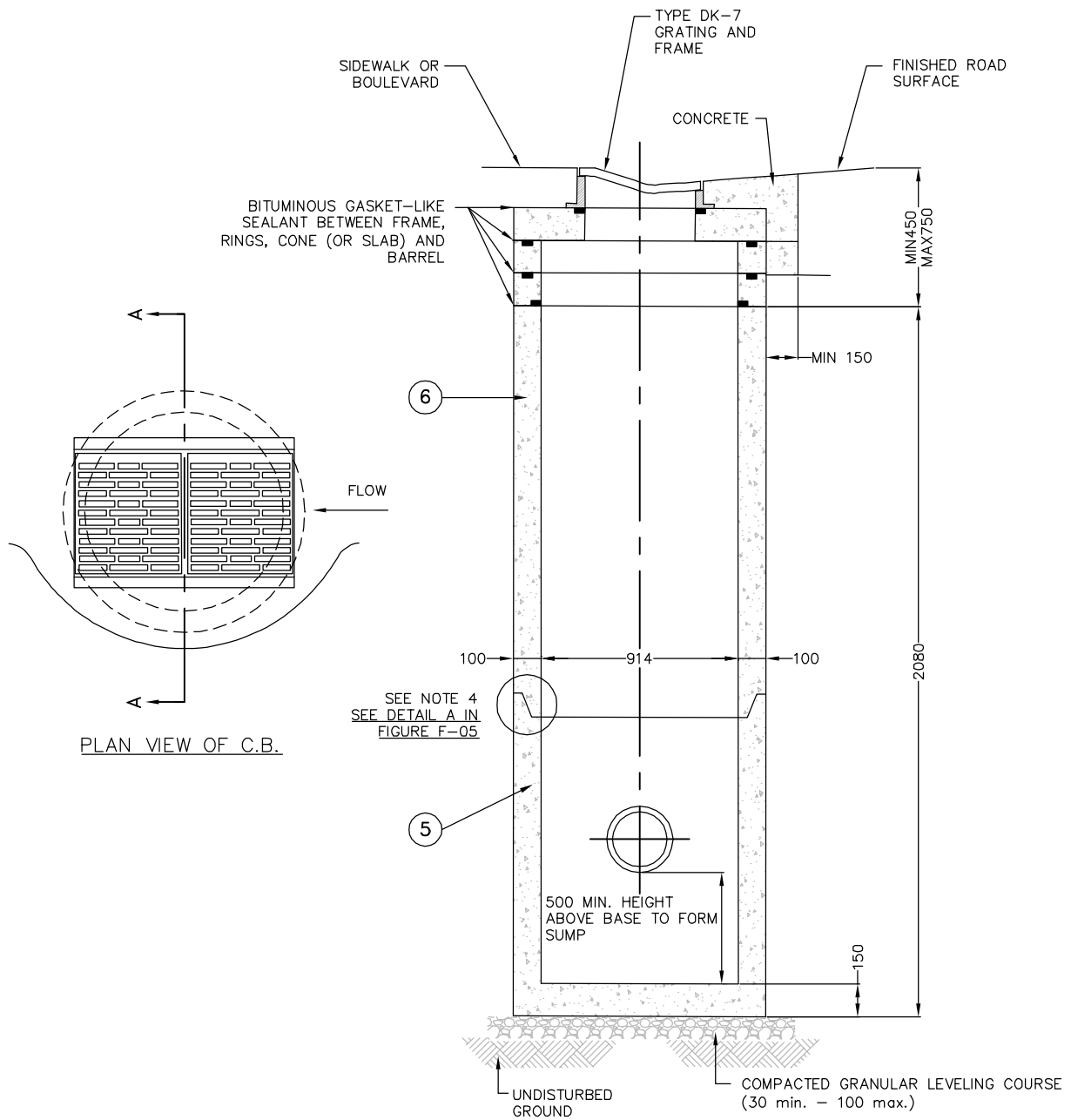
- NOTES:
1. RUBBER GASKET, KENT SEAL OR EQUIVALENT TO BE INSTALLED BETWEEN BARREL, ALL SHOULDER AND NECK RINGS AND CATCH BASIN FRAME.
 2. ALL ROUGH JOINTS SHALL BE POINTED WITH MORTAR TO ENSURE SMOOTHNESS.
 3. ALL CATCH BASIN COMPONENTS TO BE IN ACCORDANCE WITH ASTM C478.
 4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
 5. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

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Rev.		PRECAST 610mmØ CATCH BASIN	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure F-15



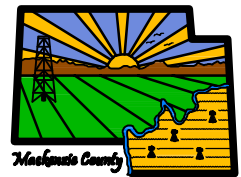
SECTION A-A

NOTES:

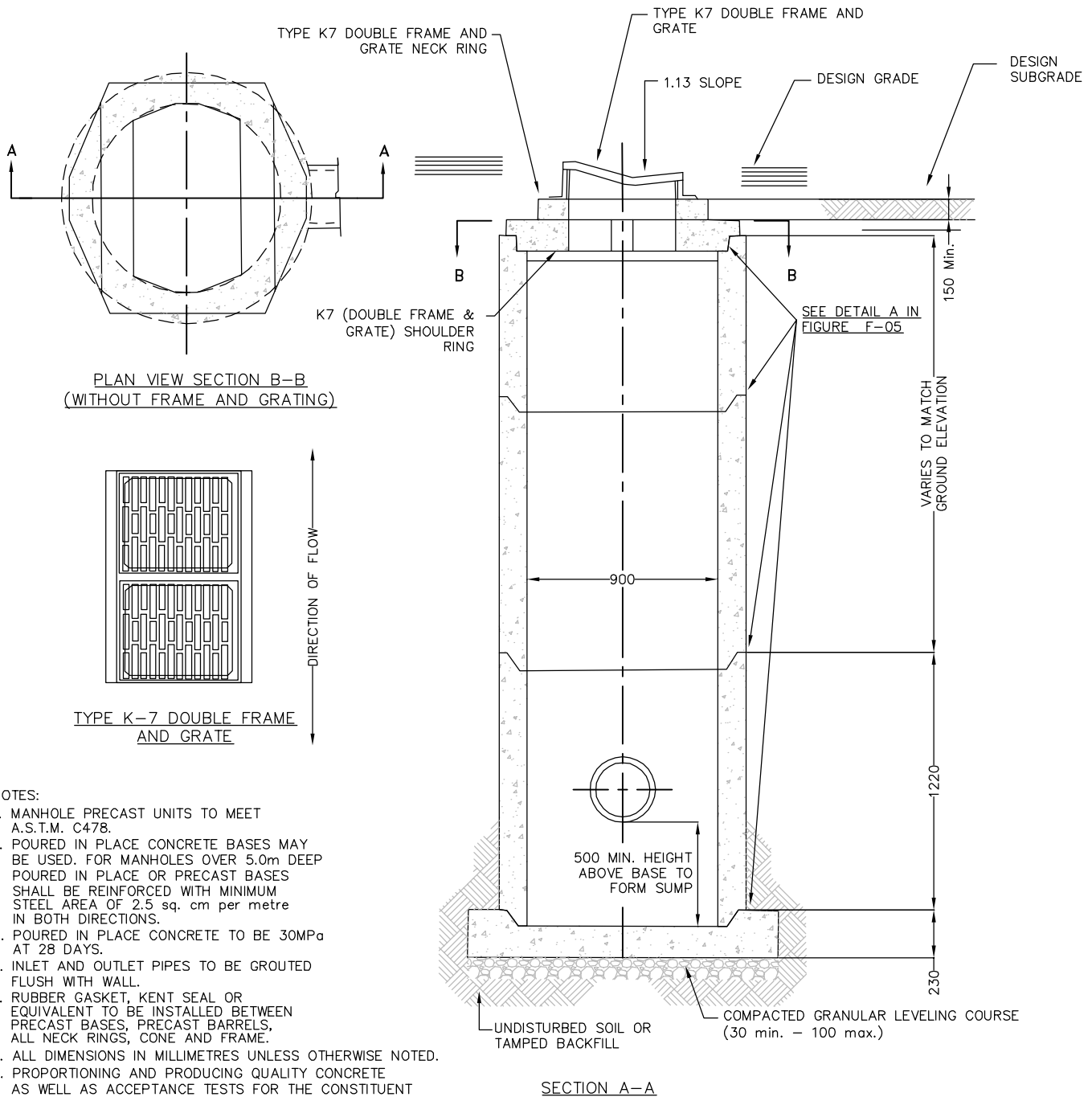
1. ITEM 5 COULD BE MADE UP FROM TWO ITEMS (BASE AND BARREL).
2. ITEM 6 COULD BE MADE UP FROM TWO ITEMS (SHOULDER RING SLAB TOP AND BARREL).
3. ITEMS 5 AND 6 COULD BE MADE AS ONE UNIT.
4. OPPOSITE ORIENTATION OF JOINTS IS ACCEPTABLE.
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
6. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		STANDARD 900mm CATCH BASIN WITH TYPE DK-7 GRATING & FRAME	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure F-16

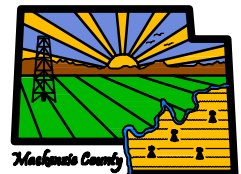


NOTES:

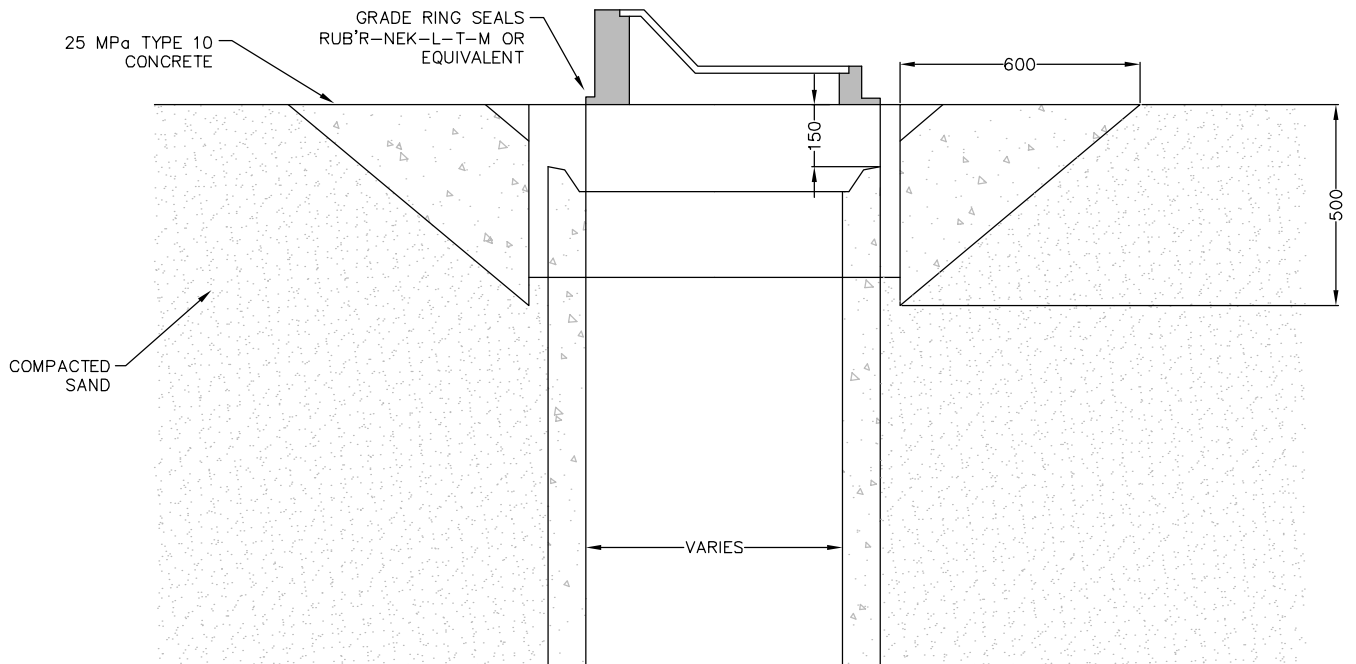
1. MANHOLE PRECAST UNITS TO MEET A.S.T.M. C478.
2. POURED IN PLACE CONCRETE BASES MAY BE USED. FOR MANHOLES OVER 5.0m DEEP POURED IN PLACE OR PRECAST BASES SHALL BE REINFORCED WITH MINIMUM STEEL AREA OF 2.5 sq. cm per metre IN BOTH DIRECTIONS.
3. POURED IN PLACE CONCRETE TO BE 30MPa AT 28 DAYS.
4. INLET AND OUTLET PIPES TO BE GROUTED FLUSH WITH WALL.
5. RUBBER GASKET, KENT SEAL OR EQUIVALENT TO BE INSTALLED BETWEEN PRECAST BASES, PRECAST BARRELS, ALL NECK RINGS, CONE AND FRAME.
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
7. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

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Rev.		STANDARD 900mm PRECAST C.B. c/w K7 DOUBLE FRAME & GRATE		Approved:	Figure F-17
Rev.		File No.: GP60.33682	Design:		
Rev.		Date: 2010-AUG-31	Drawn: K.P.L		

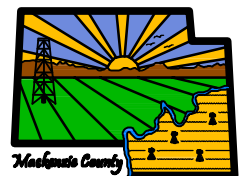


NOTES:

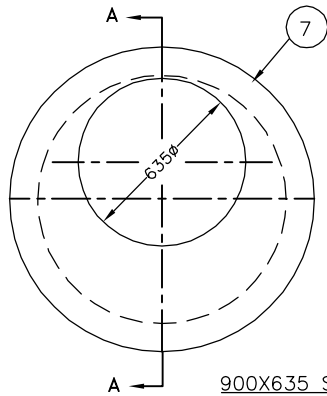
1. ALL MATERIAL IS 7.5mm (1/4) MILD STEEL PLATES.
2. ALL METAL JOINTS TO BE WELDED.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

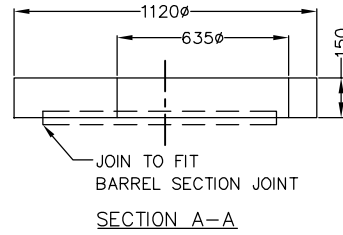
General Municipal Improvements Standards



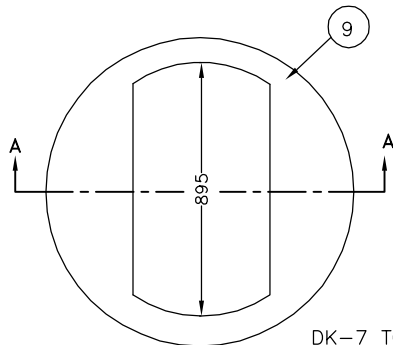
Rev.		STEEL PLATE TOP SYSTEM		Approved:	Figure F-18
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-18	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



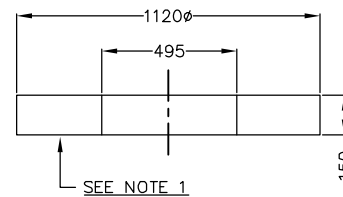
900X635 SLAB TOP
(TOP BELOW NECK FOR USE WITH
4A, 6, 8 FRAME AND GRATING)



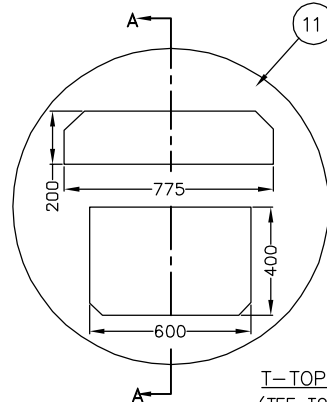
SECTION A-A



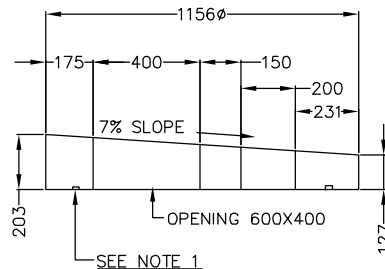
DK-7 TOP
(SLAB TOP FOR USE WITH
DK-7 FRAME AND GRATING)



SECTION A-A



T-TOP
(TEE TOP FOR USE WITH
F-5I WITH SIDE INLET)



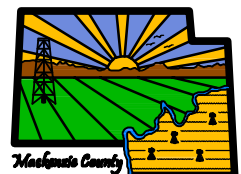
SECTION A-A

NOTES:

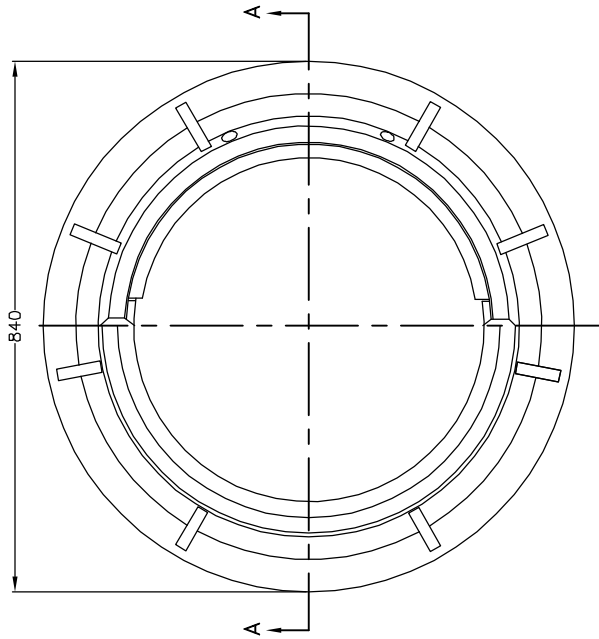
1. A CONCENTRIC GROOVE LOCATED AT MID CROSS SECTION, SUITABLE FOR SEALANT IS REQUIRED FOR NECK RINGS AND EXTENSION RINGS.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

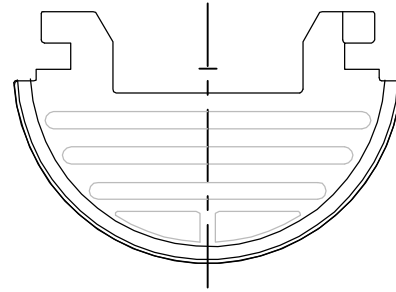
General Municipal Improvements Standards



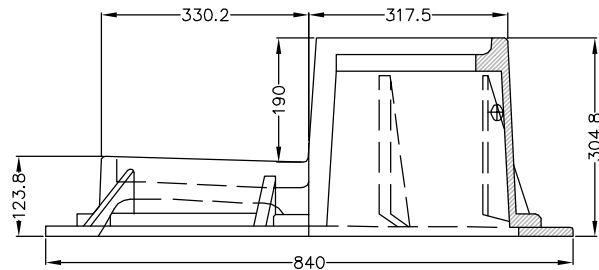
Rev.		SLABTOPS FOR STANDARD 900mm CATCH BASIN		Approved: _____	Figure F-19
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved: _____	Figure F-19	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



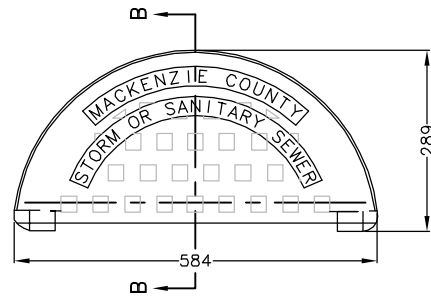
TOP VIEW (FRAME)



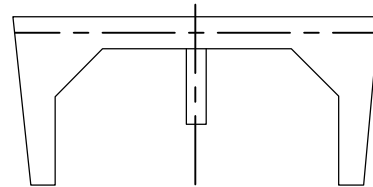
TOP VIEW - COVER (PART A)



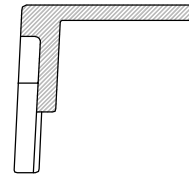
SECTION A-A



TOP VIEW - COVER (PART B)



FRONT VIEW - COVER (PART B)

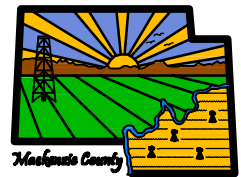


NOTES:

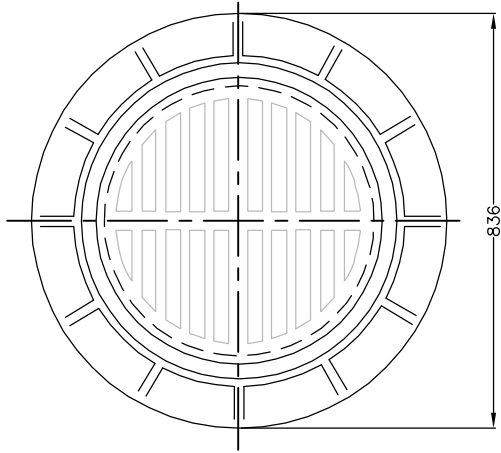
1. MATERIALS:
 FRAME: GRAY IRON CLASS 20B.
 COVER: PART A IRON CLASS 20B.
 PART B DUCTILE IRON GRADE 65-45-12.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

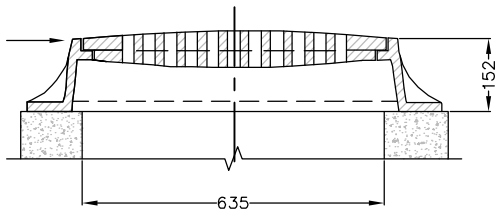
General Municipal Improvements Standards



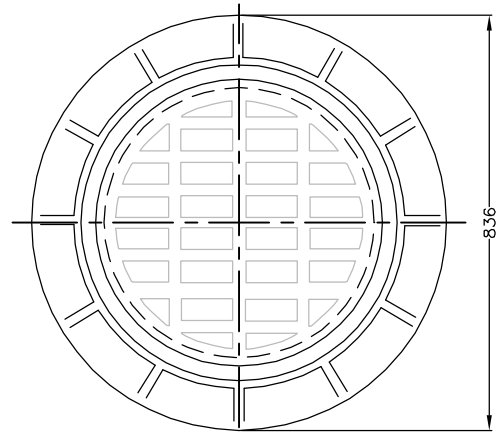
Rev.	Stewart Weir Naturally Resourceful	TWO PIECE TYPE 4A GRATING & FRAME		Approved:	Figure F-20
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



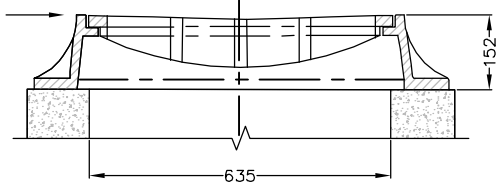
MATERIAL: GRAY IRON
 FRAME: CLASS 20B
 COVER: CLASS 20B



NO.6
 ROUND TOP CATCHBASIN
 OR MH FRAME & COVER



MATERIAL: GRAY IRON
 FRAME: CLASS 20B
 COVER: CLASS 20B

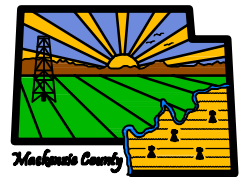


NO.8
 LARGE PAVING AND CURB RAMP
 CATCHBASIN OR MH FRAME & COVER

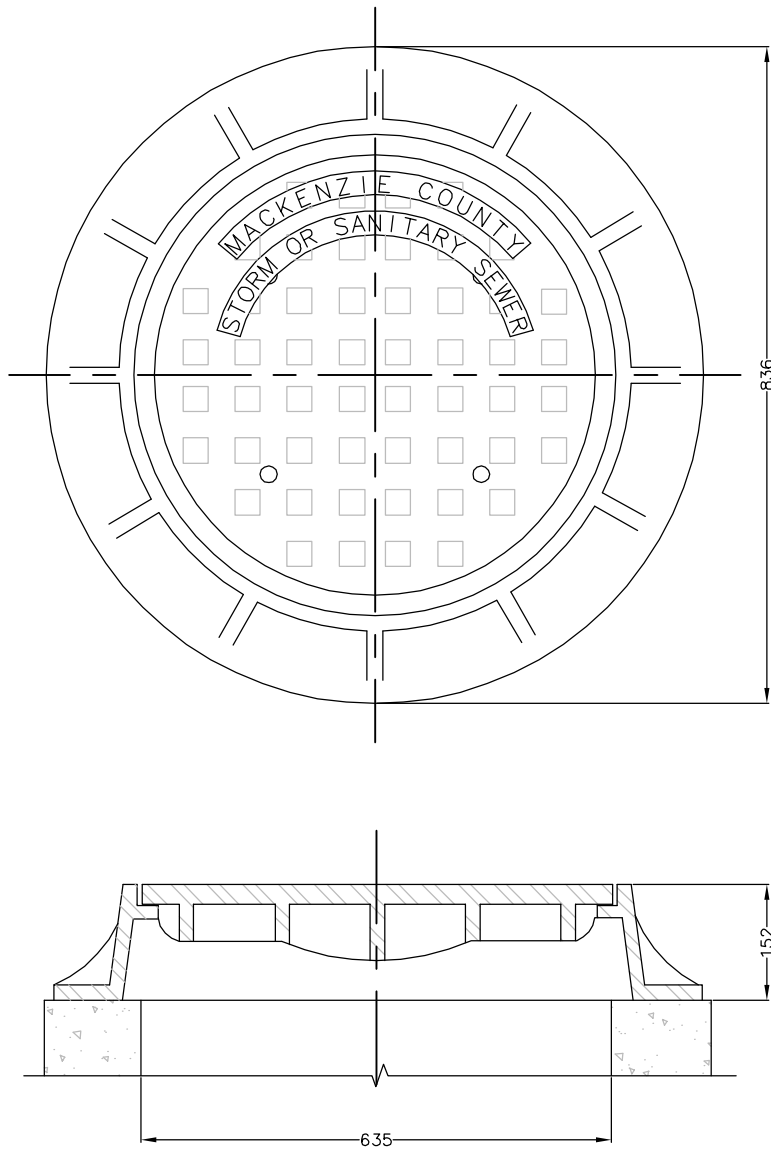
NOTES:
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		FRAME & GRATING TYPE 6 AND 8		Approved:	Figure F-21
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

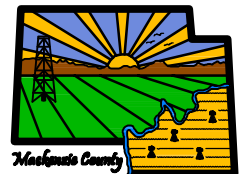


NOTES:

1. MATERIALS:
 FRAME: GRAY IRON CLASS 20B.
 COVER: GRAY IRON CLASS 20B.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

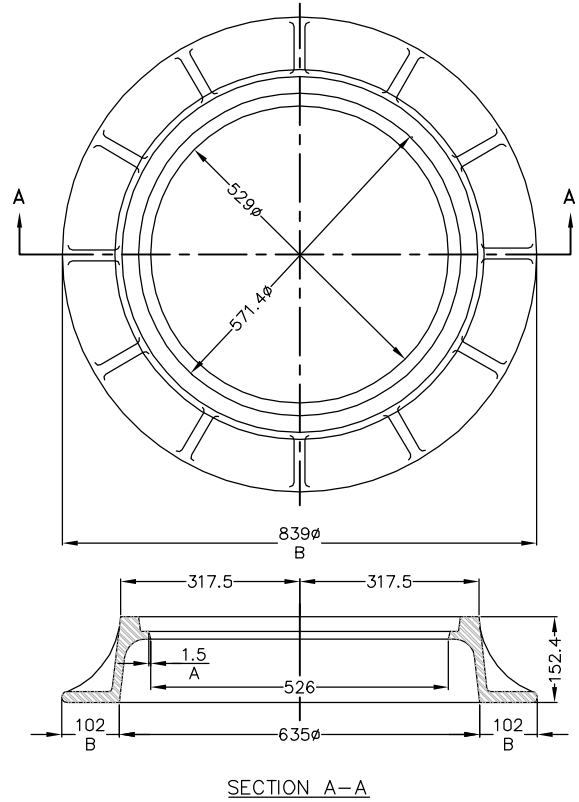
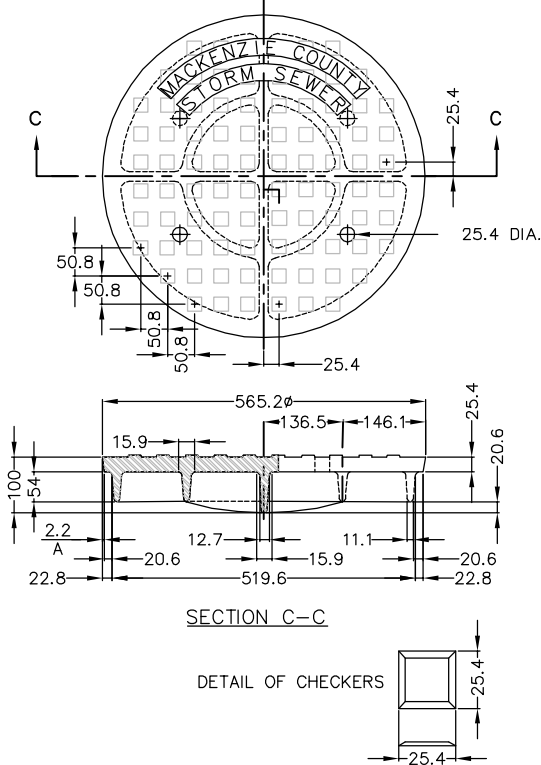
General Municipal Improvements Standards



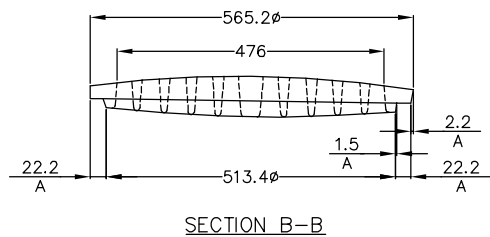
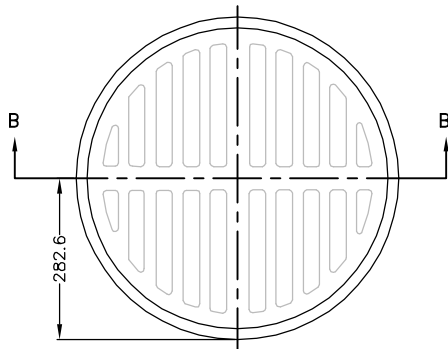
Rev.		TYPE 6A COVER AND FRAME		Figure F-22
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

No.6 STANDARD FRAME FOR MANHOLE AND ROUND CATCH BASIN TOP

No. 6A STANDARD MANHOLE COVER



No. 6B STANDARD ROUND CATCH BASIN TOP

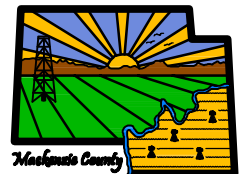


NOTES:

1. MATERIAL SPECIFICATION:
DUCTILE IRON TO CONFORM TO A.S.T.M. A536 (LATEST EDITION) GRADE 80-60-03.
2. NF-90 FRAME AND COVER IS WATERTIGHT VARIATION OF NF-80.
THERE ARE NO VENTING HOLES IN NF-90 COVER AND A GASKET IS PLACED BETWEEN THE FRAME AND COVER.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

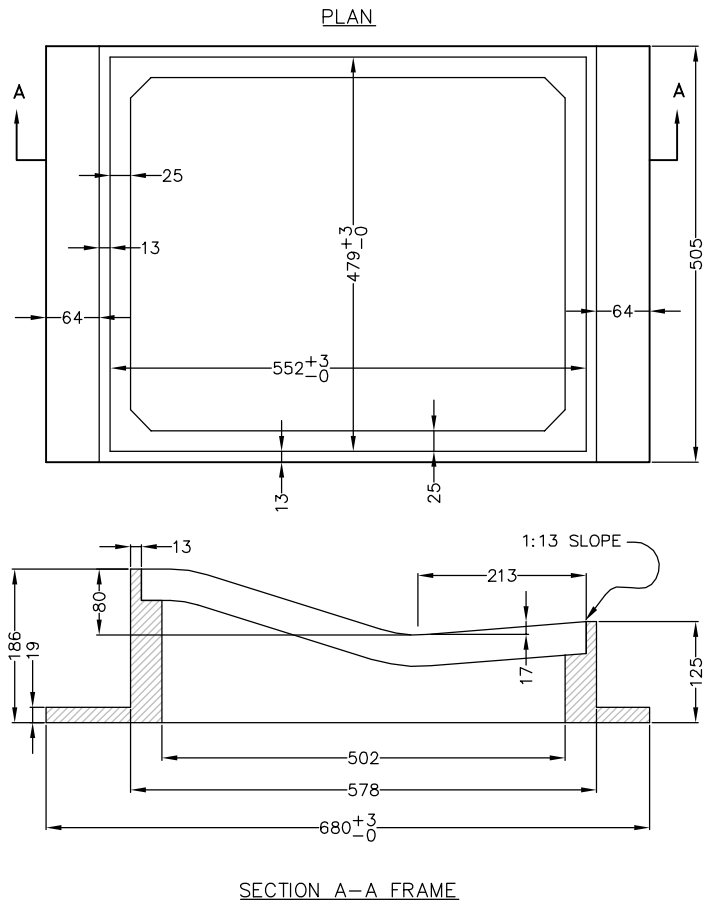
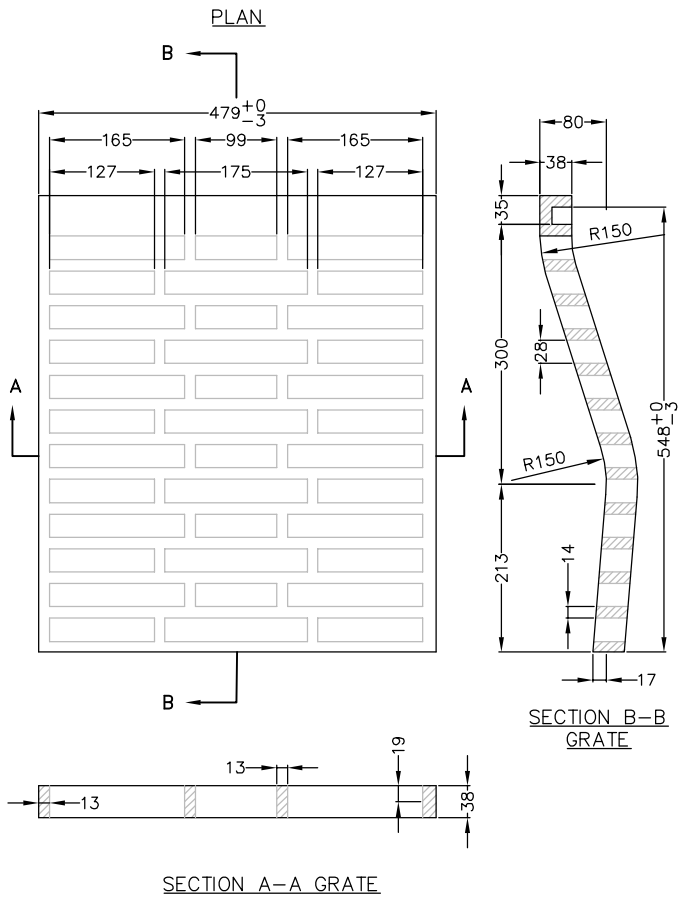
MACKENZIE COUNTY

General Municipal Improvements Standards



ROUND TOP CATCH BASIN AND MANHOLE

Rev.			Approved:	Figure F-23
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:		
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

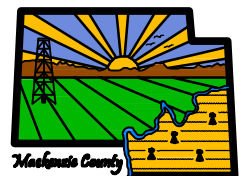


NOTES:

1. MATERIALS:
 - FRAME
 - GREY CAST IRON TO CONFORM TO CLASS 25B A.S.T.M. A48 (LATEST EDITION).
 - GRATE
 - DUCTILE IRON TO CONFORM TO A.S.T.M. A536 (LATEST EDITION) GRADE 80-55-06.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



FRAME & GRATING TYPE K-7

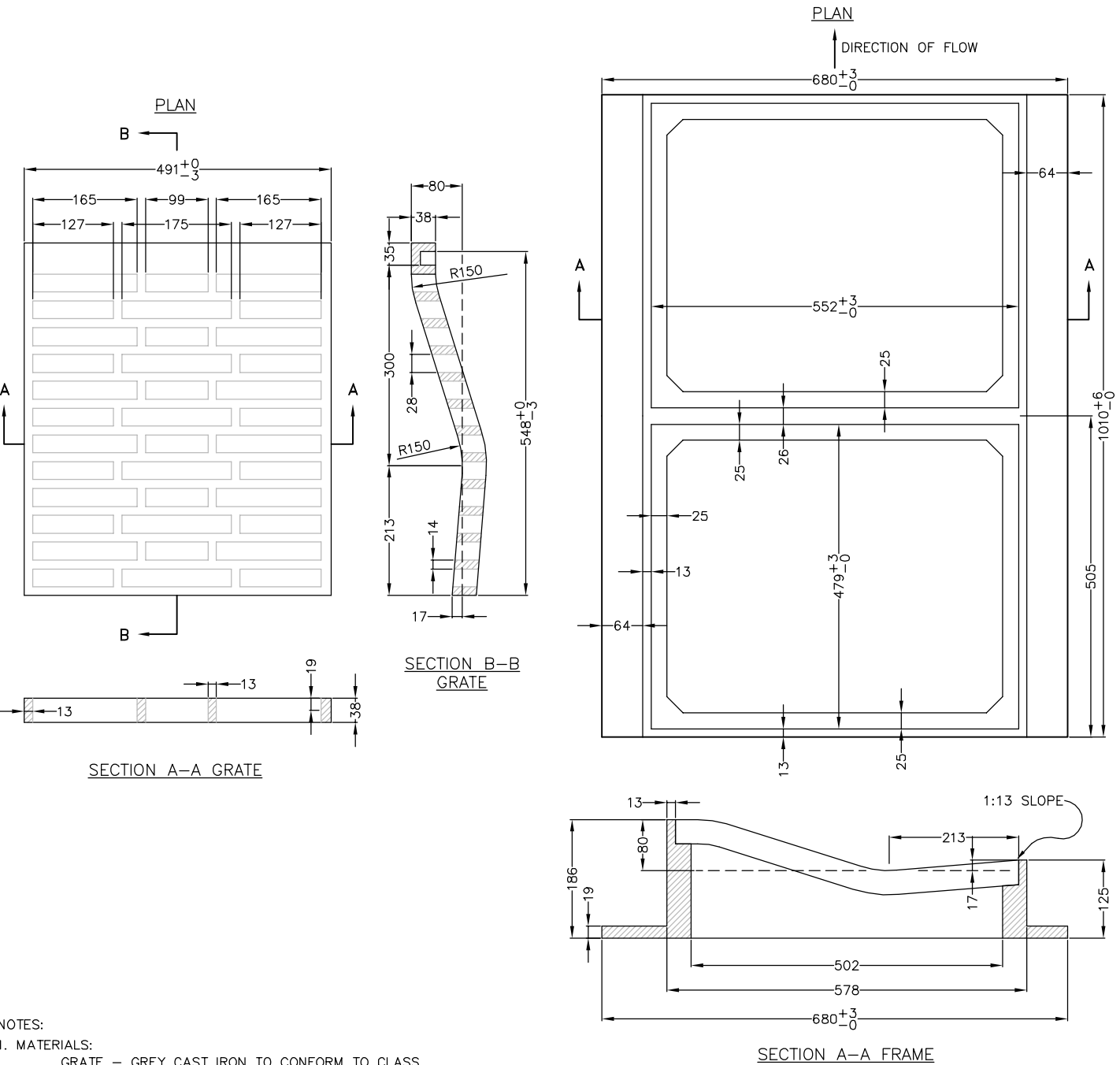
Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L.

Design:
Scale: N.T.S.

Approved:

Figure F-24

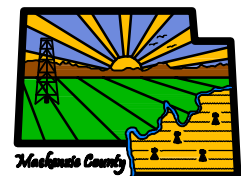


NOTES:

1. MATERIALS:
 - GRATE - GREY CAST IRON TO CONFORM TO CLASS 25B A.S.T.M. A48 (LATEST EDITION).
 - FRAME - DUCTILE IRON TO CONFORM TO A.S.T.M. A536 (LATEST EDITION) GRADE 80-55-06.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



K-7 DF&G CATCH BASIN

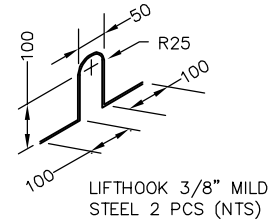
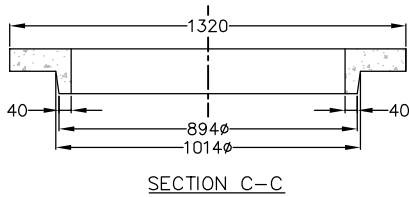
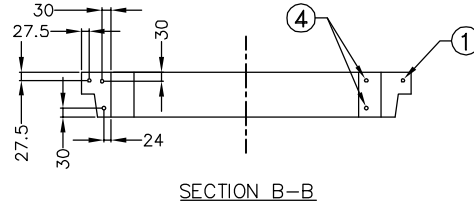
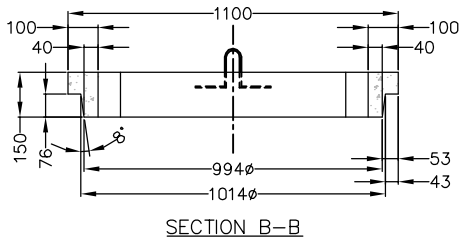
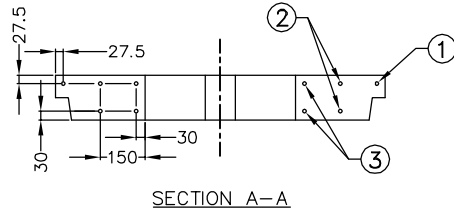
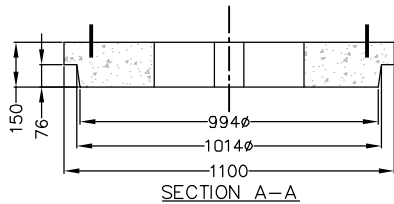
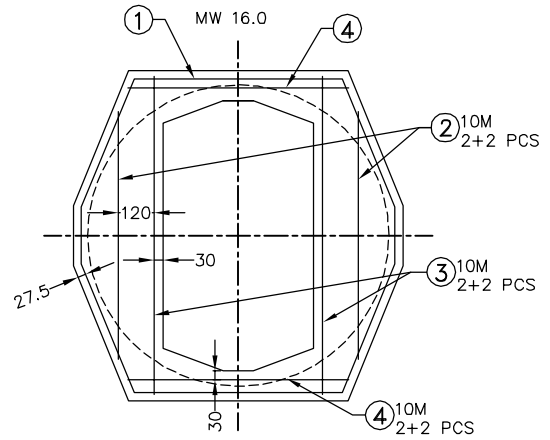
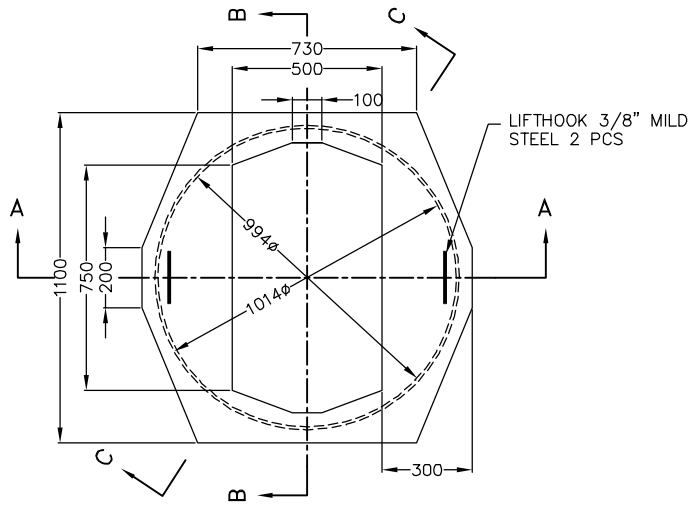
Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L.

Design:
Scale: N.T.S.

Approved:

Figure F-25

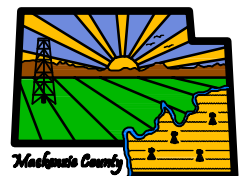


NOTES:

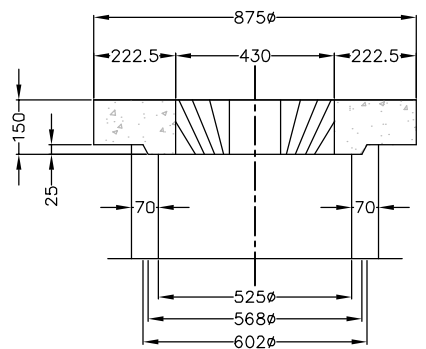
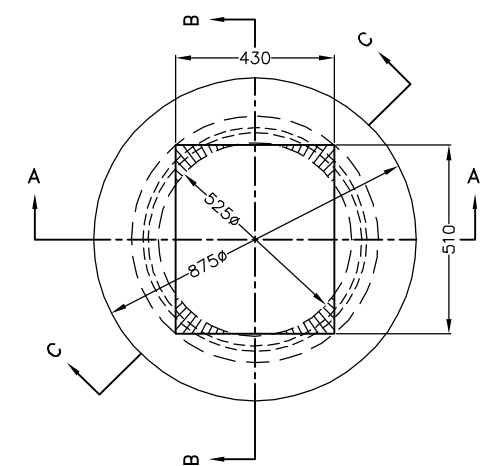
1. 25mm MINIMUM COVER.
2. 10M REINFORCING BARS @ 250 (OR EQUIVALENT STEEL AREA).
3. CONCRETE: 30 MPa AT 28 DAYS.
4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
5. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

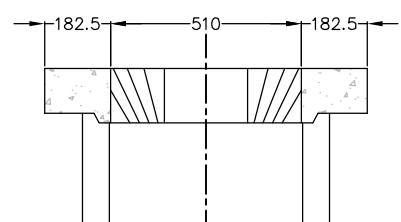
General Municipal Improvements Standards



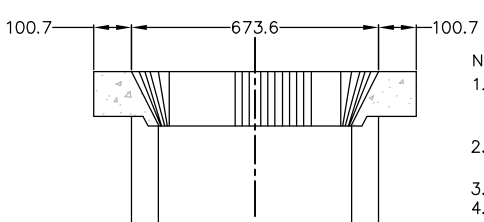
Rev.		K-7 DF&G SHOULDER RING		Approved:	Figure F-26
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-26	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



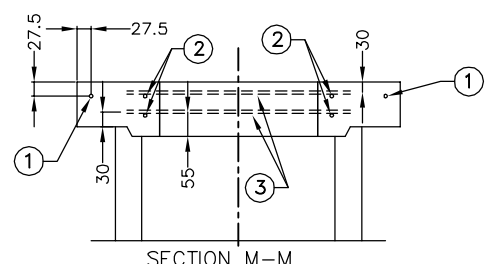
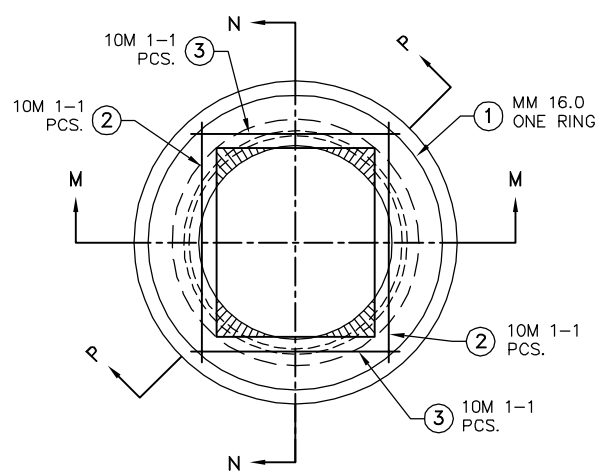
SECTION A-A



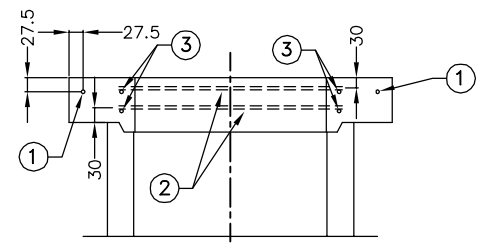
SECTION B-B



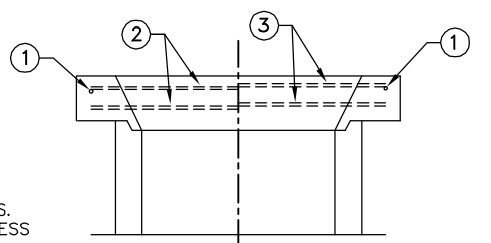
SECTION C-C



SECTION M-M



SECTION N-N

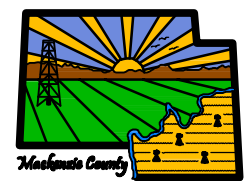


SECTION P-P

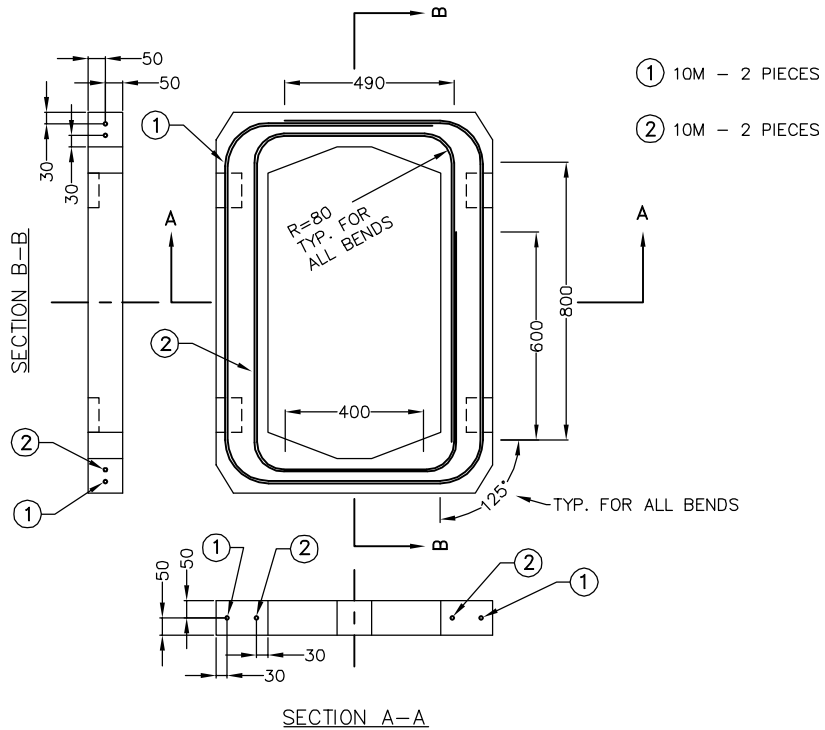
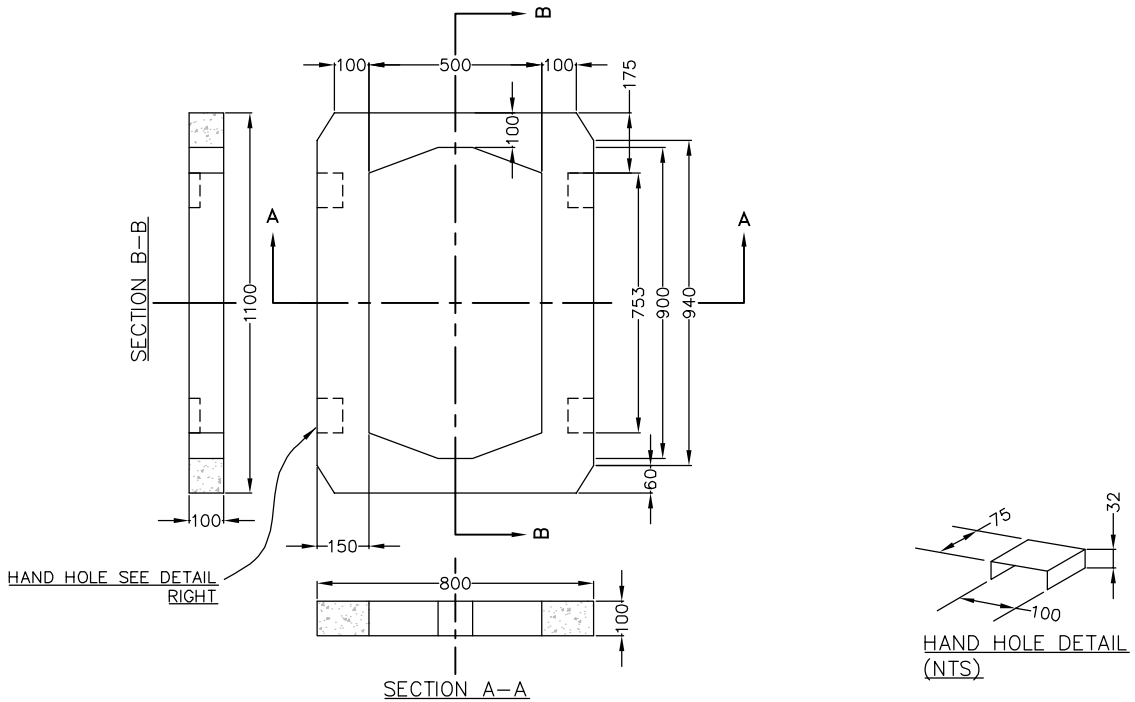
- NOTES:
1. MINIMUM 25mm COVER TO ALL RE-BARS EXCEPT WHERE NOTED ON DRAWING.
 2. 10M REINFORCING BARS @ 250 (OR EQUIVALENT STEEL AREA).
 3. CONCRETE: 30 MPa S.R. AT 28 DAYS.
 4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
 5. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	K-7 SF&G SHOULDER	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure F-27

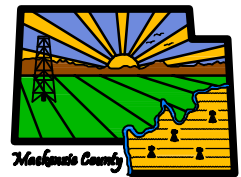


NOTES:

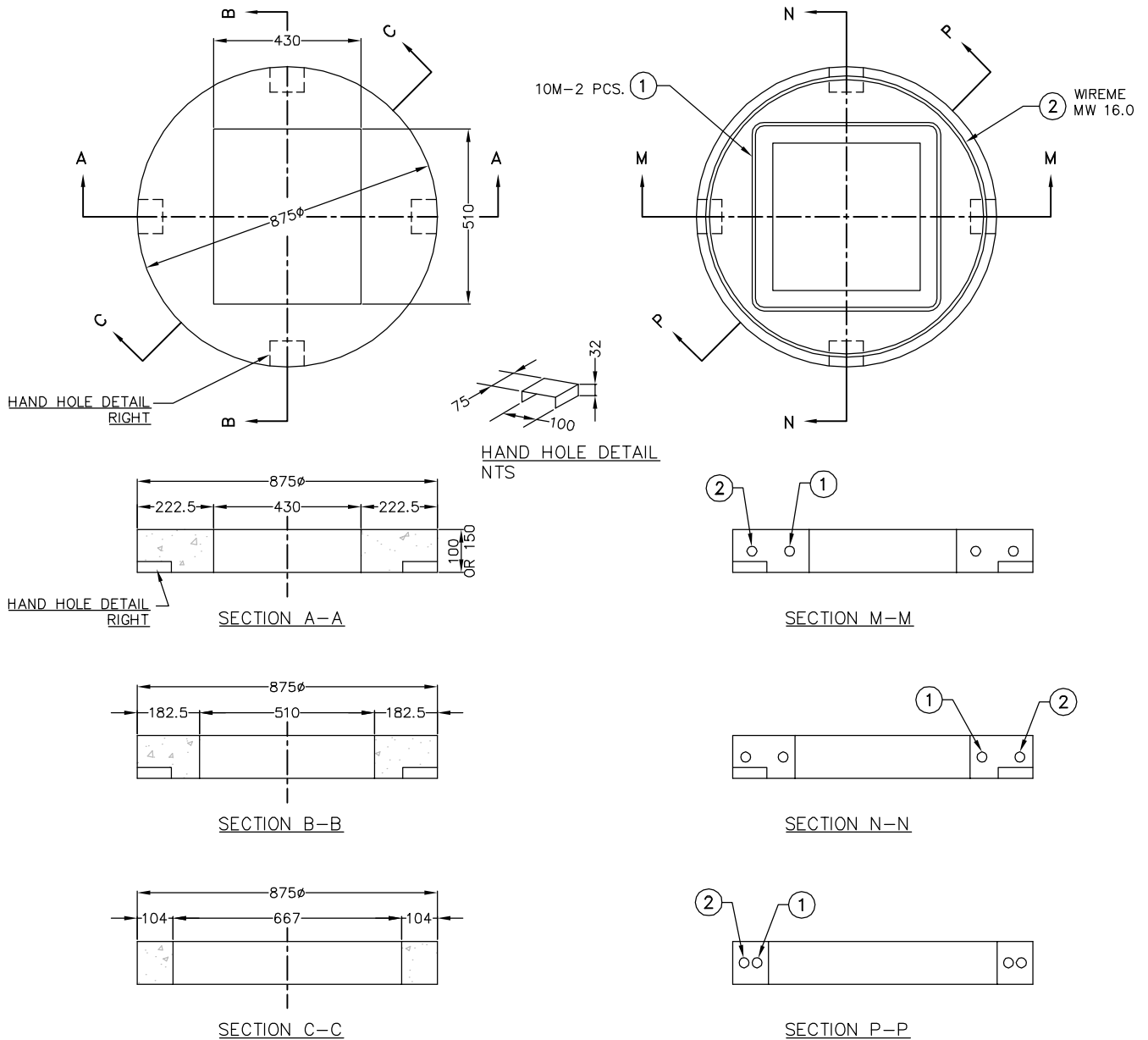
1. 25mm MINIMUM COVER.
2. 10M REINFORCING BARS @ 250 (OR EQUIVALENT STEEL AREA).
3. CONCRETE : 30 MPa S.R. AT 28 DAYS.
4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
5. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

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Rev.	Stewart Weir Naturally Resourceful	K-7 DF&G NECK RING		Approved:	Figure F-28
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-28	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

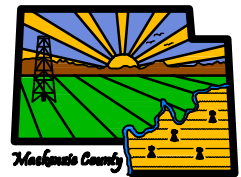


NOTES:

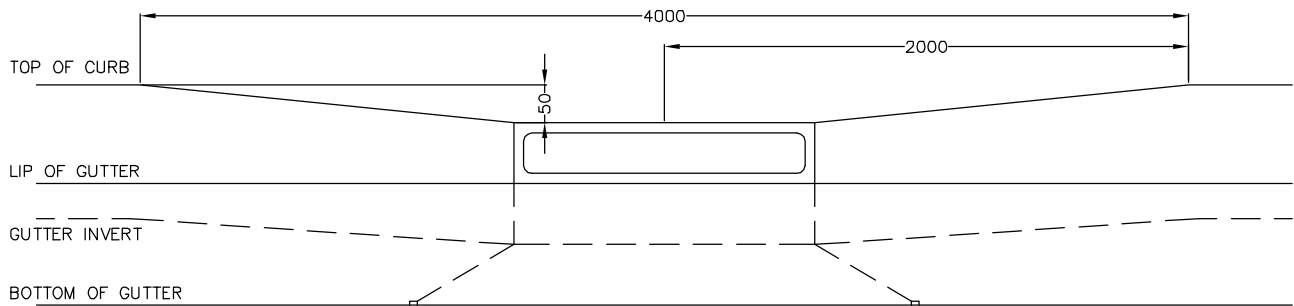
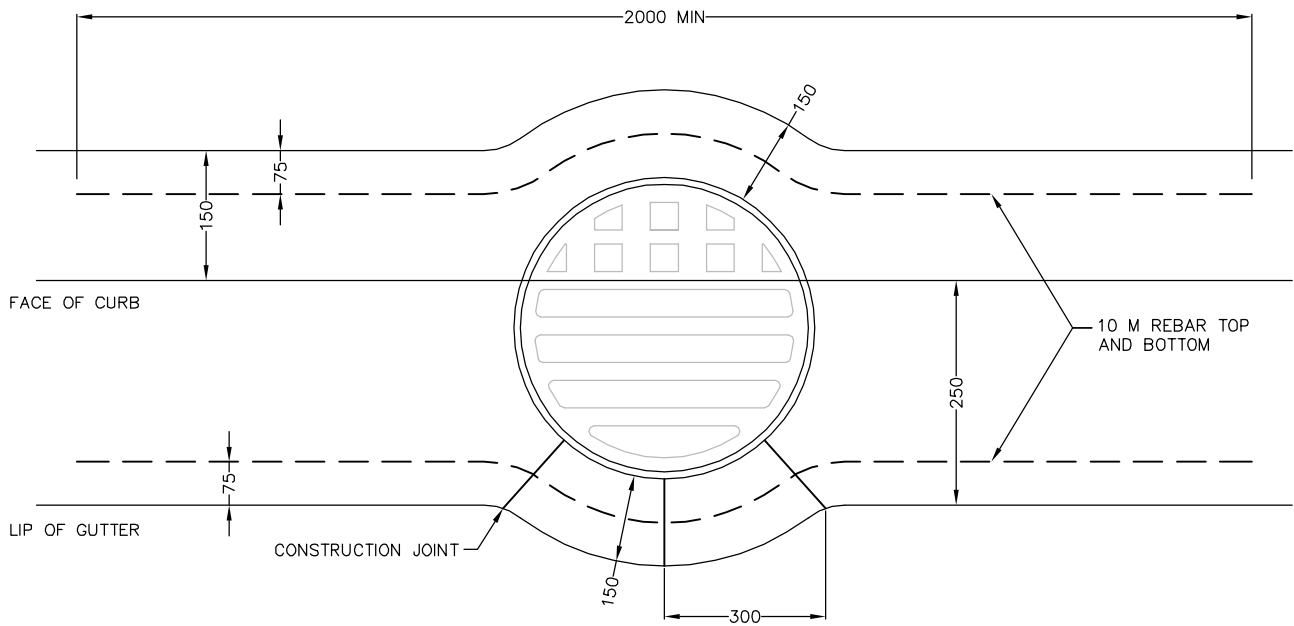
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. 25mm MINIMUM COVER.
3. 10M REINFORCING BARS @ 250 (OR EQUIVALENT STEEL AREA).
4. CONCRETE: 30 MPa S.R. AT 28 DAYS.

MACKENZIE COUNTY

General Municipal Improvements Standards



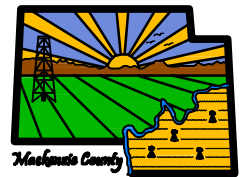
Rev.		<p>K-7 SF&G NECK RING</p>		<p>Approved:</p>	<p>Figure F-29</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure F-29</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



TYPICAL CATCH BASIN INSTALLATION
150 CURB & 250 GUTTER

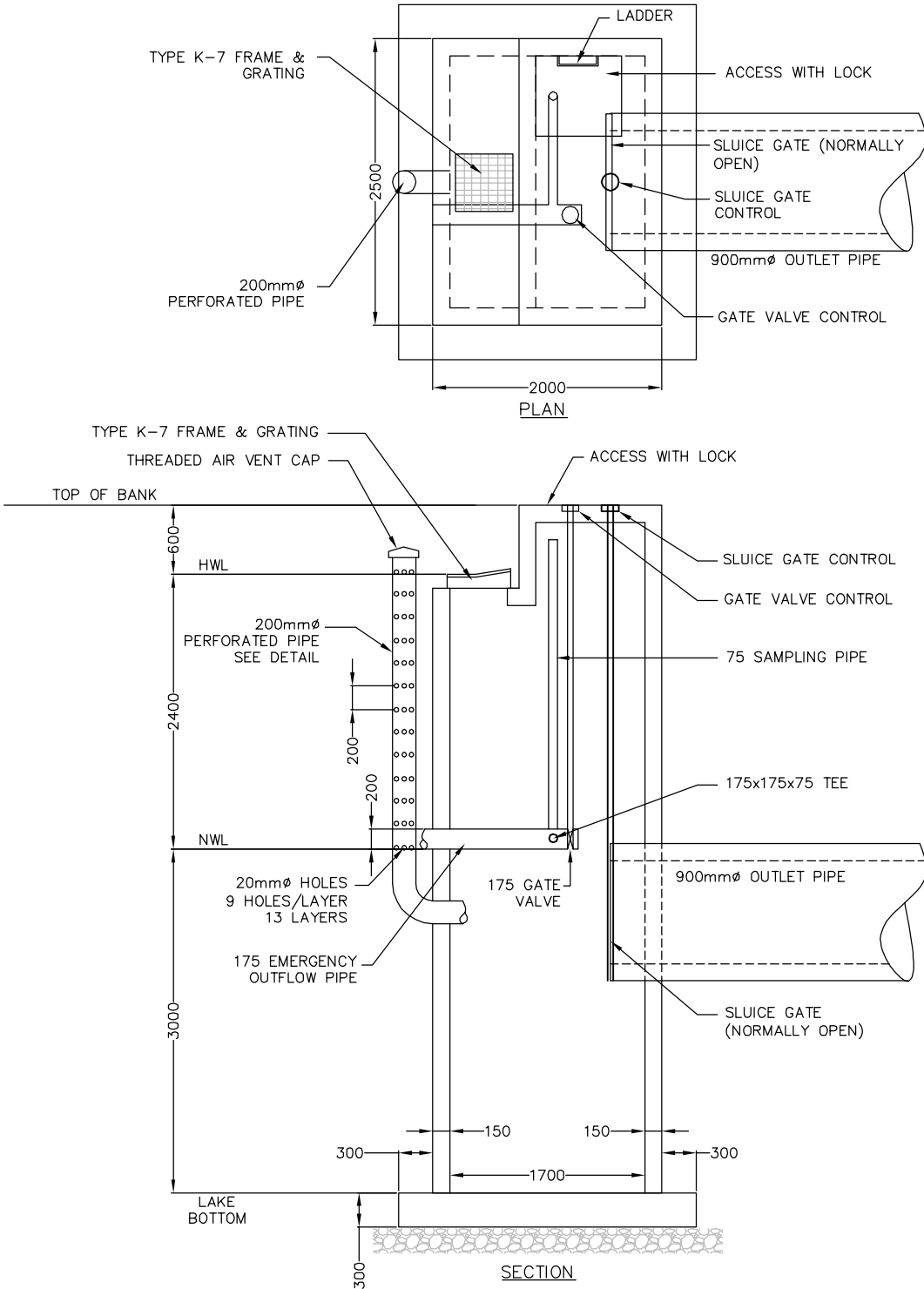
Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L.

Design:
Scale: N.T.S.

Approved:

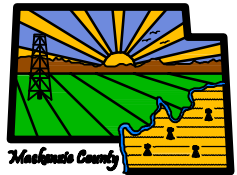
Figure F-30



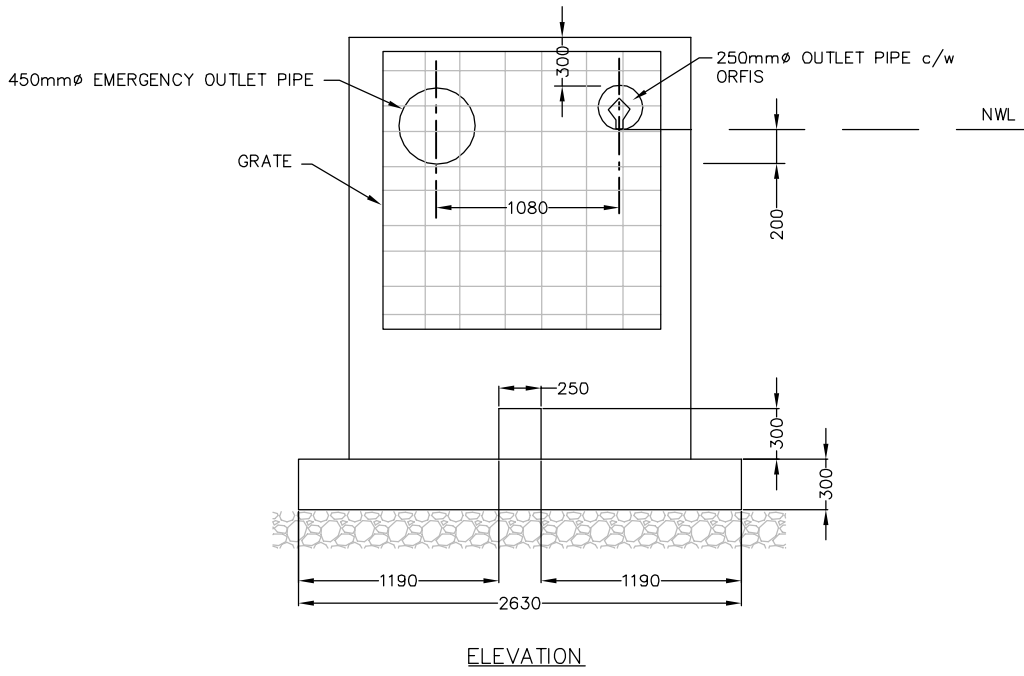
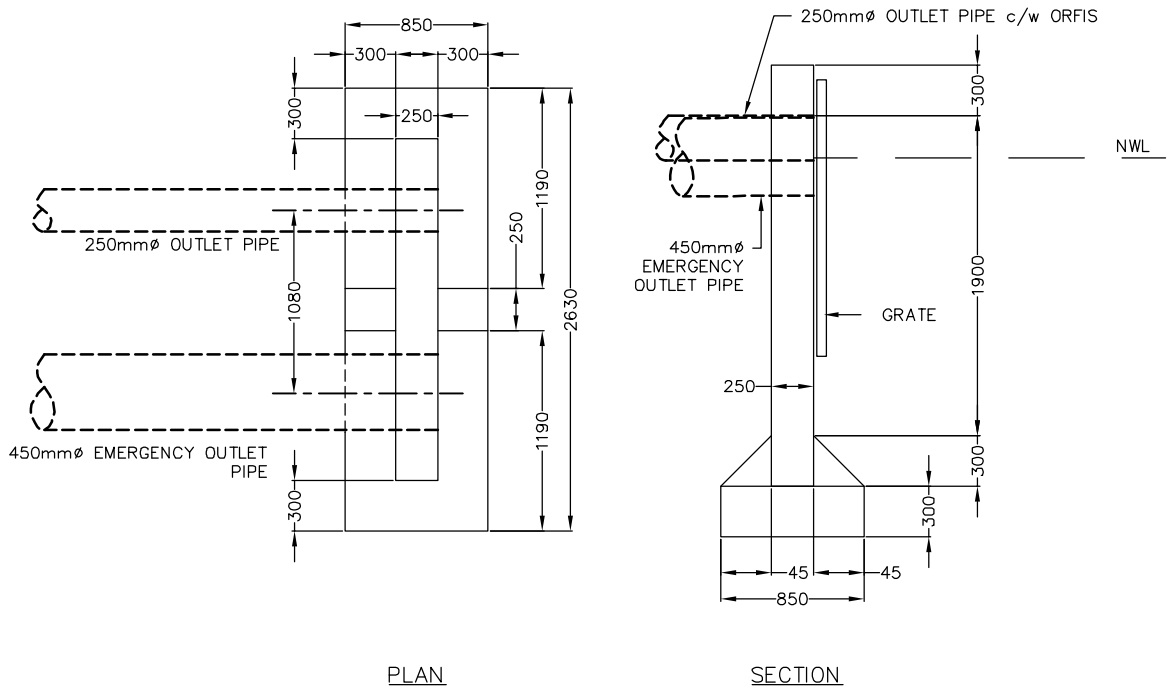
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



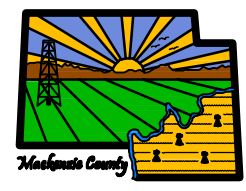
Rev.	Stewart Weir Naturally Resourceful	STORM POND OUTLET STRUCTURE		Figure F-31
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-31
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		



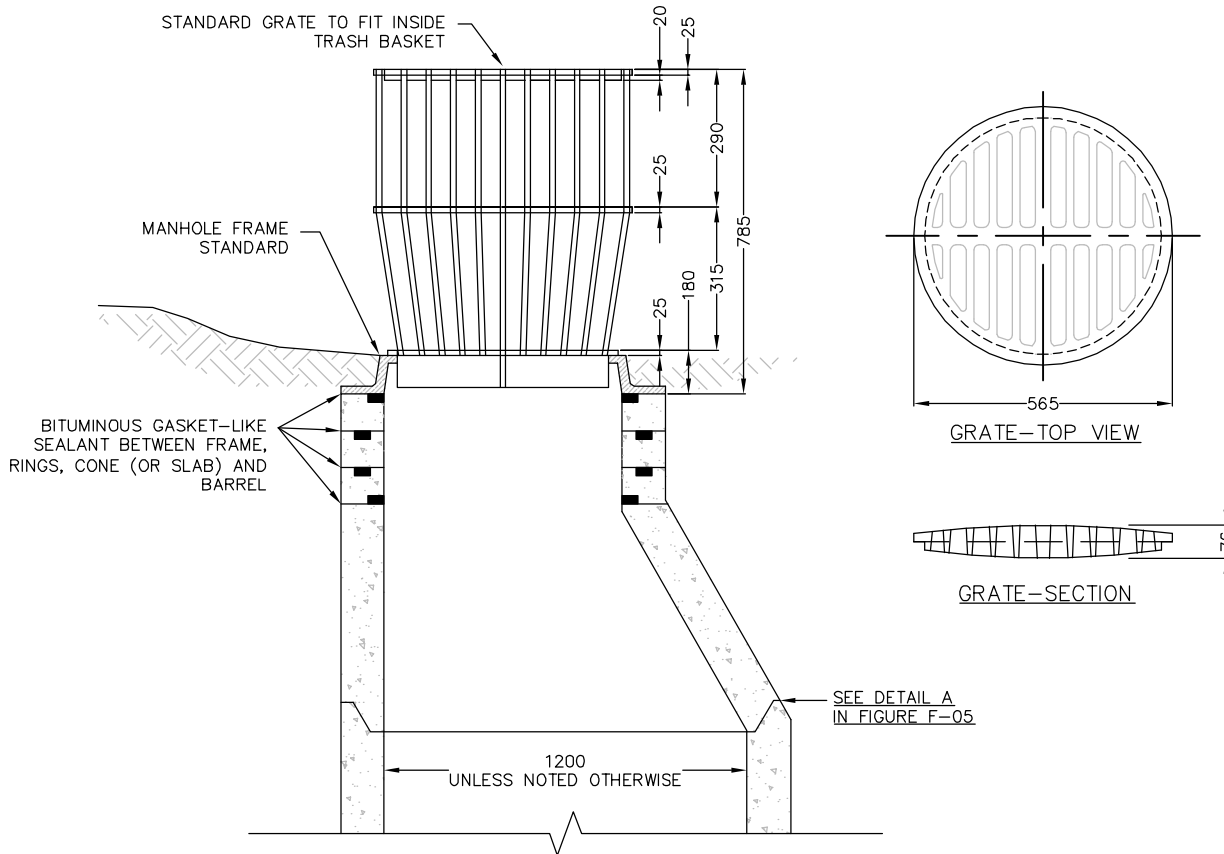
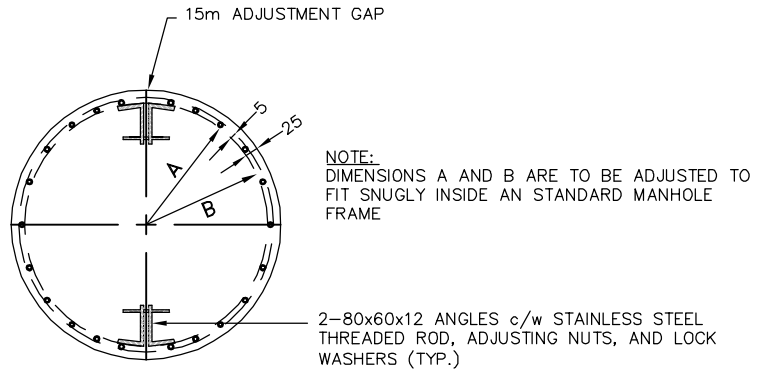
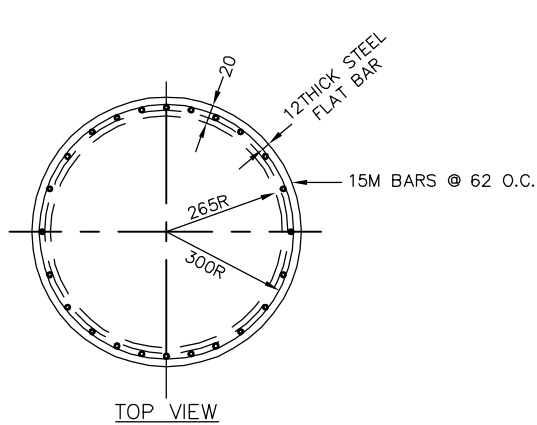
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

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Rev.		STORM POND OUTLET CONTROL		Figure F-32
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-32
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

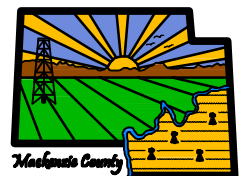


NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



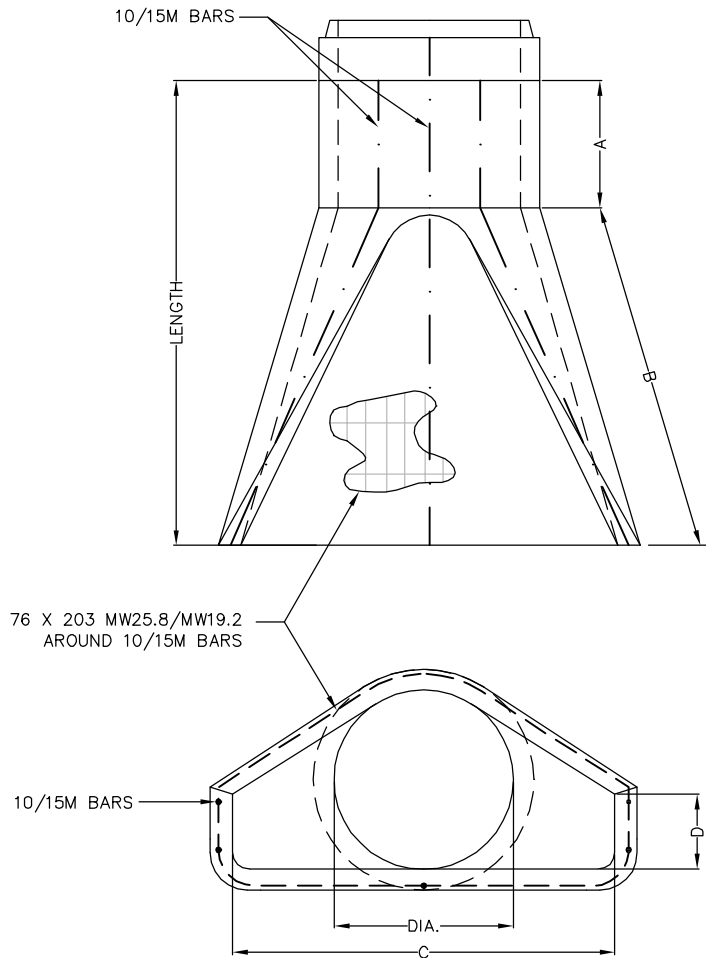
SWALE INLET STRUCTURE

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:	
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Figure F-34



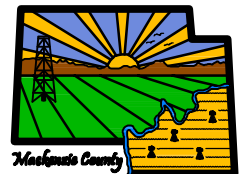
DIAMETER (mm)	ACTUAL DIMENSIONS			
	A	B	C	D
600	749	1168	1207	254
1050	889	1650	1981	533

NOTE : 1050mm CULVERT TO COME WITH GATE

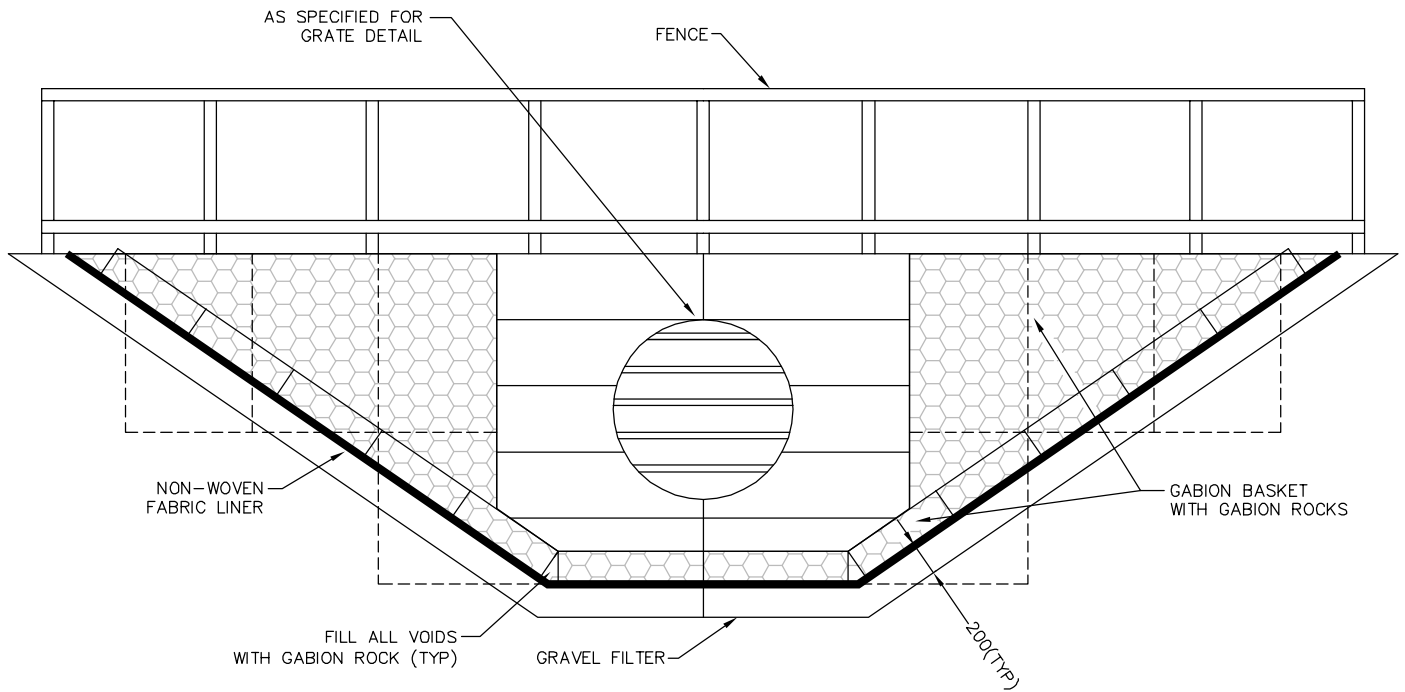
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



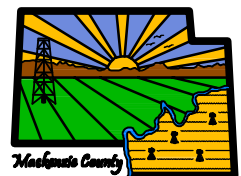
Rev.		CONCRETE CULVERT FLARED END DETAIL		
Rev.		File No.: GP60.33682	Design:	Approved:
Rev.		Drawn: K.P.L	Scale: N.T.S	
Date: 2010-AUG-31				



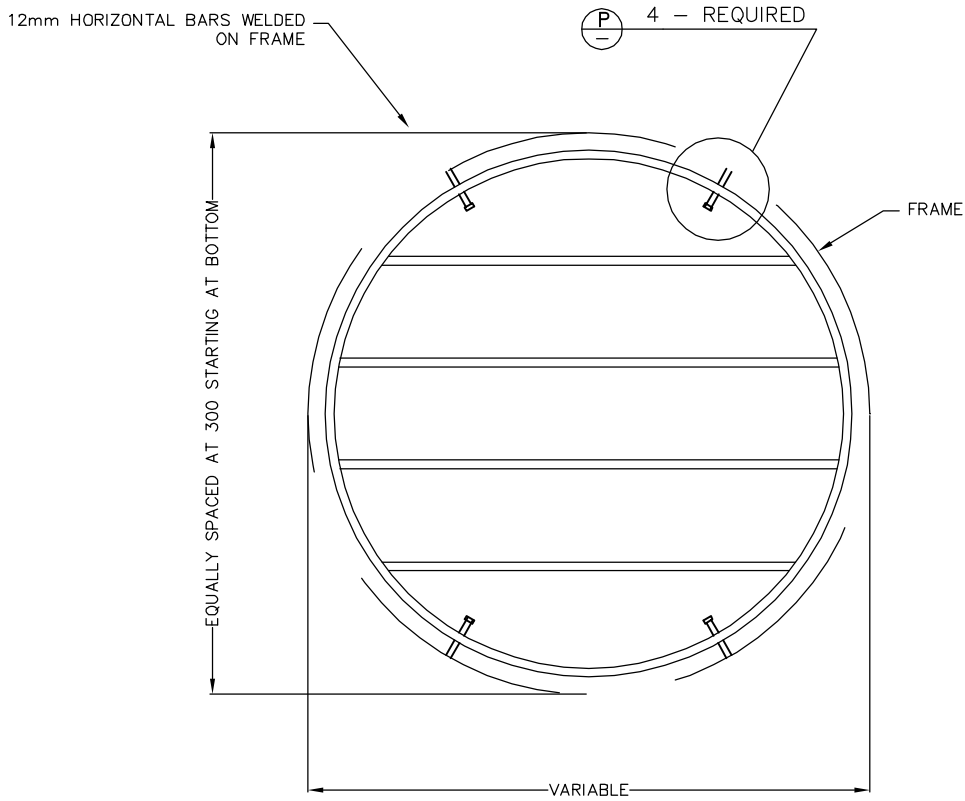
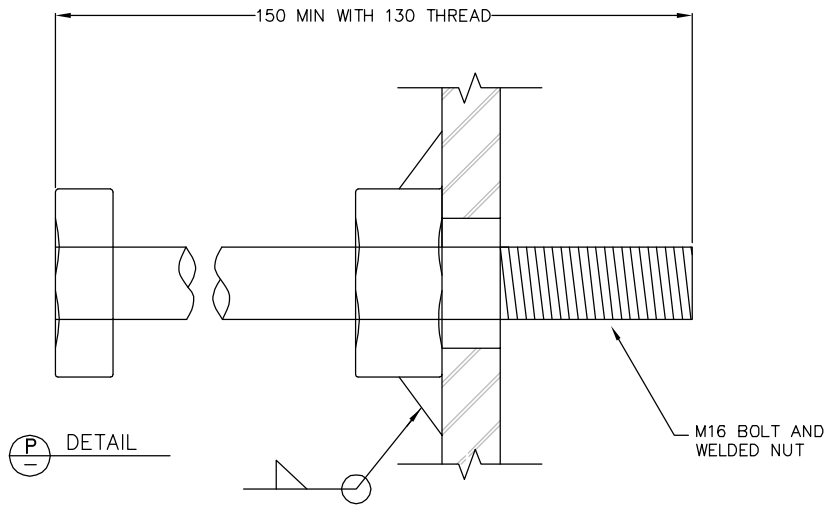
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



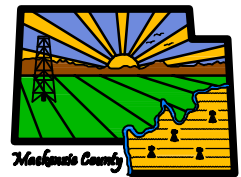
Rev.	Stewart Weir Naturally Resourceful	GABION BASKET DETAIL STORM SEWER OUTLET (OUTLETS GREATER THAN 0.9m ϕ)	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure F-36



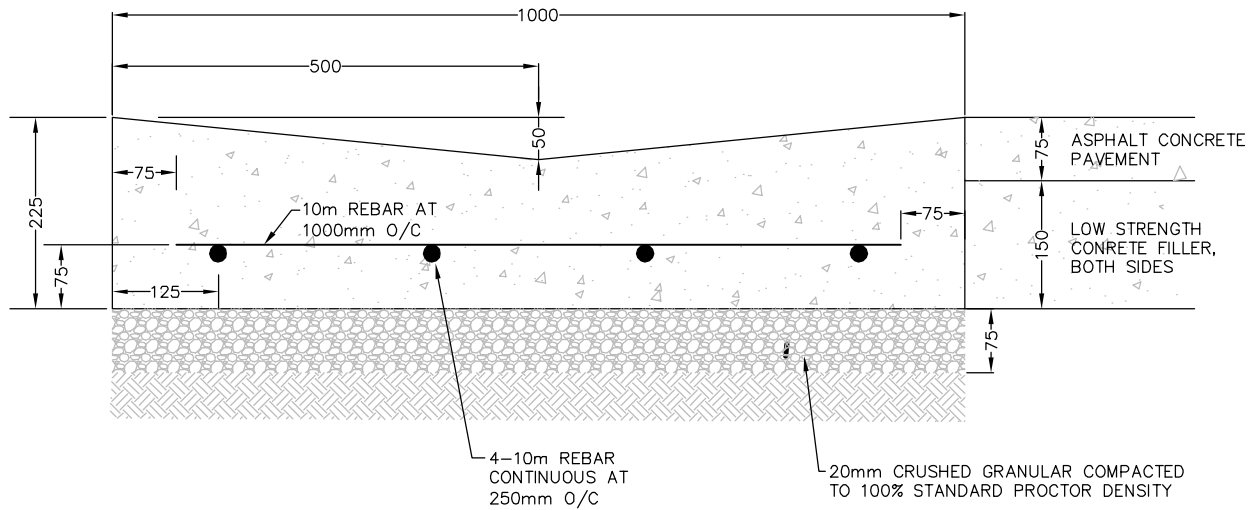
NOTE:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

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Rev.		PIPE GRATE DETAIL STORM SEWER OUTLET		Approved:	Figure F-37
Rev.					
Rev.		File No.: GP60.33682 Design:	Approved:	Figure F-37	
Date: 2010-AUG-31	Drawn: K.P.L. Scale: N.T.S.	Approved:	Figure F-37		

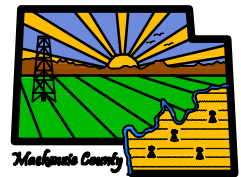


NOTES:

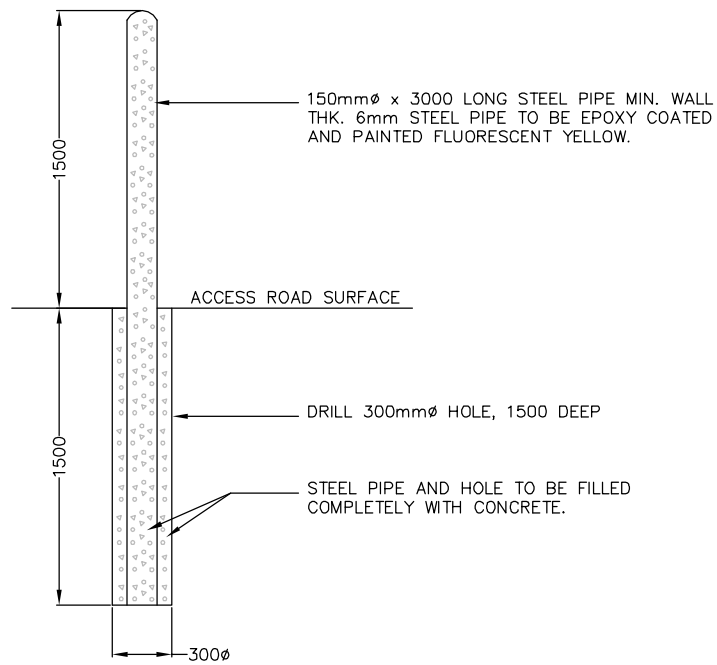
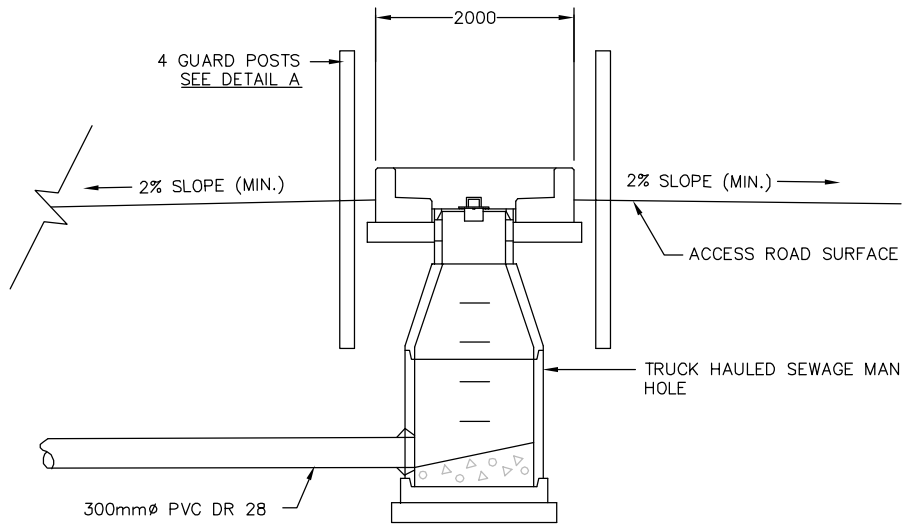
1. EXPANSION/CONTRACTION JOINT REQUIRED ON ONE END. IF DONE IN 2 POURS, ONLY CONSTRUCTION JOINT REQUIRED.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		1000mm CONCRETE SWALE	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	



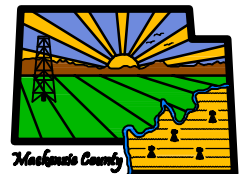
DETAIL A - GUARD POST

NOTES:

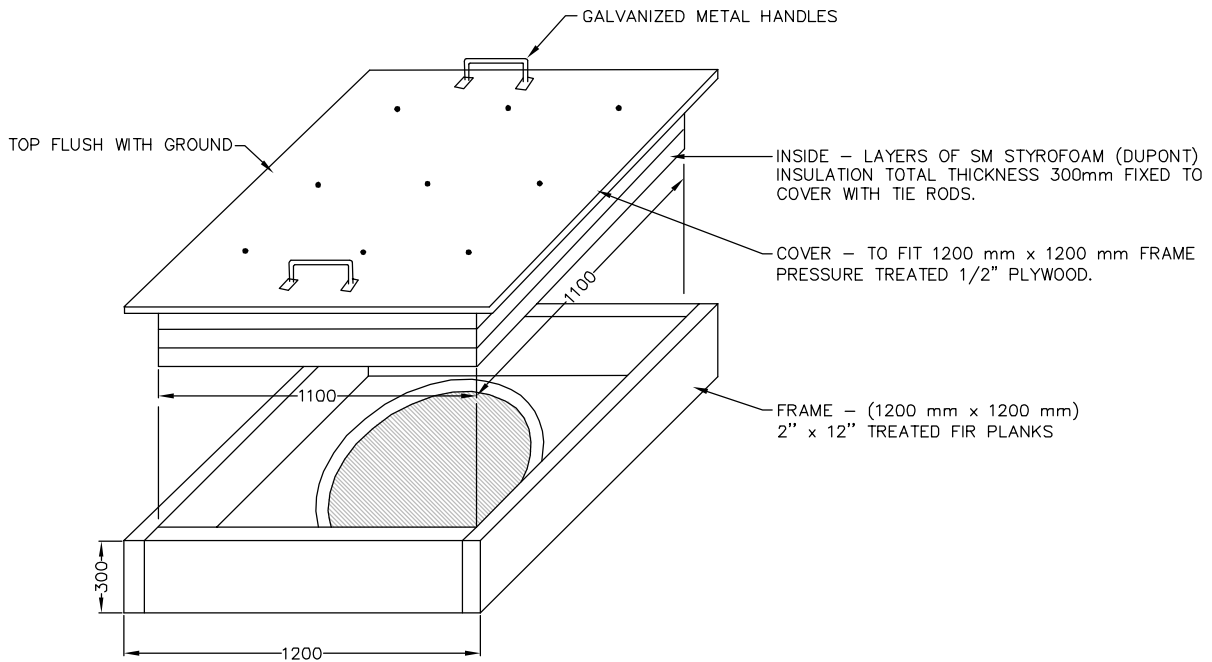
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



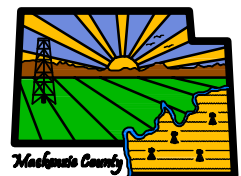
Rev.		<p style="text-align: center;">GUARD POSTS</p>		<p style="text-align: right;">Figure F-39</p>
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		



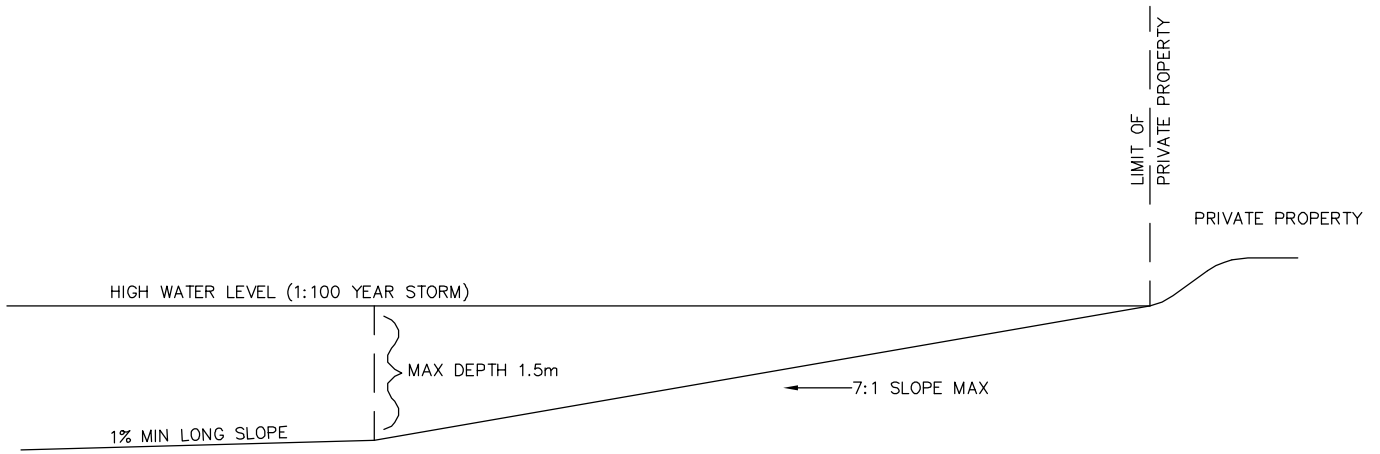
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards

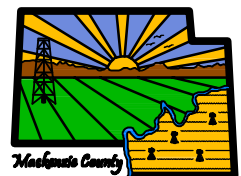


Rev.		FROST BOX DETAIL		Figure F-53
Rev.				
Rev.		File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

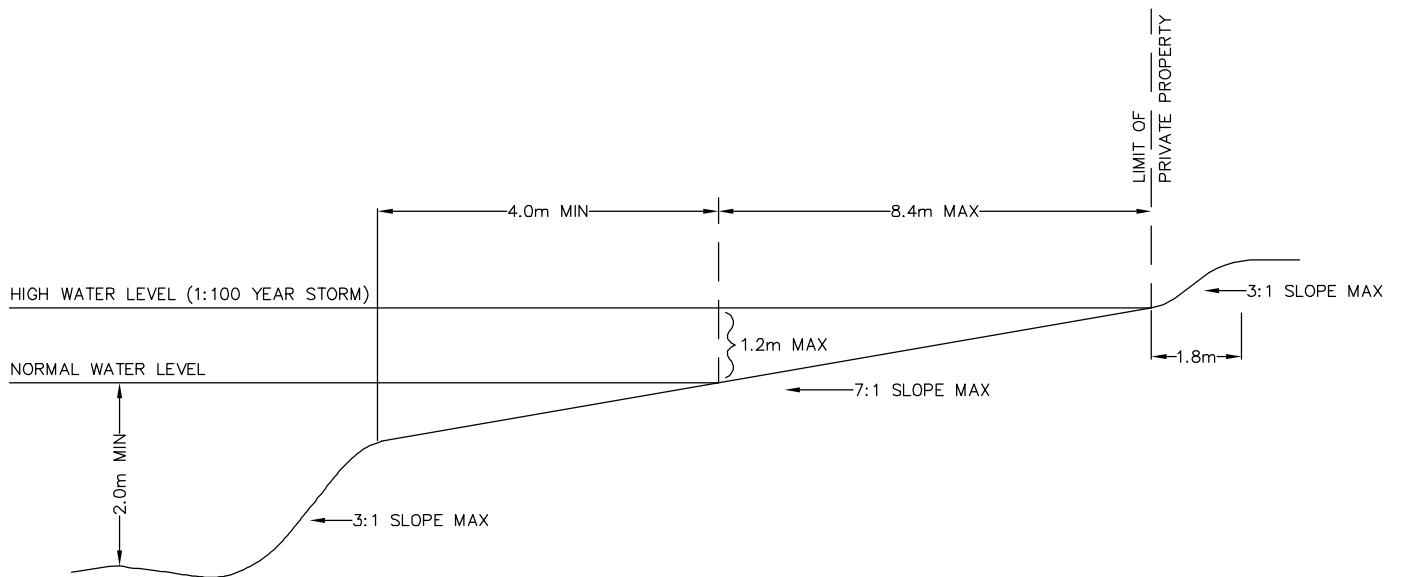


MACKENZIE COUNTY

General Municipal Improvements Standards

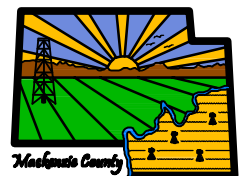


Rev.		<p>TYPICAL DRY POND SECTION</p>		<p>Approved:</p>	<p>Figure F-54</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure F-54	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPICAL WET POND SECTION		Approved: _____ Figure F-55
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved: _____	Figure F-55
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

SECTION G TRANSPORTATION

G.1 INTENT

- G.1.1** This section is intended to provide design and construction information for transportation infrastructure projects proposed as part of an urban or rural subdivision development, or the access road connecting such subdivision to the Municipality's road system, and which will meet the servicing requirements for commercial, industrial and residential subdivision. These 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.1.2** 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 municipal improvements according to accepted engineering practices and standards that address and meet the specific needs and site conditions of the subdivision. Site-specific conditions may warrant more stringent standards are met. The Developer, through their Consultant, is responsible to confirm whether minimum standards are appropriate for the specific proposed subdivision. For issues not referenced herein, the current Transportation Association of Canada (TAC) or Alberta Transportation (AT) standards shall be used.
- G.1.3** Road classification and designation shall be in accordance with the classification system outlined in the Transportation Association of Canada (TAC) manual Geometric Design Standards for Canadian Roads and Streets and the Urban Supplement to the Geometric Design guide for Canadian Roads. Designations of a subdivision as "rural" or "urban" and individual street classification within the subdivision are to be based on functional use established by the Municipality.
- G.1.4** It is the Developer's responsibility, in addition to these Standards, to satisfy all requirements and conditions required by the following acts and regulations:
- ✓ *Public Lands Act*
 - ✓ *Municipal Government Act*
 - ✓ *Water Act*
 - ✓ *Environmental Protection & Enhancement Act*
 - ✓ *Provincial Wetlands Policy*
 - ✓ *Alberta Environment, Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*
 - ✓ *Alberta Highway Geometric Design Guide*
 - ✓ *Transportation Association of Canada (TAC) Geometric Design Guidelines*
 - ✓ *TAC Uniform Traffic Control Devices for Canadian Roads*
 - ✓ *TAC Highway Lighting Design Guide*

- ✓ *Municipality Bylaws*
- ✓ *Fisheries Act*
- ✓ *Species at Risk Act*
- ✓ *Navigable Water Protection Act*

G.2 GENERAL

- G.2.1** For each proposed subdivision, the appropriate roadway classifications and design designation shall be determined during the planning stages in consultation with the Municipality. General guidelines identifying the roadway designations and minimum applicable requirements for each type of Land Use Districts are provided in Section C of these Standards.
- G.2.2** Where conflicts or inconsistencies with these Standards arise due to adoption of other transportation planning documents, the Developer shall be responsible for satisfying the more stringent requirements.
- G.2.3** 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 Municipality for review. The request will be reviewed and a written reply returned with the final decision.
- G.2.4** The Developer shall be responsible for quality control testing related to the roadway construction including but not necessarily limited to sieve analysis, densities, mix designs, 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.3 ROADWAYS LEVEL OF SERVICE

- G.3.1** The Developer's Consulting Engineer shall be responsible for determining an estimated Annual Average Daily Traffic (AADT) generated by the proposed subdivision in order to determine the required cross sectional elements and pavement structure.
- G.3.2** 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 sub-grade to allow for future base paving.

G.4 DESIGN CRITERIA

G.4.1 Traffic Analysis and Traffic Impact Assessments

The Developer is responsible to carry out a traffic impact assessment when required by the Municipality. 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. This traffic assessment shall also include but will not be necessarily limited to the following:

- i. Volume of daily traffic generated by the proposed subdivision at full development. If the planned subdivision is staged, then the assessment will also include daily traffic volumes at the end of each consecutive subdivision stage.
- ii. Layout of the internal road system of the proposed subdivision with the accesses clearly marked.
- iii. Location of the proposed access points.
- iv. Sight distance assessments at the proposed access points.
- v. Full review of the proposed access points using Alberta Transportation Design guidelines, establishing whether or not intersectional improvements are required.
- vi. Traffic signal warrant and pedestrian accommodation at major intersections for urban subdivisions.

G.4.2 All off-site road improvements required as a result of the proposed subdivision 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 ten (10) one-way trips per household. Trip generation rates for other types of subdivision shall be justified by the Developer and approved by the Municipal Engineer.

G.5 DESIGN DESIGNATIONS

G.5.1 The Municipality uses the following two design designations identified as Rural and Urban Roadways. The cross section elements for these design designations are shown in the attached drawings.

G.5.2 For the purpose of these 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 within the Municipality.

- G.5.3** The roadway design shall be prepared considering the future requirements, economic factors, safety considerations, staging, and other roadway users not directly associated with the proposed subdivision.
- G.5.4** The selected design speed shall relate to the expected operating speed on the road after improvement. It shall reflect public expectations and include an allowance for safety. Typically, the design speed shall be 10 km/hr higher than the anticipated posted speed limit.
- G.5.5** Where parking is required, the shoulder width may be included as part of the parking lane. Deletion of parking requirements will be considered where lots do not front on to the roadway (including lots with back lanes) and “No Parking” signs are provided by the Developer. Right-of-way widths shall not be reduced.
- G.5.6** Rear lanes (alleys) shall have a surfaced width of 5.6 m within a 6.0 m right-of-way and a minimum longitudinal grade of 0.6 %. If the rear lane is to have a gravel surface, the lane shall be cross sloped to one side at a minimum grade of 3.0 %. If the rear lane is to be paved, the lane shall have a centre swale and cross slopes of 2.5 %. Where rear lane traffic activity is expected to be high, wider surfaced widths and rights-of-way may be required by the Municipality.
- G.5.7** Urban roads are to be assumed to have curb and gutter. Parking lanes are required. The requirement for sidewalks will be reviewed by the Municipality on a subdivision specific basis.
- G.5.8** Geometric design requirements for rural roadways are shown in the Table 5.8-1:

Table 5.8-1 Geometric Design Requirements for Rural & Urban Roadways

Designation	Surface	AADT ¹	Truck Traffic	Min. ROW ^{**} (m)	Preferred ROW ² (m)	Design Speed (km/h)	Posted Speed (km/h)	SSD ³ (m)	Crest k (m)	Sag k (m)	Min. Horiz. Radius (m)
Access Road 7.0m	Gravel	< 25	Negligent	20	30	40	30	65	7	11	
Rural Road 8.0m	Gravel	< 100	Minimal	20	30	60	50	85	15	20	90
Local Road 8.0m	Gravel	< 200	Minimal	30	30	60	50	85	15	20	90
Collector Road 9.0m	Gravel	> 200	Minimal	30	40	60	50	85	15	20	90
Collector Road 10.0m	Gravel	> 200	Significant	30	40	70	60	140	35	30	190
Paved Local Road 8.0m	ACP	< 200	Significant	30	40	60	50	85	15	20	90
Arterial Road 9.0m	ACP	< 500	Significant	40	40	60	50	85	15	20	90
Arterial Road 10.0m	ACP	< 2000	Significant	40	40	70	60	140	35	30	190
Arterial Road 11.0m	ACP	> 2000	Significant	40	40	70	60	140	35	30	190
Urban Road 9.0m	ACP	< 2000	Significant	20	20	60	50	85	15	20	90
Urban Road 11.5m	ACP	> 2000	Significant	30	30	70	60	140	35	30	190

Note: The recommended design speeds are for internal roadway systems only.

Design characteristics of high speed roadways (with >60 km/h posted speed limit) shall be based on the latest Alberta Transportation standards.

¹ Average Annual Daily Traffic ² Right-of-Way ³ SSD (Stopping Sight Distance)

G.5.9 Geometric design requirements for urban roadways are shown in the Table 5.9-1:

Table 5.9-1 Geometric Design Requirements for Urban Roadways

Street Classification	Operating Speed (km/h)	Right-of-Way Width (m)	Pavement Width (m)
Local Roads:			
Residential:	50	20.0	9.0
Commercial / Industrial:	50	20.0	9.0
Collector Roads:			
Residential:	50	20.0	11.0
Commercial / Industrial:	60	20.0	11.0
Arterial Roads:	50	30.0	13.5

G.5.10 Roadway sub-grade 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. The minimum pavement structure permitted for each roadway designation, both rural and urban, is provided in Table 5.10-1:

Table 5.10-1 Minimum Pavement Design Standards

Roadway Designation	Asphaltic Concrete Pavement Thickness (mm)	Granular Base Thickness (mm)	Granular Sub-Base Thickness (mm)	Total Thickness of the Paving Structure (mm)
Arterial	100	200	350	650
Industrial Collector	100	200	300	600
Residential Collector	75	100	200	375
Industrial Local	100	150	300	550
Residential Local	75	75	200	350

All pavement structures shall meet the following minimum requirements for the California Bearing Ratio (CBR):

- i. Prepared sub-grade in a soaked condition: CBR > 4
- ii. Granular sub-base: CBR > 20
- iii. Granular base: CBR > 80

Where soils of a lower stability are present, an increase in pavement structure shall be required based on engineering calculations.

Any modification to the pavement standards must be substantiated by a geotechnical report and approved by the Municipality. The Developer's Consulting Engineer shall also take into account traffic volumes and axle loading.

G.5.11 Vertical Alignment

- i. The minimum gutter grades shall be 0.4 %, 0.5 % along tangents, 0.6 % around curb returns and 0.8 % on lanes. A maximum gradient of 4 % for a distance of 30 m from the curb return for all roadways connecting to any intersection.
- ii. The maximum longitudinal grade for all roadways shall be 6.0 %. All roadways shall be crowned or have a cross fall as shown in the applicable standard drawing. The standard cross fall grade is 2.5 %.

G.5.12 Vertical Curves

- i. Vertical curves shall be calculated according to TAC design guides using the TAC urban supplement as appropriate.
- ii. The minimum length of a vertical curve shall be 30 m on local roads, and greater than or equal to the design speed in km/h on collector and arterial roads.
- iii. Vertical curves are not required where the algebraic difference of the grades is less than 1.5.

G.5.13 Horizontal Alignment

- i. The minimum degree of curvature of the centerline of the carriage way is dependent on the road classification and its design speed.
- ii. All horizontal curves shall be designed to meet TAC design guides, using the TAC urban supplement as appropriate.
- iii. Minimum edge of pavement radius for residential cul-de-sacs is 11 m. For industrial cul-de-sacs the minimum edge of pavement radius shall be 14 m.

- iv. Curb return radius requirements:
 - a. At residential local road intersections: 7.5 m
 - b. At residential collector road intersections: 12.5 m
 - c. At industrial and commercial road intersections: 15 m
(to accommodate trucks turning)
 - d. For arterial road intersections, curb returns shall be designed to properly accommodate the design vehicle types and expected volumes of traffic.
- v. Paraplegic ramps shall be required at all intersections which have sidewalks.

G.5.14 Gravel Roadway Standard Specifications

Gravel roads shall require the specific approval of the Municipality. Cross-sections and ditch design requirements are the same as for paved roadway standard:

- i. Sub-grade – 1 m of acceptable material (clay or sand as approved by the Geotechnical Engineer) with no organic or any other deleterious materials.
- ii. Crown – 2.5 % to 3.0 %.
- iii. The source of granular material shall be approved by the Municipality. The size and gradation shall conform to the recommended standards outline below:

Sieve Size	Passing, %
20,000	100
10,000	35 - 77
5,000	15 - 55
1,250	0 - 30
80	0 - 12

The granular material shall have a minimum of 40 % two face fracture. Gradation properties of gravel for surfacing shall be specified and reviewed by the Municipal Engineer prior to commencing of work.

- iv. The estimated gravel application rates shall be as shown in the Table 5.14-1:

Table 5.14-1 Gravel Surface Granular Material Application Rates (Estimated)

Roadway Finished Sub-grade Width (m)	Granular Material Application Rate (Estimated) (m³/km)
7.0	300
8.0	350
9.0	400
10.0	450
11.0	500
12.0	550
13.0	600
14.0	650
15.0	700
16.0	750
17.0	800
18.0	850

Conditions of the sub-grade at the time of construction may warrant adjustments to the rates shown in the Table 5.14-1. The actual surface granular material application rate shall be determined by the Geotechnical Engineer on a project specific basis and soil conditions and shall be approved by the Municipality.

The gravel roadway surface will be graveled in two distinctive layers of granular material. Upon the Municipality approval, the Developer shall supply and place the first layer of gravel in accordance with the specified gradation and rate of application. No gravelling shall be permitted until the finished sub-grade has been tested, inspected and accepted by the Municipality.

The application of the second layer shall not be permitted until the first layer is inspected and accepted by the Municipality.

All entrances to lots shall be graveled at a minimum rate of 8 m³ per entrance, as measured from the shoulder of the roadway to the property line.

G.5.15 Intersections and Approaches

- i. Intersections and approaches shall be designed intersecting the roadways at 90 degrees wherever possible. The minimum angle of intersection for two roadways shall be 75 degrees unless otherwise approved by the Municipality. The Developer shall also refer to the applicable Land Use Bylaw for additional standards.
- ii. Intersection design shall incorporate accepted sight distances based on the roadway classification and best engineering practice. Minimum intersection spacing shall be 60 m measured from centreline to centreline.

- iii. Intersectional treatments shall be designed based on estimated 20-year traffic volumes. All necessary widening of existing rights-of-way shall be provided by the Developer.
- iv. Approaches shall be situated such that they do not access directly onto a roadway with an estimated AADT of greater than 4,000. Approaches shall be located and designed to access the parcel's most desirable building location. All approaches shall have the same paving structure as the adjoining roadway and be constructed to the property line or the right-of way boundary.
- v. All rural residential subdivision lots and private properties accessed by local and collector roadways shall require construction of at least one approach to the property from the accessing roadway.
- vi. Residential and industrial approaches shall have 10 m wide finished top or pavement. Residential approaches shall have a width of 6 m at the property line and minimum radii of 5 m. Approaches shall have a minimum lateral clearance of 1.5 m from any surface feature, such as hydrants, power poles, curb cocks, etc. Approaches shall not be situated on a curb return.
- vii. For corner lots, the approaches shall access the roadway with a lesser traffic volume wherever possible. Wherever possible, approaches shall not be located within 100 m of an intersection with the exception of multi-lot subdivisions.
- viii. 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.
- ix. Industrial approaches shall be constructed to the same minimum requirements and specifications as private approaches, with the exception that the width of the approach may be increased to accommodate the type of traffic through the approach. Geometric requirements for the industrial approaches shall be followed as:
 - a. Light industrial approach:
 - Minimum turning radius 12 – 15 m
 - Minimum road surface width 11.5 m
 - b. Heavy industrial approach:
 - Minimum turning radius 15 m
 - Minimum road surface width 15 m

- x. The following minimum culvert diameters shall be used at the intersections and approaches:
 - a. Residential approach 500 mm
 - b. Industrial approach 600 mm
 - c. Roadway centreline 600 mm

Culverts shall be corrugated steel or concrete reinforced Class III. Depth of cover shall meet manufacturer's requirements, with a minimum of 300 mm. The Developer shall also confirm that culvert sizing is consistent with the storm water management plan for the proposed subdivision, increasing the diameter as necessary to meet flow requirements.

G.5.16 Cul-de-sacs

- i. The maximum length for any cul-de-sac without a Public Utility Lot (PUL) shall be 120 m from the centreline of the intersecting street to the start of the bulb. Cul-de-sacs in excess of 120 m shall require a 6 m wide PUL allowing for emergency vehicle access and watermain looping.
- ii. 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.
- iii. Cul-de-sacs shall be graded to drain towards the intersecting street unless a PUL is provided to allow drainage to escape.
- iv. The minimum cul-de-sac bulb radius for residential areas shall be 11 m measured to the face of curb or 18 m measured to the shoulder.

G.5.17 Ditches

- i. Ditches shall be designed to effectively convey site drainage from the area consistent with the approved storm water management plan. General ditch specifications are as follows:
 - a. Roadway ditches 4:1 side slopes, 3:1 back slope.
 - b. Drainage channels 3:1 side and back slopes.
 - c. 1 m wide ditch bottom within subdivisions, 3 m wide ditch bottom for rural sections outside of the proposed subdivision, or collector or arterial roads.
 - d. Maximum gradient 6 %, minimum gradient 0.5 %.
 - e. Ditch depth to be sufficient for drainage and snow storage requirements and to accommodate approach culverts, generally 1.0 m (0.6 m minimum).
- ii. Where roadway and ditch requirements result in a portion of the ditch or ditch back slope extending beyond the road right-of-way, the Developer shall be responsible to secure appropriate drainage easements in the name of the Municipality.

G.5.18 Pavement Structure

- i. Roadways, other than rear lanes (alleys), shall be paved with hot mix asphalt if required by the Municipality. Pavement structure shall be determined by the professional Engineer based on Municipality requirements and a geotechnical investigation conducted by an accredited firm or agency. The results of the geotechnical investigation shall be submitted to the Municipality for review prior to any detailed pavement structure design. Paved roadways shall be designed in accordance with the following minimum design axle loadings:
 - a. Local roads: 8,165 kg (18,000 lb) per axle
 - b. Collector and industrial roads: 10,886 kg (24,000 lb) per axle
- ii. Design parameters shall be submitted to the Municipality review and approval. The Municipality reserves the right to request the Developer to engage a geotechnical engineering agency to carry out CBR tests on the road sub-grade prior to paving to confirm the adequacy of the design. Alternative pavement designs may be approved by the Municipality.
- iii. Gravel surfacing is permitted on rural roads. Road structure designs must be approved by the County Engineer prior to submission of design drawings.

G.6 CONSTRUCTION

G.6.1 Clearing and Grubbing

All clearing and grubbing work shall be done within the limits of rights-of-way, permanent and temporary working easements, and shall include the complete disposal of all buildings and structures, vegetation and other debris. All work shall be performed in accordance with current Federal, Provincial and Municipality fire and public safety regulations, Acts and laws and approved construction drawings and specifications.

G.6.2 Earthwork

- i. Topsoil stripping and stockpiling: topsoil shall be stripped to its full depth on all road rights-of-way and excavation areas, and stockpiled for use in final grading and/or landscaping purposes, as shown on the Contract Drawings and Specifications.
- ii. All excavations shall be done within the limits of the proposed work, to the lines, grades and dimensions as shown on the Contract Drawings, noted in the Contract Documents or specifically approved otherwise. Surplus or unsuitable material shall be disposed of as determined by the Developer's Consulting Engineer and approved by the Municipality. Subsoil stripped shall be stockpiled in a topsoil-free area to prevent potential contamination.

- iii. Where sufficient quantity of suitable fill material is not available from excavation on the site, additional fill may be borrowed from other sources. The Developer shall be responsible for securing borrow sites, and all associated environmental approvals. All borrow sites will be reclaimed to the satisfaction of the Municipality meeting all specifications and regulations.
- iv. During the embankment construction, earth materials shall be placed in successive uniform layers not exceeding 300 mm loose thickness. Each layer shall be compacted to a minimum of 98 % of Standard Proctor Maximum Density, with the earth materials field moisture content being maintained within +/- 2 % of the Optimum Moisture Content, unless stated otherwise. Only native or imported earth material approved by the Municipal Engineer shall be used for embankment construction.
- v. Side slopes and back slopes shall not be steeper than 4:1. Where, in the opinion of the Municipality, such slopes are not sufficient for the native soil condition, the Developer shall provide suitable slopes acceptable to the Municipality.
- vi. All proposed routes for hauling materials and construction equipment shall be approved by the Municipality prior to commencement of the work.
- vii. All work shall be carried out so that excavated areas will drain to catch basins, manholes, or to a natural drainage course during construction. The Developer shall take necessary environmental control measures as specified by the Provincial regulations and Contract Drawings and Specifications.

G.6.3 Sub-grade Preparation

- i. In the areas excavated to the design sub-grade elevations, the top of the sub-grade shall be scarified to a minimum depth of 150 mm below the surface, graded and compacted to a minimum of 100 % of Standard Proctor Maximum Density with the earth materials field moisture content being maintained within +/- 1 % of the Optimum Moisture Content. The finished cut area shall conform to the lines, grades and dimensions as shown on the Contract Drawings.
- ii. In the areas filled to the design sub-grade elevations, any portion of fill more than 300 mm below the top of sub-grade shall be placed in successive uniform layers not exceeding 300 mm loose thickness and compacted to a minimum density of 98 % of Standard Proctor Maximum Density with the earth materials field moisture content being maintained within +/- 3 % of the Optimum Moisture Content. The top 300 mm shall be placed in successive uniform layers not exceeding 150 mm loose thickness and compacted to a minimum density of 100 % of Standard Proctor Maximum Density with the earth materials field moisture content being maintained within + 1 % to - 2 % of the Optimum Moisture Content.

- iii. It is understood that the moisture content requirements will also depend on actual site conditions during construction and the soil types. It is the Developer’s responsibility to exercise best engineering practices to achieve the requirements specified by the Municipality.
- iv. During placement and compaction of the earth materials, measures shall be taken by the Developer as to maintain the moisture content of the materials as specified. When a deficiency in moisture content exists, the soils shall be watered and thoroughly mixed prior to compaction until the specified moisture content is uniformly attained. When there is an excess of moisture, the soils shall be worked and aerated prior to compaction until the specified 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 Consulting Engineer shall be required to determine appropriate measures in order to meet the required moisture contents and densities.
- v. 80 mm granular sub-base material (as defined in Section G.6.4) shall be used to stabilize the sub-grade in areas where silty in-situ soil materials exist. The minimum structural requirements shall be shown on the detailed cross section drawings. After removal of unsuitable sub-grade soils, pit run materials shall be placed in the excavation in consecutive layers not exceeding 150 mm and compacted to 100 % of Standard Proctor Maximum Density. Water shall be applied and mixed uniformly with the pit run materials prior to compaction until the moisture content is from 1 % to 2 % above the Optimum Moisture.

G.6.4 Base Course

- i. The sub-grade shall be finished to conform to the required section, grade and density prior to placement of base course material.
- ii. Granular materials shall consist of crushed gravel free from vegetation, clay or other extraneous materials and meet the following specifications:
 - a. Granular sub-base - 80 mm (3") crushed gravel. The gravel shall be crushed and meet the following grading requirements:

Sieve Size Passing	Cumulative % by Weight
80,000	100
50,000	80 - 100
25,000	50 - 75
5,000	25 - 55
80	2 - 10

At least 20 % by weight of material retained on the 5,000 sieve shall have at least one fractured face. Plasticity index shall not exceed 8.

- b. Granular base - 20 mm (3/4") crushed gravel. The gravel shall meet the following grading requirements:

Sieve Size Passing	Cumulative % by Weight
20,000	100
16,000	84 - 94
10,000	63 - 86
5,000	40 - 67
1,250	20 - 43
630	14 - 34
315	9 - 26
160	5 - 18
80	2 - 10

The liquid limit shall not exceed 25 and the Plasticity Index shall not exceed 6. A minimum of 60 % by weight of material retained on the 5,000 sieve shall have at least two crushed faces. A tolerance of 3 % in the amount passing the 20,000 sieve will be permitted provided all oversize material passes the 25,000 sieve.

Base course granular material shall be placed, graded and compacted in a single layer when the compacted design thickness does not exceed 150 mm. When the design thickness exceeds 150 mm the base course granular material shall be placed, graded and compacted in successive layers each not exceeding 150 mm thick.

- iii. 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 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. If necessary, and as advised by the Municipal Engineer, water shall be applied to the granular material during compaction to maintain the required uniform moisture content.
- iv. Compaction shall be reached by the use of pneumatic tire rollers, vibrating drum compactors or other approved types of compaction equipment. The Developer shall be responsible for supplying sufficient equipment as per current best construction practices and specifications in order to efficiently achieve the specified densities.
- v. Testing and inspection:
- Field density tests shall be carried out for each 2,000 m² per each layer of granular base course with a minimum of one (1) test per day of placing operations.
 - The surface shall be such that when tested with a straight edge, the maximum deviation of the surface from the straight edge shall nowhere exceed 13 mm.

- c. No segregation of rock or fine material shall exist in the completed base.
- d. Areas suspected of being deficient or excessive in thickness shall be cored at the rate of three (3) cores per 1,000 m². Base course thickness deficient by less than 6 mm will not be penalized. Areas deficient by more than 6 mm but less than 20 mm shall be paid for at an adjusted rate: the ratio of the square of the average thickness divided by the square of the design thickness. Areas deficient by more than 20 mm shall be rejected and the Developer shall reconstruct the deficient areas at his own expense as directed by the Municipal Engineer.

G.6.5 Prime Coat and Tack Coat

i. Definitions:

- a. Prime coat shall be the application of bituminous material to sub-grade or previously prepared gravel base course prior to placing bituminous surfacing material.
- b. Tack coat shall be the application of bituminous material to a previously constructed paving surface, of any type, in preparation for placing bituminous surfacing materials, and against curb gutter faces, manholes, valves and other appurtenances in the areas to be paved.

ii. Prime coat:

The asphalt types may vary from MC 30 (medium curing asphalt), from SS-1 to SS-2 or SEP 1 emulsified asphalt primer, to suit the conditions of the base. The rate of application may vary from 0.5 - 1.5 litres/m² based on conditions of the base course, or as specified by the Municipality. The application rate shall permit good prime coat penetration into the base course without causing ponding of the prime coat on the surface.

The material temperature at the time of application shall fall within the following limits:

- | | |
|-----------|-----------|
| a. MC 30: | 50 - 70°C |
| b. SS 1: | 24 - 54°C |
| c. SS 2: | 24 - 54°C |
| d. SEP 1: | 15 - 50°C |

The Contractor shall choose, in consultation with Municipal Engineer, between SEP.1, SEP.2, or SS1 for applications through August 31 and between MC-30, SEP-1, SEP-2 or SS1 after August 31.

iii. Tack coat:

The asphalt for the tack coat may vary from SS-1 (emulsified asphalt), from RC 30 to RC 70 or RC 250 (rapid curing asphalts), depending on pavement conditions at the time of application. The rate of application may vary from 0.25 to 0.90 litres/m², or as specified by the Municipality. The application rate shall ensure that uniform coverage is achieved and that the tack coat provides a good bond after curing.

The material temperature at the time of application shall fall within the following limits:

- | | |
|------------|-----------------------------|
| a. SS 1: | 24 - 54°C |
| b. RC 30: | 50 - 70°C (after August 31) |
| c. RC 70: | 75 - 98°C (after August 31) |
| d. RC 250: | 100 - 110°C |

G.6.6 Seal Coat and Fog Coat

i. Definitions:

- a. Seal coat shall consist of a surface treatment composed of a single application of bituminous material on an existing bituminous surface immediately followed by covering with aggregate.
- b. When a seal coat is applied without cover then it shall be referred to as a fog coat, a light application of slow-setting asphalt emulsion diluted with water. The emulsion shall be diluted with an equal amount of water and sprayed at the rate of 0.45 - 0.70 litres/m² or as specified by the Municipality, in order to renew old asphalt surfaces.

ii. Bituminous material:

The liquid asphalt used for seal coating shall be rapid curing or emulsified asphalt. The actual grade and type of the material shall be determined to suit the surface conditions and shall be approved by the Municipality.

Temperatures of applications for rapid curing asphalts shall fall within the following ranges:

- | | |
|------------|-------------|
| a. RC 30: | 50 - 70°C |
| b. RC 70: | 75 - 90°C |
| c. RC 250: | 100 - 110°C |

Temperatures of applications for emulsified asphalts shall fall within the following ranges:

- a. RS 1k: 15 - 50°C
- b. RS 2k: 15 - 50°C

iii. Mineral aggregate:

a. Chip seal aggregate shall be free from soft shale, organic or other deleterious matter and shall have at least one crushed face. The maximum moisture content in the chips shall be 1 % for RC asphalts applications and 3 % for RS asphalts applications.

b. Sand seal shall meet the following gradation specifications:

Sieve Size Passing	Cumulative % by Weight
5,000	100
315	0-15
80	Less than 2

The maximum moisture content in the sand shall be 2 % for RC asphalts applications and 5 % for RS asphalts applications.

c. Graded aggregate seal coat shall meet the following gradation specifications:

Sieve Size Passing	Cumulative % by Weight
12,500	100
10,000	70 - 93
5,000	30 - 60
1,250	9 - 28
315	0 - 15
160	0 - 11
80	0 - 8

and a minimum of 60 % fraction on two sides for material passing the 5,000 sieve.

iv. Application of bituminous material:

a. Seal coats shall be applied during daylight hours when the shade temperature is 10°C or higher. No bituminous material shall be applied when the roadway surface is damp or wet, or when weather conditions are such that the bitumen will become chilled before the cover aggregate can be spread and rolled. Work shall not be started without consent of the Municipality and shall be promptly terminated in the event of unfavorable surface or weather conditions. Prior to the application of the binder all dust, dirt and foreign matter will be swept from the surface for the full width of the area intended for seal coat.

- b. The approved bituminous material shall be uniformly applied on the properly prepared surfaces at a rate specified by the Municipality and within the following ranges:
- Fog coat: 0.23 - 0.7 litres/m²
(with a distributor having special fog nozzles for the purpose of applying a light spray)
 - Sand seal: 0.5 - 1.4 litres/m²
 - Chip seal: 0.9 - 1.8 litres/m²
 - Graded aggregate seal: 1.2 - 2.5 kg/m²
- c. The application of bituminous material shall not proceed until a supply of aggregate is immediately available to allow covering of the entire bitumen treated area in less than 5 minutes. The bitumen treated area shall be promptly covered with approved mineral aggregate at a rate of 5.5 - 11.0 kg/m² for sand, of 8.0 - 16.0 kg/m² for chips, and of 20 - 30 kg/m² for graded aggregate.
- v. Application of mineral aggregate material:
- a. Special care shall be taken when spreading mineral aggregates in order to maintain uniform and secured cover. If, in the opinion of the Municipal Engineer, uniform distribution of the aggregate is not being achieved, the cover aggregate shall be alternately drag-broomed and rolled until it is uniformly bonded over the full width of the area of application.
 - b. Longitudinal laps may be from 150 to 250 mm in width, but there shall be no overlap at the end junction of the applications. In order to prevent lapping at transverse junctions, building paper or metal sheets shall be put over the treated surface, with sufficient offset back from the joint and onto the cover aggregate, so that sprayers operate at normal capacity until reaching the boundary to which the application is to be made. The bitumen application shall cease on building paper or metal sheets. Any paper used for covering joints shall be removed and disposed of.
 - c. Immediately after the mineral aggregate has been applied, the road surface shall be rolled sufficiently so that the maximum amount of cover aggregate will be "keyed". Rollers of a weight that crushes the mineral aggregate shall not be allowed. The Developer may use steel wheel, pneumatic tire or vibratory rollers. The minimum number of five (5) complete coverings by the rollers shall be carried out within 30 minutes of the application of the bituminous material. The speed of the rollers shall be such that the suction of the tire shall not lift the aggregate from the sealed surface, or 8 km/hour, whichever is less.

- d. No traffic shall be permitted on the sealed roadway until after the rolling has been completed and the bituminous material has set to a degree satisfactory to the Municipality. No traffic shall be permitted on the sealed roadway until at least 24 hours after the application of the bituminous material.

G.6.7 Asphaltic Concrete Pavement

- i. Pavement design:
 - a. Asphaltic concrete pavement shall consist of mineral aggregate, filler and asphaltic binder. Pavement shall be placed and compacted to the specified thickness and shall conform to the lines, grades and cross sections as shown on the Contract Drawings.
 - b. All design parameters, including, but not limited to, traffic count, percentage of types of vehicles, California Bearing Ratio (CBR) shall be determined by the Developer's Consulting Engineer and shall be submitted to the Municipality.
 - c. The pavement structure shall be designed to carry the anticipated loadings and traffic capacity for a 20 year life. All roadways shall be paved with full depth asphalt or a structure with an equivalent strength.
 - d. Asphaltic concrete mix designs shall be Marshall Mix Designs and prepared by a recognized material testing laboratory. Mix designs shall be forwarded to the Municipality for review and approval.
 - e. No paving operations shall be allowed until the sub-grade has been tested, inspected and approved by the Municipality.
 - f. Asphalt materials, mixing, spreading and rolling shall conform to current specifications and good construction practices.
 - g. Staged construction for asphalt work may be required by the Municipality, with the final lift of asphalt placed during the construction season prior to issuance of the Final Acceptance Certificate. The Developer must make such minor temporary alterations as may be required to prevent drainage issues during the interim stage.
 - h. Type I Surface Course shall be used for all overlays, bottom and top lifts, for local, collector and arterial roadways. Type II Base Course may be used for bottom lifts for local, collector and arterial roadways. Type III Base Course may be used for bottom lifts of arterial roadways.

- ii. Mix design:

Mix designs shall be based on the Marshall Method and shall conform to the following requirements:

- a. Compaction blows on each face: 75
- b. Min. Marshall stability at 60°C: 6,700 N

- c. Flow: 1.5 to 3 mm
- d. Air voids (total mix): 3.5 - 4.5 %
- e. Min. voids in mineral aggregates: 15 %
- f. Asphalt content (total mix): 5 – 8 %
- g. Min. retained stability: 75 %

The mix design shall be carried out by an accredited testing agency and shall be submitted to the Municipality for approval at least four (4) weeks prior to commencement of work.

iii. Materials:

- a. Asphaltic concrete pavements, both surface and base courses, shall consist of mineral aggregate, filler and asphaltic binder and shall be placed to the specified thickness and compacted to the specified density, conforming to the lines, grades and cross-sections shown on the Contract Drawings.
- b. Mineral Aggregates - when tested by means of laboratory sieve, the combined aggregates in the mix shall meet the following gradation:

Sieve Size Passing	Cumulative % by Weight		
	Type I	Type II	Type III
	Surface Course	Base Course	Base Course
20,000	-	-	100
16,000	-	100	90 - 100
12,500	100	80 - 92	-
10,000	83 - 92	70 - 84	56 - 84
5,000	55 - 70	50 - 65	35 - 64
2,500	38 - 55	37 - 52	21 - 49
1,250	26 - 45	26 - 45	11 - 34
630	18 - 38	18 - 38	8 - 30
315	12 - 30	12 - 30	5 - 21
160	8 - 20	8 - 20	3 - 15
80	4 - 10	4 - 10	2 - 8

- c. A minimum of 70 % of the surface course and 60 % of the base course material on the 5,000 sieve shall have at least 2 crushed faces.
- d. Asphalt mix shall be uniform in character, shall not foam when heated to 177°C and shall meet the following requirements:

ASTM Designation		AC-150/200(A)	AC-200/300(A)
D2170	Penetration at 24 ^o C, 100 gm, 5 sec.	150.0	200.0
D5	Ductility at 24 ^o C (cm)	100.0	-
D113	Min. solubility in carbon tetrachloride (%)	99.5	99.5
D2042	Flash Point, Cleveland Open Cup	205.0	175
D2171	Thin Film Oven Test Penetration after test at 24 ^o C, 100 gm, 5 sec., (% of original)	4.0	4.0
	Ductility at 15.6 ^o C, cm. min		100.0

- e. Should the grading of the mineral aggregates supplied to the asphalt plant not meet the specified gradation, mineral filler shall be added in such quantities as will be required to meet the Specifications. Mineral filler shall consist of Portland cement, Pozzolan, commercially ground stone dust or other mineral dust approved by the Municipality. Mineral filler shall have a "Zero" Plasticity Index and shall conform to the following gradation requirements:

Sieve Size Passing	Cumulative % by Weight
400	100
160	90
63	70
45	62

- f. Asphaltic mix design shall be based on the Marshall Method and shall conform to the following criteria, depending on traffic loading and mix type:

	<u>Type I</u>	<u>Type II</u>	<u>Type III</u>
Marshall Stability (min)	8,500	8,500	6,700
Flow Value	2 – 3.5	2 – 3.5	2 – 3.5
% Air Voids	3 – 5	3 – 5	3 – 5
% Voids in the Mineral aggregate	14	14	14
Asphalt Cement Grade	150/200A	150/200A	150/200A
Voids Filled with asphalt (%)	65 – 75	65 – 75	65 – 75
Retained Stability % (min)	70	70	70
Theoretical Film thickness (min)	8 – 8.5	8 – 8.5	7 - 8

The mix design shall be performed by an accredited testing agency and shall be submitted to the Municipality for review and approval at least two (2) weeks prior to the commencement of paving operations. A separate and complete mix design shall be required for any change in the nature of the source of the material.

iv. Tolerances:

- a. The amount of bituminous material designated for the job shall be within 0.3 percentage points.
- b. The temperature of asphaltic mixtures shall not vary from those specified by more than 9°C.
- c. Hot plant-mixed materials shall be placed with sufficient time remaining to allow for compaction be completed during daylight hours, when the air temperature is above 2°C and rising, and the roadway surface is dry.
- d. A minimum compacted thickness of hot mix asphaltic concrete on all roadways shall be 50 mm, unless specified otherwise. Asphalt pavement with excess thickness may be accepted if surface, grade tolerances and textures are met, and no additional payment will be made to the Developer. In areas where the specified asphalt pavement thickness is in question, three (3) cores shall be taken from each 1,000 m² of applicable mat and the average thickness of the three cores shall be considered as reference thickness for that area. If the average core thickness is deficient from the specified thickness, that area shall be assessed a payment reduction factor according to the Table 6.7-1:

Table 6.7-1 Asphaltic Concrete Pavement Unit Price Reduction for Pavement Thickness

Thickness Deficiency (mm)	Payment Reduction Factor (%)
0 - 5	0
6 - 9	10
10 - 12	25
13 - 15	50
> 15	Reject

- e. Each mat of hot-mix placed shall be compacted to a minimum of 97 % of Marshall Density regardless of pavement type. The complete pavement shall have a tightly knit structure and be free from segregation and surface cracking. If the average core density is below the specified density, the represented area of mat may be accepted subject to the following payment reduction factors being applied to the unit price of the mix as shown in the Table 6.7-2 (based on the Alberta Transportation's Standard Specification 3.50 "Asphalt Concrete Pavement – End Product Specification"):

Table 6.7-2 A Unit Price Adjustment for Density Unit Price Adjustment

Lot Mean Density (% of Marshall Density)	Payment Reduction Factor (%)
97.0 - 98.0	No reduction
96.9	0.05
96.8	0.20
96.7	0.45
96.6	0.80
96.5	1.20
96.4	1.75
96.3	2.40
96.2	3.10
96.1	4.00
96.0	4.90
95.9	5.90
95.8	7.05
95.7	8.25
95.6	9.55
95.5	11.00
95.4	12.50
95.3	14.10
95.2	15.80
95.1	17.60
95.0	19.50
94.9	21.50
94.8	23.60
94.7	25.80
94.6	28.10
94.5	30.50
94.4 or lower	Reject (Remove & Replace)

- f. No adjustments to the Contract price shall be made for asphaltic concrete pavements found to have excess densities beyond the values stipulated in the Contract Documents.
- g. Monetary compensations for deficient asphaltic concrete pavements assessed to the Developer do not relieve the Developer of the maintenance requirements stipulated in the Contract Documents.

- v. Construction:
- a. Asphaltic concrete mix shall not be placed:
 - During periods of rain or when there is imminent danger of rain.
 - During excessive winds.
 - When air temperature is 2°C or cooler, except in specific situations where, in the opinion of the Municipality, conditions warrant the risk involved.
 - b. The prepared base shall be dry and clean of all loose or foreign materials. Where tack coat or asphalt sealer is applied, it shall be thoroughly cured prior to placing the asphaltic concrete mix. Where existing pavements are to be overlaid, a leveling course of hot asphaltic concrete mix may be required prior to placing the surface course, as specified by the Municipality. The leveling course shall be placed with a paving spreader and shall meet all of the requirements stated in this Section, unless otherwise approved by the Municipality.
 - c. The asphaltic concrete mix shall be transported in vehicles equipped with protective covers and clean, tight, smooth-sided boxes. The inside surface of the box shall be lubricated with a light coating of soap or detergent solution; petroleum derivatives shall not be permitted. Any accumulation of dirt or asphaltic material in the box shall be thoroughly removed and cleaned before loading with hot asphaltic concrete mix. Trucks shall have an easily accessible 12 mm diameter hole in the side panel of the box located at a distance of 300 mm from the bottom for the purpose of checking temperatures of the asphaltic concrete mix.
 - d. The delivered asphaltic concrete mix shall be spread at temperatures that, when measured in the hopper of the spreader, are not lower than 125°C or higher than 150°C. Unless otherwise permitted by the Municipality, the mix shall be spread by a mechanical self-powered paver equipped with an automatic leveling device, and capable of spreading the mix without segregation or tearing in thicknesses varying from 12 mm to 100 mm and widths from 2.5 m to 4.2 m, and to true line, grade and cross-section as shown on the Contract Drawings.

- e. Prior to roller compaction, the surface of the mat shall be checked and inequalities adjusted. Areas found to have fat spots, sandy accumulations or other irregularities shall be removed and replaced with fresh hot mix. Irregularities in alignment and grade shall be corrected by the addition or removal of the mix before rolling compaction. Prior to addition of the material, the surface shall be loosened up to ensure proper bonding. Edges against which additional pavement is to be placed shall be straight and as close to vertical as practical. The mat shall be worked on to achieve a true line and vertical face.
- f. In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished manually, if so directed by the Municipality. Placing manually shall be performed carefully and the mix shall be distributed uniformly to avoid segregation of aggregates. Broadcasting of material shall not be permitted. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed. Lumps shall be removed from the area. Following placing and before compaction, the surface shall be inspected and all irregularities shall be corrected prior to compaction.
- g. The Contractor shall provide heating equipment for keeping hand tools free from asphalt build up. Caution shall be exercised to prevent high heating temperatures which may burn the material. The temperature of the tools, when used, shall not be greater than the temperature of the mix being placed.
- h. When constructing longitudinal joints between mats, a narrow strip along the edge of the mat that will be joined with another mat shall be left without rolling until the adjoining mat has been placed against it. The joint that is formed shall be compacted immediately after the adjacent mat has been placed and while the mix is still sufficiently warm to ensure proper bond between the mats.
- i. When constructing transverse joints between mats, those shall be carefully formed, leveled and thoroughly compacted to provide a smooth surface with no bumps or dips. Joints shall be straight-edged or string-lined to assure smoothness and true alignment, and shall have a minimum of 1 m horizontal longitudinal offset from joints of nearest mats.
- j. In order to ensure that the surface of the previously placed mat does not cool prior to placing of the adjacent mat, the paver shall not advance from the beginning of the adjacent mat beyond the limits shown in the table below:

Air Temperature, °C	Maximum Length of Advancement, (m)
27	250
15 - 27	190
7 - 15	125
7	90

When the surface course is being laid and the air temperature is below 7°C, an infrared heat generator shall be used in front of the spreader in order to heat the abutting joint. The heat generator shall be attached to the side of the asphalt paver and located so as to heat a minimum of 100 mm wide of the previously placed mat and a minimum of 100 mm wide of the adjoining mat. The heat generator shall provide a minimum of 120,000 KJ/hour of flameless heat energy flow and a minimum of 850°C unit face temperature in 1 m of exposed joint. Oxidized or carbonized bituminous materials forming as a result of infra-red heating shall not be accepted. Transverse joints shall be similarly heated using a portable infra-red heat generator with a minimum output of 60,000 KJ/hour with a minimum 850°C unit face temperature in 500 mm of exposed joint.

- k. Where directed by the Municipal Engineer, the top surface of the joints shall be coated with the approved bituminous material or sealant. Where previously placed mats are to be abutted, it shall be cut back to a point where the height of the vertical cut face equals the depth of the previously placed mat. The exposed edge of the existing pavement shall be coated with an approved bituminous material or sealant and fresh hot mix shall be placed against it, leveled and thoroughly compacted.
- vi. Testing and inspection:
- The following standard tests shall be carried out for each 1,000 tonnes of asphalt placed pavement, to a minimum of two (2) sets of tests during each placing shift:
- a. Marshall Stability, as per ASTM D1559.
 - b. Sieve Analysis, as per ASTM C136 & C117.
 - c. Bulk Specific Gravity, as per ASTM D2726.
 - d. Bitumen Content, as per ASTM D2172.
 - e. % Voids in the Mineral Aggregate (VMA), as per ASTM D2726.
 - f. Air Voids, as per ASTM D3203.
 - g. Core Densities (one (1) core per each 1,000 m² of constructed pavement).

G.7 RE-CYCLED ASPHALT

G.7.1 General

- i. Asphaltic concrete pavement surface re-cycling is a rehabilitation process in which the surface of the existing pavement is heated in place, scarified, re-mixed, re-placed and compacted.
- ii. Asphalts, recycling agents, freshly produced asphalt mix, aggregates, or a combination of these may be employed to obtain the desirable pavement characteristics. Emulsified asphalt or recycling agent can be applied to the surface prior to the placement of a new wearing course.
- iii. The surface recycling shall not be done during periods of rain, during excessive winds or when the ambient temperature is 2^oC or cooler.

G.7.2 Cold Mix Re-cycling

- i. Cold mix re-cycling is a process in which reclaimed asphaltic concrete pavement materials and/or reclaimed aggregate materials are combined with freshly produced asphalt and/or recycling agents to produce a cold base mix.
- ii. Cold mix re-cycling shall involve ripping, scarifying, pulverizing or crushing of the existing asphaltic concrete pavement, which is then either hauled to a central site for processing and upgraded with asphalt cement or emulsified, or it is treated in place. Prior to construction, representative samples of all materials shall be provided by the Contractor, and the asphalt content, asphalt consistency and aggregate gradation shall be determined through laboratory testing by the accredited agent. The materials shall then be blended and a minimum mix design requirements shall be developed. Construction of an asphalt surface course over the cold mix pavement is optional and shall be as per Contract Drawings and Specifications.

G.7.3 Hot Mix Re-cycling

- i. Hot mix re-cycling is a process in which reclaimed asphaltic concrete pavement materials and/or aggregate materials are combined with freshly produced asphalt and/or recycling agents, and/or new aggregate as necessary, to produce a hot mix which conforms to the asphaltic concrete pavement standards.
- ii. The existing asphaltic concrete pavement shall be scarified by mechanical means and the material removed to a crushing plant where it is sized, or the material may be sized in place with rotating drum milling equipment or hammer mills, and then hauled to a central site for processing. This material contains both asphalt and aggregate. The gradation of the aggregate and the consistency of the extracted asphalt shall be determined through laboratory testing by the accredited agent. If determined necessary, soft asphalt or recycling agent shall be used to enhance the properties of weathered asphalt in the reclaimed asphalt pavement.

G.7.4 Asphaltic Dust Abatement

i. General:

Asphaltic dust abatement consists of mixture of crushed aggregate and crude oil that is road mixed-in-place, spread, placed and graded upon the previously prepared roadway surface, compacted and finished as shown on the Contract Drawings and Specifications.

ii. Materials:

- a. The Developer shall submit the information about the source of aggregates and a representative sieve analysis test results for each type of aggregate to the Municipality for approval. The crushed aggregate, whether produced or processed, shall be tested by the accredited testing firm or agent in accordance with the current standard testing methods. The crushed aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock, and shall be free from elongated particles, injurious quantities of flaky particles, soft shale, organic matter, clay lumps and other deleterious foreign matter. The aggregate shall meet the following specified gradation requirements:

Sieve Size,	Passing, %
16,000	100
12,500	89 - 100
10,000	78 - 94
5,000	55 - 70
1,250	26 - 45
630	18 - 38
315	12 - 30
160	8 - 20
80	4 - 10

A maximum tolerance of 3 % in the amount passing the maximum size sieve shall be permitted, providing that 100 % of all oversized aggregate passes the sieve having openings no greater than 5 mm larger than the specified maximum size of the aggregate, and shall have a minimum two face fracture of 60 % for the size of aggregate greater than 5,000 µm.

- b. Crude oil shall be of pipeline quality and meet the following specifications:

Property	Unit	Specification
Absolute Density	@ 15°C	940 - 960
A.P.I. Gravity	@ 15°C	16 - 18.5
Pour Point	ASTM	24°C to -28°C
Water and sediment	% by volume	Max. 0.5 %

Total Sulphur	% by mass	Max. 4 %
Kinematic Viscosity:		
at 20°C	MM ² /sec	1,010
at 40°C	MM ² /sec-	241
at 60°C	MM ² /sec	84
H ₂ S	PPM	Max. 10
Spray Temperature	°C	Max. 25
Carbon Residue	Mass Fraction	0.128

G.8 CONCRETE

G.8.1 Intent

This standard covers the manufacture and placing of concrete, reinforced concrete and related work for the construction of curbs, gutters, sidewalks, catch basins, duct lines, sewers and other ancillary structures associated with roadway construction but not including bridges.

G.8.2 Materials

i. Portland cement:

Portland cement shall conform to the Standard Specifications for Portland cement (ASTM Designation C150), and shall be of the following types:

- | | |
|------------------------|---------|
| a. Normal | Type 10 |
| b. High early strength | Type 30 |
| c. Sulfate resistant | Type 50 |

ii. Concrete aggregates.

Concrete aggregates shall conform to the Standard Specifications for Concrete Aggregates (ASTM Designation C33).

iii. Air entraining agent.

Air entraining agents shall conform to ASTM Standard Specification C260.

iv. Calcium chloride.

Normally, the use of calcium chloride admixtures shall not be permitted. During cold weather conditions, should the use be approved by the Municipality, calcium chloride shall conform to ASTM Standard Specification D098. The maximum calcium chloride admixture content shall be 2 % by weight of cement in Type 10 concrete only.

v. Water.

Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials or other deleterious substances.

vi. Metal reinforcement.

Reinforcing bars shall be deformed bars in accordance with ASTM Standard Specification A615.

vii. Cold drawn wire.

Cold drawn wire or welded wire fabric for concrete reinforcement shall conform to the requirements ASTM Standard Specification A82.

viii. Curing compound.

Curing compound shall be resin based impervious and shall conform to ASTM Standard Specification C309 Type ID - Type B. The curing compound shall contain white fugitive dye. The use of curing compounds shall not profoundly change the colour of the concrete. The curing compound shall produce a film on the concrete surface that is distinctly visible for a period of at least four (4) hours after application.

ix. Sealing solution.

Sealing compound shall be mixture of 50 % Kerosene or Varsol and 50 % boiled Linseed Oil or approved alternate.

x. Retarding admixtures.

Retarding admixtures shall conform to ASTM Standard Specification C494.

xi. Fly ash.

Maximum fly ash content shall be 10 % by mass of cement. The use of fly ash in concrete shall not be permitted after September 1st.

G.8.3 Concrete mix design

i. Concrete used for curbs, gutters, and sidewalks shall meet the following requirements:

- | | |
|--|------------|
| a. Min. compressive strength at 28 days: | 30 MPa |
| b. Max. size of coarse aggregate: | 20 mm |
| c. Slump: | 25 - 75 mm |
| d. Entrained air content: | 5 - 8 % |

ii. All concrete shall achieve a compressive strength of 30 MPa in 7 days when placed after September 30th.

G.8.4 Composition and Proportioning

- i. The design of the concrete structure is based upon the assumption that concrete shall develop the specified compressive or flexural strength at 28 days and a 7 day test resulting in approximately 70 % of the 28-day strength.
- ii. Cement and aggregate shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter; any material that has deteriorated or that has been damaged shall not be used for concrete.
- iii. Batching materials:
 - a. Cement shall be measured by weight and shall be weighed on a scale separate from those used for other materials.
 - b. Aggregate shall be measured by weight. Batch weights shall be based upon dry materials and shall be required weights of dry material plus the total weight of moisture (both absorbed and surface) contained in the aggregate.
 - c. Water shall be measured by volume or by weight. The device for the measurement of the quantity of water shall be readily adjustable and, under all operation conditions, shall have accuracy within 1 % of the quantity of water required for the batch. The device shall be so arranged that the measurement shall not be affected by variable pressures in the water supply line. Measuring tanks shall be equipped with outside taps and valves to provide for checking their calibration, unless other means are provided for readily determining the amount of water in the tank.
 - d. Powdered admixtures shall be measured by weight and paste, or liquid admixtures by weight or volume, within a limit of accuracy of 3 % of the required weight. All air entraining agents, or other admixtures, shall be introduced to the mix at the batching plant during the initial batching cycle. No admixtures shall be added at the job site.

G.8.5 Concrete Classes

Unless otherwise specified, all concrete used in roadway construction shall be one of the following classes as shown in Table 8.5-1:

Table 8.5-1 Classes of Concrete

Class	Minimum 28 Day Compressive Strength (MPa)	Slump (mm)	Entrained Air Limits (%)	Max. Aggregate Size (mm)
Class A: Exposed pavement	30	60 +/-10	5.5 - 8	28
Class B: Pavement base or unexposed use	30	60 +/-20	5.5 - 8	28
Class C: Exposed road associated works	30	60 +/-20	5.5 Up	28
Class D: General unexposed use	30	60 +/-20	5.5 - 8	28
Class E: Filler	10	80 +/-20	5.5 - 7	28

No subscript shall be used when Normal Portland Cement is required. A subscript “30” attached to any of the above classes shall indicate that High Early Cement is specified. A subscript “50” attached to any of the above classes shall indicate that Sulphate Resistant cement is specified.

Any concrete placed after September 30 will not be accepted unless the specified 28-day minimum compressive strength is attained in seven (7) days after placing and sampling.

G.8.6 Equipment

- i. All equipment used for batching, mixing and hauling concrete shall conform to ASTM Standard Specification C 94.
- ii. Hauling:
 - a. When hauling equipment is used, concrete shall be delivered to the site and discharged into the work within 1.5 hours after introduction of the mixing water to the cement and aggregate mix.
 - b. All concrete shall be hauled using drum-type haulers capable of agitating or mixing the concrete within speed tolerances as specified by the equipment manufacturer.

G.8.7 Forms

- i. Forms, either of steel or wood, shall conform to the shape, lines and dimensions of the concrete as shown on the Contract plans. Lumber used to form future exposed concrete surfaces shall be dressed to a uniform thickness and shall be free from loose knots or other defects. Joints in forms shall be either horizontal or vertical. For unexposed surfaces and rough work, undressed lumber shall be used. Lumber once used in forms shall have nails withdrawn and surfaces in contact with the concrete are to be thoroughly cleaned before being used again for forming for another concrete structure.
- ii. Forms shall be substantial and sufficiently tight to prevent leakage. They shall be properly braced or tied together so as to maintain position and shape. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- iii. Bolts and rods shall be used for internal ties. They shall be so arranged that when the forms are removed, no metal shall be within 25 mm of any surface. Wire ties shall be permitted only on light work. They shall not be used through surfaces where discoloration would be objectionable. Forms shall be set to line and grade, and so constructed and fastened as to produce true lines. Special care shall be used to prevent bulging of the form when placing concrete.
- iv. The inside of forms shall be coated with non-sustaining mineral oil or other approved material, or thoroughly wetted (except in freezing weather). Where oil is used, it shall be applied before the reinforcement is placed.
- v. Forms shall not be disturbed until the concrete has adequately hardened. Shoring shall not be removed until the concrete member has acquired sufficient strength to safely support its own weight and the load upon it.
- vi. In the case of sidewalks, monolithic curbs, gutters and walks, the Contractor shall backfill with 15 MPa concrete between pavement and walk edges as soon as possible after the removal of forms. The backfill shall be left 60 mm low to allow for bituminous asphaltic infill, as approved by the Municipality.

G.8.8 Placing of Concrete

- i. The prepared sub-grade elevation shall be the design elevation of the bottom of the concrete structure. The sub-grade shall be compacted to the following minimum requirements:
 - a. Curbs, driveways and swales in travelled areas 100 % of Standard Proctor Density
 - b. Sidewalks 98 % of Standard Proctor DensityNo more than 25 mm of cushion material shall be placed on the sub-grade.

- ii. Concrete shall be handled from the mixer to the place of final placing as rapidly as practicable by methods that shall prevent the separation or loss of the ingredients. The interval between placing successive batches shall not exceed 50 minutes. It shall be placed in the forms as nearly as practicable in its final position to avoid re-handling. The sequence of concrete placement shall be arranged so that concrete which has partially hardened shall not be subjected to injurious vibration.
- iii. The vertical height of free fall of concrete shall not exceed 1 m. For falls greater than 1 m, chutes or concrete pumps shall be used.
- iv. During placement, concrete shall be sufficiently tamped and vibrated with suitable equipment to secure close bond with the reinforcement, eliminate entrapped air voids, and ensure a homogeneous structure with adequate consolidation. Particular care shall be given to placing and tamping along the faces of the forms to ensure a dense smooth surface. Vibrations shall be of sufficient duration to thoroughly compact the concrete but the duration shall not be long enough to cause segregation. Vibrators shall not be used for moving concrete. After the initial set of the concrete the forms or concrete structure shall not be jarred and no strain shall be placed on the ends of projecting reinforcement.
- v. If a section is to be continued at a later date, a construction joint shall be made with three (3) 10 mm diameter reinforcing bars equally spaced and extending a minimum of 0.5 m into both the existing and the future pour. Vibration shall be done by pencil vibrators and/or a vibrating screen, and shall be of sufficient duration only to prevent honeycombing.
- vi. The Developer shall submit the specifications of the proposed concrete slip form / extrusion equipment to the Municipality for review prior to use. The approved slip form / extrusion machine shall be so designed as to place, spread, consolidate, screed and finish the concrete in one (1) complete pass in such a manner that the minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section. The machine shall shape, vibrate and/or extrude the concrete for the full width and depth of the concrete section being placed. The operation of the machine shall be continuous until a section or scheduled pour is completed. The interval between successive loadings of the concrete hopper shall not exceed 30 minutes. If the operations are delayed, or if the section is to be continued later, the machine shall be emptied and a joint constructed as outlined herein. A similar joint shall be constructed at the beginning of the extruded section. Excess concrete that has passed through the machine shall not be re-used.

- vii. No concrete shall be placed on frozen sub-grade, subbase or base. After September 30th, all concrete shall attain the specified strength in 7 days from placing. When the ambient temperature is less than 5°C, concrete delivered to the site shall have a temperature not less than 15°C. For concrete placed in conditions when the ambient temperature is expected to fall below 2°C, the Contractor shall completely cover the concrete and forms, maintaining an adequate air cushion between the concrete and cover, using approved insulating material. If, using insulation, temperature of 18°C cannot be maintained for 72 hours after placing, then concrete work shall cease.
- viii. Hot weather shall be considered to be an air temperature in the shade of 23°C or above. The concrete temperature at the time of placing in hot weather shall not exceed 30°C. In the event that this limit is exceeded, the concrete operations shall be suspended until the constituent materials of the concrete are cooled.

G.8.9 Reinforcing

- i. Reinforcing shall be installed as required by the Contract Drawings and Specifications. Where necessary, additional reinforcing steel shall be installed as directed by the Municipality at no additional cost to the Municipality.
- ii. Lane crossings and commercial crossings shall be reinforced. Reinforcement bars shall be provided where concrete swales meet sidewalks, where concrete sidewalks are poured separately from the curb and gutter or when the pouring of concrete is suspended by more than 30 minutes. Reinforced joints shall contain one (1) 10M bar for every 300 mm of width of the structure, and the bars shall extend a minimum of 600 mm into both sides of the joint.

G.8.10 Finishing

- i. Working of the surface in the finishing operations shall be kept to a necessary minimum to produce the specified finish. The finished surface shall have a fine granular or sandy texture without exposed aggregate or entrapped air holes.
- ii. If there is evidence of excess water on the concrete surface, finishing shall be delayed until the excess water has evaporated.
- iii. A nylon bristle brush of an approved type shall be required. Surface grooves made by the broom shall not be more than 3 mm deep. Before brushing, all surplus water shall be removed from the brush.
- iv. A burlap finish shall be formed by dragging longitudinally in the direction of concrete placement a multiple ply burlap drag equal in length to the width of the concrete slab and having at least 1 m in contact with the concrete. The dragging shall be carefully done so as to produce a finished granular or sandy texture without disfiguring marks.

- v. Where approved by the Municipality, mortar consisting of cement and fine sand, mixed in the proportions used in the concrete, may be applied to extruded concrete to fill irregularities in the surface. This mortar shall not be applied after the concrete has attained its initial set, and at no time shall excess mortar be applied to cover the concrete surface.

G.8.11 Curing

- i. Exposed concrete surfaces shall be protected by using a resin base impervious membrane or another method of curing approved by the Municipality.
- ii. Resin base compound shall be applied under pressure to the concrete surface to form the impervious membrane. The application with a spray nozzle shall be done in such a manner as to cover the entire surface thoroughly and completely with a uniform film at a rate that shall depend on the roughness of the surface of the concrete but in no case shall be less than 0.25 litres/m² of concrete surface.
- iii. If moist curing is specified in the Contract Documents, after the concrete has set sufficiently, the exposed surfaces of the concrete shall be kept continuously moist using wet burlap or polyethylene film in contact with the concrete for at least seven (7) consecutive days after placing, when normal or sulfate resistant Portland cements are used, and for at least three (3) consecutive days, when high early strength cement is used.

G.8.12 Surface Sealing

Two applications of an approved sealing solution shall be sprayed on all exposed concrete. The concrete shall be dry and swept clean when the solution is applied. First application shall be made within seven (7) days after placing the concrete. Second application shall be made immediately after the first has been absorbed and concrete surface regains its dry appearance. The first application shall give coverage of maximum of 9 m² of concrete surface per one (1) litre of sealant. The second application shall give coverage of maximum of 12 m² of concrete surface per one (1) litre of sealant.

G.8.13 Joints

- i. Stress relieving, contraction, construction and longitudinal joints shall be constructed where required as shown on the Contract Drawings and Specifications.
- ii. Where specified, stress relieving joints shall be constructed either by sawing or by installation of polyethylene separators. Sawn joints shall be saw cut as late as possible following concrete finishing but without permitting cracking to develop in the concrete. The time at which such saw cutting is to be undertaken shall be determined by the Contractor. The Contractor shall be wholly responsible for all concrete defects arising from the cutting operation. As an alternative to saw cutting, stress relieving joints may be formed by equipment capable of inserting polyethylene film into the fresh concrete in a straight line and to the depth specified.

- iii. Contraction joints shall be formed to fully control cracking. Surface joints shall not exceed 12 mm in depth. Generally, transverse contraction joints shall be formed every 3 m. Where specified, sawn joints shall be saw cut in such a manner that the edges are smooth and no aggregate is removed from the surface of the concrete. Formed contraction joints shall be constructed with plates penetrating the concrete to specified depth. The joint edges shall be finished with a 6 mm radius in both edges when the plates are removed.
- iv. Tooled joints in extruded concrete shall be formed to depth specified and finished to a 6 mm radius on both edges. The construction method shall be at the option of the Contractor, but shall be subject to approval by the Municipality. The construction method used shall not affect the line and grade of the extruded structure.
- v. A surface joint, or a “dummy” joint, shall be constructed to the depth specified and finished to a 6 mm radius on both edges.
- vi. Construction joints shall be constructed with a formed Keyway or "Vee" as shown on the Contract Drawings. Edges shall be finished to a 6 mm radius. This joint is to be formed at a 10 mm depth.
- vii. When required, expansion joints shall be shown on the Contract Drawings.

G.8.14 Testing and Inspections

- i. Slump, air content and compressive strength tests shall be performed on the concrete for each 150 m³ placed for each class of concrete, with at least one (1) test for each day of placing concrete, unless otherwise specified.
- ii. Sampling and testing shall be performed in accordance with the following:
 - a. Compression test specimens: Standard method of "Making and Curing Concrete Test Specimens in the Field" in accordance with ASTM Specification C31.
 - b. Compression test: Standard Method of "Test for Compressive Strength of Cylindrical Concrete Specimens" in accordance with ASTM Specification C39.
 - c. Air content: Standard Method of "Test for Air Content of Freshly Mixed Concrete by the Pressure Method" in accordance with ASTM Specification C231.
 - d. Slump: Standard Method of "Test of Slump of Portland Cement Concrete" in accordance with ASTM Specification C143.
 - e. Sampling fresh concrete: Standard Method of "Sampling Fresh Concrete" in accordance with ASTM Specification C172.

G.8.15 Curbs

- i. Concrete curb and gutter shall be constructed on all urban roadways according to the Contract Drawings and cross sections.
- ii. The vertical face curb and gutter cross section shall be used on all roadways fronting commercial properties or public lands such as parks and Public Utility Lots (PUL), and for all arterial roadways. 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.
- iii. The rolled face curb and gutter shall be used on all local and residential roadways allowing driveway access.
- iv. Curbs shall be constructed on prepared sub-grade, cement stabilized sub-grade, granular base course, soil cement or asphalt concrete. Curbs with a radius less than 40 m shall be constructed with flexible forms, well staked and braced to the design lines and grades.
- v. Curbs shall be constructed using Portland cement conforming to CSA A3000. Materials, production, delivery, placement and finishing shall conform to CSA A23.1. One (1) slump, air content and compressive strength test shall be required for every 60 m³ of cast in place concrete. The minimum specified 28-day concrete compressive strength shall be 30 MPa. Air entrainment shall be within 6 – 8 % by volume.
- vi. Curb returns on all residential street intersections shall have a minimum radius of 9 m. Curb returns on all commercial and industrial street intersections shall have a minimum radius of 15 m and shall be designed to accommodate heavy truck turning movements.
- vii. 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.
- viii. For all urban cross sections, wick drains shall be placed below the curb between the sub-grade and granular base course. The wick drain shall be connected to the nearest catch basin.
- ix. Curbs shall be backfilled with suitable soil within seven (7) days of concrete placement and prior to placement of the roadway structure. The clay material shall be backfilled and compacted as specified by the Municipality to within 100 mm below the top of the curb to allow for the placement of topsoil material.

G.8.16 Sidewalks

- i. Sidewalks shall be accessible to all persons as well as being safe, functional and aesthetically pleasing as approved by the Municipality. Sidewalks installed for new subdivisions shall be integrated with the existing walkway system on intersecting roadways. Curb ramps shall be constructed at all curbed intersections.
- ii. Horizontal sidewalk alignment for separate sidewalks shall be at a constant offset from the adjacent roadway. Separate sidewalks shall be a minimum of 1.5 m wide, with the exception of mobile homes communities, where the minimum width of concrete sidewalk shall be 1.2 m. 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.
- iii. The granular base course under the sidewalk shall consist of 150 mm compacted thickness of Designation 2 Class 20 aggregate. The gravel base course under the sidewalk shall be compacted to 100 % of Standard Proctor Maximum Density.
- iv. Sidewalks shall be constructed using Portland cement conforming to CSA A3000. Materials, production, delivery, placement and finishing shall conform to CSA A23.1. One (1) slump, air content and compressive strength test shall be required for every 60 m³ of cast in place concrete. The minimum specified 28-day concrete compressive strength shall be 30 MPa. Air entrainment shall be within 6 – 8 % by volume. All sidewalks shall be reinforced as per the Contract Drawings.
- v. 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.
- vi. For every 200 m of length all sidewalks shall be imprinted with the Contractor's stamp indicating year of construction. Sidewalks shall also be imprinted with a "CC" at all curb cock locations.

G.9 PAVED PATHWAYS, GRANULAR WALKWAYS AND WOODCHIP MULCH HIKING TRAILS

- G.9.1** It is the Developer's responsibility to design and construct walkways and trails as required by the Development Agreement. Where a walkway or trail is required to be incorporated into a proposed subdivision, the alignments and locations within the subdivision shall allow for adequate public access to parks, recreational areas and environmental and municipal reserves. Rest areas are to be incorporated into the right-of-way width for every 800 m of length of walkway or trail. Rest areas shall incorporate a bench and a waste receptacle as approved by the Municipality.

- G.9.2** Wherever possible, walkways and trails shall be centered 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. 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. Where the walkway or trail right-of-way is not shared with other utilities, R.O.W shall be a minimum of 6 m wide with a minimum clearance of 2 m from the edge of the walkway or trail to the property line.
- G.9.3** Top of bank walkways and trails shall be designed and constructed so as not to impede natural and post subdivision drainage down the embankment. Grading shall ensure that concentrated overland flows are not generated anywhere along the bank unless an engineered outlet structures is present.
- G.9.4** 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.
- G.9.5** 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 proposed and adjacent subdivisions.
- G.9.6** The walkway sub-grade shall be compacted to a minimum 95 % of Standard Proctor Density for a minimum depth of 150 mm. Surfacing material shall be approved by the Municipality prior to installation.
- G.9.7** The asphalt and other materials for paved pathways, mixing, placing and compaction shall conform to the current Standards and Specifications.
- G.9.8** 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 0.06 m below excavation depth. The granular material shall be spread uniformly and compacted to 95 % of Standard Proctor Density.
- G.9.9** 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 0.06 m below excavation depth. The woodchip mulch shall be spread uniformly with a minimum 2 % crown or cross fall and smooth roller compacted in-place ensuring a uniform depth and surface appearance.
- G.9.10** Where walkway or trail is planned through wooded areas, the minimum width shall be 1.5 m or as specified by the Municipality. The minimum headroom clearance at the center line of the walkway or trail shall be 2.5 m. Vegetation shall be cleared for a minimum of 0.6 m outside from either edge of the walkway or trail.

G.10 TRAFFIC CONTROL DEVICES

G.10.1 General

- i. A traffic control device is a sign, signal, marking, barrier or other device placed upon, over or adjacent to a roadway that is intended to regulate, warn, or guide the roadway user. Traffic control devices shall be manufactured and installed in accordance with the latest version of the *"Uniform Traffic Control Devices for Canada"*.
- ii. Traffic control devices intended for use within and, if needed, adjacent to the proposed subdivision shall be justified, assigned and designed by the Professional Engineer and shall be approved by the Municipality prior to installation.
- iii. Traffic control devices shall be kept serviceable year-round for the safe movement of traffic in day, night and adverse weather driving conditions. No traffic control device, nor its support, shall bear any commercial advertising.
- iv. Temporary traffic control devices shall be installed to provide roadway users and pedestrians with adequate warning of construction or otherwise unusual and hazardous conditions. It shall be the Developer's responsibility to design a plan showing temporary traffic control devices, types, locations, spacing and other characteristics and submit it to the Municipality for approval. Whenever possible, such plan shall be a part of the proposed subdivision engineering design approved prior to commencing of construction. During construction period, should changes or updates to such plan become necessary, the submission of changes to the Municipality for approval shall be at least 72 hours prior to construction activity taking place or otherwise normal traffic flow disruption within or adjacent to the proposed subdivision.

G.10.2 Traffic Signs

- i. Traffic signs inform roadway users of traffic regulations, changing roadway characteristics, warn about road hazards and provide necessary information for route selection. Simplicity in design, care in placement and a standard of maintenance are essential. Traffic signs shall be installed only when justified and approved by the Municipality and according to the Contract Drawings and Specifications. Signs shall be placed so as not to obstruct the view of oncoming vehicles.
- ii. Materials:
 - a. Traffic signs made of treated ferrous and non-ferrous metal and waterproof resin bonded plywood are suitable for use in permanent signs. Wooden boards may be approved for use to construct large signs and temporary and seasonal signs. Information sign panels shall be constructed with high intensity reflective surface as per latest standards.

- b. Where applicable, it is encouraged that all signs be placed on existing supports used for other purposes, such as traffic signals or street lights. If sign posts are required, they shall be made of galvanized steel as approved by the Municipality and shall have breakaway coupling installed 50 mm above ground level or sign base. Stainless steel fasteners shall be used to attach signs to their supports. Damaged signs shall not be allowed for installation.
- c. Sign posts shall be 50 mm diameter schedule 40 galvanized steel posts.
- iii. Sign posts shall be located horizontally at 3 m offset from the shoulder of the roadway and at least 0.3 m from the curb. Sign posts shall be installed vertical and the signs shall be levelled. The bottom of the sign shall be from 1.5 m to 2.5 m above the top surface of the nearest travel lane, with the preferred height at 2.0 m, whenever possible. Signs shall be positioned with best possible visibility for roadway users in mind. Stop signs and yield signs shall be positioned in line with the nearest property line of the intersecting roadway allowance.
- iv. Street identification signs shall be located within 10 m of the intersection in the direction of the near-side approaching traffic. Street identification signs shall be offset at least 1 m from the edge of the road and mounted 3.0 - 3.5 m above the finished roadway surface. Street identification signs shall be a minimum size of 15 cm x 60 cm and a maximum of 15 cm x 90 cm. The lettering shall be 10 cm 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.
- v. It is the Developer's responsibility to design, supply and install a Municipal Address Sign. The Municipal Address Sign shall be positioned within the roadway right-of-way adjacent to the first lot on the right hand side at the main entrance to the proposed subdivision. The sign design and proposed location shall be submitted to the Municipality for approval prior to installation.

G.10.3 Pavement Markings

- i. Pavement markings are traffic control devices placed on the pavement surface to delineate and clarify traffic and pedestrian movement by regulating, warning and conveying information to roadway users without diverting attention from the roadway. Refer to the *"Uniform Traffic Control Devices for Canada"* manual for pavement marking details.
- ii. Temporary traffic marking materials shall be either industrial traffic marking paint or thermoplastic material unless otherwise approved by the Municipality. Permanent traffic markings, required for issuance of the FAC, shall be thermoplastic material.

- iii. Pavement markings shall conform to the following:
 - a. Color: yellow (solid) lines shall delineate the separation of opposing traffic flows. White lines shall delineate the separation of traffic flows in the same direction. All lateral pavement markings shall be white.
 - b. Pattern: solid longitudinal lines shall indicate that lane changing is not permitted. Broken longitudinal lines shall indicate that lane changing is permitted. The line to gap ratio for broken lines shall be 3:6. Lateral pavement markings shall indicate the limits of the roadway user's right-of-way concerning stopping, pedestrian crosswalks, no parking areas and other requirements and limitations.

G.10.4 Vehicular Barriers

- i. While vehicular barriers are designed and installed to reduce the hazard of errant vehicles leaving the roadway surface, they themselves shall also be considered as potential hazards. Installation of the vehicular barriers shall be warranted only where the severity of a potential accident prevented by the vehicular barrier is greater than the hazard presented by the presence of the traffic barrier itself. The purpose of the vehicular barriers is to shield those hazards that cannot be eliminated.
- ii. Vehicular barriers shall be designed by the Professional Engineer and approved by the Municipality prior to installation. Vehicular barriers shall be considered for installation at the following locations:
 - a. across the end of a walkway that terminates in a lane,
 - b. across the end of a lane cul-de-sac that abuts a roadway,
 - c. along a lane that parallels an adjacent roadway,
 - d. near permanent water bodies,
 - e. at areas showing a significant and hazardous difference in grade separation,
 - f. bridge abutments,
 - g. retaining walls, and
 - h. as a longitudinal divider on narrow medians.

G.11 DRAINAGE AND CULVERTS

G.11.1 It is the Developer's responsibility to design and construct a drainage system that will meet the flow requirements as per Municipality Specifications.

G.11.2 Ditches shall have a flat bottom, and width shall be as per applicable design standard. Ditches for rural roadways shall have back slope no steeper than 2:1. Ditch grades shall match the roadway grades wherever practical. 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. Drainage channels shall be provided with means of erosion control as necessary. All drainages shall be seeded.

G.11.3 Culvert design and sizing shall be the responsibility of the Developer's Consulting 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 sub-grade elevation. Culverts shall be new galvanized corrugated steel pipe with a minimum wall thickness of 1.6 mm or as required to meet the loading criteria.

G.11.4 Minimum pipe diameters for various uses are as follows:

i. Residential approach	500 mm
ii. Industrial approach	600 mm
iii. Roadway centreline	600 mm

G.11.5 Culverts shall have appropriate end treatments depending on application. Inverts shall be extended to the toe of the side slope. The culvert grade shall not be less than the ditch grades at the inlet and outlet. Culverts shall have a sufficient amount of cover to protect against damage from the expected traffic loading. Minimum cover shall be 300 mm 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.11.6 Low Level Crossing

- i. 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 shall be constructed of erosion resistant materials to withstand the effect of water flowing over the top of the crossing. The crossing culverts shall be designed to carry normal flows based on available historical stream flow data.
- ii. The crossing location shall 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. A topographic survey of the water stream crossing area shall be done to ensure proper installation of the crossing and its future operational success.
- iii. 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.

- iv. 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 sub-grade 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 150 mm. Each layer shall be compacted to the degree specified by the Municipality. 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.
- v. 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.
- vi. 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 450-600 mm to prevent erosion. The approved filter cloth shall be placed over the culvert bed prior to placing of the fill materials. The filter cloth shall be extended up over the end-wall slopes of the crossing, and shall be placed over the sub-grade immediately under the erosion-resistant surface structure. The erosion resistant surface structure shall be constructed above the culverts, extending down over the crossing end walls and around the culverts.
- vii. 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.
- viii. 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 300 mm shall be maintained.

G.12 BOULEVARD GRASSING

G.12.1 Intent

The work shall include, but shall not be necessarily limited to, placing of topsoil, seeding, watering and at least two (2) successive cuttings of grassed areas as shown on the Contract Drawings.

G.12.2 Materials

- i. All materials shall be subject to inspection, testing and approval by the Municipality prior to placing.
- ii. Topsoil shall be of a natural, fertile agricultural soil of the "A" horizon layer, capable of sustaining plant growth. It shall be free of subsoil, clay lumps, stones, live plants or any other extraneous matter, whether organic or inorganic, which may be detrimental to the grass or any other plants. Topsoil shall contain no toxic materials and have a pH value of 6.0 - 7.5.
- iii. The seed mixture shall comply with Federal and Provincial seed Specifications and have a minimum germination of 75 % and a minimum purity of 97 %. Bags of the seed mixture shall be clearly tagged showing the name of the supplier and the contents. The seed mixture shall be No. 1 lawn seed mixture and shall consist of:
 - a. Kentucky Blue Grass - 50% by weight
 - b. Creeping Red Fescue (*Festuca Rubra*) - 40% by weight
 - c. Red Top - 10% by weight
- iv. Sod shall be No. 1 nursery-grown sod consisting of a uniform mixture of:
 - a. Kentucky Blue Grass - 60% by weight
 - b. Creeping Red Fescue (*Festuca Rubra*) - 40% by weight

Sod also shall be:

- a. first cut and a minimum of 18 months old,
 - b. healthy with a thick growth and free of noxious weeds,
 - c. minimum 20 - 25 mm in thickness, and
 - d. sufficiently moist to prevent burning at the edges.
- v. Root fertilizer shall conform to the following:
- a. granular water soluble fertilizer 10-6-4 Super phosphate,
 - b. granular water soluble fertilizer 5-20-10 or equivalent.
- Supplementary fertilizer shall conform to the following:
- a. organic fertilizer 14-7-6,
 - b. even 35 %.
- vi. Peat moss shall be mixed with topsoil and meet the following specifications:
- a. have pH value of 5.0 - 7.0,
 - b. have a water holding capacity of 1,100 % by weight,

- c. be free of toxic material, live plants, live roots or seeds, and
- d. be delivered in a pulverized condition.

G.12.3 Construction

- i. The Contractor shall be responsible for the control of weed growth until the final acceptance of the work.
- ii. All rocks larger than 50 mm in diameter, roots and other foreign matter shall be removed. The subsoil shall be mechanically loosened to a depth of not less than 50 mm immediately prior to placing the topsoil.
- iii. The topsoil shall be uniformly spread on the prepared areas to a minimum compacted depth of 150 mm measured after the area is readied with the soil seed equipment. If organic material is required to meet the specifications for topsoil, peat moss in pulverized condition shall be added in the field and mixed with cultivation equipment. The area shall then be disked, harrowed and floated thoroughly to a depth of 75 mm leaving the soil in a good viable condition and true to grade.
- iv. After the topsoil has been properly prepared, a uniform application of the fertilizer shall be done at the rate of 5 kg/100 m² using a mechanical spreader. The fertilizer shall be thoroughly and evenly mixed with the soil to a maximum depth of 75 mm. Approximately 6 weeks after germination, supplementary application of an organic fertilizer, such as 10-6-4 or equivalent, shall be done at a rate of 5 kg/100 m².
- v. Grass seed shall be sown at a rate of 2.5 kg/100 m² by one or more of the following methods:
 - a. Hand application with a cyclone type seeder capable of distributing seed in two directions in equal amounts. Hand application shall require a 6 mm top dressing or mulch of pulverized peat moss.
 - b. Mechanical application with a calibrated grass seeder complete with compaction roller.
 - c. Hydro-seeding by applying of the approved turf-fiber at a rate of 0.135 kg/m².
 - d. After seeding is finished, and to avoid damage as a result of washing, the area shall receive light watering with a fine spray to a penetration of not less than 25 mm. In areas where seed fails to germinate, the Contractor shall re-cultivate and re-seed such areas until germination occurs.
- i. At the time of the supplementary fertilizing, the following repairs and maintenance shall be carried out by the Contractor:
 - a. Top dressing: repair ruts, unevenness and erosion problems,
 - b. Over-seeding: re-cultivate and re-seeded damaged areas,

- c. Weed spraying: the approved weed killer shall be applied 1 week after the fertilizer had been applied.
- ii. Sodding shall be done on all areas where slopes are 2:1 or greater. Sod may be substituted for grass seeding on all other areas. The sod shall be closely butted together and placed evenly, in staggered rows, with all newly-laid sod matched to the existing grade of other landscaped or cultivated areas as specified. The sod shall be top dressed and rolled with a medium weight roller (90-120 kg) to a smooth and even surface. After placement, the sod shall be continuously watered for one (1) week or until significant root growth has occurred. Approximately four (4) weeks after placement, and following the initial cutting, an organic fertilizer shall be applied at the rate of 5 kg/100 m².
- iii. The first and second grass cutting shall be done by the Contractor when the grass is approximately 100 mm in height. Cut height shall be 50 mm.
- iv. Growing season:
 - a. Grass seeds shall not be planted before May 15 or after September 1.
 - b. Sod shall not be placed before May 15 or after September 1. Sod placing on slopes 3:1 or steeper shall not be done when the temperature is above 23°C.
 - c. Within one (1) year after the issuance of a Construction Completion Certificate for subdivision projects including paved roadways construction, the Developer shall sod and plant trees along all roadways boulevards. Deciduous trees shall be placed in a uniform lineal manner. The Developer shall be responsible for full maintenance and tree replacement for 1 calendar year after sodding and planting.

G.13 PARKING LOTS

G.13.1 Parking lot design shall conform to the Municipality Land Use Bylaw. The minimum parking stall standards are as follows:

Parking Angle	Width of Stall (m)	Depth of Stall Perpendicular to Maneuvering Aisle (m)	Width of Stall Parallel to Maneuvering Aisle (m)	Width of Maneuvering 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.13.2 Parking lot pavement structure for public lands shall be determined by the Developer's Consulting Engineer based on the results of the geotechnical investigation and anticipated loading but shall not be less than the following:

- | | |
|---|---|
| i. Light traffic:
(Gravel standard) | 175mm granular base
25mm surface gravel |
| ii. Light traffic:
(Paved standard) | 175mm granular base course
75mm asphalt concrete pavement |
| iii. Heavy traffic:
(Paved standard) | 225mm granular base course
100mm asphalt concrete pavement |
| iv. Heavy industrial:
(Paved standard) | Case specific based on projected loading |

G.14 BOAT LAUNCHES

G.14.1 Background

- i. 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.
- ii. 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.
- iii. 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.
- iv. 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.14.2 Objectives of these Standards is to ensure that proposed works associated with boat launch construction, repair and maintenance protect water quality, fish, wildlife and aquatic and shoreline habitat.

G.14.3 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.14.4 Best Management Practices

- i. 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.
- ii. Application of a Best Management Practice 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.
- iii. 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.
- iv. 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 geomorphologies and engineer, working either independently or in coordination.

G.14.5 Municipal Launch Facilities

- i. 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.
- ii. 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:
 - a. 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.
 - b. Number and location of access points available for new subdivision, and whether development of new facilities and/or rehabilitation of existing facilities would better meet current and projected demand.

- c. Type of launch facilities required based on the types of watercraft to be supported.
 - d. Adequate provisions for vehicle turn-around and parking areas and associated services.
 - e. Installation of signage for identification and warning of sensitive habitats in the proximity to the launch facility.
 - f. Use of applicable best management practices to avoid or reduce impacts to the environment during launch facilities construction, use and maintenance.
- iii. The following design details should be incorporated, where appropriate, during the launch facilities design process:
- a. 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 1 m 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.
 - b. 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.
 - c. 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.
 - d. Pre-cast concrete planks shall be required for construction of the underwater portion of hard surface boat launch ramps.

G.14.6 Maintenance and Upgrading of Existing Facilities

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.
- 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.14.7 Design Best Practices

- i. Qualified design professional shall ensure that the site assessment and design consider the following factors:
 - a. Local soil conditions and characteristics.
 - b. Local shoreline and stream mouth accretion/erosion dynamics, including local water currents and associated patterns of sediment transport and deposition.
 - c. Local shoreline morphology and potential impacts or changes.
 - d. Historical water levels during the proposed seasons of use.
 - e. Minimizing direct, indirect and cumulative impacts on existing or potential fish and wildlife use, aquatic and riparian habitat.
 - f. Ability to access, repair and maintain the facility with minimal impact.
 - g. Potential erosion or sediment releases resulting from proposed works.
 - h. Implementing control measures that may be required to reduce the potential for establishment of invasive aquatic plants.
 - i. Minimizing the potential for storm water and contaminated runoff from roadways, parking areas, etc. reaching the water body.
 - j. Minimizing the footprint of the works and associated foreshore disturbance.
 - k. Minimizing the effects of watercraft wakes on adjacent shoreline areas and reducing the potential for sediment accumulation on the ramp.
 - l. Avoiding direct and indirect impacts to other properties or services.
- ii. 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.
- iii. 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.
- iv. 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.

- v. 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.14.8 Construction and Operational Best Practices

- i. 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.
- ii. A pre-construction meeting shall be held between the environmental monitor and the Contractor to ensure a common understanding of the best work practices.
- iii. 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.
- iv. 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.
- v. 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.
- vi. 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.

- vii. Construction shall be monitored by an appropriate qualified professional (biologist, hydrologist, fluvial geomorphologies 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.
- viii. 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.
- ix. 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.14.9 Construction Materials

- i. 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:

- a. 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.
- b. Cast in place concrete shall remain inside sealed forming structures (concrete leach is alkaline and highly toxic to aquatic life). Pre-cast concrete structures are preferred.
- c. Isolated containment facilities for wash-down water from equipment, concrete carrying vehicles and tools shall be available on site.
- d. CO₂ 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.
- e. In the event of spills or sediment entry to the water body, emergency mitigation and clean-up measures shall be immediately implemented. All such occurrences shall be reported to DFO.
- f. 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.

ii. Treated wood:

Caution shall be taken where preserved wood and preservative treatments are used. Manufacturer's precautions and instructions shall be followed at all times. Wood preservatives shall not be applied near or over the water surface.

iii. 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.

iv. 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.

v. 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.

vi. Sediment control:

The following measures shall be taken by the Contractor to prevent or minimize the sediment occurrence during the construction of launch facilities:

- a. Minimize disturbance to existing vegetation on and adjacent to the water body shoreline.
- b. Have sediment control measures (e.g. silt curtain, silt fencing) in place before starting any works that may result in sediment occurrence.
- c. 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.

vii. Removal of existing structures and site restoration:

- a. 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.

- b. 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.
- c. Site restoration shall be provided for long-term recovery and eliminate any depressions that may result in fry entrapment during low water levels.
- d. Disturbed areas above the high water mark shall be graded to a stable angle of repose.
- e. Disturbed areas shall be seeded and/or vegetated to prevent surface erosion by hydro seeding with heavy mulch, pacifier and seed mix, by installing erosion blankets, and/or by heavy seeding/planting with native vegetation.
- f. All remaining equipment, supplies and materials, as well as sediment and erosion control measures, shall be removed from the site.

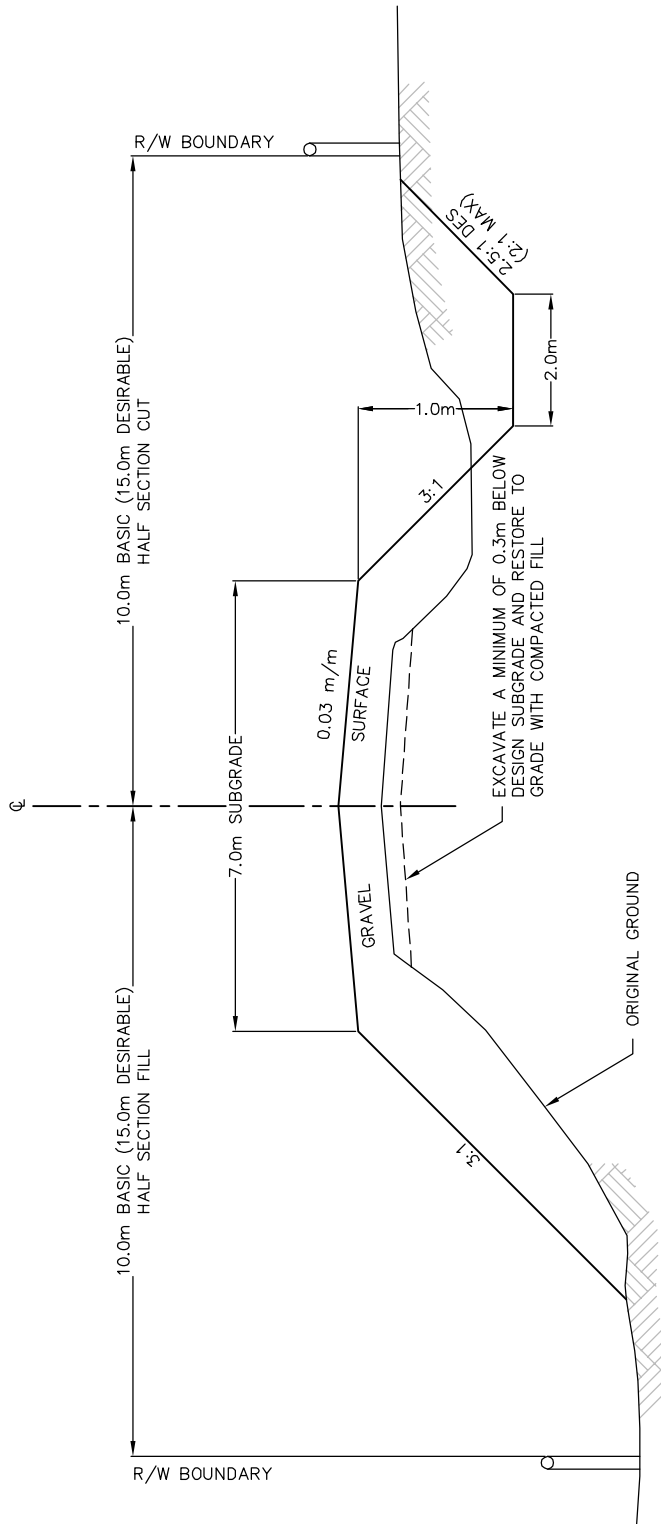
G.15 LIST OF DRAWINGS

G-01	Typical Cross Section for Grading & Gravel Surfacing (RLU-207G)
G-02	Typical Cross Section for Grading & Gravel Surfacing (RLU 208G(a))
G-03	Typical Cross Section for Grading & Gravel Surfacing (RLU-208G(b))
G-04	Typical Cross Section for Grading & Gravel Surfacing (RLU-209G)
G-05	Typical Cross Section for Grading & Gravel Surfacing (RLU-210G)
G-07	Typical Cross Section for Asphalt Concrete Pavement Surfacing (Local Road 8.0m)
G-09	Typical Cross Section for Asphalt Concrete Pavement Surfacing (Arterial 9.0m)
G-10	Typical Cross Section for Asphalt Concrete Pavement Surfacing (Arterial 10.0m)
G-11	Typical Cross Section for Asphalt Concrete Pavement Surfacing (Arterial 11.0m)
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- G-73 Low Level X-ing with Culvert
- G-74 Low Level X-ing with Culvert
- G-75 Low Level X-ing with Culvert
- G-76 Low Level X-ing with Culvert

END OF SECTION

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CUT SECTION

- WIDTH OF DITCH – 2.0m STANDARD;
- V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAX

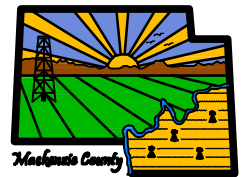
NOTE:
 THIS STANDARD IS INTENDED FOR LOW VOLUME ROADS THAT WILL BE GRAVEL SURFACED ONLY AND WILL HAVE LITTLE OR NO TRUCK TRAFFIC. TYPICALLY THIS 7.0m ROADWAY IS USED ON ROADS WITH AADT < 25.

FILL SECTION

- 3:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31



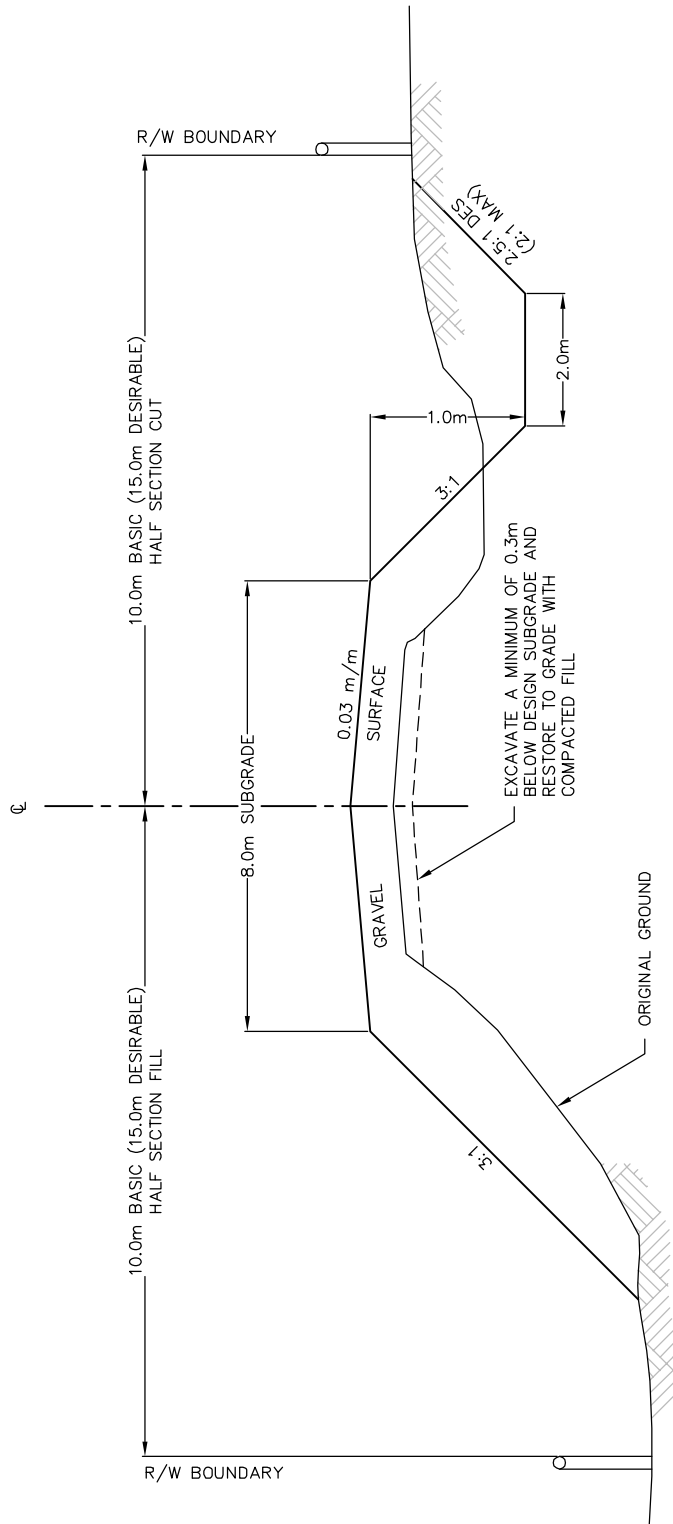
File No.: GP60.33682
 Drawn: K.P.L.

Design:
 Scale: N.T.S

TYPICAL CROSS SECTION FOR GRADING & GRAVEL SURFACING (RLU-207G)

Approved:

Figure **G-01**



NOTE:
THIS STANDARD IS INTENDED FOR LOW VOLUME LOCAL ROADS THAT WILL BE GRAVEL SURFACED ONLY. TYPICALLY THIS 8.0m ROADWAY IS FOR ROADS WITH AN AADT < 100.

FILL SECTION

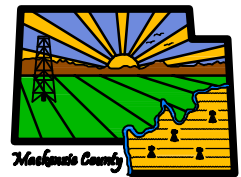
- 3:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

CUT SECTION

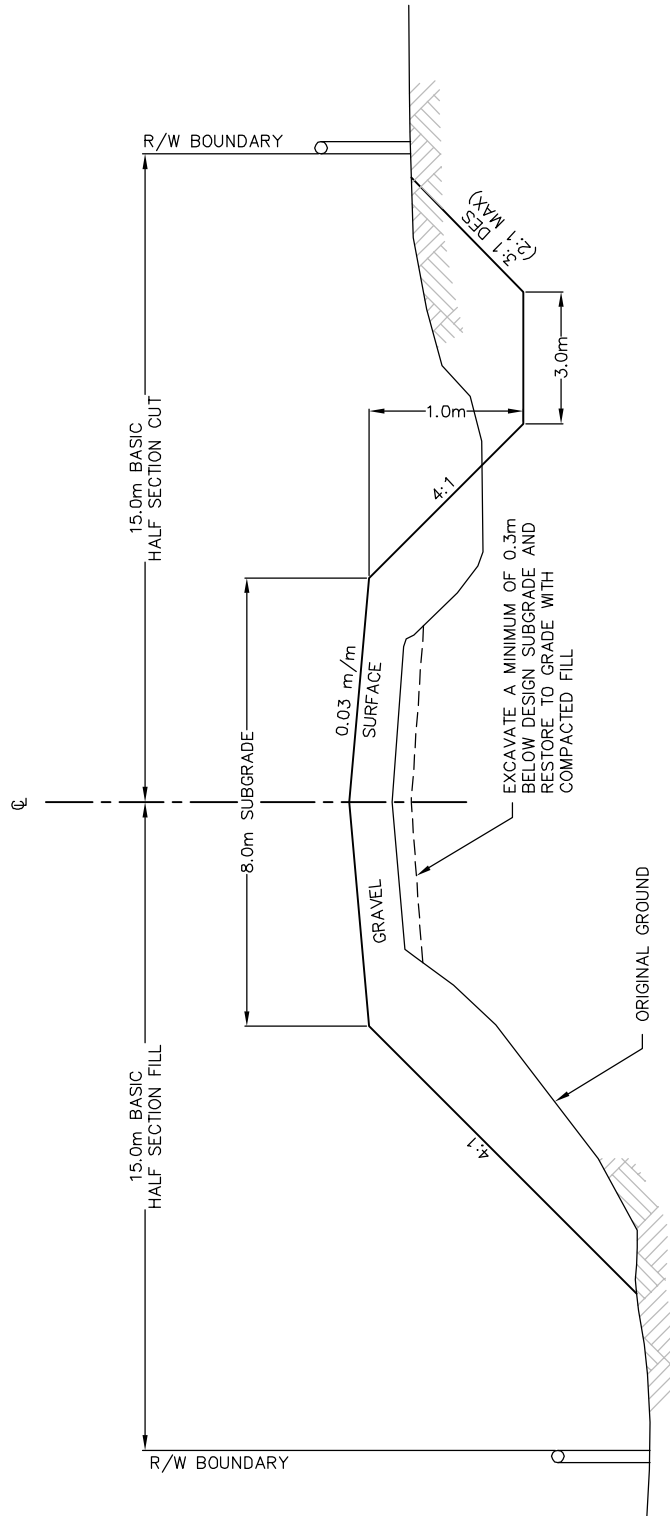
- WIDTH OF DITCH – 2.0m STANDARD; V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAX

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.			TYPICAL CROSS SECTION FOR GRADING & GRAVEL SURFACING (RLU-208G(a))		Figure G-02
Rev.					
Rev.					
Rev.					
Date: 2010-AUG-31	File No.: GP60.33682	Design:	Approved:		
	Drawn: K.P.L	Scale: N.T.S			



CUT SECTION

- WIDTH OF DITCH – 3.0m STANDARD;
- V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAX

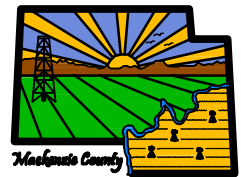
NOTE:
THIS STANDARD IS INTENDED FOR LOW VOLUME ROADS THAT WILL BE GRAVEL SURFACED ONLY AND WILL HAVE LITTLE OR NO TRUCK TRAFFIC. TYPICALLY THIS 8.0m ROADWAY IS USED ON ROADS WITH AADT < 200

FILL SECTION

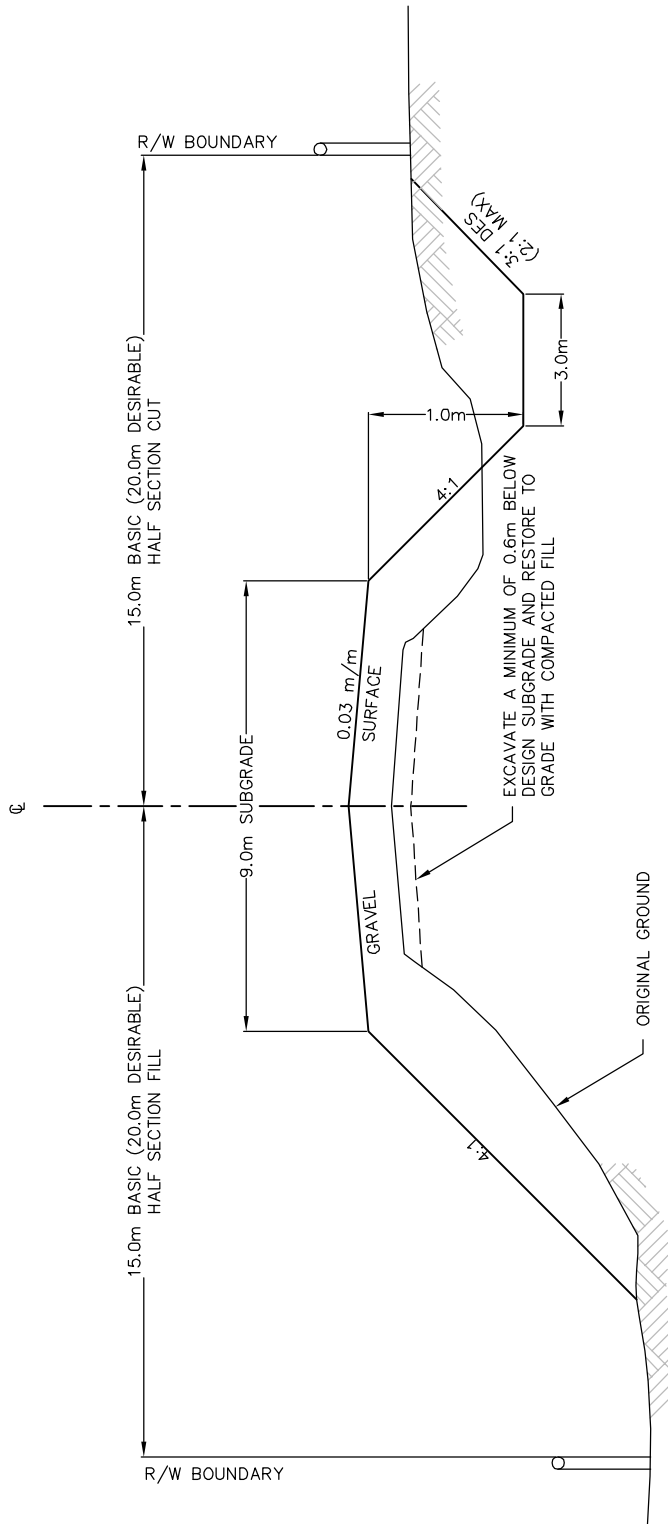
- 4:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPICAL CROSS SECTION FOR GRADING & GRAVEL SURFACING (RLU-208G(b))	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure G-03



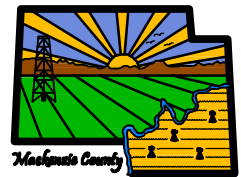
NOTE:
THIS STANDARD IS INTENDED FOR LOW VOLUME LOCAL ROADS WHICH WILL BE GRAVEL SURFACED ONLY. THIS 9.0m ROADWAY IS TYPICALLY USED FOR AADT > 200.

- FILL SECTION**
- 4:1 SLOPE FOR ALL FILLS
 - ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
 - WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

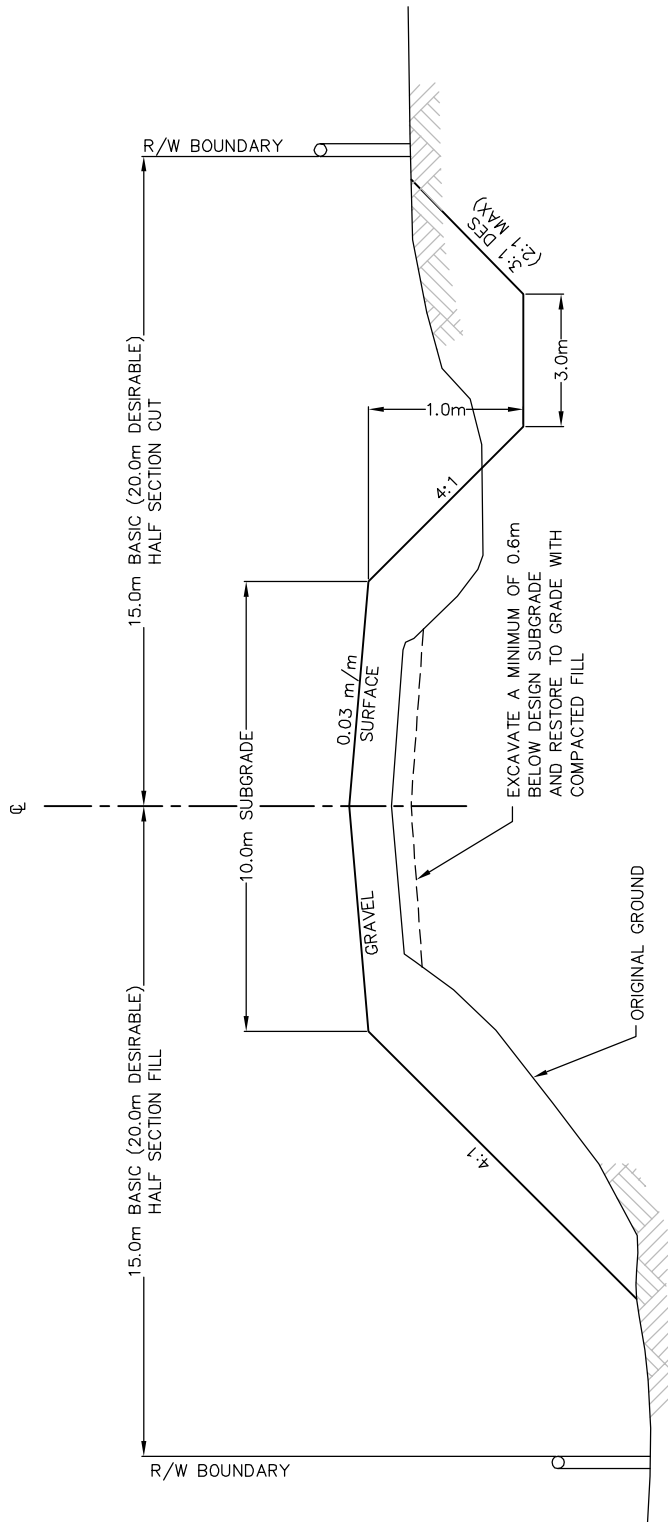
- CUT SECTION**
- WIDTH OF DITCH - 3.0m STANDARD; V-DITCH MINIMUM
 - BACKSLOPE VARIABLE UP TO 2:1 MAX

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPICAL CROSS SECTION FOR GRADING & GRAVEL SURFACING (RLU-209G)		Approved:	Figure G-04
Rev.					
Rev.					
Date: 2010-AUG-31	File No.: GP60.33682 Drawn: K.P.L.	Design: Scale: N.T.S.			



FILL SECTION

- 4:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

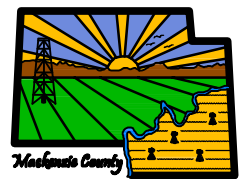
NOTE:
THIS STANDARD IS INTENDED FOR LOW VOLUME LOCAL ROADS WHICH WILL BE GRAVEL SURFACED ONLY. THIS 10.0m ROADWAY IS TYPICALLY USED FOR AADT > 200 (WHERE TRUCK VOLUMES WARRANT ADDITIONAL SUBGRADE WIDTH).

CUT SECTION

- WIDTH OF DITCH - 3.0m STANDARD; V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAXIMUM

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

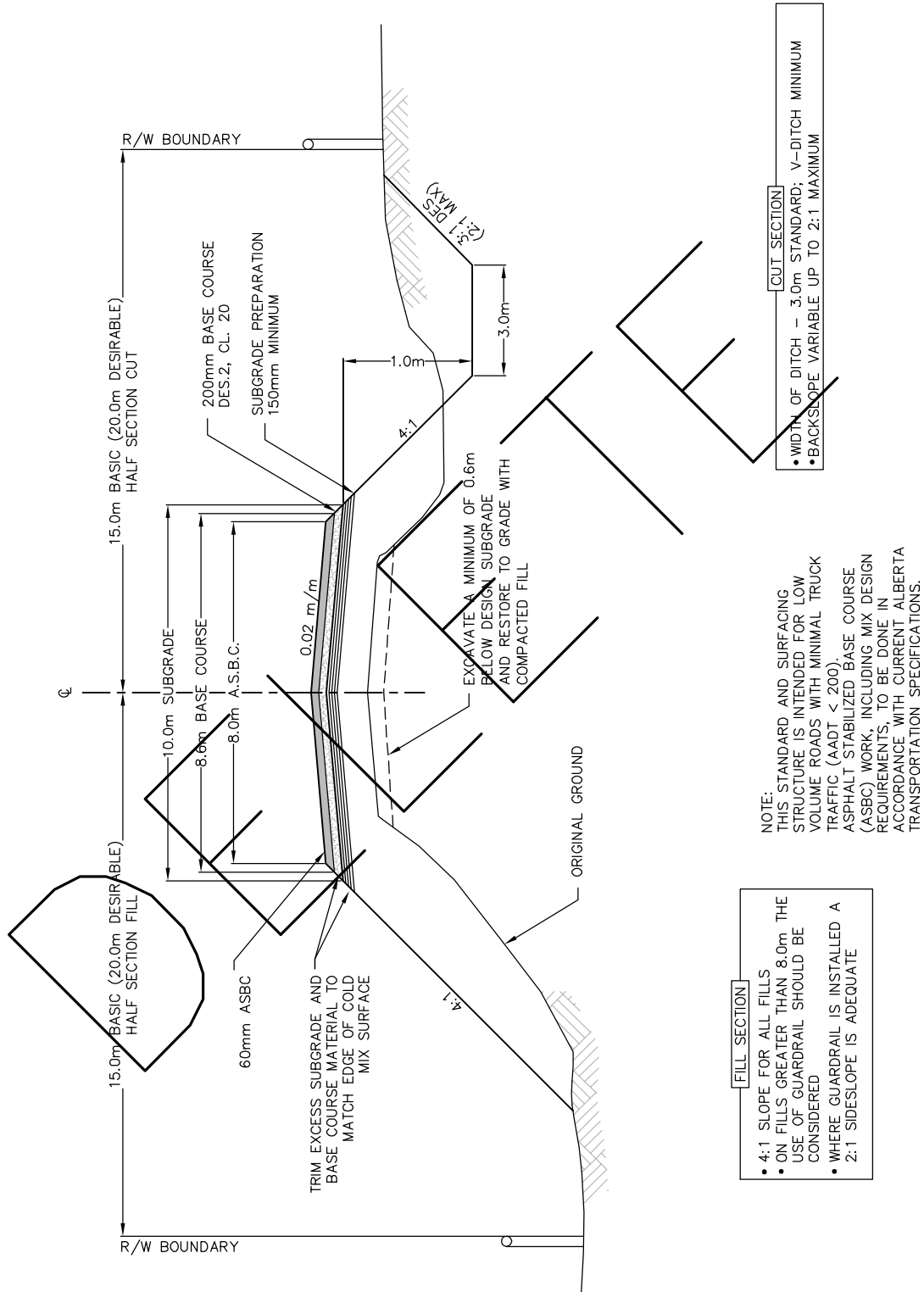


File No.: GP60.33682	Design:
Drawn: K.P.L	Scale: N.T.S

TYPICAL CROSS SECTION FOR GRADING & GRAVEL SURFACING (RLU-210G)

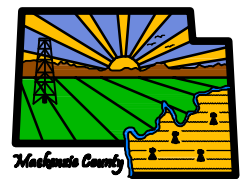
Approved:

Figure **G-05**

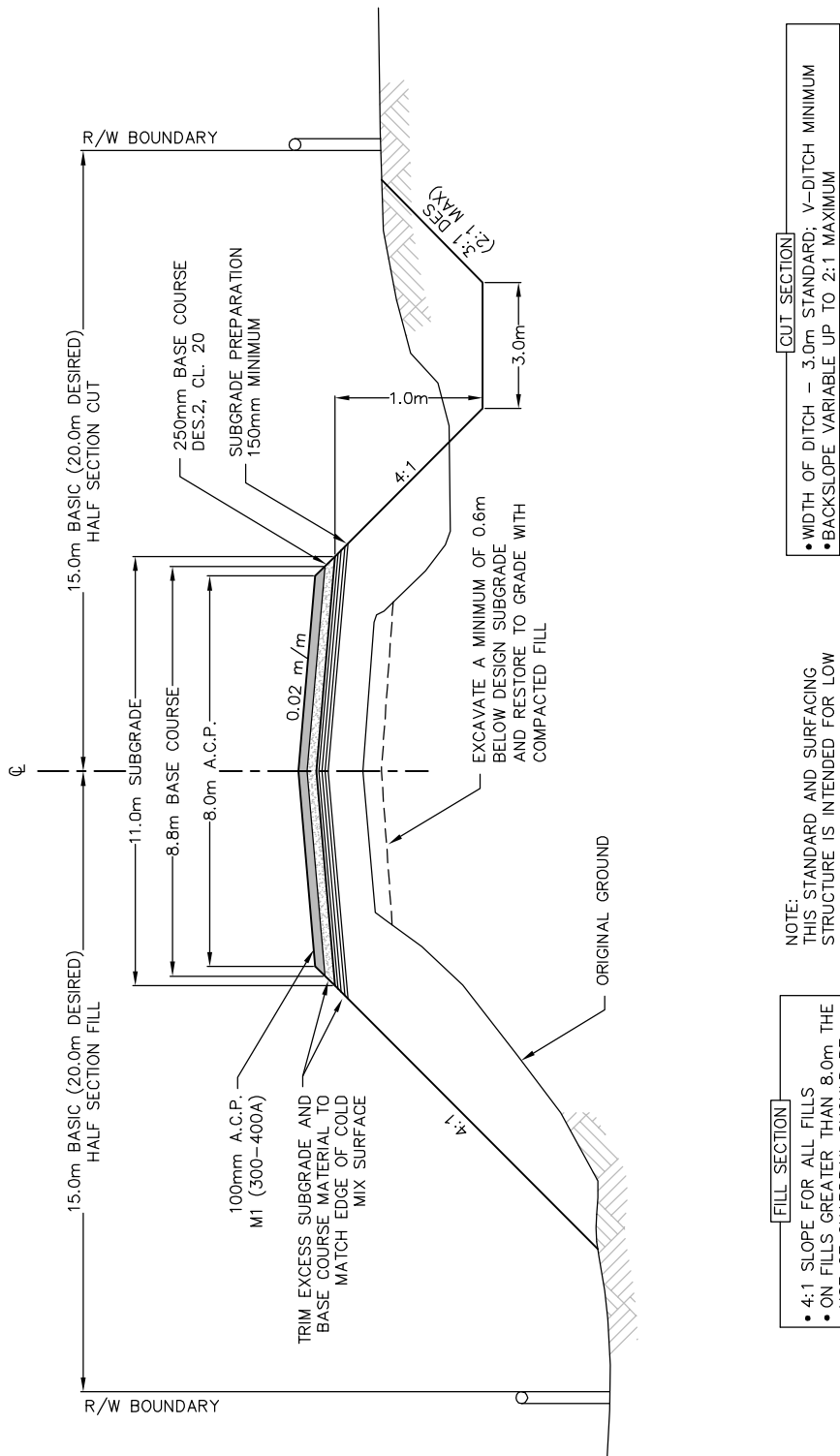


MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPICAL CROSS SECTION FOR ASPHALT STABILIZED BASE COURSE SURFACING (PAVED LOCAL ROAD 8.0m)		Approved:	Figure G-06
Rev.		File No.: GP60.33682	Design:		
Rev.		Date: 2010-AUG-31	Drawn: K.P.L		



CUT SECTION

- WIDTH OF DITCH - 3.0m STANDARD; V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAXIMUM

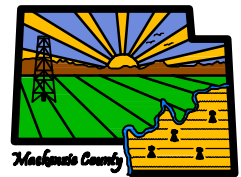
NOTE:
THIS STANDARD AND SURFACING
STRUCTURE IS INTENDED FOR LOW
VOLUME ROADS (AADT < 200).

FILL SECTION

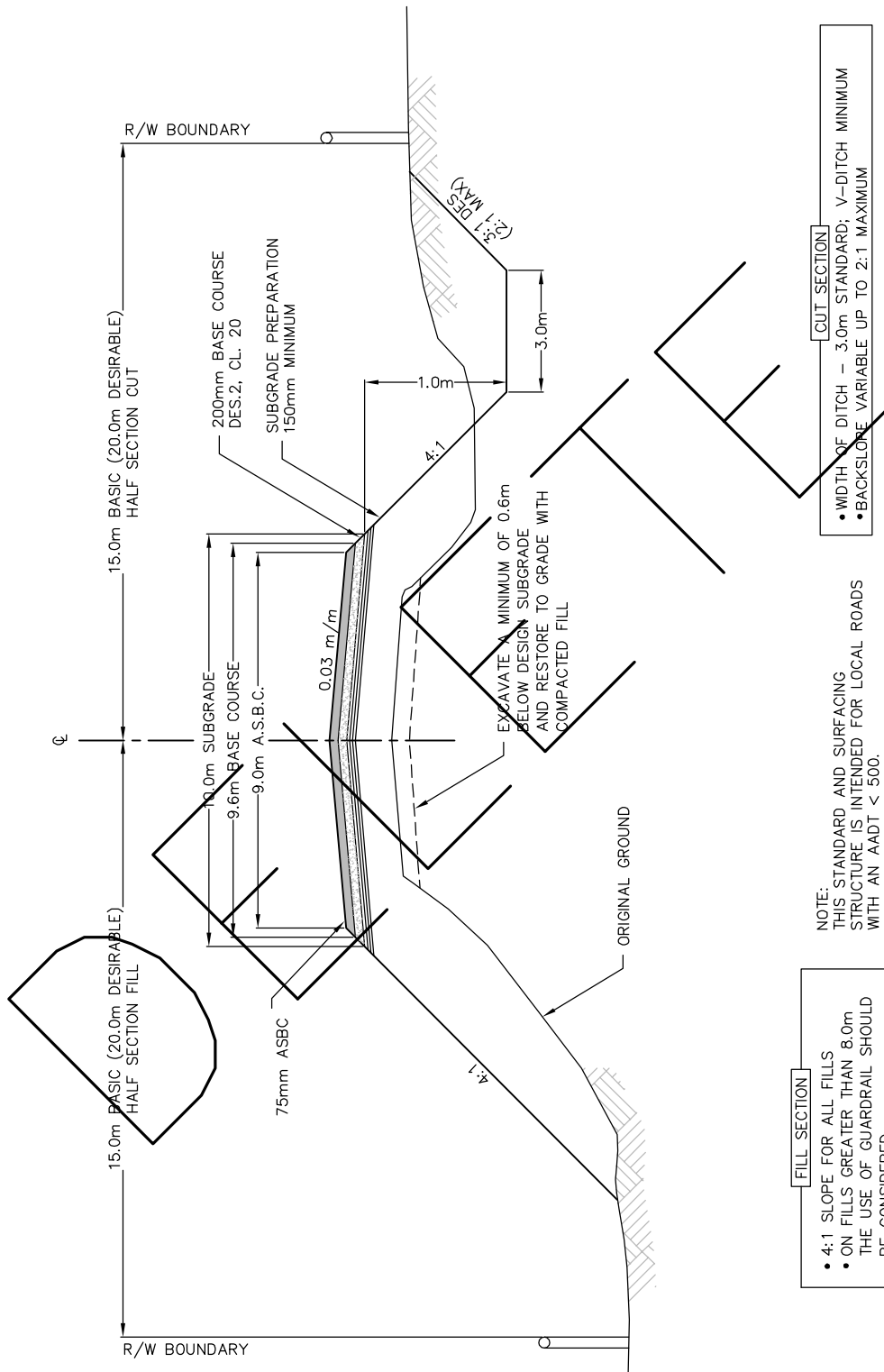
- 4:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE
USE OF GUARDRAIL SHOULD BE
CONSIDERED
- WHERE GUARDRAIL IS INSTALLED
A 2:1 SIDESLOPE IS ADEQUATE

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	TYPICAL CROSS SECTION FOR ASPHALT CONCRETE PAVEMENT SURFACING (PAVED LOCAL ROAD 8.0m)	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure G-07



CUT SECTION

- WIDTH OF DITCH – 3.0m STANDARD; V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAXIMUM

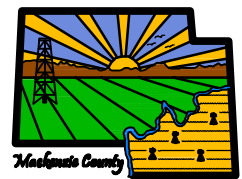
NOTE:
 THIS STANDARD AND SURFACING STRUCTURE IS INTENDED FOR LOCAL ROADS WITH AN AADT < 500.
 ASPHALT STABILIZED BASE COURSE (ASBC) REQUIREMENTS, TO BE DONE IN ACCORDANCE WITH CURRENT ALBERTA TRANSPORTATION SPECIFICATIONS.

FILL SECTION

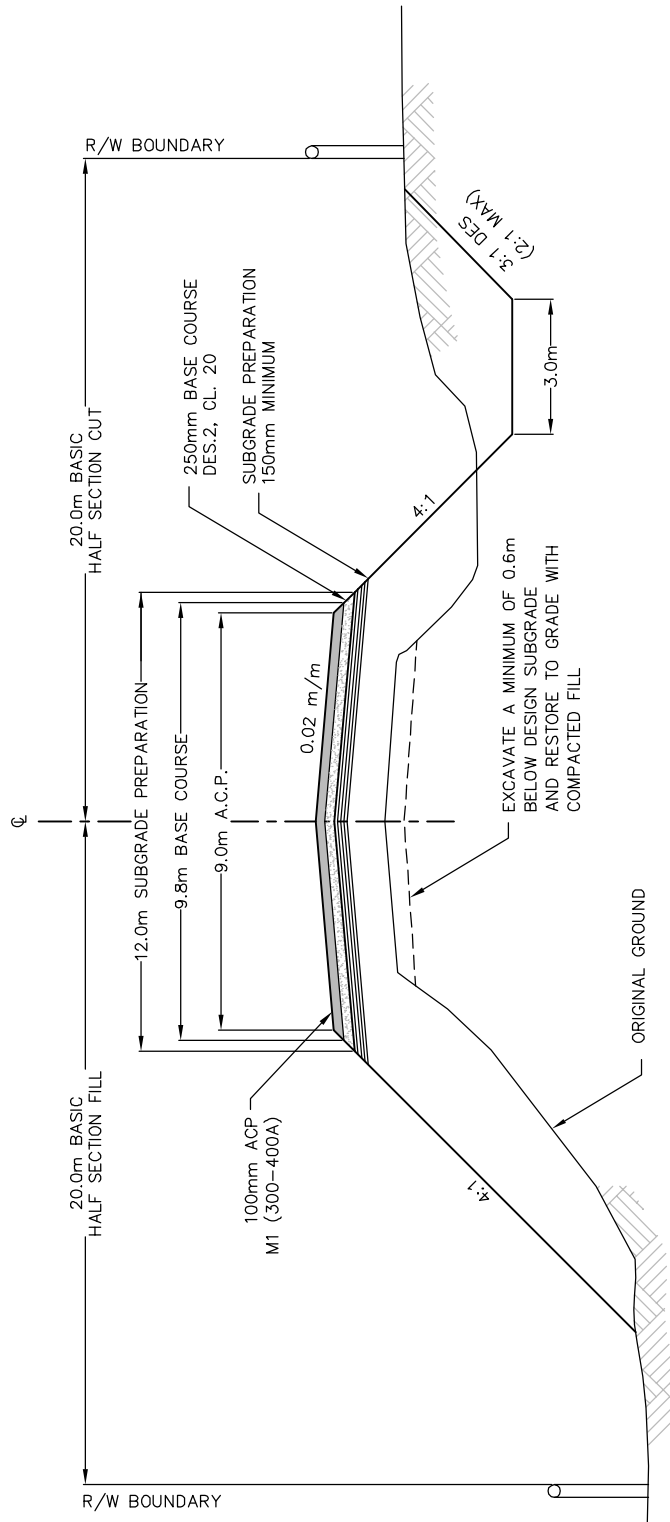
- 4:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPICAL CROSS SECTION FOR ASPHALT STABILIZED BASE COURSE SURFACING (EXISTING – ARTERIAL 9.0m)	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure G-08



CUT SECTION

- WIDTH OF DITCH - 3.0m STANDARD; V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAXIMUM

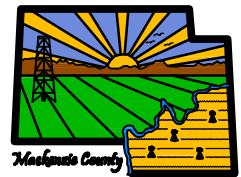
NOTE:
THIS STANDARD AND SURFACING STRUCTURE IS INTENDED FOR LOCAL ROADS WITH AN AADT < 500.

FILL SECTION

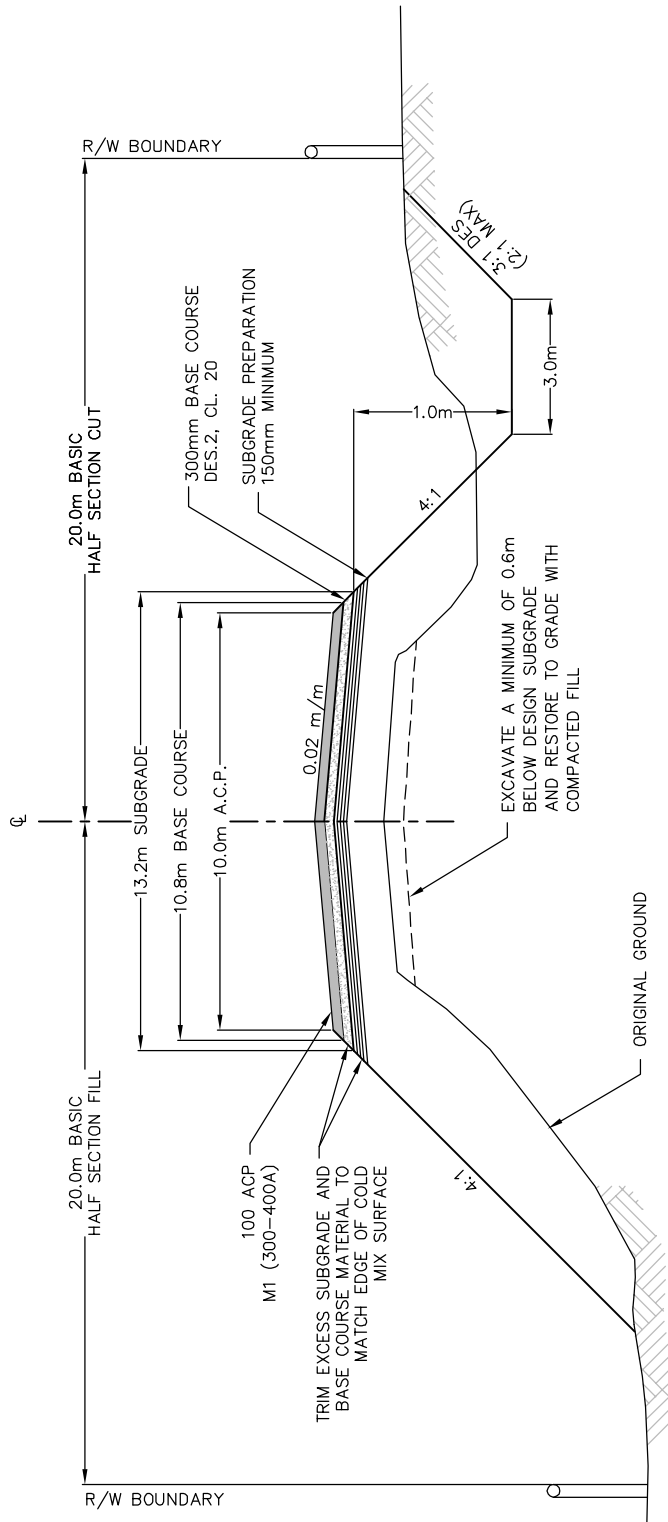
- 4:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

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Rev.		TYPICAL CROSS SECTION FOR ASPHALT CONCRETE PAVEMENT SURFACING (PROPOSED - ARTERIAL 9.0m)	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure G-09



CUT SECTION

- WIDTH OF DITCH – 3.0m STANDARD; V–DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAXIMUM

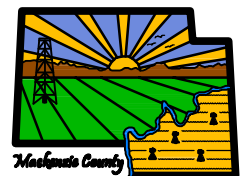
NOTE:
THIS STANDARD AND SURFACING STRUCTURE IS INTENDED FOR LOCAL ROADS WITH AN AADT < 2000.

FILL SECTION

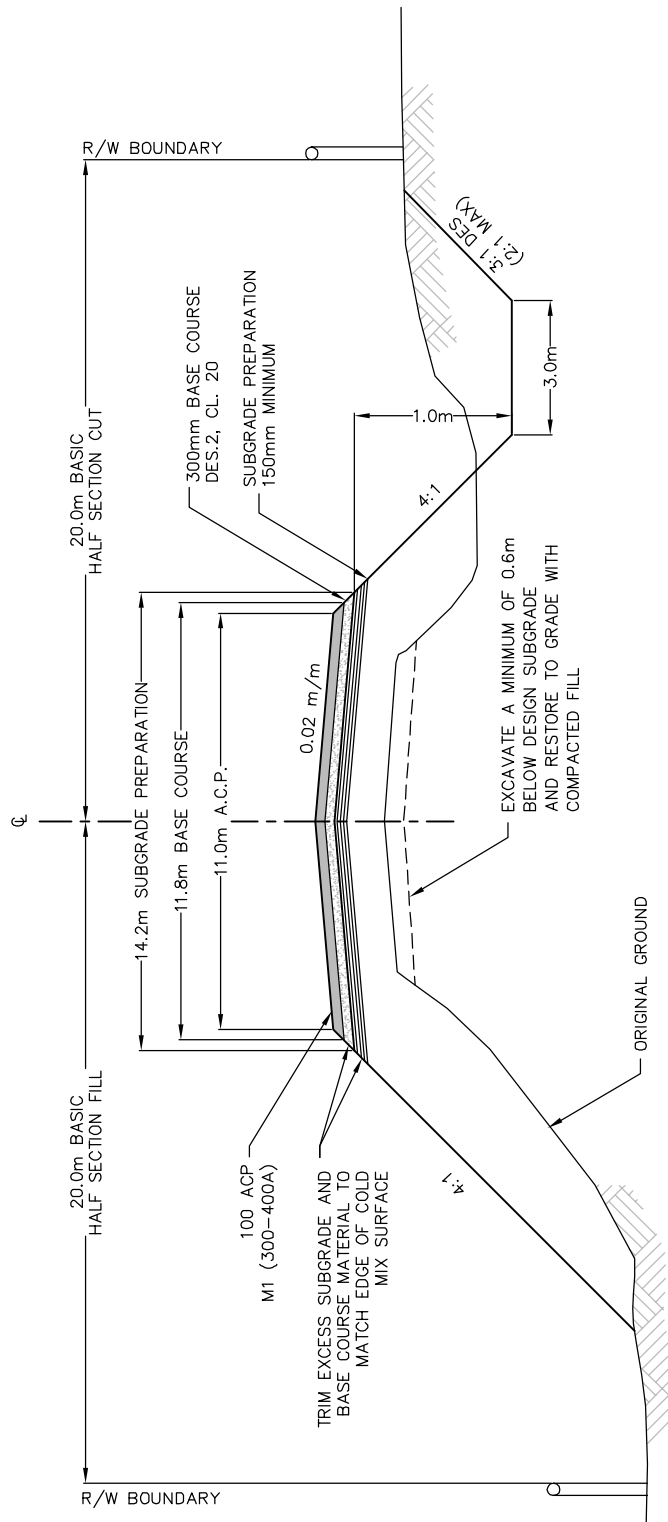
- 4:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

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Rev.		TYPICAL CROSS SECTION FOR ASPHALT CONCRETE PAVEMENT SURFACING (ARTERIAL 10.0m)		Approved:	Figure G-10
Rev.		File No.: GP60.33682	Design:		
Rev.		Drawn: K.P.L	Scale: N.T.S		
Date: 2010-AUG-31					



FILL SECTION

- 4:1 SLOPE FOR ALL FILLS
- ON FILLS GREATER THAN 8.0m THE USE OF GUARDRAIL SHOULD BE CONSIDERED
- WHERE GUARDRAIL IS INSTALLED A 2:1 SIDESLOPE IS ADEQUATE

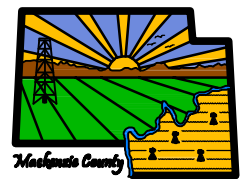
CUT SECTION

- WIDTH OF DITCH – 3.0m STANDARD; V-DITCH MINIMUM
- BACKSLOPE VARIABLE UP TO 2:1 MAXIMUM

NOTE: THIS STANDARD AND SURFACING STRUCTURE IS INTENDED FOR LOCAL ROADS WITH AN AADT > 2000.

MACKENZIE COUNTY

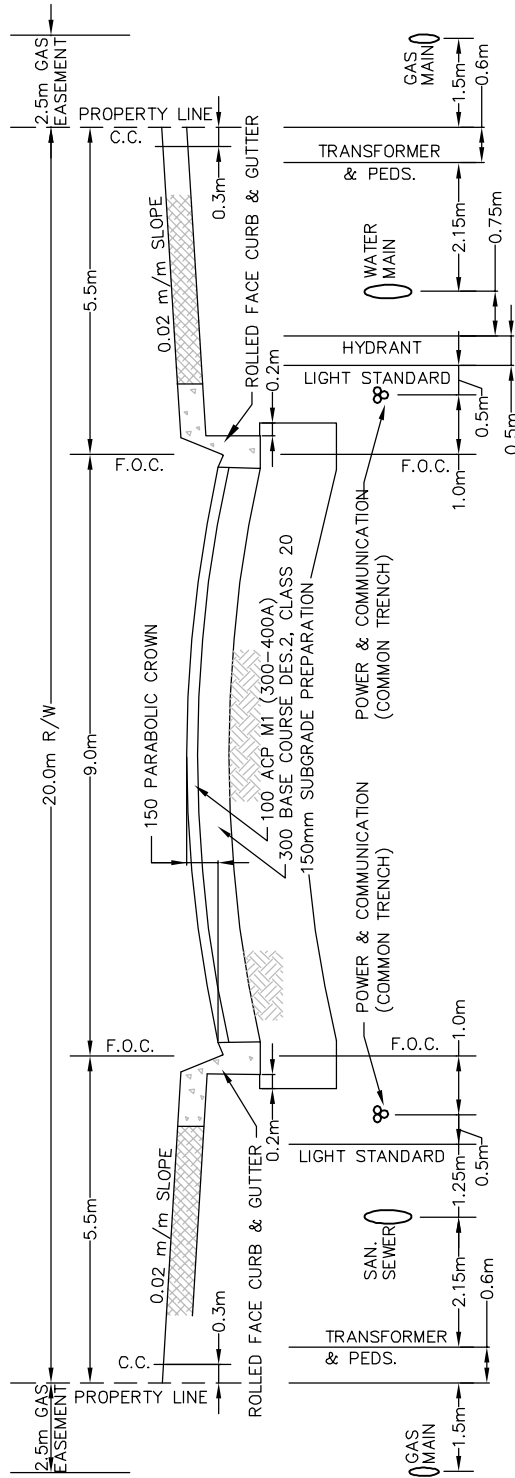
General Municipal Improvements Standards



Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

Stewart Weir Naturally Resourceful	File No.: GP60.33682	Design:
	Drawn: K.P.L	Scale: N.T.S

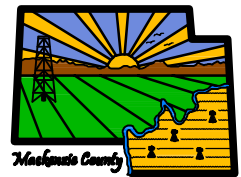
TYPICAL CROSS SECTION FOR ASPHALT CONCRETE PAVEMENT SURFACING (ARTERIAL 11.0m)	
Approved:	Figure
	G-11



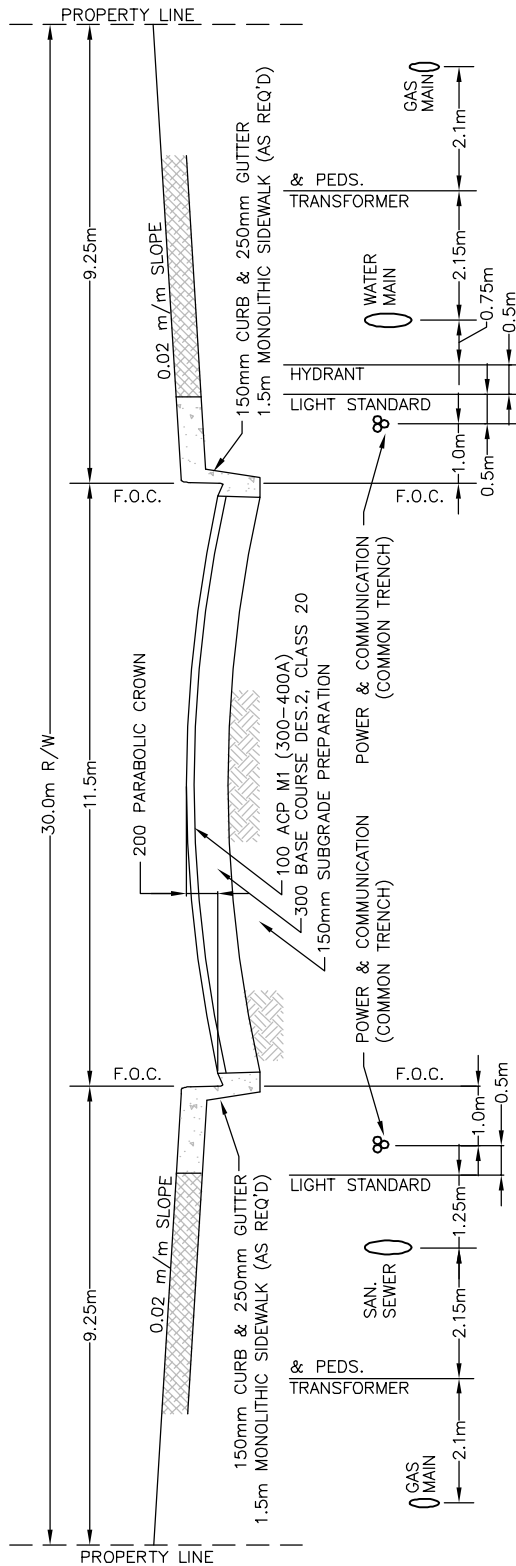
- NOTES:
1. THIS STANDARD AND SURFACING STRUCTURE IS INTENDED FOR LOCAL ROADS WITH AN AADT < 2000
 2. WICK DRAIN SHALL BE PLACED BELOW THE CURB BETWEEN THE SUBGRADE AND BASE COURSE AND CONNECTED TO THE NEAREST CATCH BASIN.

MACKENZIE COUNTY

General Municipal Improvements Standards



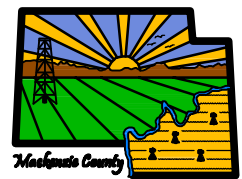
Rev.		TYPICAL CROSS SECTION & UTILITIES LAYOUT – URBAN 9.0m		Approved:	Figure G-12
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



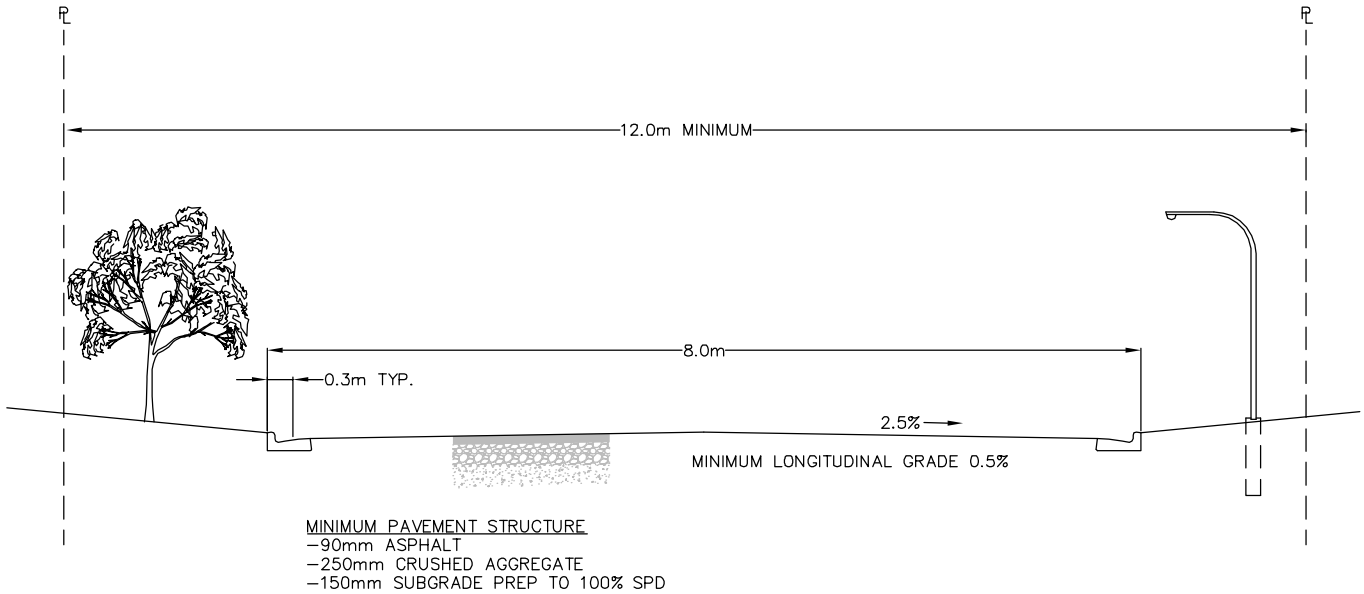
- NOTES:
1. THIS STANDARD AND SURFACING STRUCTURE IS INTENDED FOR LOCAL ROADS WITH AN AADT > 2000.
 2. WICK DRAIN SHALL BE PLACED BELOW THE CURB BETWEEN THE SUBGRADE AND BASE COURSE AND CONNECTED TO THE NEAREST CATCH BASIN.
 3. ALL DIMENSION IN METRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

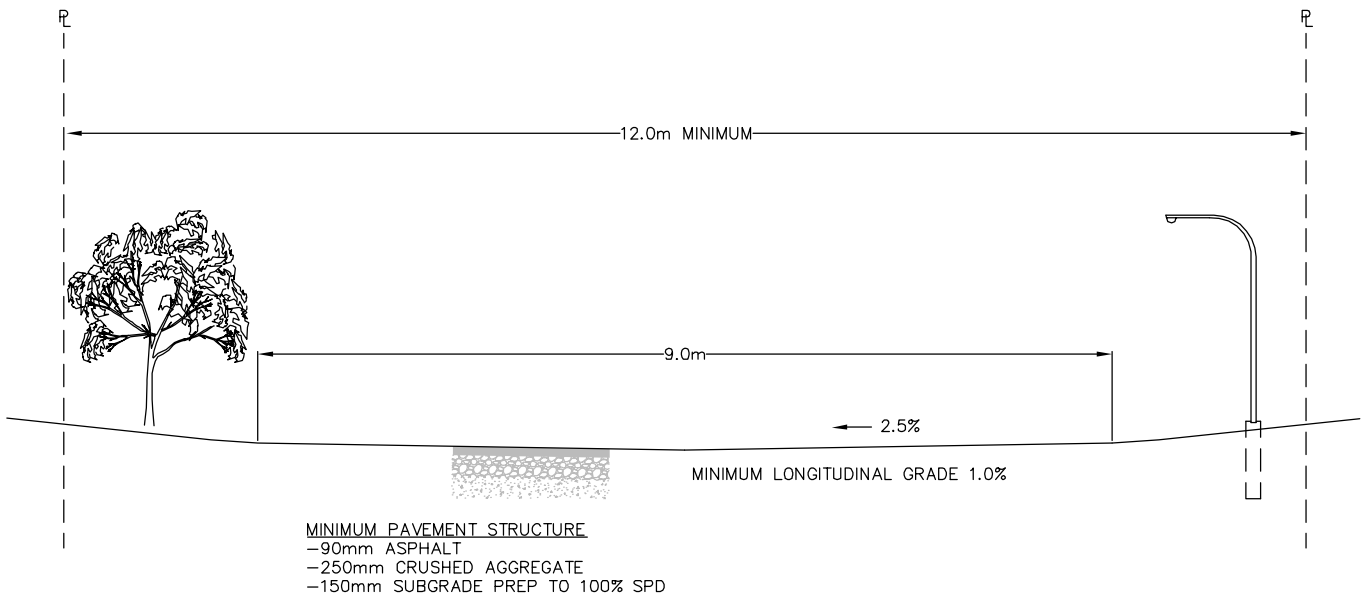
General Municipal Improvements Standards



Rev.			<p>TYPICAL CROSS SECTION & UTILITIES LAYOUT – URBAN 11.5m</p>		<p>Figure G-13</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:		Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



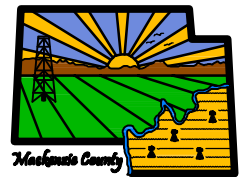
CURB AND GUTTER SECTION



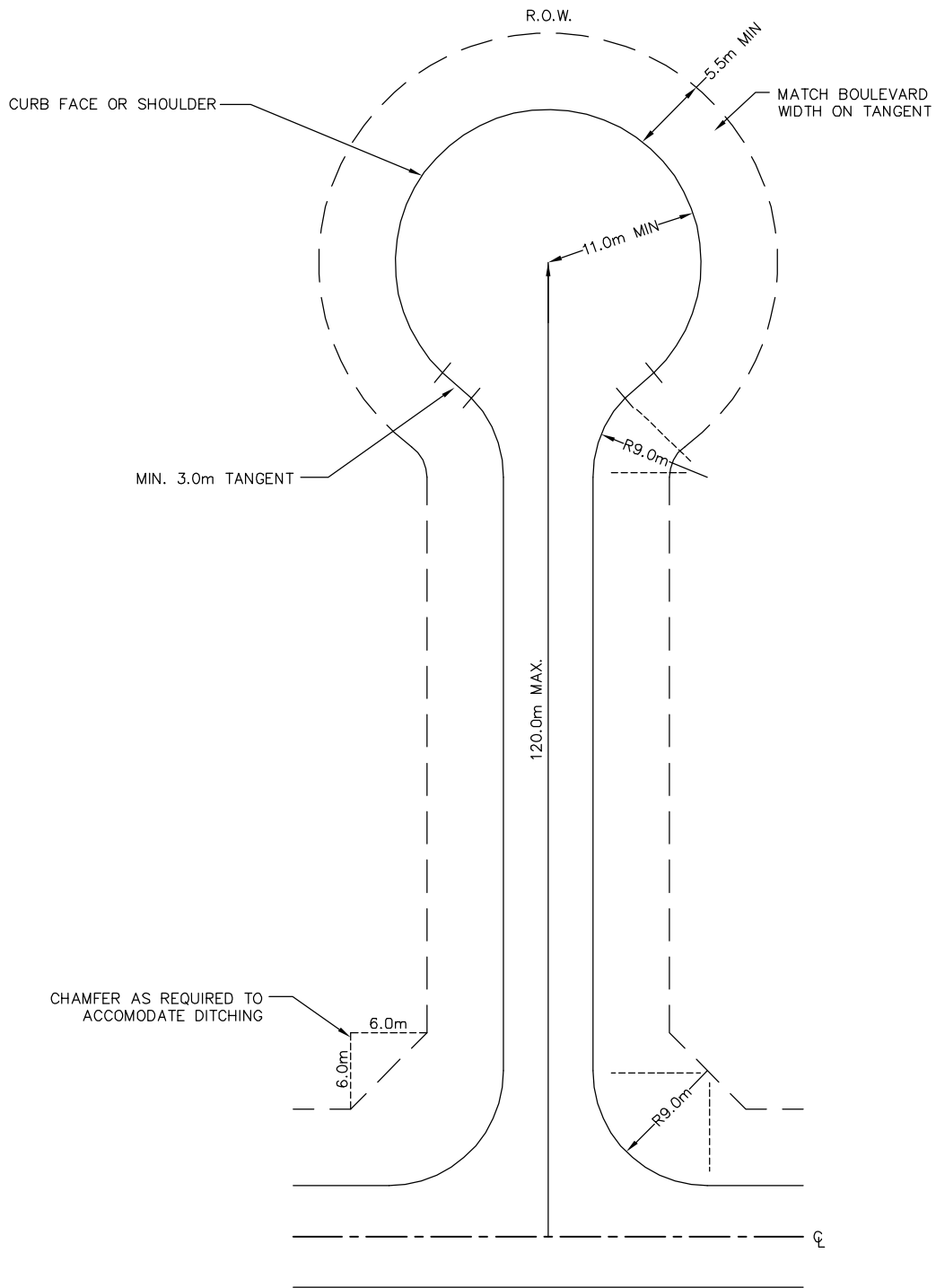
SWALE SECTION

MACKENZIE COUNTY

General Municipal Improvements Standards

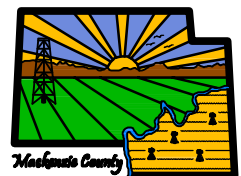


Rev.		MANUFACTURED HOMES ROADWAY SECTION		Approved:	Figure G-14
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure G-14
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



MACKENZIE COUNTY

General Municipal Improvements Standards



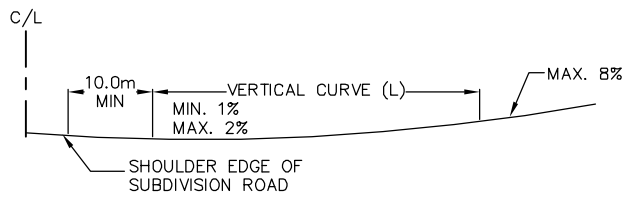
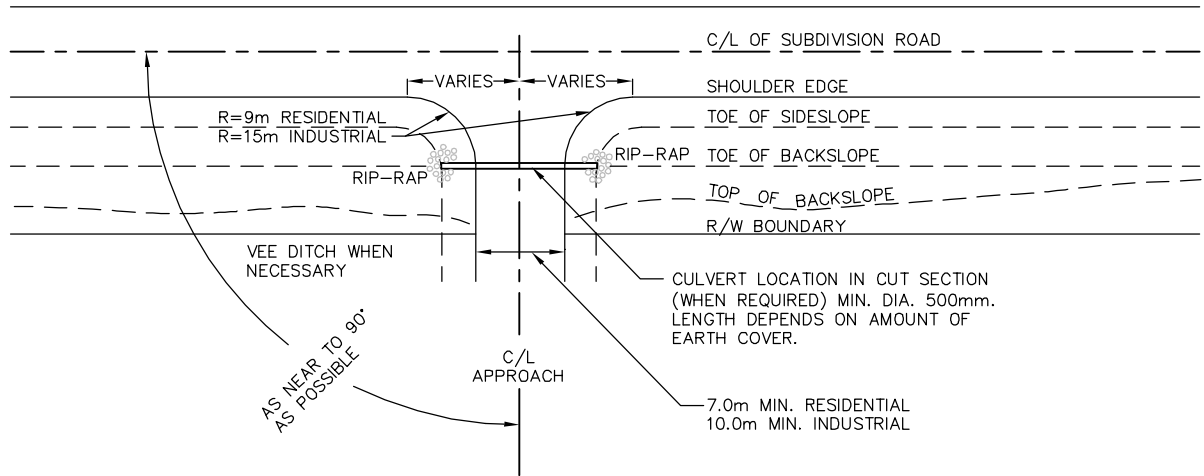
TYPICAL CUL-DE-SAC DETAIL
URBAN & RURAL STANDARD

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

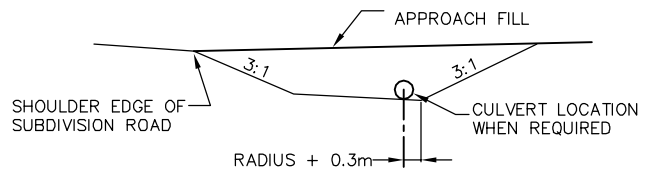
File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:	
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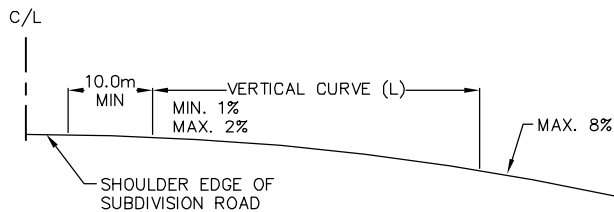
Figure	G-15
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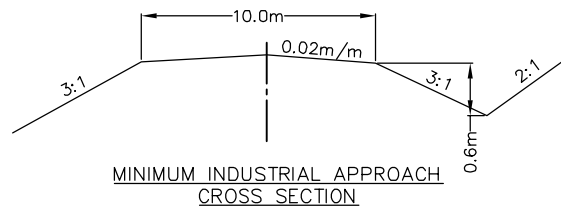
PROFILE - APPROACH IN CUT



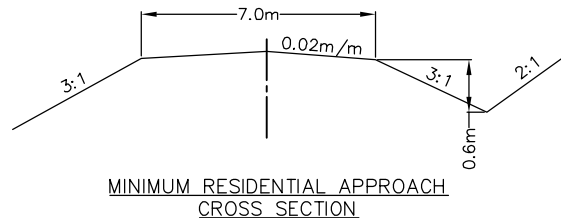
DETAIL OF DITCH & CULVERT LOCATION



PROFILE - APPROACH IN FILL



MINIMUM INDUSTRIAL APPROACH CROSS SECTION



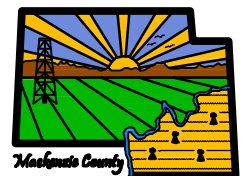
MINIMUM RESIDENTIAL APPROACH CROSS SECTION

MINIMUM LENGTH OF VERTICAL CURVE		
ALGEBRAIC DIFFERENCE IN GRADIENT (%)	LENGTH L (METRES)	
	CREST	SAG
1	5	7.5
2	12	15
3	18	23
4	25	30
5	30	38
6	37	46
7		46
8		46
9		46

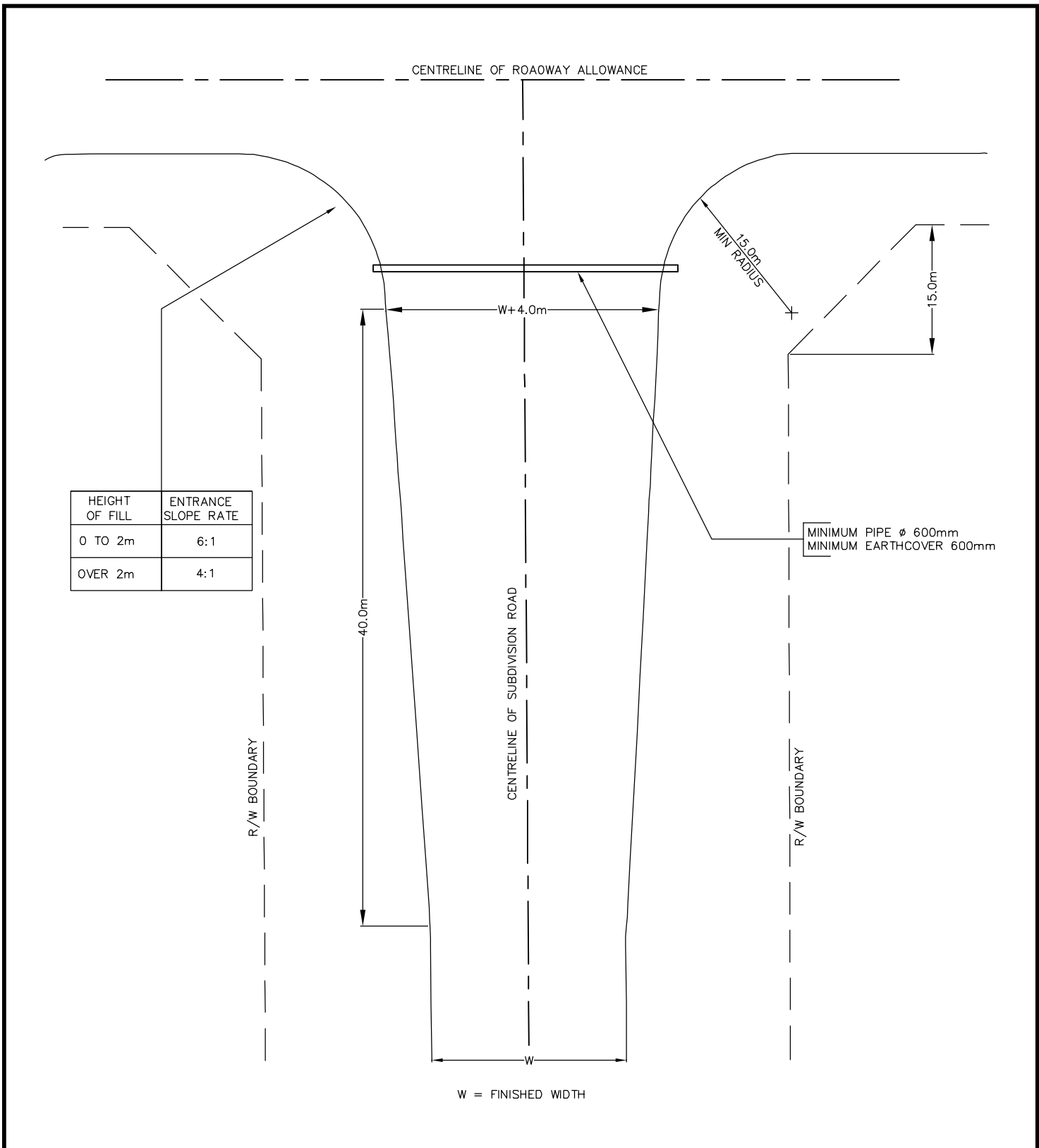
NOTE
ALL ENTRANCES ARE TO BE FROM THE INTERNAL ROAD SYSTEM AND ARE TO PROVIDE REASONABLE ACCESS TO THE LOTS, EACH LOT IS TO HAVE A PRIVATE APPROACH.

MACKENZIE COUNTY

General Municipal Improvements Standards

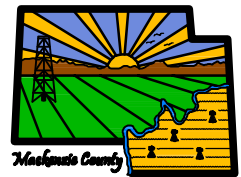


Rev.		RESIDENTIAL / INDUSTRIAL APPROACH STANDARD		Approved:	Figure G-16
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-16	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.
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Date: 2010-AUG-31



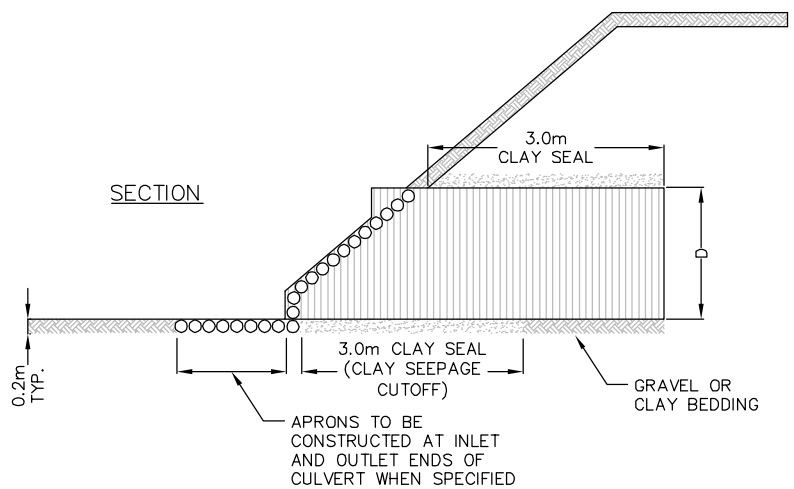
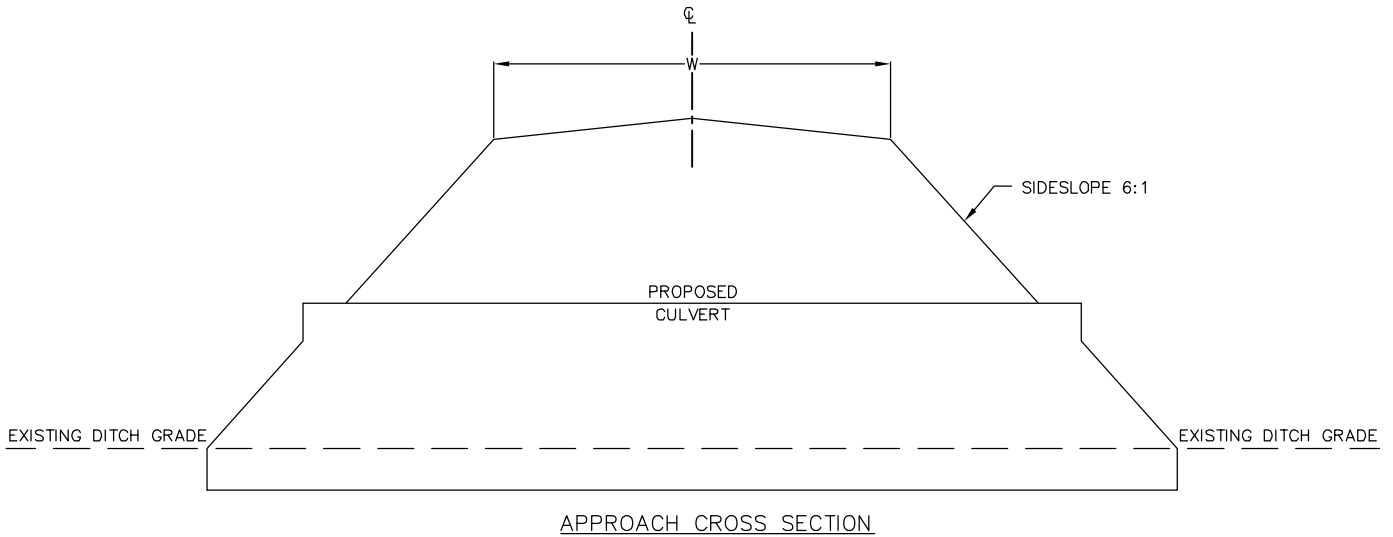
File No.: GP60.33682
 Drawn: K.P.L.

Design:
 Scale: N.T.S.

MAJOR INTERSECTION LAYOUT INDUSTRIAL - RURAL STANDARD

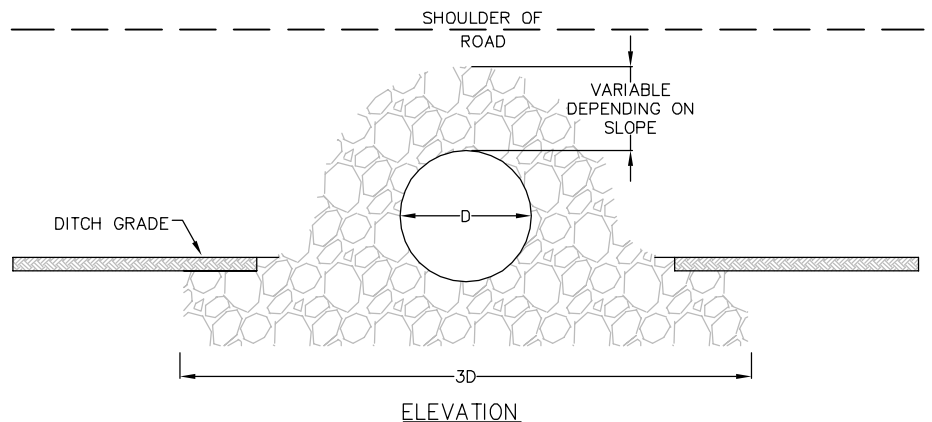
Approved:

Figure **G-17**



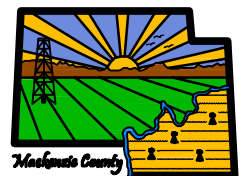
NOTES:

1. THE SIDE SLOPES OF THE APPROACH SHALL BE A MINIMUM OF 6:1 ON APPROACHES TO ALL ROADS.
2. THE MINIMUM CULVERT DIAMETER IS 500mm WITH A 300mm DEPTH OF COVER OVER C.S.P. IS PREFERRED. THE CULVERT SHALL BE ALIGNED WITH THE BACK OF THE DITCH BOTTOM. THE CULVERT IS TO BE COUNTERSUNK 20% OF THE PIPE DIAMETER BELOW THE DITCH BOTTOM.
4. THE CULVERT SHALL BE OF SUCH LENGTH AS TO PROVIDE A NEAT, FINISHED APPEARANCE WITHOUT EXCESS EXPOSED PIPE. STRAIGHT END CULVERTS ARE NOT ACCEPTABLE.
5. ROCK RIP-RAP SHALL BE HAND LAID AT BOTH ENDS OF THE CULVERT IN ACCORDANCE WITH THE DRAWING G-20.



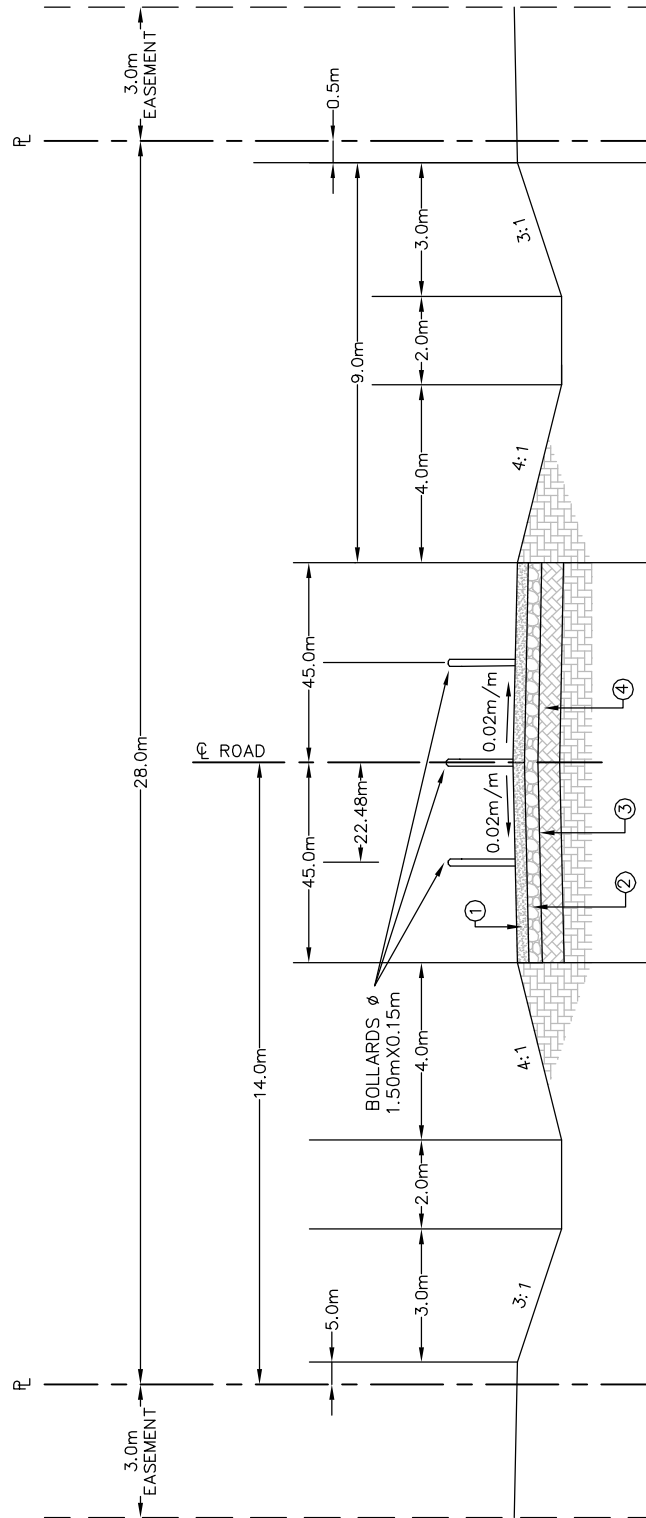
MACKENZIE COUNTY

General Municipal Improvements Standards



ACCESS WITH CULVERT

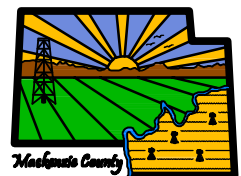
Rev.			Approved:		Figure G-18
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:			
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



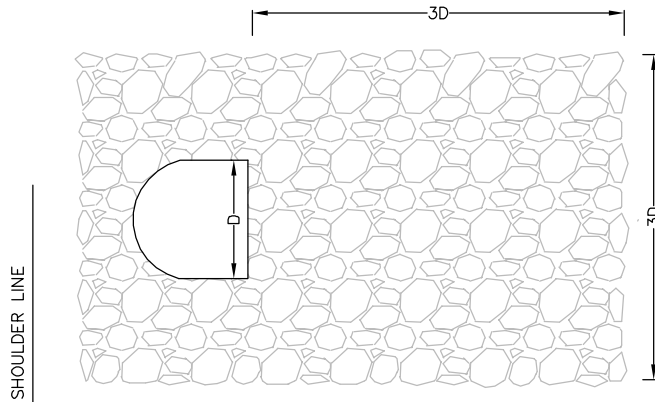
- NOTES:
1. 50mm DEPTH COMPACTED GRAVEL/SHALE 10mm - 20mm DIAMETER.
 2. 75mm DEPTH 20mm DIAMETER CRUSHED GRAVEL BASE COMPACTED TO 98% S.P.D.
 3. WOVEN FABRIC UNDER GRAVEL (TENSAR SSI GEOGRID/NILEX 2006 AMOCO GEOTEXTILE OR APPROVED EQUIVALENT).
 4. 150mm DEPTH SUBGRADE COMPACTED TO 98% S.P.D. ON:
 A) NATIVE SUBGRADE - FREE OF TOPSOIL, ROOTS AND/OR DEBRIS.
 B) COMMON FILL - CLEAN CLAY OR GRANULAR MATERIAL PLACED OVER APPROVED SUBGRADE AND COMPACTED TO 98% S.P.D.
 5. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
 6. MUNICIPALITY MAY ACCEPT ALTERNATE EASEMENT WIDTH.

MACKENZIE COUNTY

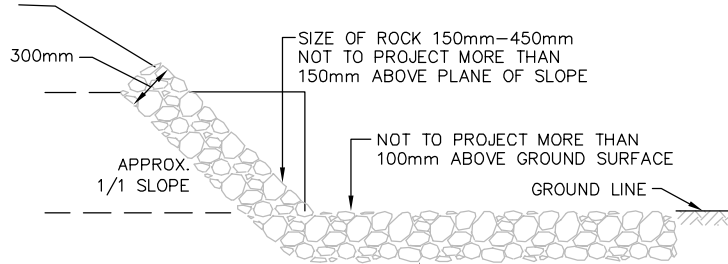
General Municipal Improvements Standards



Rev.			EMERGENCY LANE ACCESS DETAIL	
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-19
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

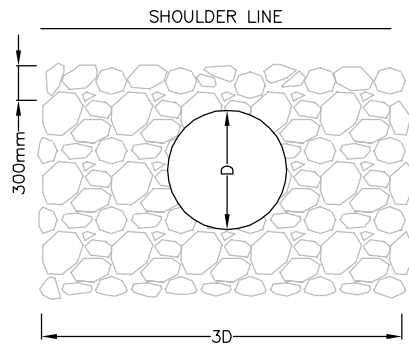


TOP VIEW (OUTLET)

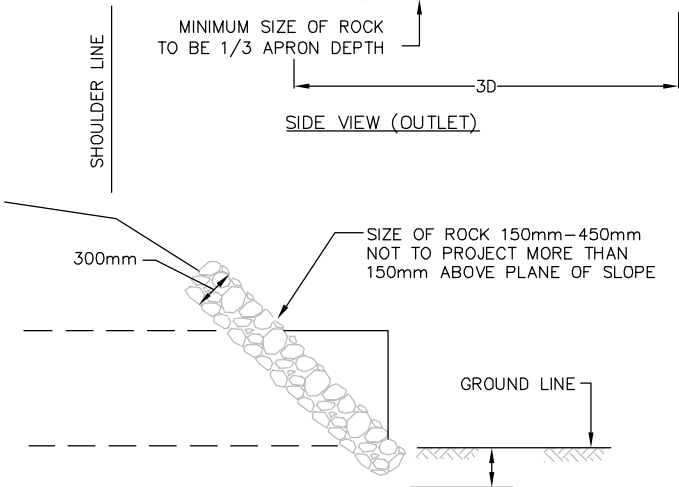


SIDE VIEW (OUTLET)

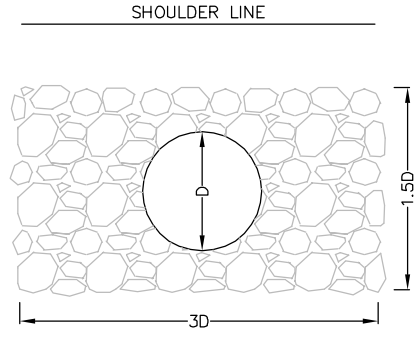
DIAMETER OF PIPE D	EQUIVALENT SIZE OF PIPE ARCH
400mm	450mmX340mm
500mm	580mmX390mm
600mm	680mmX480mm
800mm	930mmX645mm
1000mm	1160mmX800mm
1200mm	1425mmX960mm
1400mm	1660mmX1090mm
1600mm	1870mmX1230mm
1800mm	2130mmX1400mm



FRONT VIEW (OUTLET)



SIDE VIEW (INLET)



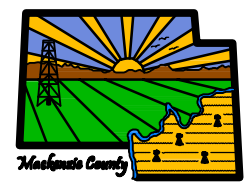
FRONT VIEW (INLET)

DIAMETER OF PIPE - D	300mm	500mm	600mm	800mm	1000mm	1200mm	1400mm	1600mm	1700mm	1800mm
* QUANTITY	1	2	3	5	10	13	16	20	28	33
APRON DEPTH	300mm	500mm			600mm			750mm		

*TOTAL QUANTITY OF RIP-RAP IN CUBIC METRES

MACKENZIE COUNTY

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HAND PLACED RIP-RAP FOR PIPE CULVERTS

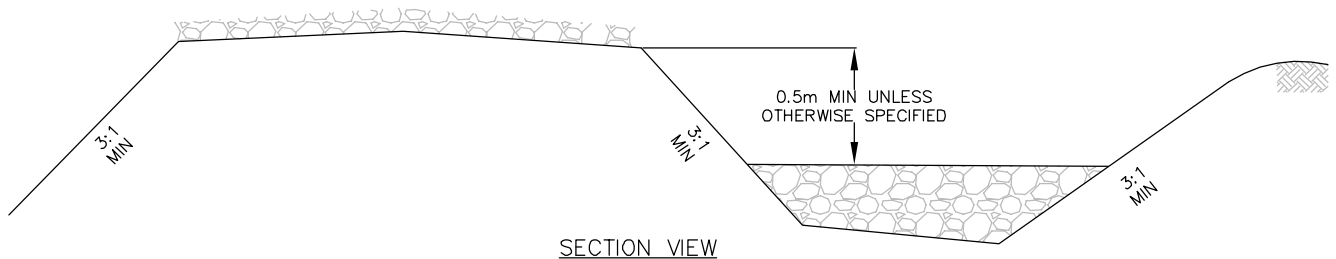
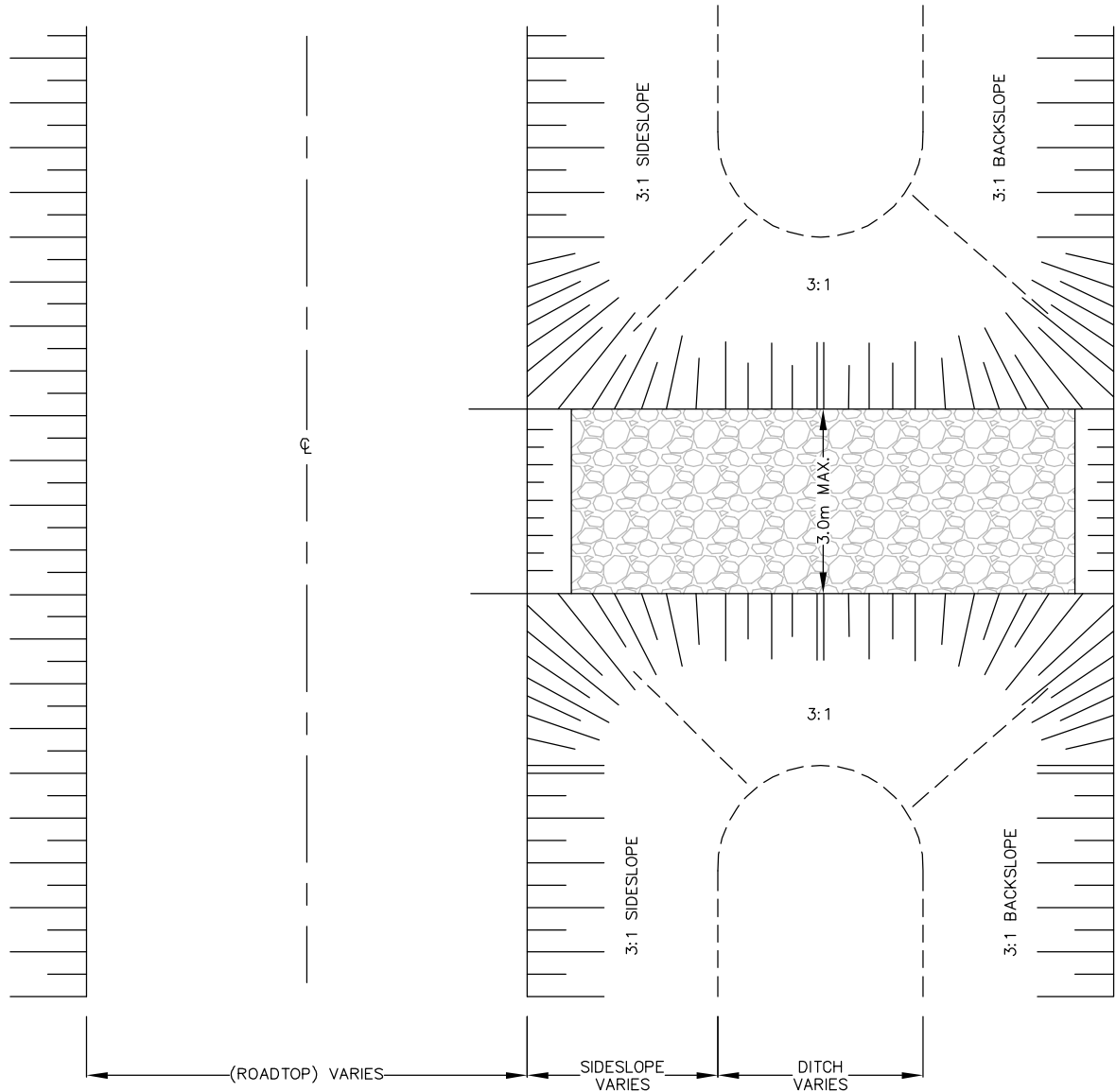
Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:

Figure G-20

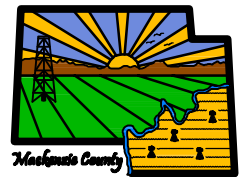
PLAN VIEW



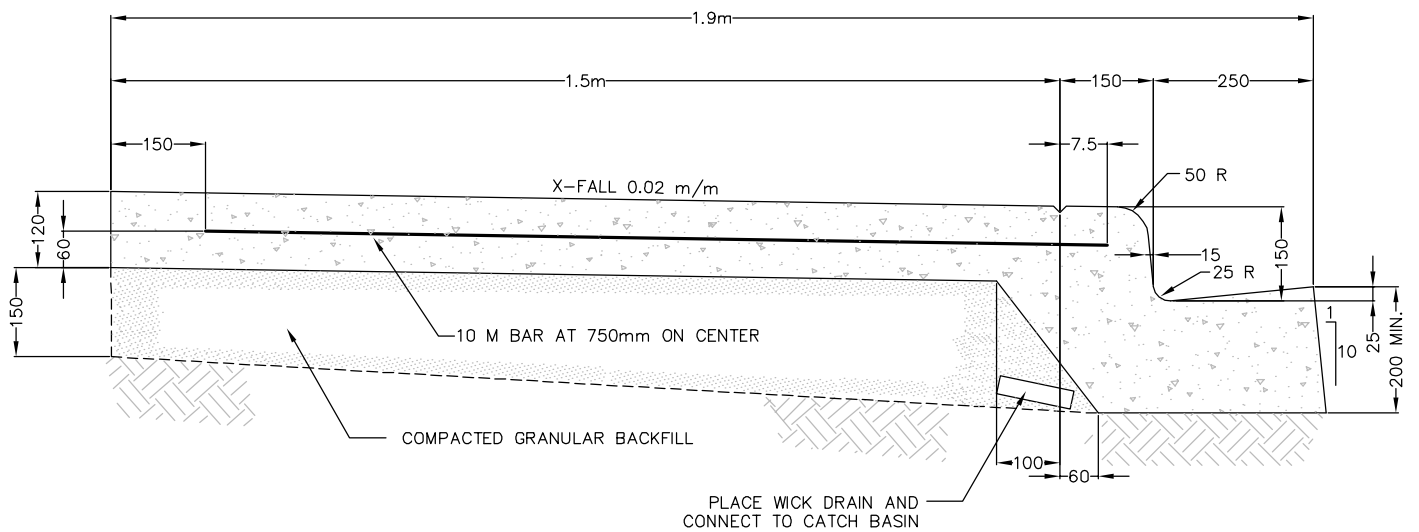
SECTION VIEW

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TYPICAL VIEWS OF A DITCH BLOCK		Approved:	Figure G-21
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-21	
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			

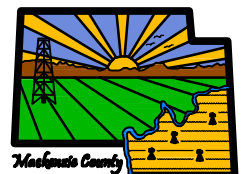


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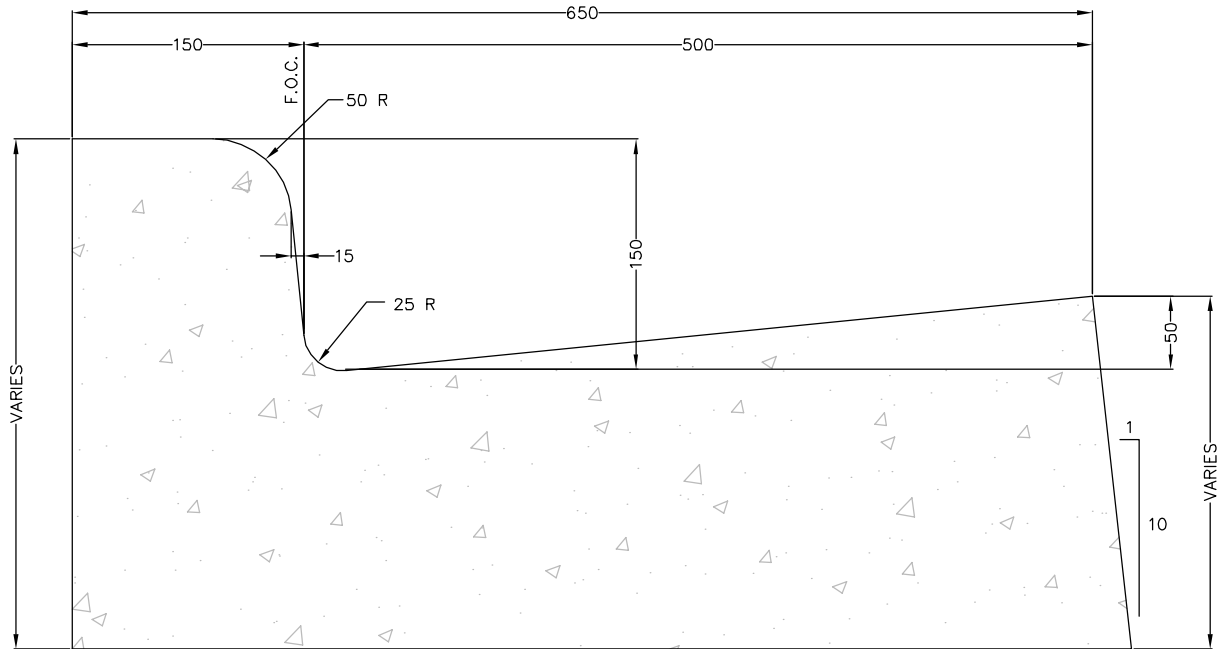
1. DEPTH OF GUTTER FACE TO MATCH ROAD STRUCTURE.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>1.5m MONOLITHIC WALK WITH 150 CURB & GUTTER</p>		<p>Approved:</p>	<p>Figure G-23</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-23	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

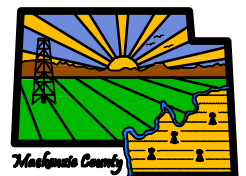


NOTES:

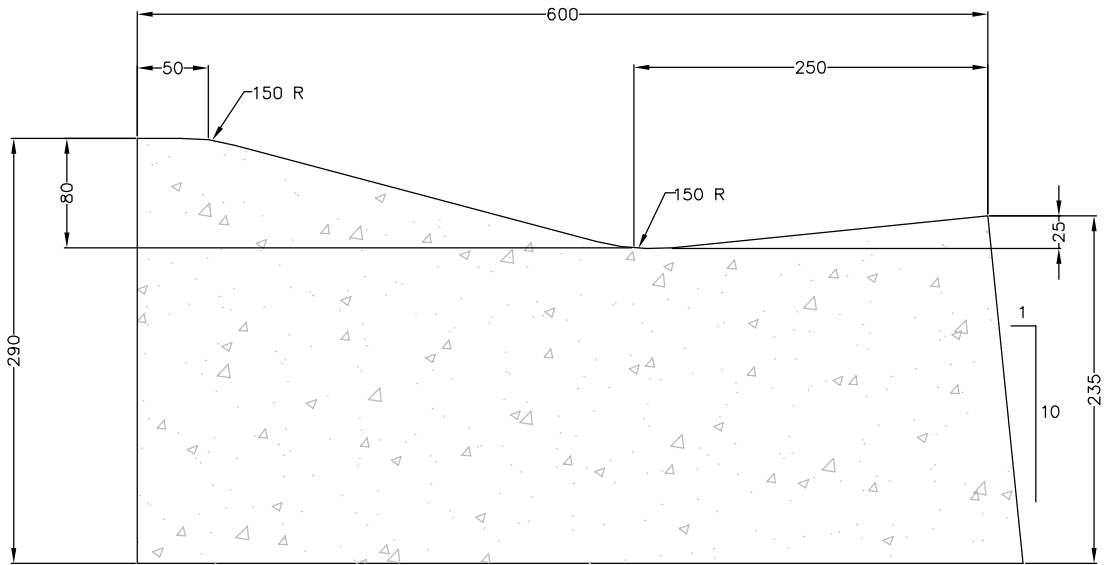
1. DEPTH OF GUTTER FACE TO MATCH DEPTH OF ROAD STRUCTURE.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		150 CURB WITH 500 GUTTER	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	

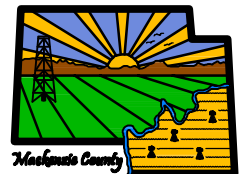


NOTES:

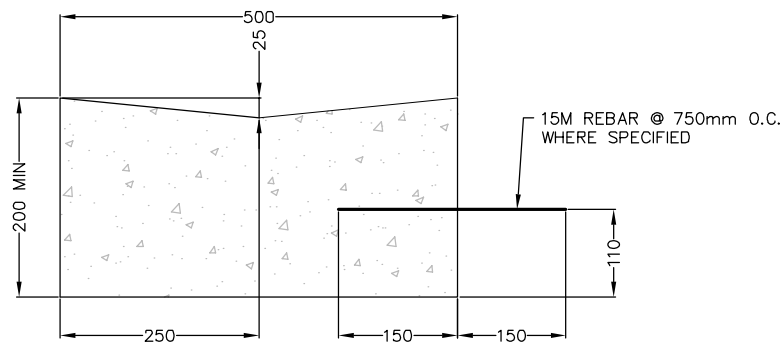
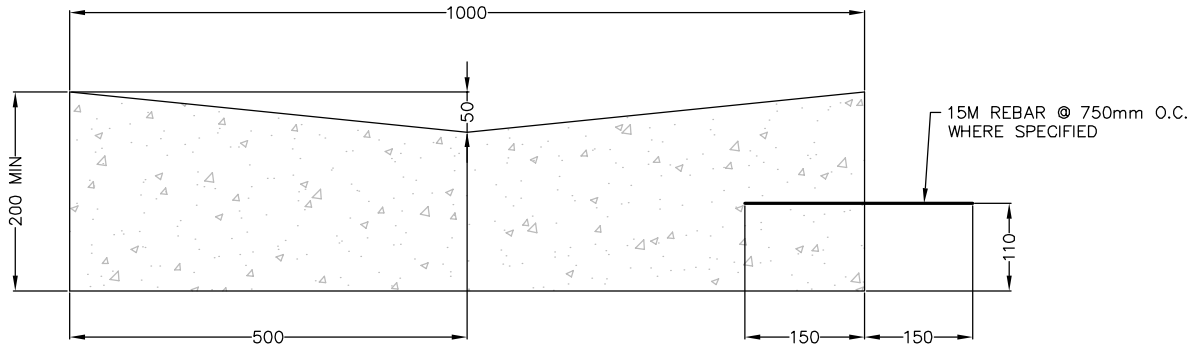
1. DEPTH OF GUTTER FACE TO MATCH DEPTH OF ROAD STRUCTURE.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		ROLL FACE CURB AND GUTTER		Figure G-26
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-26
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

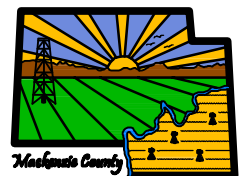


NOTES:

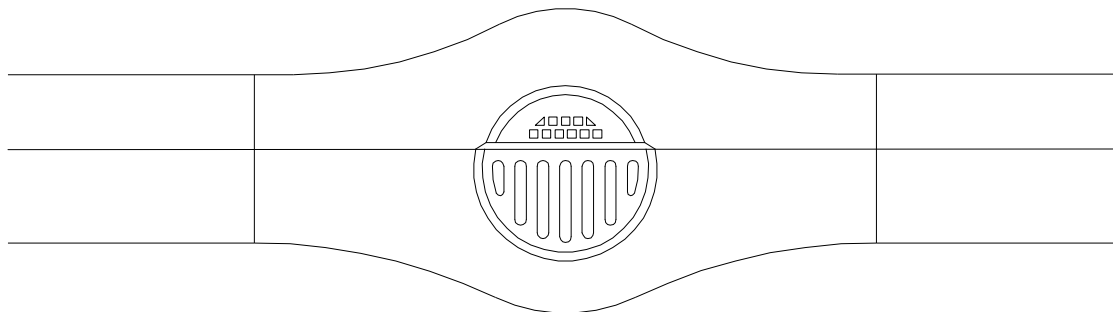
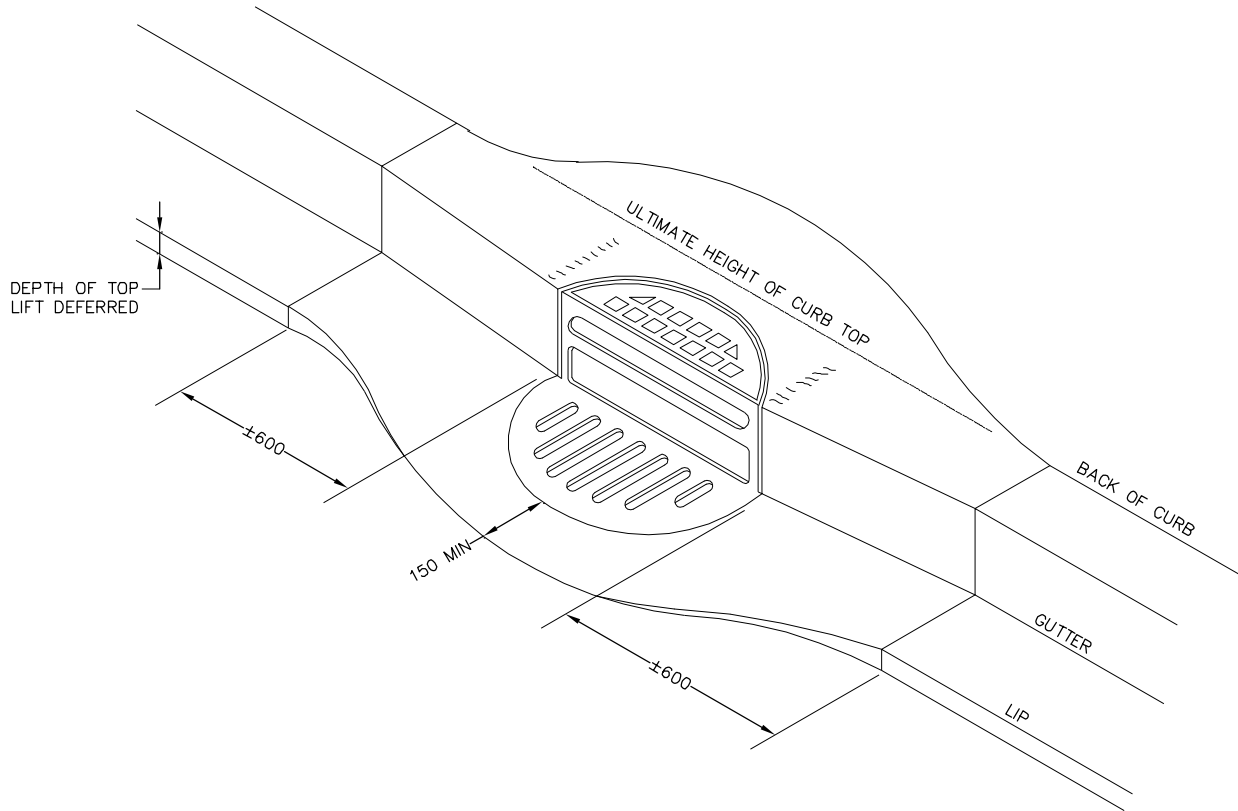
1. DEPTH OF GUTTER FACE TO MATCH ROAD STRUCTURE.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>500mm & 1000mm CONCRETE GUTTER (SWALE)</p>		<p>Approved:</p>	<p>Figure G-27</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-27	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



PLAN VIEW

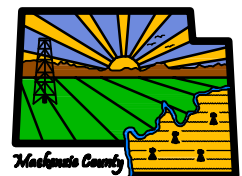
CATCH BASIN WHEN ASPHALT TOP LIFT IS DEFERRED

NOTES:

1. TYPICAL CURB & GUTTER TREATMENT AT CATCH BASIN. LOCATION TO BE DETERMINED BY ENGINEER.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

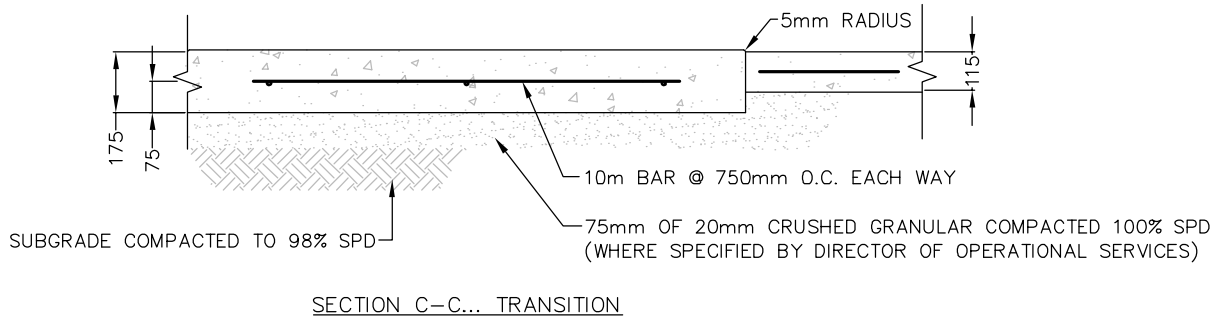
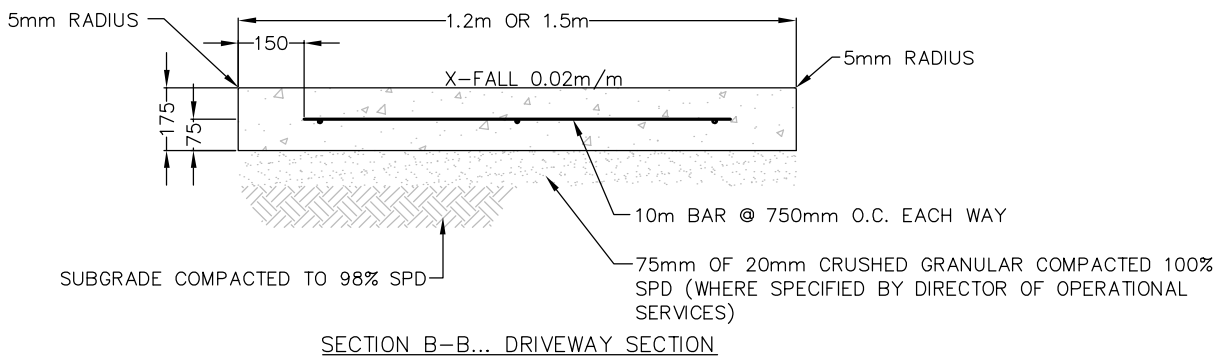
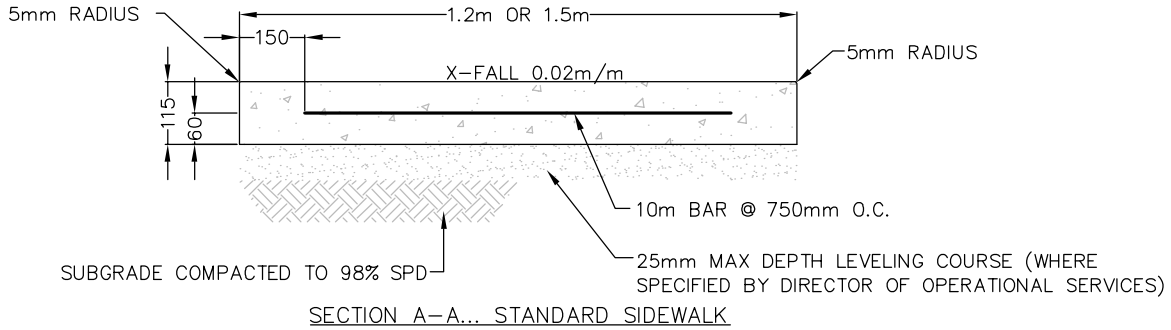
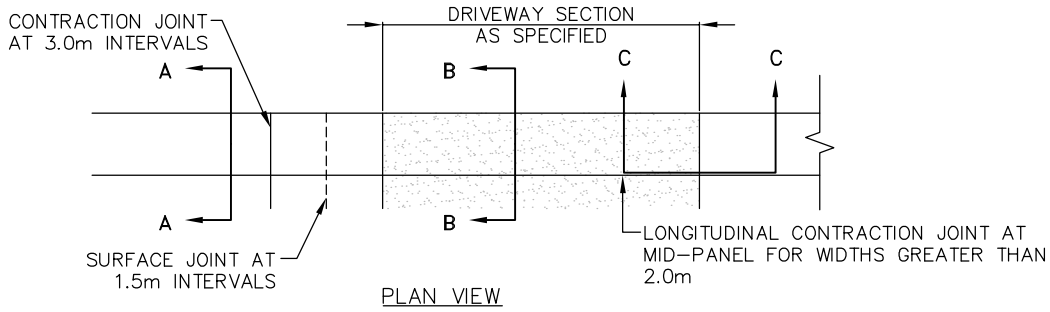
MACKENZIE COUNTY

General Municipal Improvements Standards



DEPRESSED CURB & GUTTER FOR CATCH BASIN

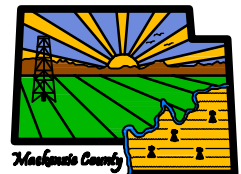
Rev.			Approved:	Figure G-28
Rev.				
Rev.			Approved:	Figure G-28
Rev.				
Date: 2010-AUG-31	File No.: GP60.33682	Design:	Approved:	Figure G-28
	Drawn: K.P.L	Scale: N.T.S		



NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



1.2m OR 1.5m SEPARATE SIDEWALK

Approved:

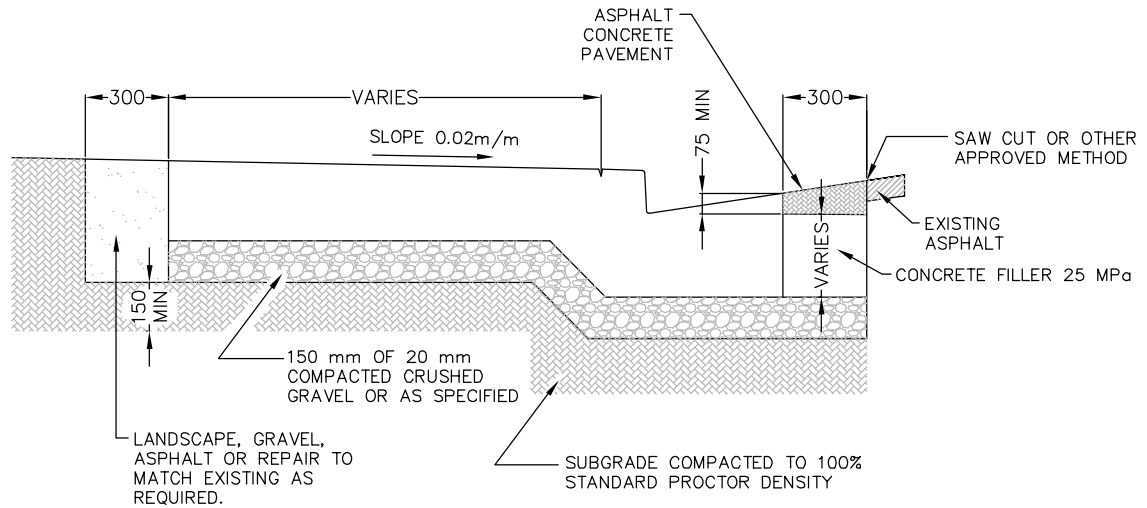
Figure G-29

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.: GP60.33682

Design:
Scale: N.T.S

Drawn: K.P.L

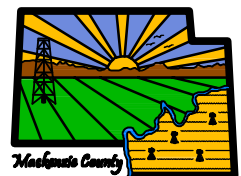


NOTES:

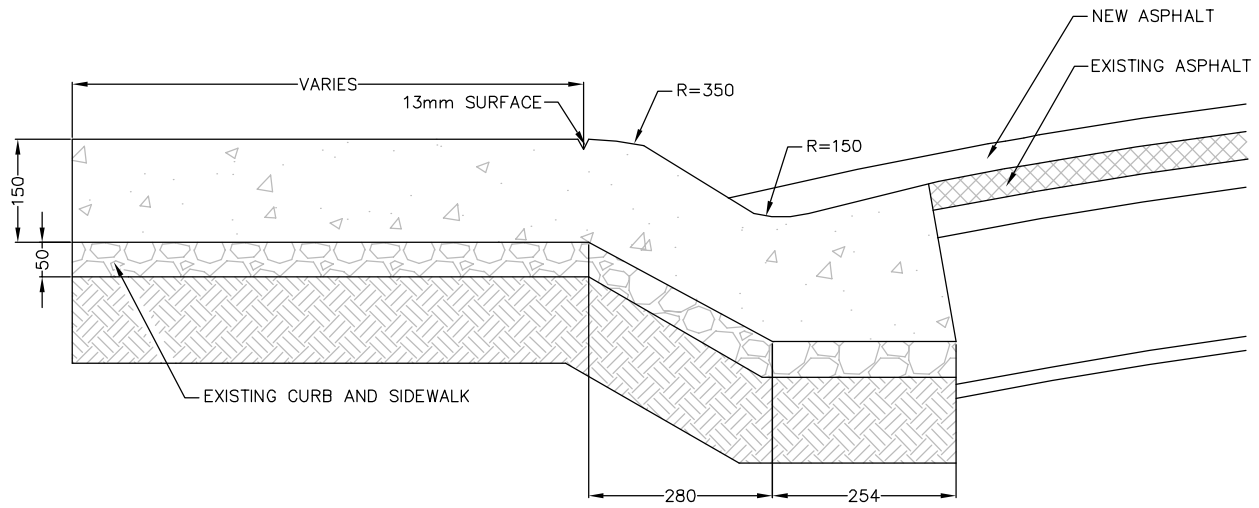
1. PLACE PAVING STONE OR CONCRETE SIDEWALK AS PER PLANS.
2. USE APPROPRIATE CURB AND GUTTER AS PER CONCRETE STRUCTURES DRAWINGS.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		RECONSTRUCTION OF SIDEWALK		Figure G-30
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

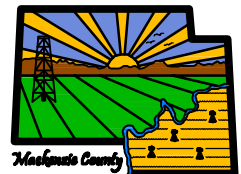


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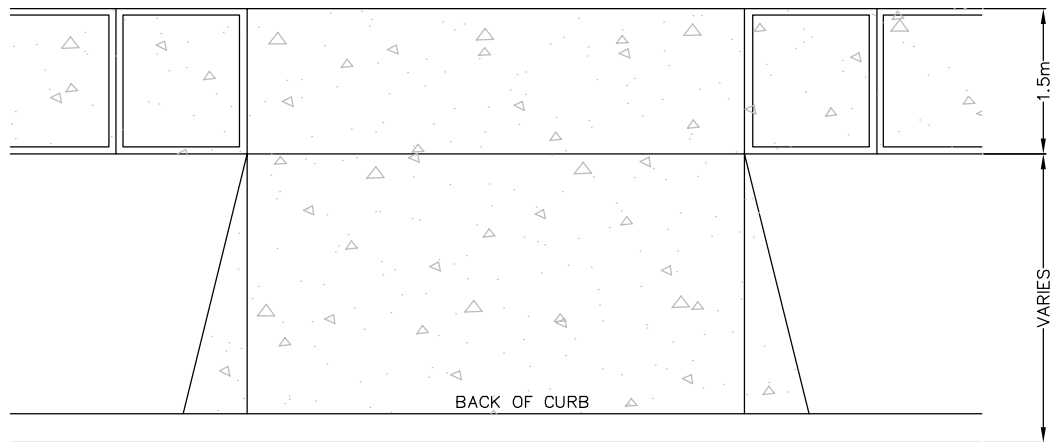
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

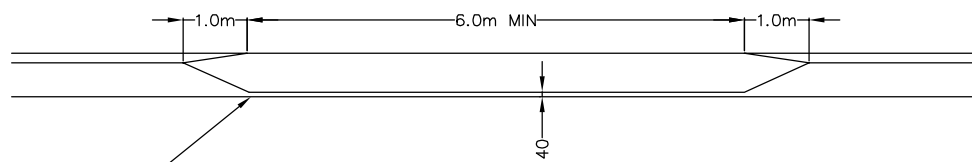
General Municipal Improvements Standards



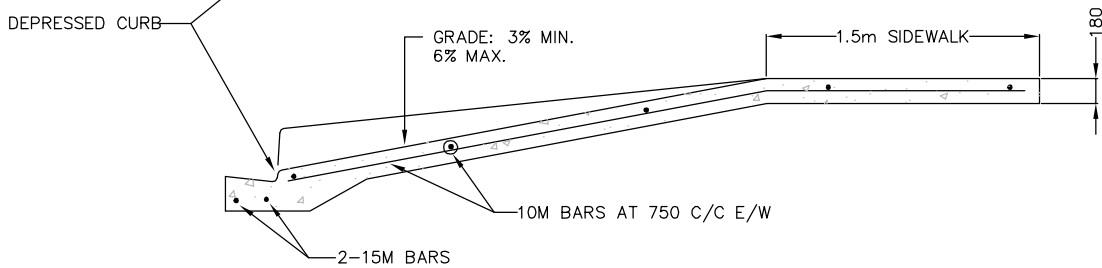
Rev.		<p>TYPICAL MATCH OF NEW OVERLAY AND EXISTING CURB & GUTTER</p>		<p>Approved:</p>	<p>Figure G-31</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-31	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



LIP OF GUTTER
PLAN



ELEVATION



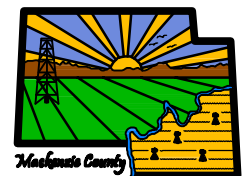
SECTION

NOTES:

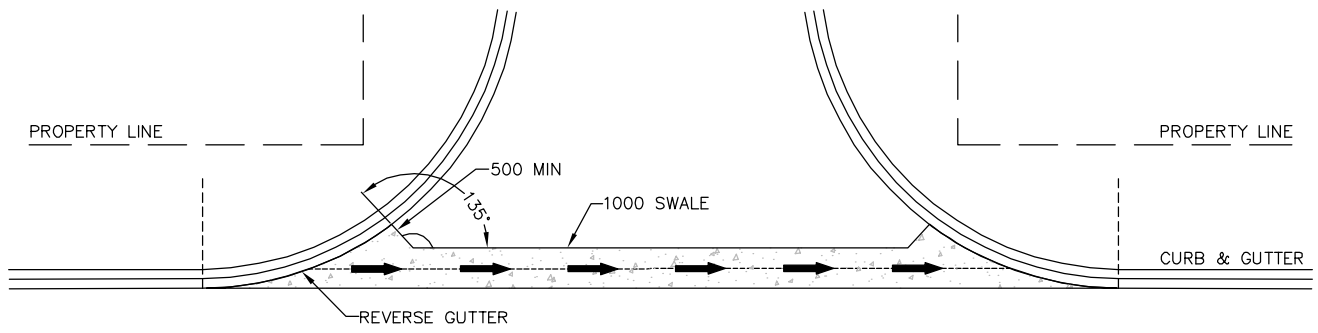
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. 30 MPa TYPE 50 SR CONCRETE.
3. SUBGRADE TO BE COMPACTED TO 98% SPD.
4. 100mm DEPTH OF GRANULAR COMPACTED TO 100% S.P.D. TO BE PLACED BELOW THE CONCRETE.
5. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

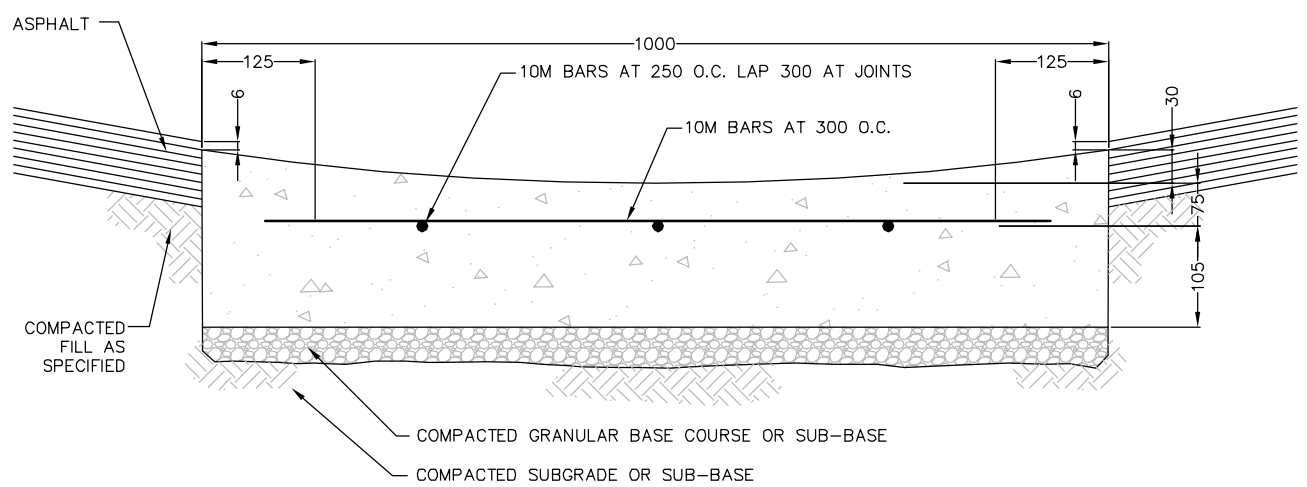
General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	LANE OR COMMERCIAL CROSSING (HAND PLACED)		Approved:	Figure G-32
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure G-32
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



PLAN



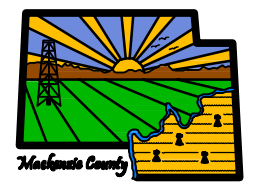
SECTION

NOTES:

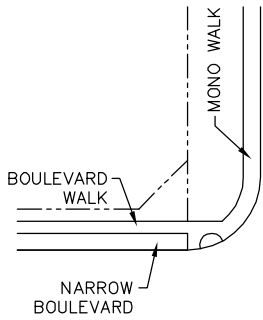
1. CONTRACTION JOINTS SPACED AT 3m INTERVAL.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

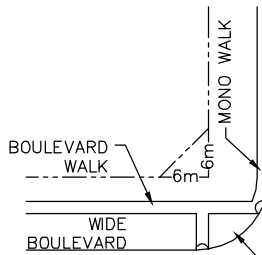
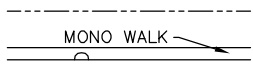
General Municipal Improvements Standards



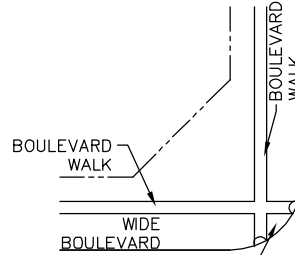
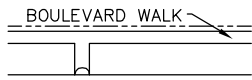
Rev.		1000mm CONCRETE SWALE PLAN & SECTION		Approved:	Figure G-34
Rev.					
Rev.		File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



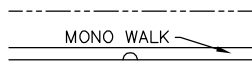
RAMP TYPE A



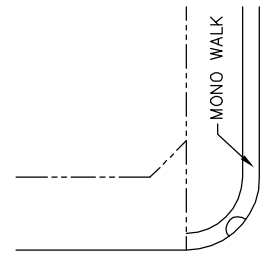
RAMP TYPE B



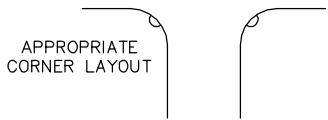
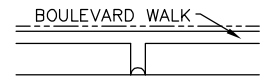
RAMP TYPE B



CONCRETE IF LESS THAN 3.0m² USE RAMP TYPE A

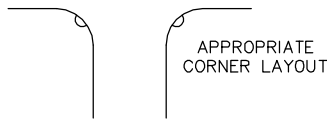


RAMP TYPE A



LOCATE RAMP DIRECTLY ACROSS FROM CORNER RAMPS

RAMP TYPE C



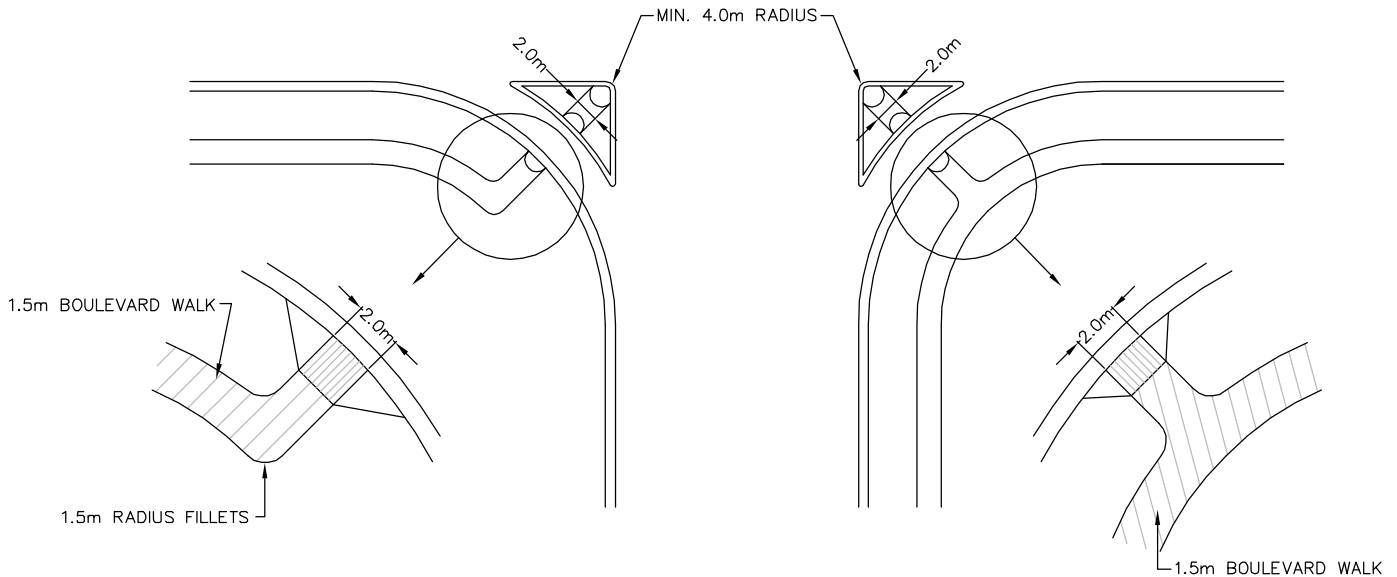
LOCATE RAMP DIRECTLY ACROSS FROM CORNER RAMPS

RAMP TYPE D

RAMP TYPE C

RAMP TYPE D

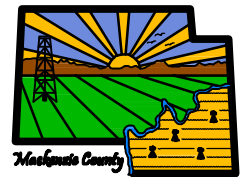
TANGENT LAYOUT



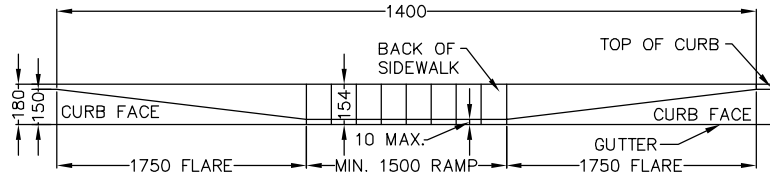
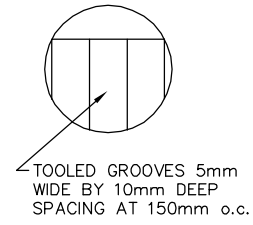
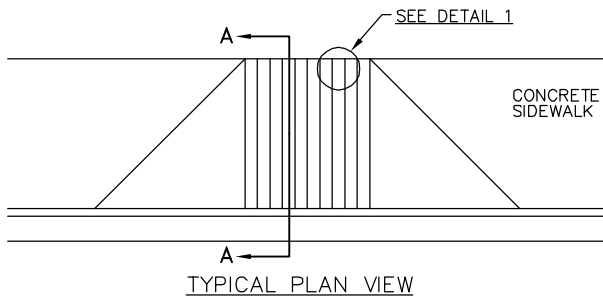
RAMP TYPE D INTERSECTION LAYOUT

MACKENZIE COUNTY

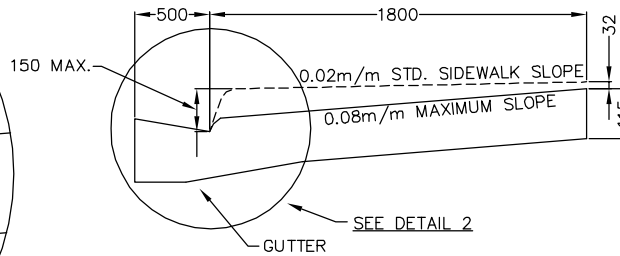
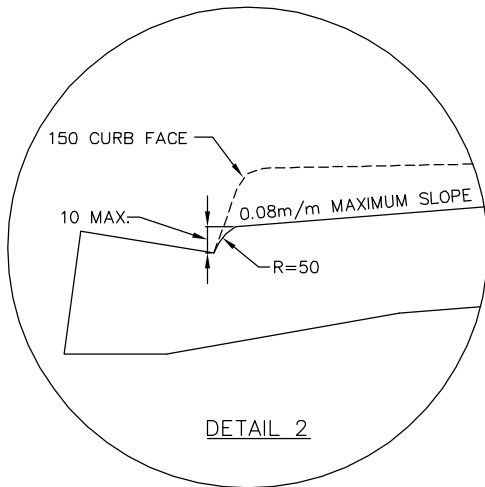
General Municipal Improvements Standards



Rev.		<p>CURB RAMP LOCATIONS</p>		<p>Approved:</p>	<p>Figure G-35</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure G-35</p>	
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			



TYPICAL ELEVATION



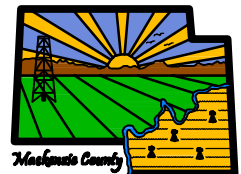
TYPICAL CROSS SECTION (A-A)

NOTES:

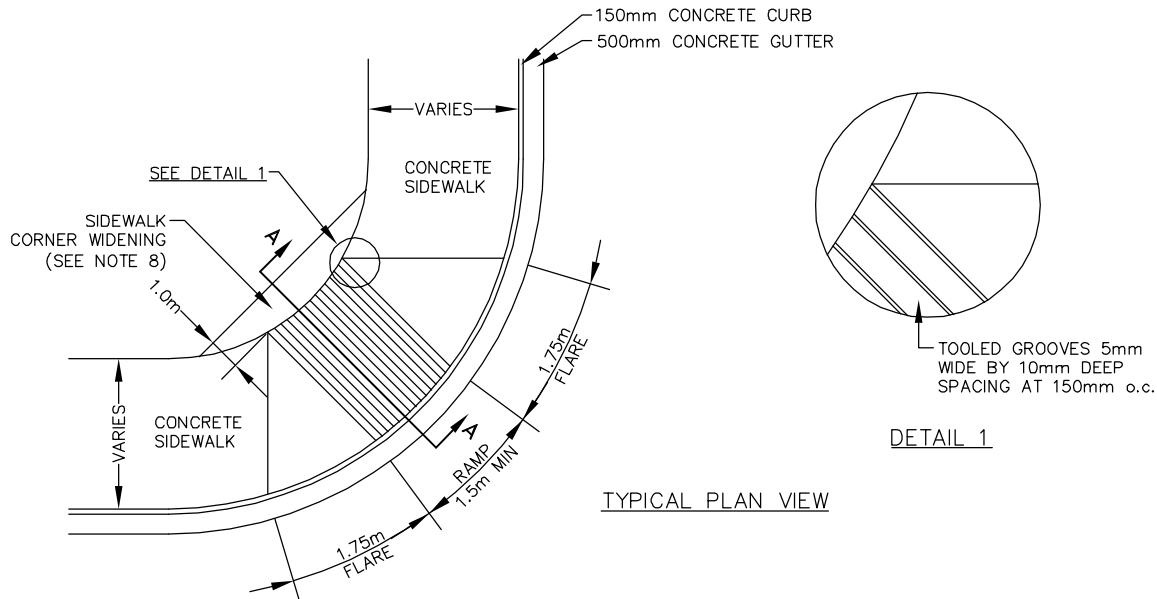
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. RAMP FOR USERS OF WHEELCHAIRS/BICYCLES SHOULD BE LOCATED AT ALL JUNCTIONS OF CROSSWALKS AND SIDEWALKS. RAMP MUST BE LOCATED WITHIN A SIDEWALK.
3. GROOVES ON SIDEWALK RAMP ARE TO ALERT PERSONS WHO ARE VISUALLY IMPAIRED OF THE CURB-CUT AND A STREET CROSSING.
4. WHERE CROSSWALKS ARE CONTROLLED BY SIGNALS WITH A PUSH-BUTTON SYSTEM, THE SIDEWALK AND RAMP MUST ALLOW ACCESS FOR WHEELCHAIR TO PUSH BUTTON.
5. MINIMUM WIDTH OF RAMP IS 1500mm. IT MAY BE NECESSARY TO BUILD WIDER RAMP IN BUSY URBAN AREAS WHERE VOLUME OF PEDESTRIAN TRAFFIC IS HIGH.
6. MAXIMUM RAMP SLOPE IS 0.08m/m.
7. WHERE THE SIDEWALK IS LESS THAN 1800mm WIDE, THE 0.08m/m MAX. SLOPE SHOULD NOT BE EXCEEDED AND THEREFORE THE BACK OF THE SIDEWALK MUST BE LOWERED ACCORDINGLY.
8. WHERE RIGHT-OF-WAY IS AVAILABLE, THE SIDEWALK IS TO BE WIDENED AT CORNER LOCATIONS AS SHOWN SO THAT AT LEAST A 1.0m WIDTH OF "FLAT" SIDEWALK IS PROVIDED ADJACENT TO THE RAMP.

MACKENZIE COUNTY

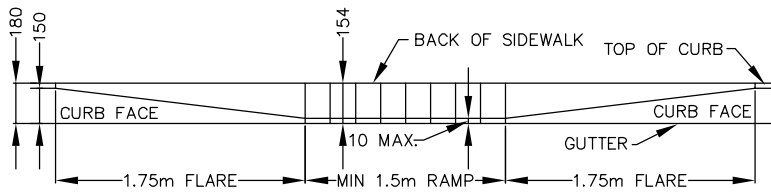
General Municipal Improvements Standards



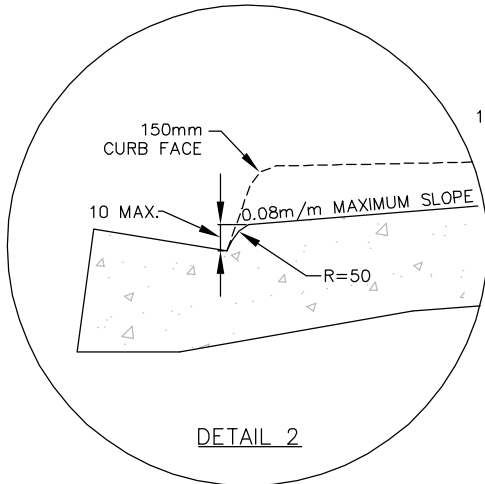
Rev.		CONCRETE SIDEWALK RAMP FOR WHEELCHAIR OR BICYCLE ON TANGENT (TYPE 1)	
Rev.		Approved:	Figure
Rev.		File No.: GP60.33682	Design:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	



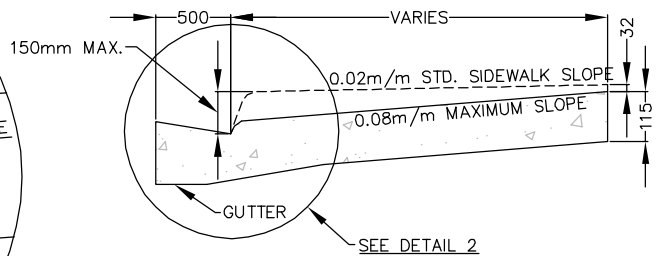
TYPICAL PLAN VIEW



TYPICAL ELEVATION



DETAIL 2



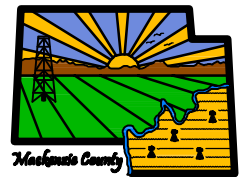
TYPICAL CROSS SECTION (A-A)

NOTES:

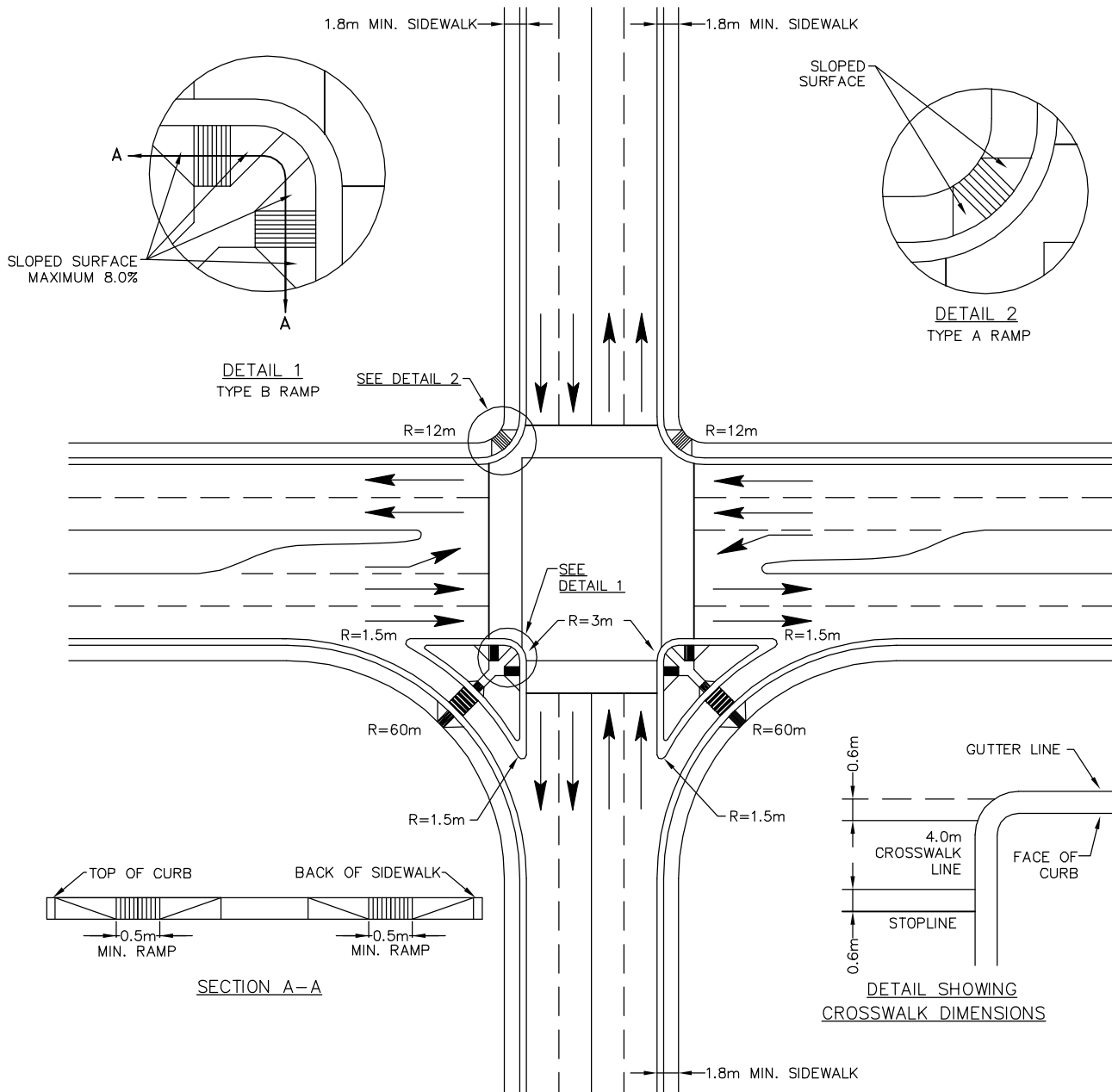
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. RAMPS FOR USERS OF WHEELCHAIRS/BICYCLES SHOULD BE LOCATED AT ALL JUNCTIONS OF CROSSWALKS AND SIDEWALKS. RAMPS MUST BE LOCATED WITHIN A SIDEWALK.
3. GROOVES ON SIDEWALK RAMPS ARE TO ALERT PERSONS WHO ARE VISUALLY IMPAIRED OF THE CURB-CUT AND A STREET CROSSING.
4. WHERE CROSSWALKS ARE CONTROLLED BY SIGNALS WITH A PUSH-BUTTON SYSTEM, THE SIDEWALK AND RAMPS MUST ALLOW ACCESS FOR WHEELCHAIR TO PUSH BUTTON.
5. MINIMUM WIDTH OF RAMP IS 1500mm. IT MAY BE NECESSARY TO BUILD WIDER RAMPS IN BUSY URBAN AREAS WHERE VOLUME OF PEDESTRIAN TRAFFIC IS HIGH.
6. MAXIMUM RAMP SLOPE IS 0.08m/m.
7. WHERE THE SIDEWALK IS LESS THAN 1800mm WIDE, THE 0.08m/m MAX. SLOPE SHOULD NOT BE EXCEEDED AND THEREFORE THE BACK OF THE SIDEWALK MUST BE LOWERED ACCORDINGLY.
8. WHERE RIGHT-OF-WAY IS AVAILABLE, THE SIDEWALK IS TO BE WIDENED AT CORNER LOCATIONS AS SHOWN SO THAT AT LEAST A 1.0m WIDTH OF "FLAT" SIDEWALK IS PROVIDED ADJACENT TO THE RAMP.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>CONCRETE SIDEWALK RAMP FOR WHEELCHAIR OR BICYCLE ON CORNER (TYPE 2)</p>		<p>Approved:</p>	<p>Figure G-37</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	G-37
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

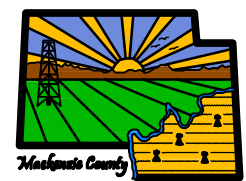


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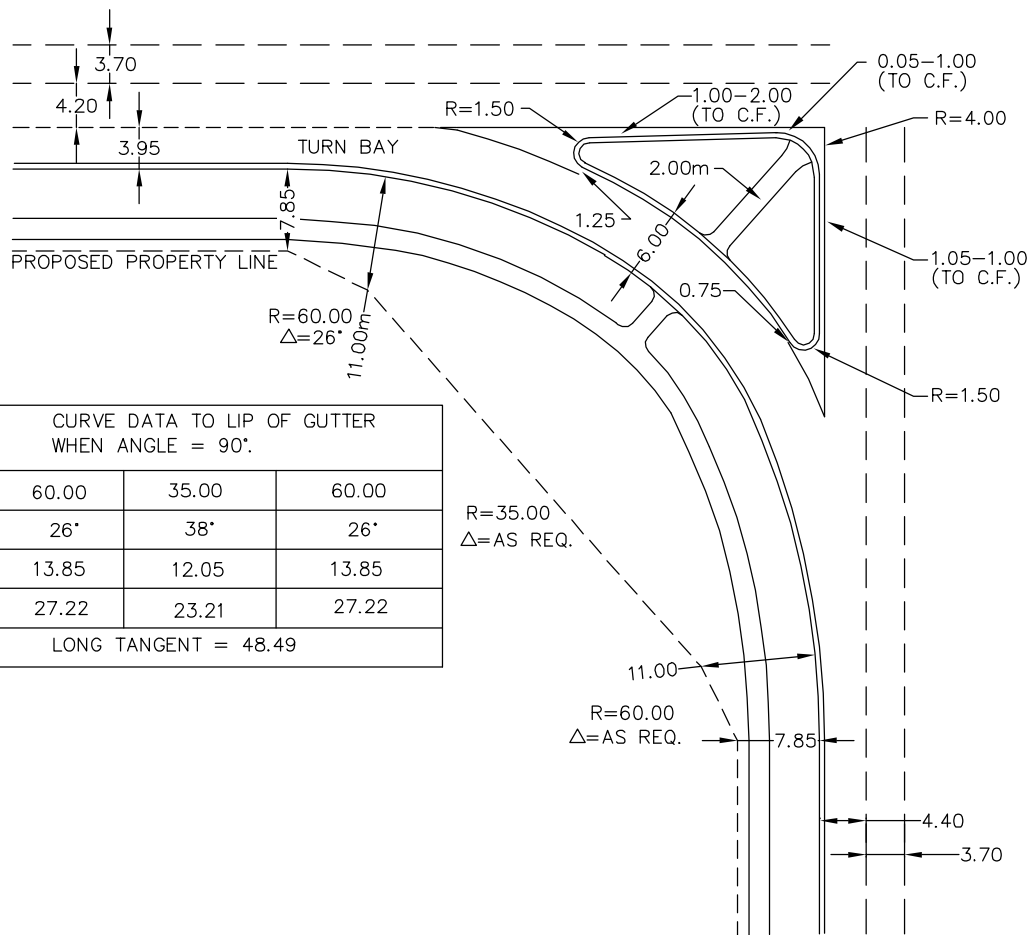
1. ALL DIMENSIONS IN METERS UNLESS OTHERWISE SPECIFIED.
2. SIDEWALK RAMPS MUST PROVIDE ACCESS DIRECTLY TO CROSSWALKS.
3. THE SELECTION OF CURB RAMP TYPE IS DEPENDANT ON THE LOCATION OF THE CROSSWALK RELATED TO THE CURB FACE. WHERE THE CURB RETURN RADIUS IS GREATER THAN OR EQUAL TO 4.0m, TWO TYPE 2 RAMPS CAN BE USED. WHERE THE CURB RETURN RADIUS IS LESS THAN 4.0m, TWO TYPE 1 RAMPS ARE REQUIRED.
4. WHERE CROSSWALKS ARE CONTROLLED BY SIGNALS WITH A PUSH-BUTTON SYSTEM, THE SIDEWALKS AND RAMPS MUST ALLOW ACCESS BY WHEELCHAIR TO THE PUSH-BUTTON.
5. ON A SHARP CORNER WHERE TWO TYPE 1 RAMPS ARE BEING USED, THE SLOPE ON THE FLARED AREAS BETWEEN TWO RAMPS CAN BE LESS THAN THE 0.08m/m MAXIMUM SHOWN. THIS WILL PROVIDE A SMOOTHER SIDEWALK FOR GENERAL USE ESPECIALLY FOR PEDESTRIANS WHO ARE NOT USING THE CROSSWALK.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		LAYOUT OF CROSSWALKS, LOCATION AND TYPE OF SIDEWALK RAMPS AT URBAN INTERSECTIONS	
Rev.		Approved:	Figure
Rev.		File No.: GP60.33682	Design:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	



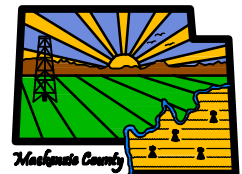
CURVE DATA TO LIP OF GUTTER WHEN ANGLE = 90°.			
R	60.00	35.00	60.00
Δ	26°	38°	26°
TAN	13.85	12.05	13.85
L.C.	27.22	23.21	27.22
LONG TANGENT = 48.49			

NOTES:

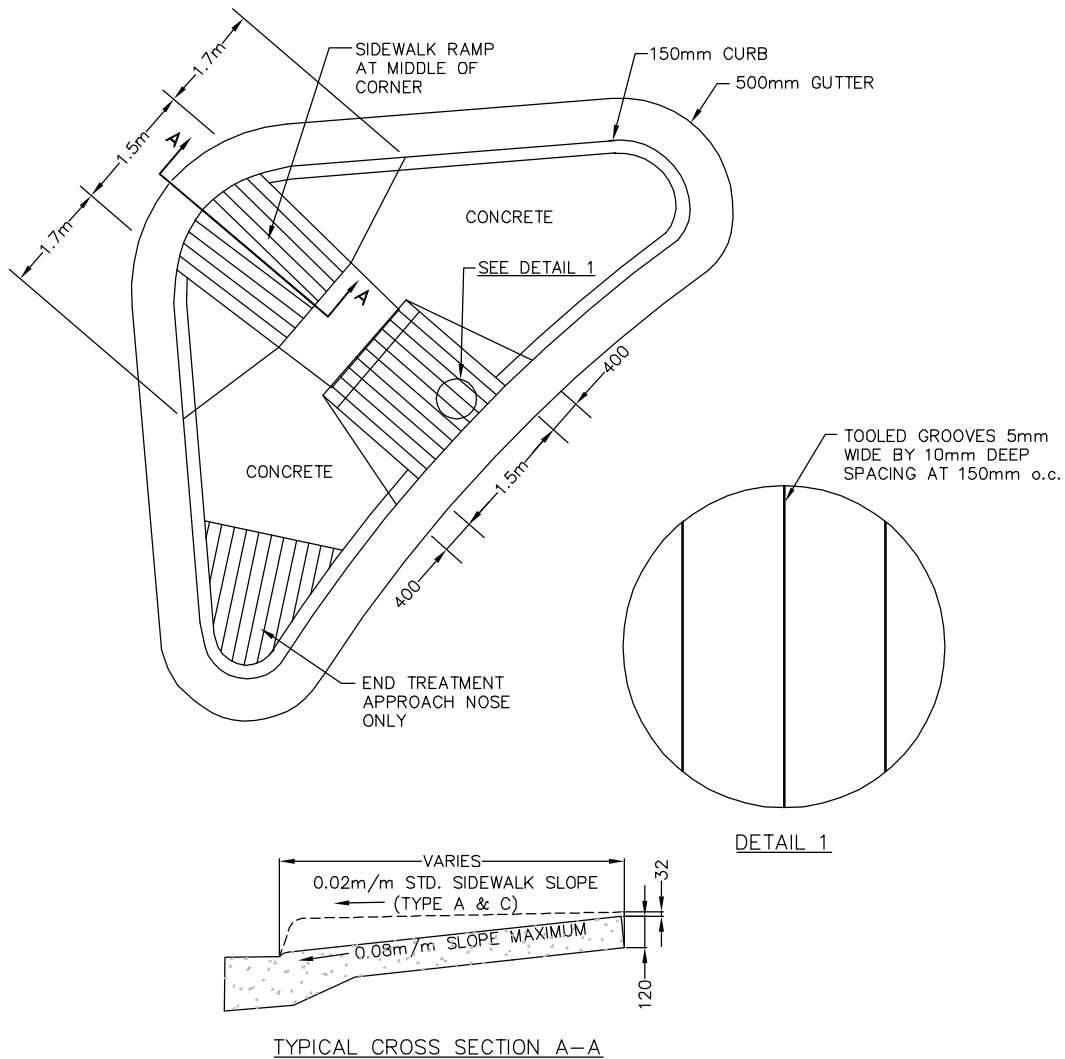
1. ALL RADII ARE TO LIP OF GUTTER.
2. PAVEMENT MARKING OFFSETS ARE TO CURB FACE.
3. THE ABOVE CURVE DATA IS APPLICABLE ONLY WITHIN A 10° DEFLECTION FROM 90°.
4. RIGHT TURN CUT-OFF TO BE REVIEWED / ADJUSTED TO ACCOMMODATE DESIGN TRUCK CLASSIFICATION.
5. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		RIGHT TURN STANDARD – ARTERIAL TO ARTERIAL NON INDUSTRIAL (AUXILIARY LANE TO NO AUXILIARY LANE)	
Rev.		Approved:	Figure
Rev.			
Date: 2010-AUG-31	File No.: GP60.33682	Design:	Scale: N.T.S.
	Drawn: K.P.L.		

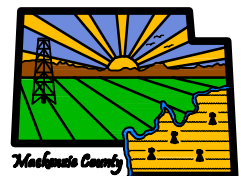


NOTES:

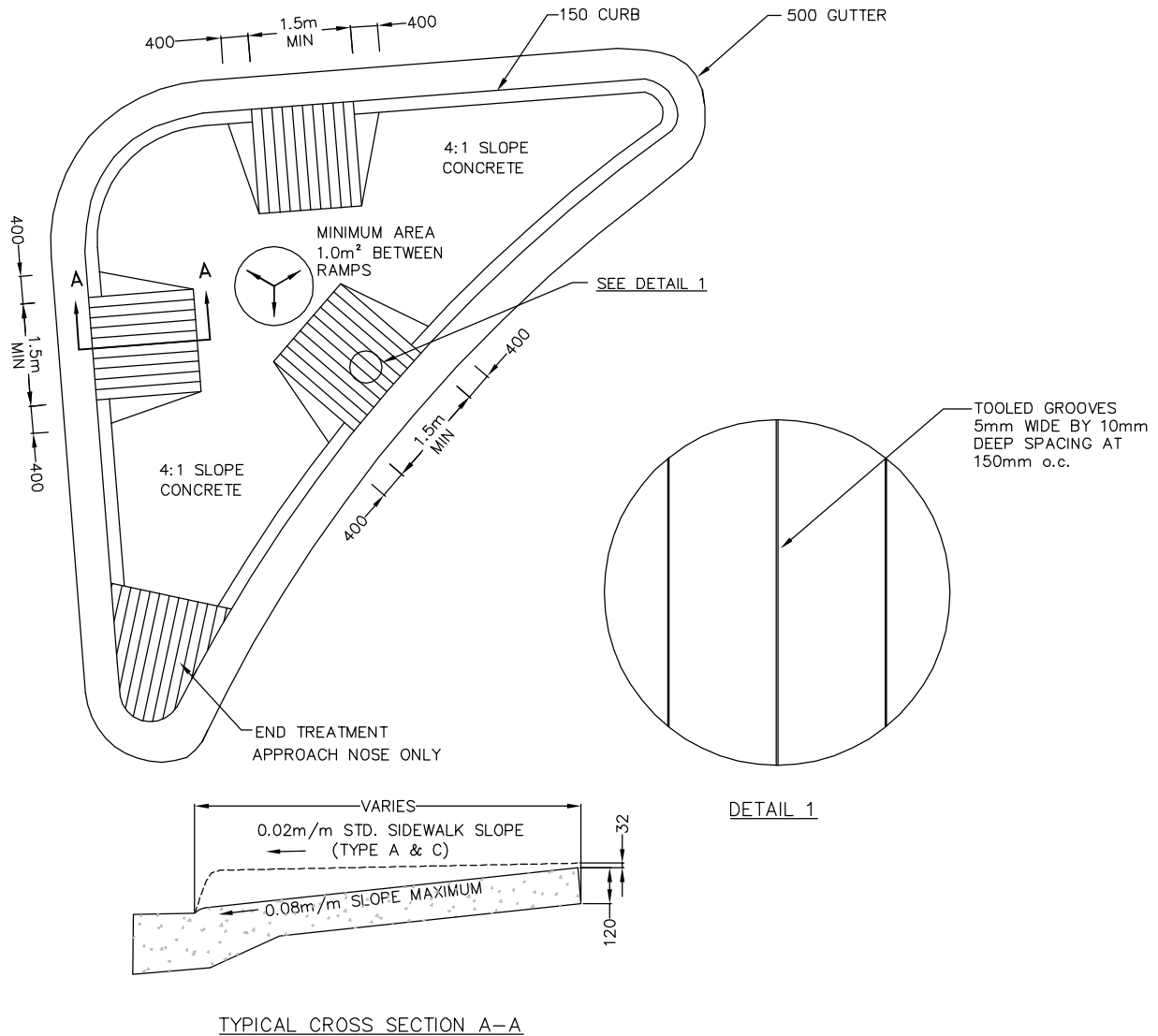
1. EXACT DIMENSIONS AND LAYOUT OF ISLAND ARE DICTATED BY LAYOUT OF INTERSECTION.
2. WHERE RAMP IS TO BE USED AS A TRANSITION, USE THE CENTER OF THE 1500mm RAMP AS THE CENTER OF THE TRANSITION.
3. CURBS AND RAMPS TO BE POURED MONOLITHICALLY.
4. IT MAY BE NECESSARY TO BUILD RAMPS WIDER AT HIGH VOLUME PEDESTRIAN TRAFFIC LOCATIONS.
5. WHEN THE CURB RETURN RADIUS IS LESS THAN 4.0m TWO RAMPS ARE REQUIRED.
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		SIDEWALK AND CROSSWALK LAYOUT OF SMALL ISLANDS AND MEDIANS, TYPE A		Approved:	Figure G-40
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

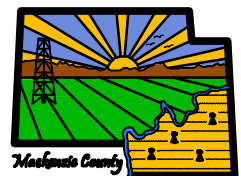


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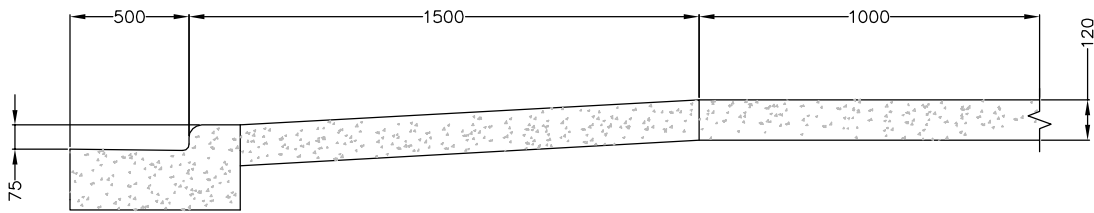
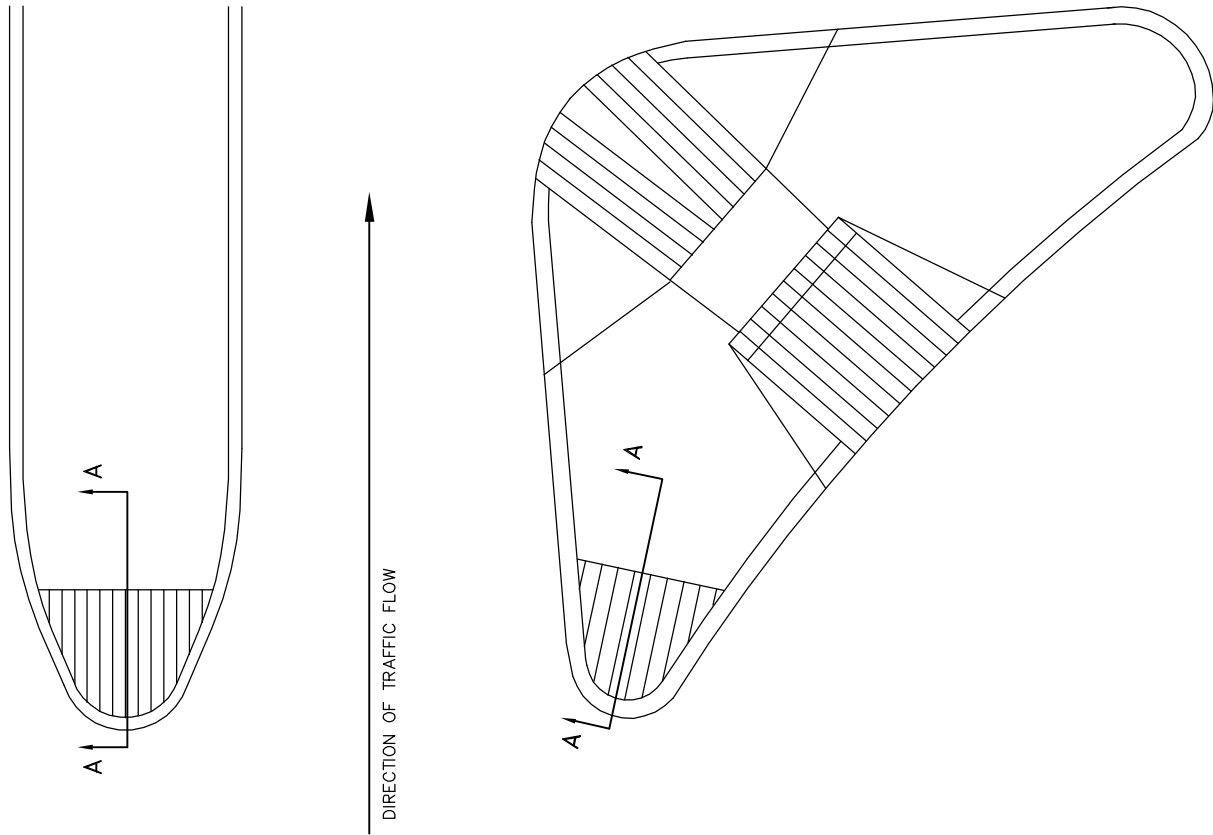
1. EXACT DIMENSIONS AND LAYOUT OF ISLAND ARE DICTATED BY LAYOUT OF INTERSECTION.
2. WHERE RAMP IS TO BE USED AS A TRANSITION, USE THE CENTER OF THE 1500mm RAMP AS THE CENTER OF THE TRANSITION.
3. CURBS AND RAMPS TO BE POURED MONOLITHICALLY.
4. IT MAY BE NECESSARY TO BUILD RAMPS WIDER AT HIGH VOLUME PEDESTRIAN TRAFFIC LOCATIONS.
5. WHEN THE CURB RETURN RADIUS IS LESS THAN 4.0m TWO RAMPS ARE REQUIRED.
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		SIDEWALK AND CROSSWALK LAYOUT OF SMALL ISLANDS AND MEDIANS, TYPE B		Approved:	Figure G-41
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			G-41

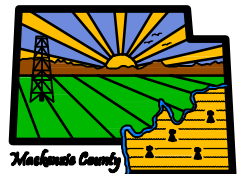


SECTION A-A

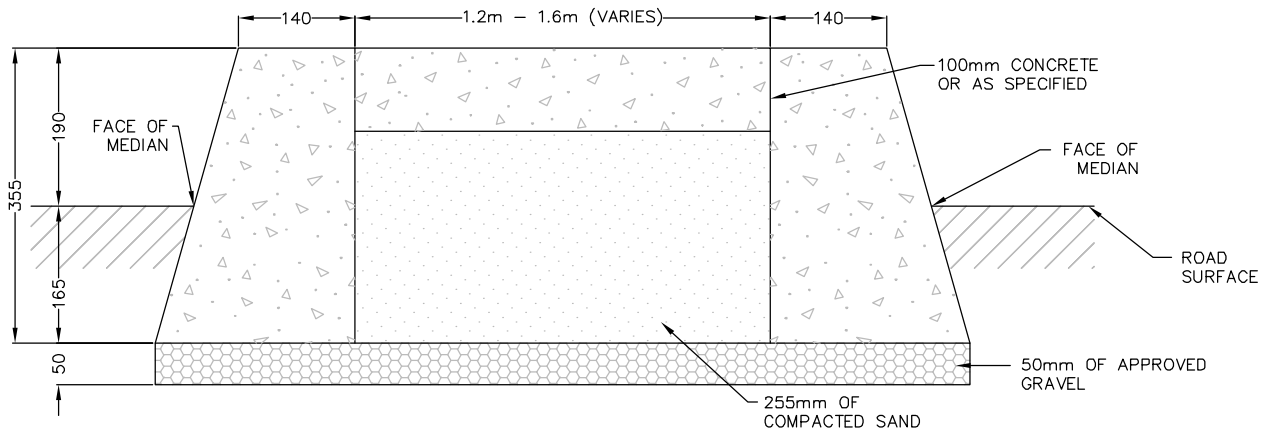
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards

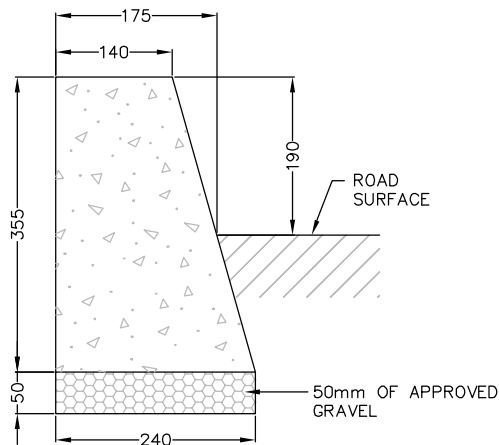


Rev.		ISLAND / WIDE MEDIAN APPROACH NOSE		Approved:	Figure G-42
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

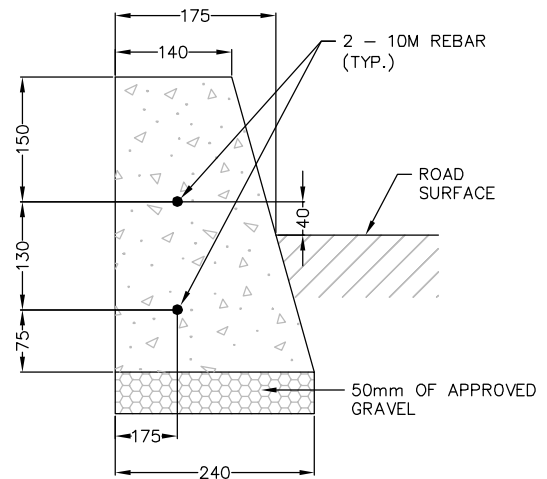


MEDIAN DETAIL

STANDARD SECTION



REINFORCED SECTION



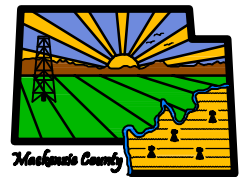
STANDARD CONCRETE CURB

NOTE:

1. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



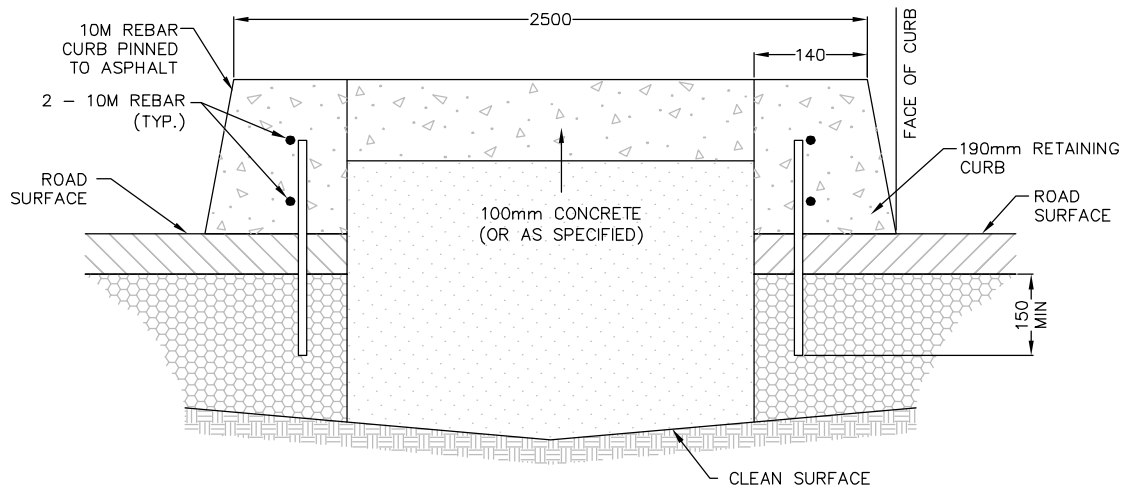
CURB & MEDIAN (GRAVEL BASE)

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

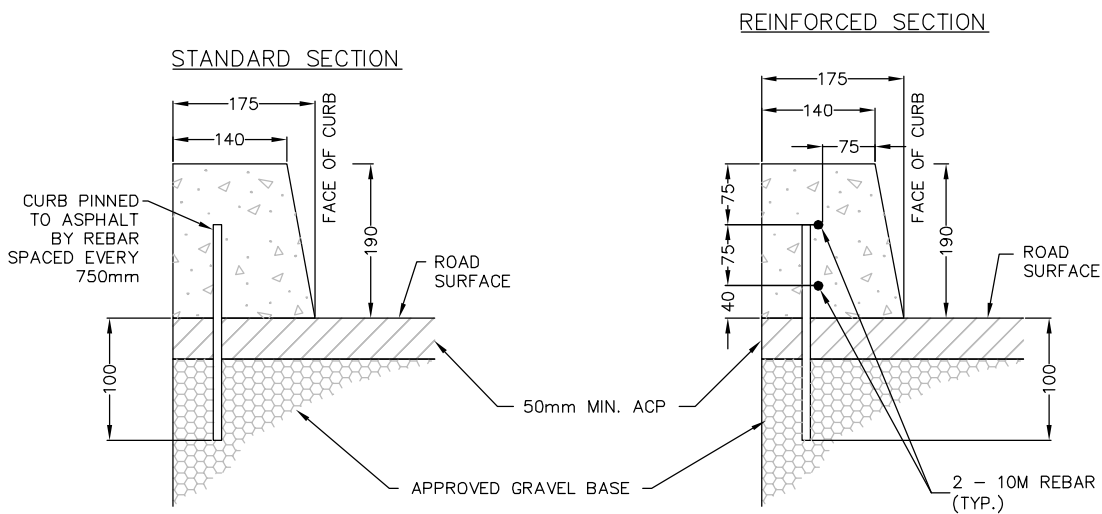
File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:	
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Figure	G-43
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MEDIAN DETAIL (PIN-ON CURBS)



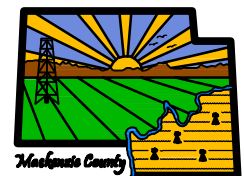
CONCRETE CURB (PIN-ON)

NOTES:

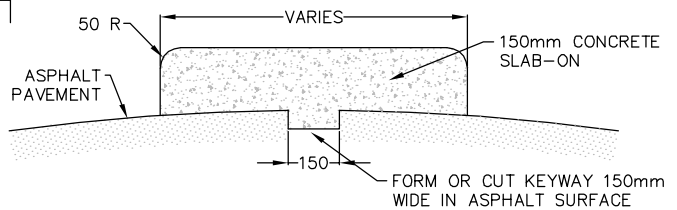
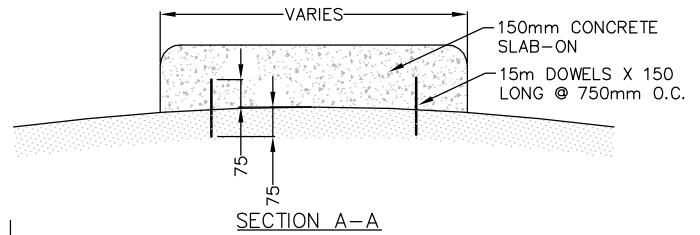
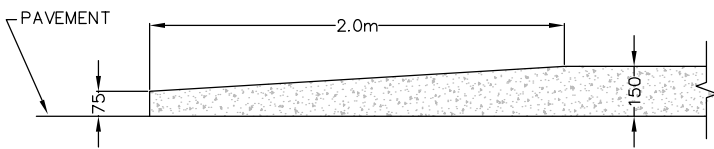
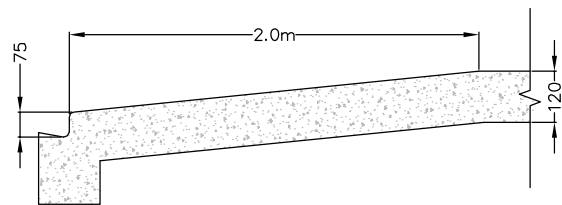
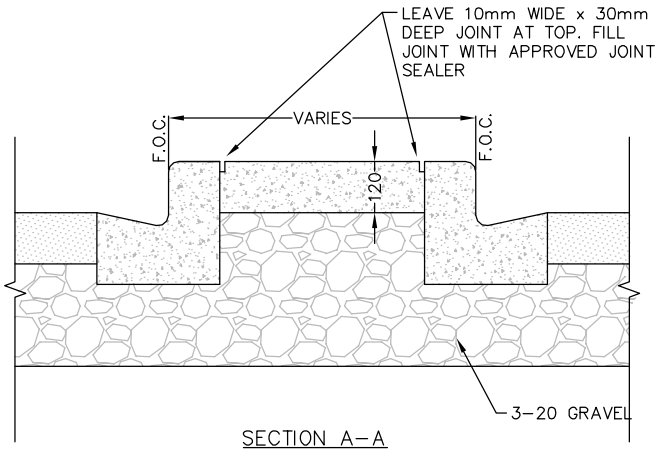
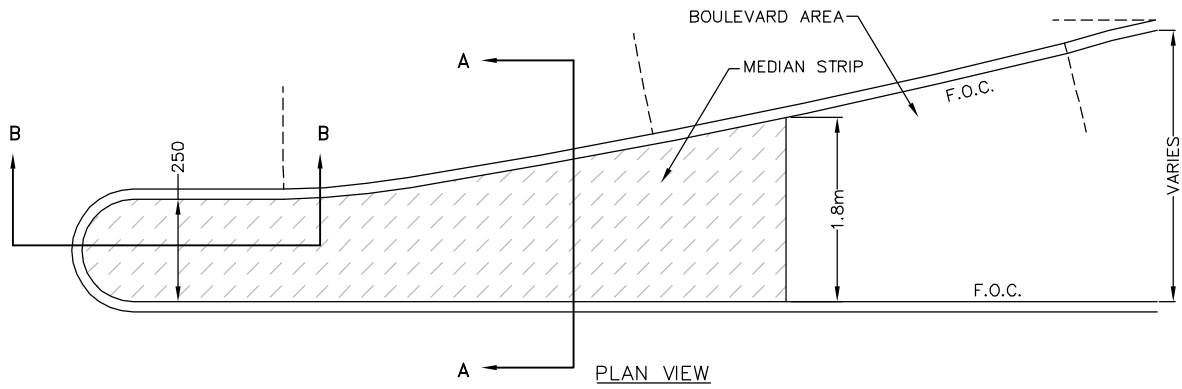
1. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>CURB AND MEDIAN (ASPHALT BASE-PIN ON)</p>		<p>Approved:</p>	<p>Figure G-44</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

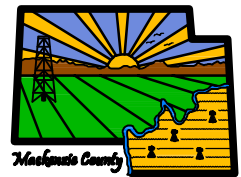


NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



CENTRE MEDIAN – END TREATMENT

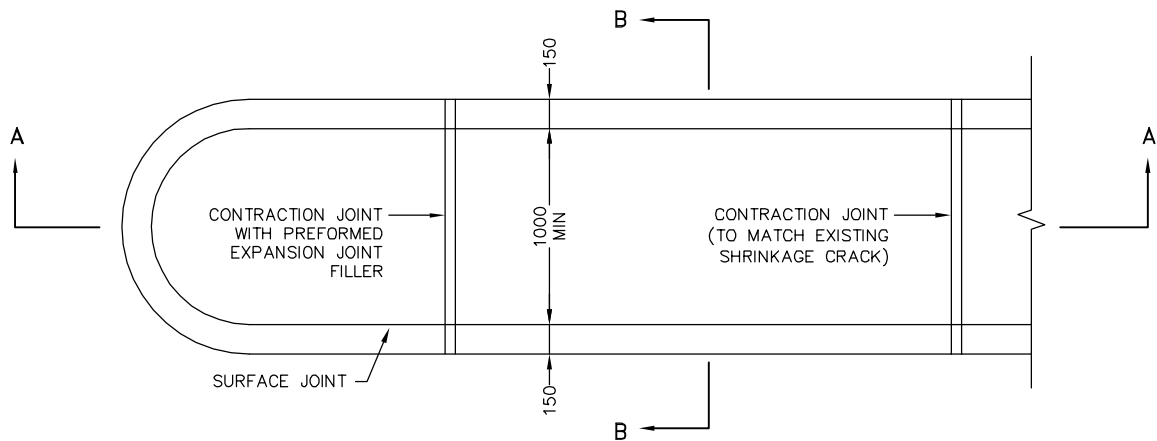
Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L

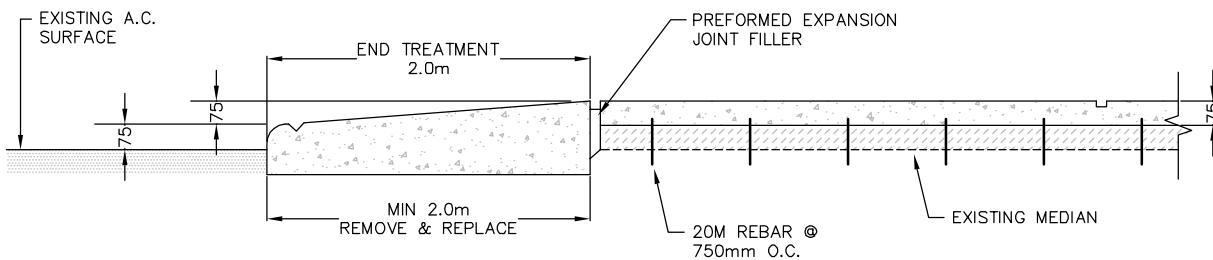
Design:
Scale: N.T.S

Approved:

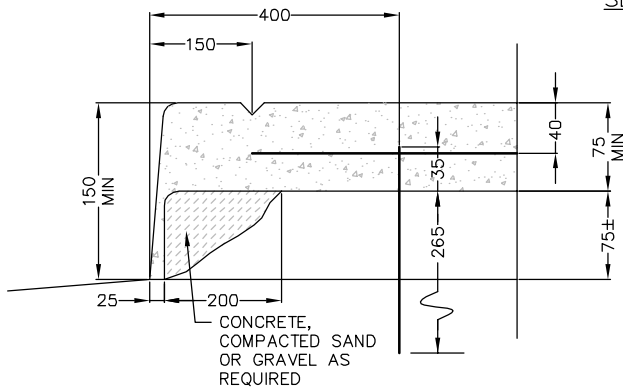
Figure G-45



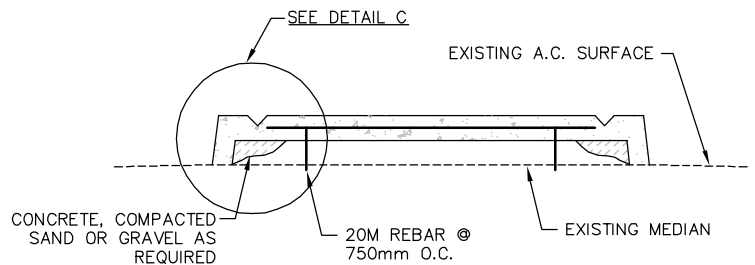
PLAN



SECTION A-A



DETAIL C



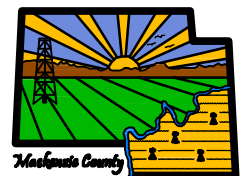
SECTION B-B

NOTES:

1. PREFORMED EXPANSION JOINT FILLER SHOULD ALSO BE PLACED AT MATCH TO EXISTING ISLAND.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

General Municipal Improvements Standards



CENTRE MEDIAN REHABILITATION

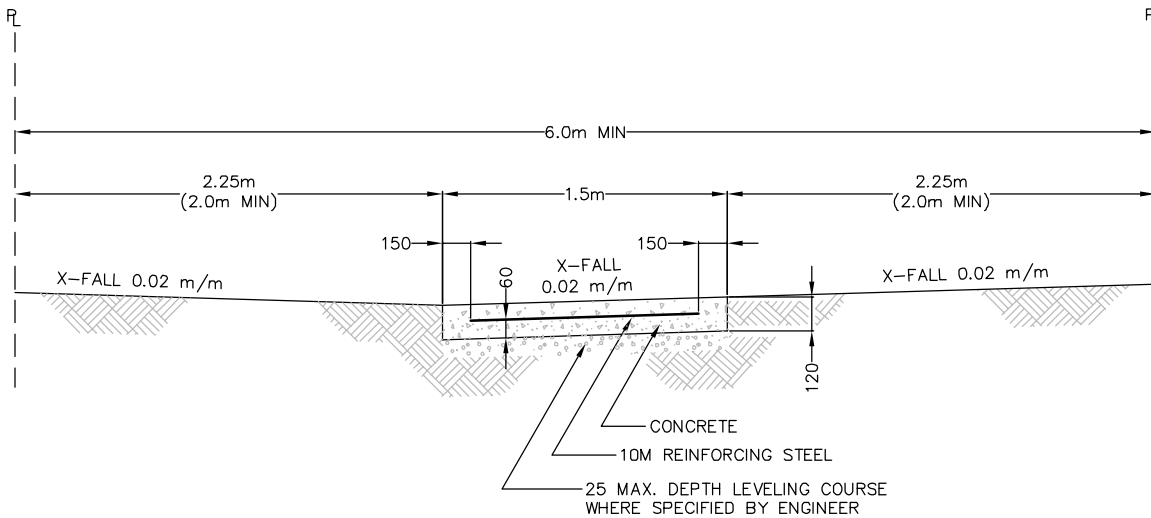
Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L.

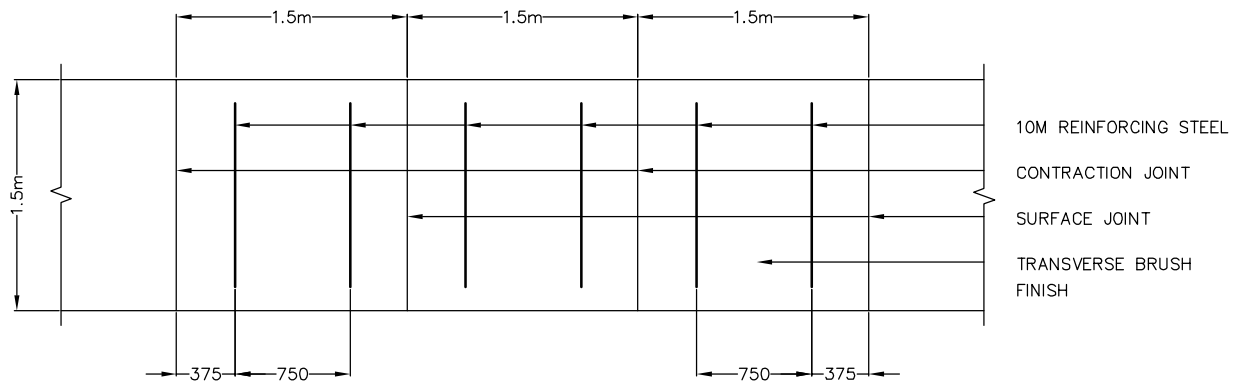
Design:
Scale: N.T.S.

Approved:

Figure G-46



TYPICAL SECTION



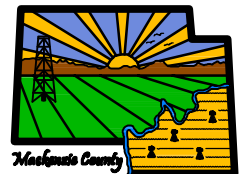
PLAN VIEW

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARD A23.1.

MACKENZIE COUNTY

General Municipal Improvements Standards



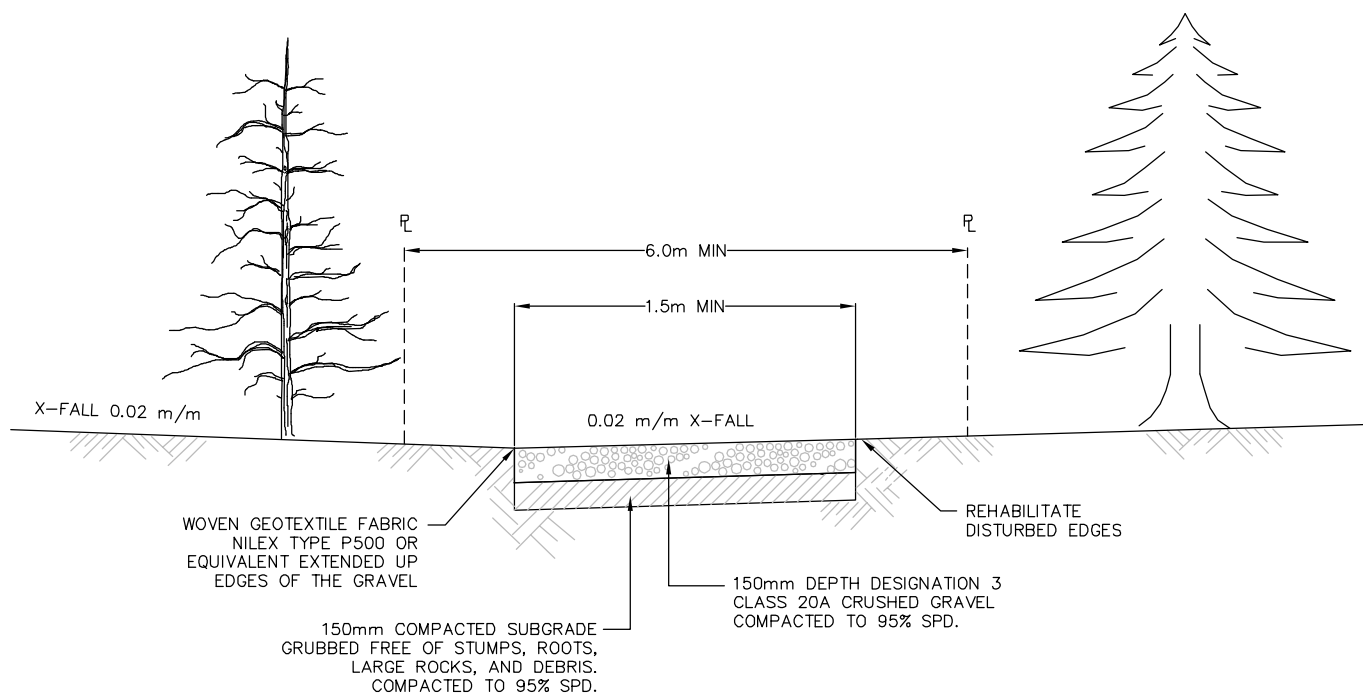
CONCRETE WALKWAY

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:	
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Figure	G-47
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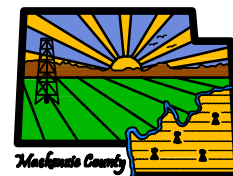


TYPICAL SECTION

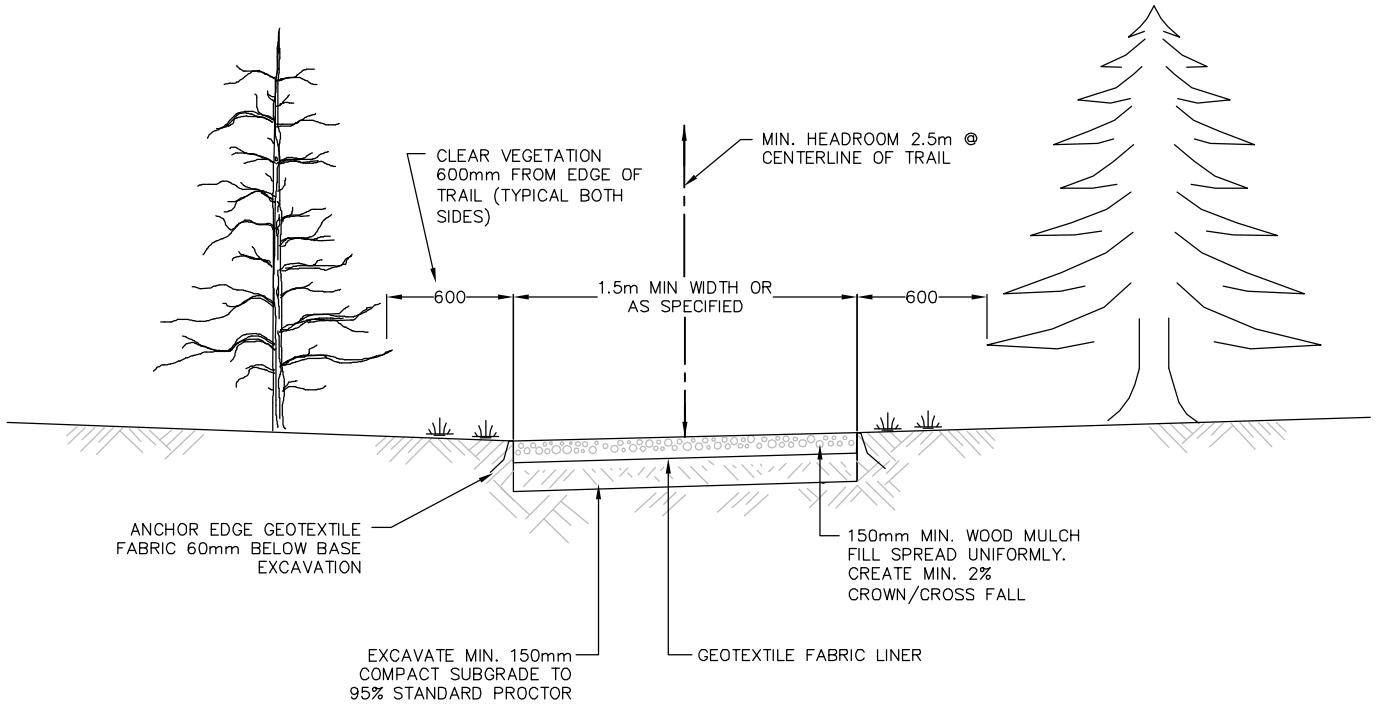
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>GRANULAR WALKWAY</p>		<p>Approved:</p>	<p>Figure G-48</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-48	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

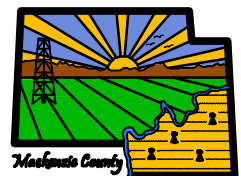


TYPICAL SECTION

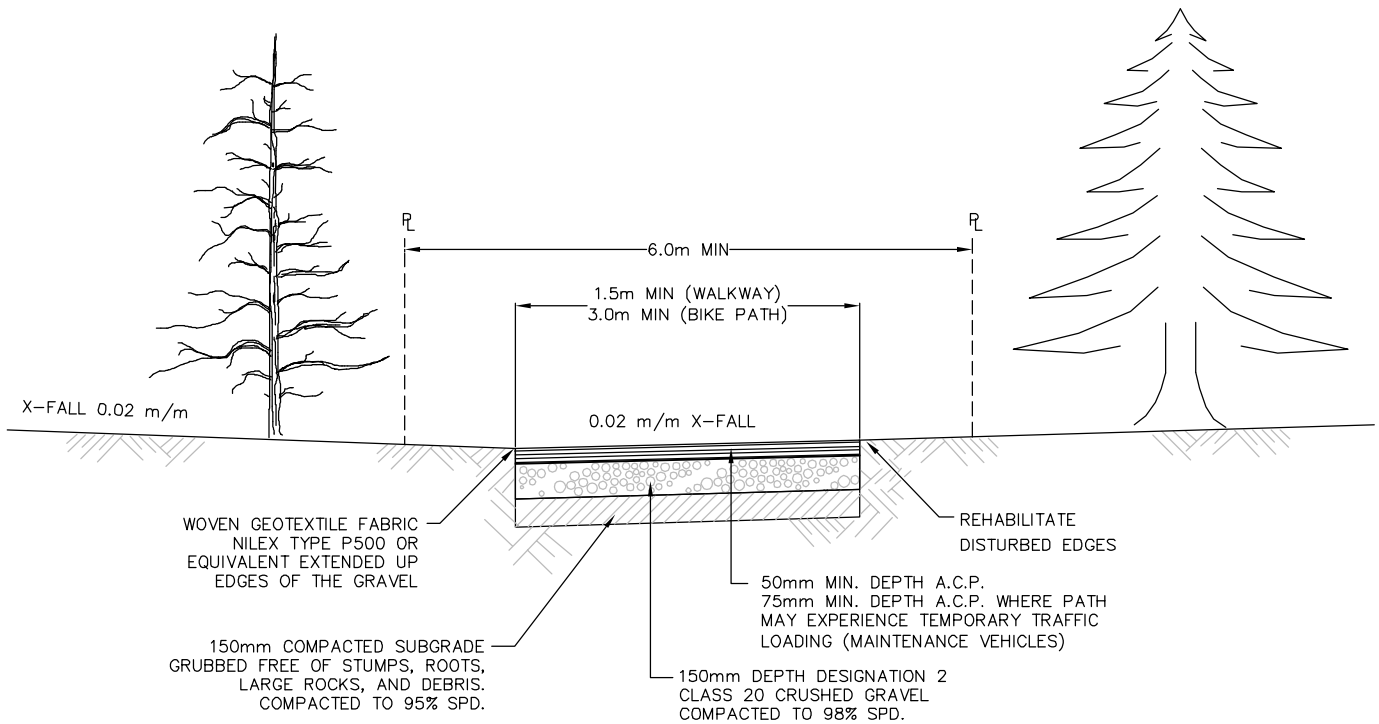
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		HIKING TRAIL	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	

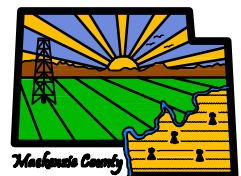


TYPICAL SECTION

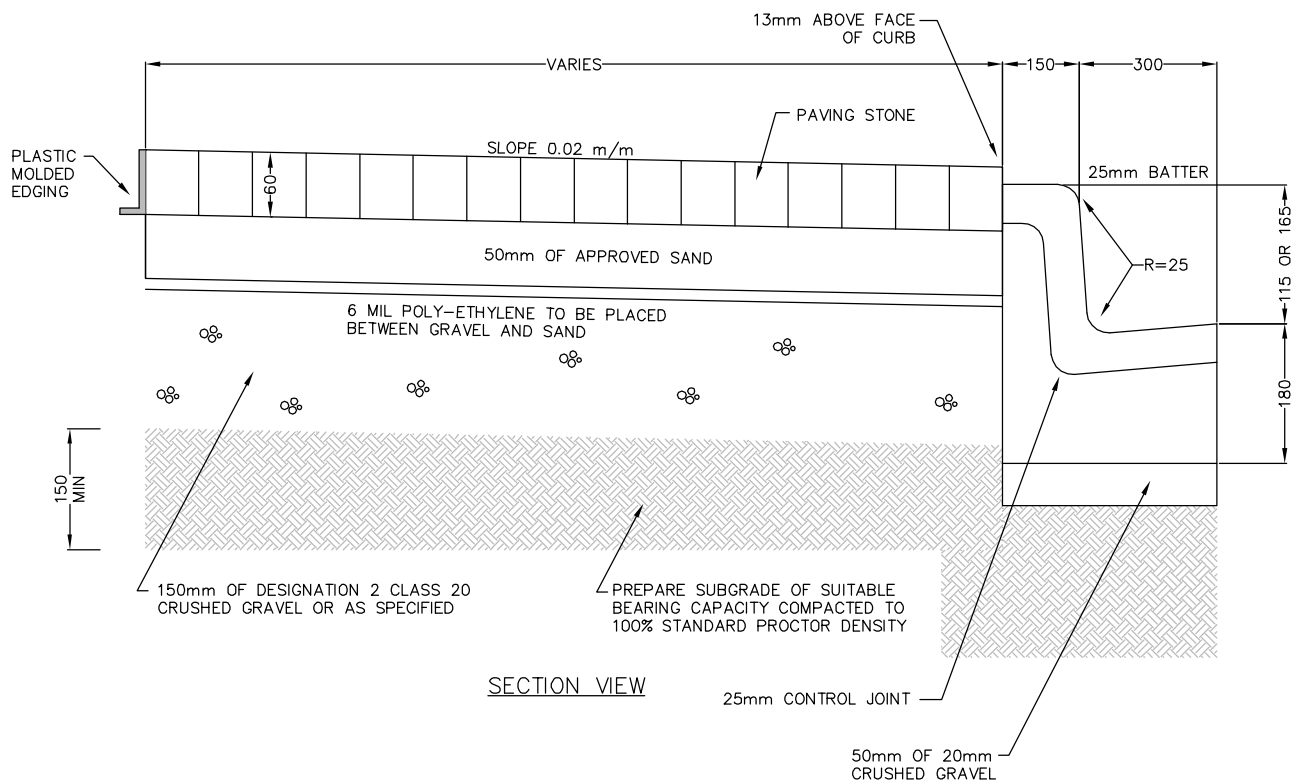
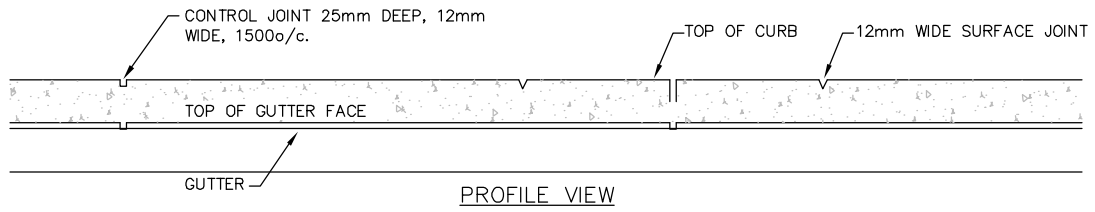
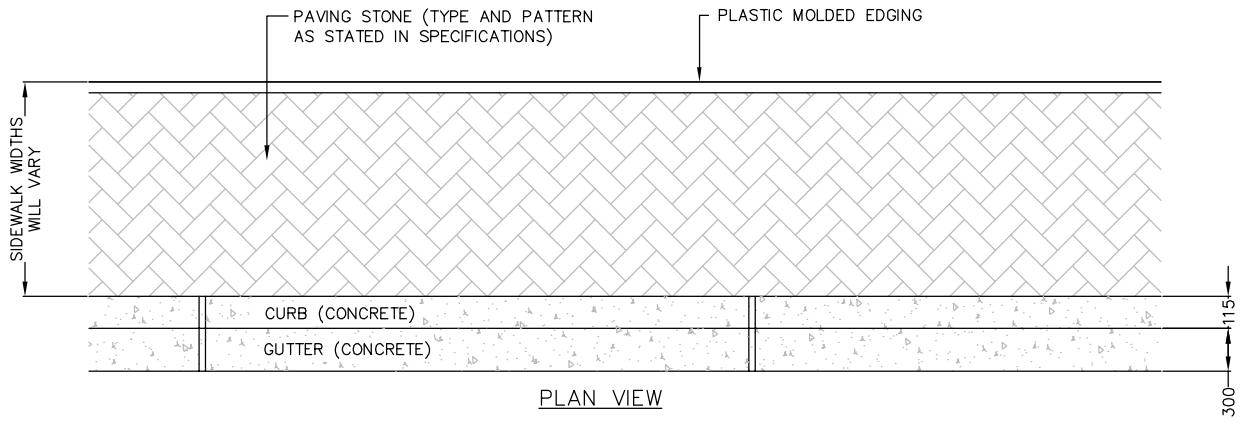
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



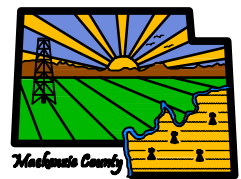
Rev.		PAVED WALKWAY / BIKE PATH	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	



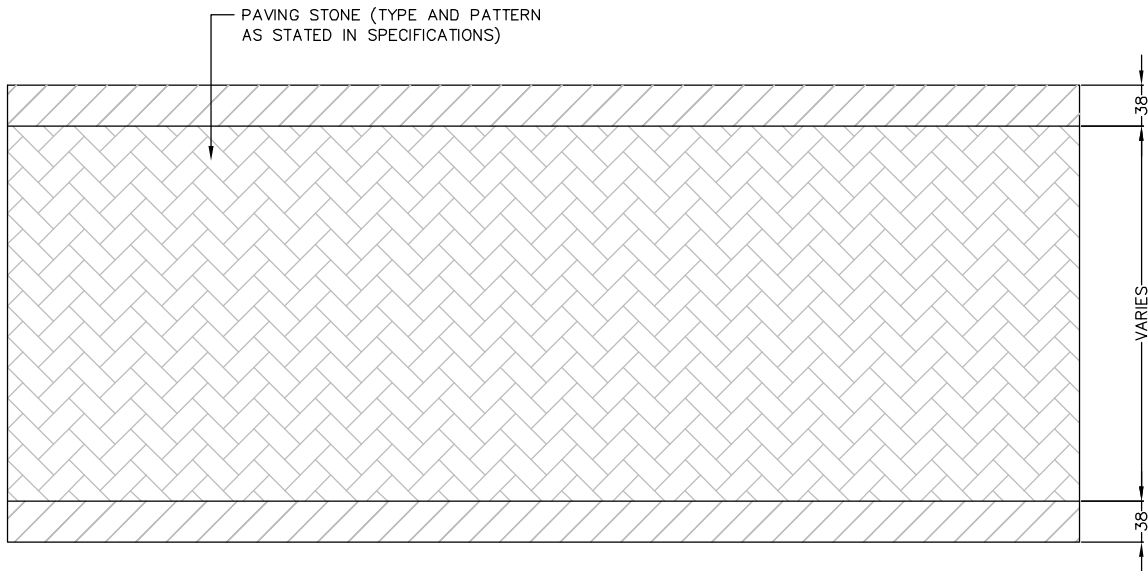
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

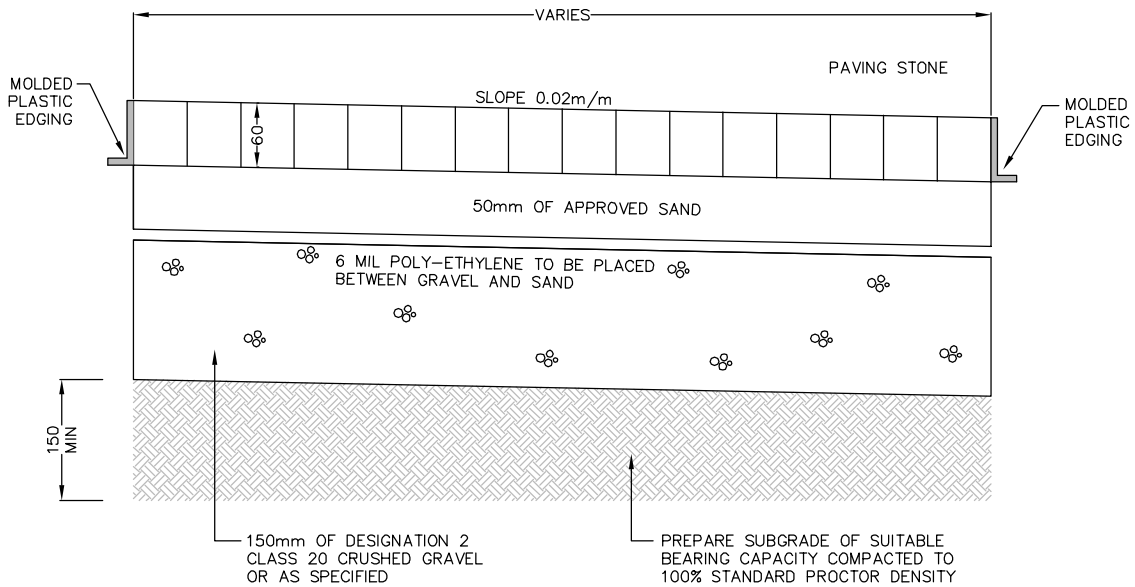
General Municipal Improvements Standards



Rev.		COMBINATION STANDARD CURB & GUTTER WITH PAVING STONE SIDEWALK	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure G-51



PLAN VIEW

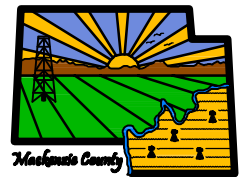


SECTION VIEW

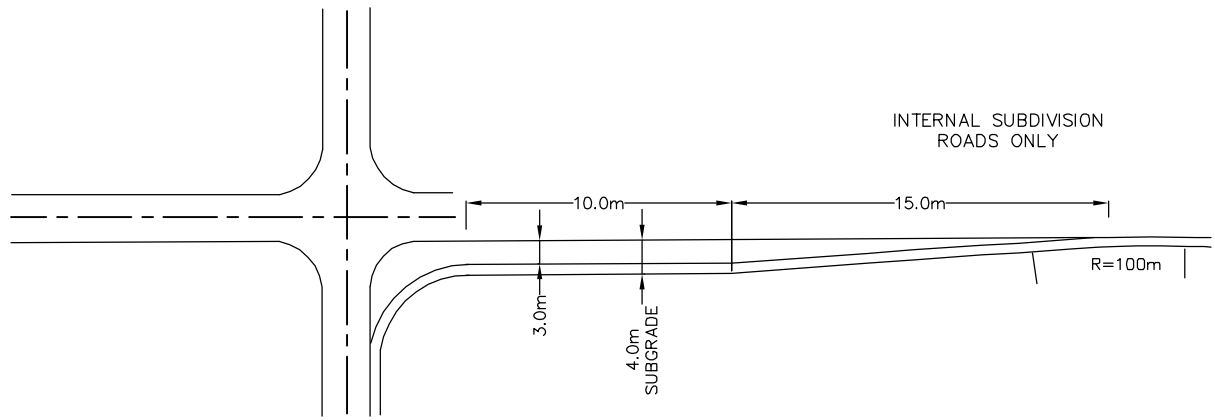
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

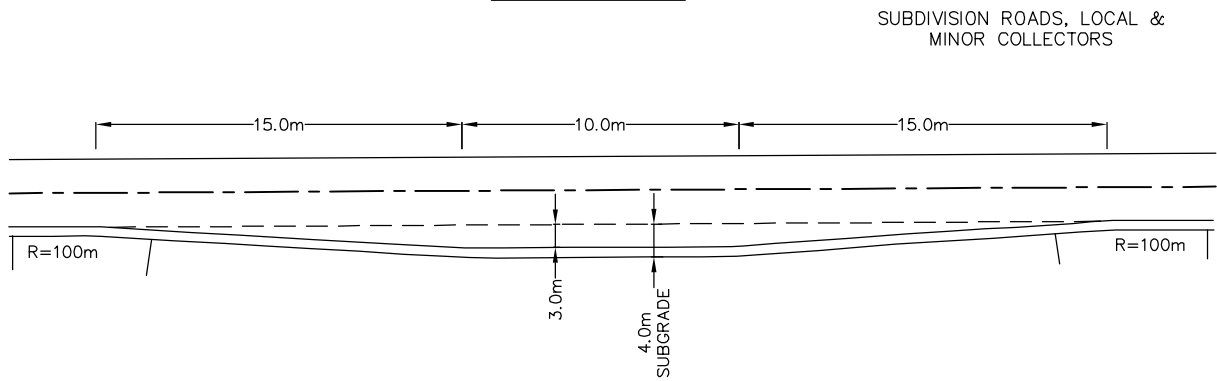
General Municipal Improvements Standards



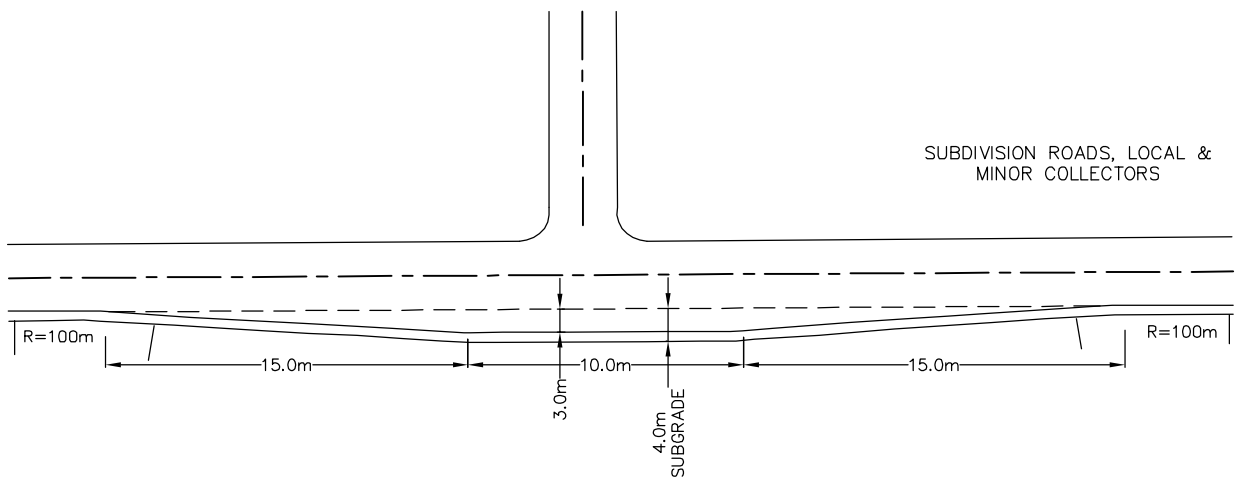
Rev.		PAVING STONE WALKWAY DETAIL		Figure G-52
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		



CORNER LOCATION



MID_BLOCK LOCATION

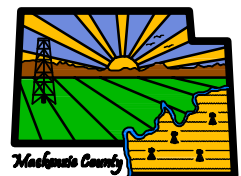


TEE LOCATION

NOTE:
ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



TYPICAL MAILBOX PULLOUT LOCATIONS

Approved:

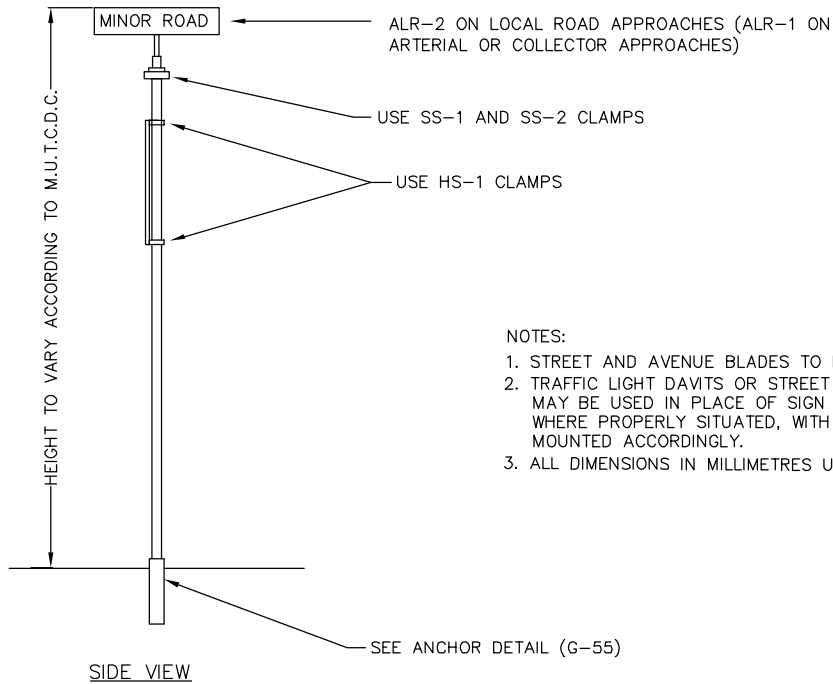
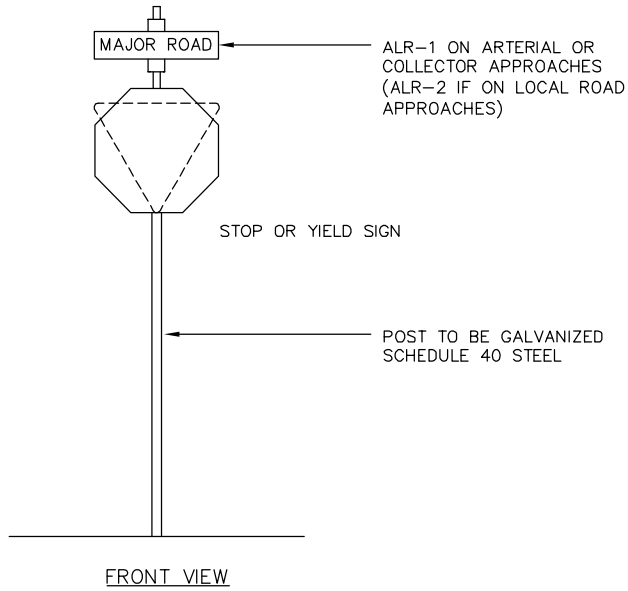
Figure

G-53

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.:	GP60.33682
Drawn:	K.P.L

Design:	
Scale:	N.T.S

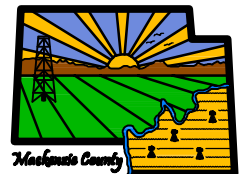


NOTES:

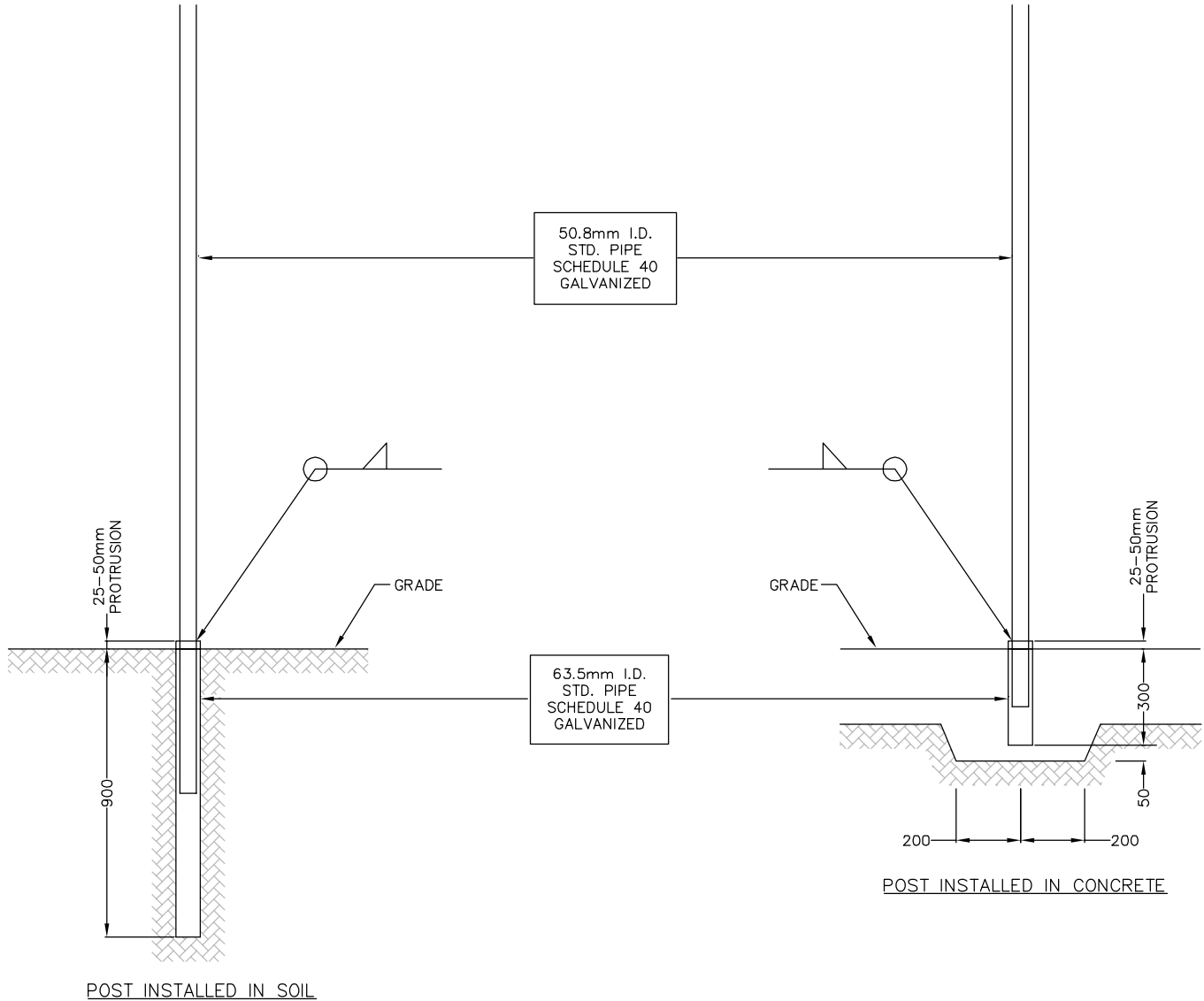
1. STREET AND AVENUE BLADES TO FACE BOTH SIDES.
2. TRAFFIC LIGHT DAVITS OR STREET LIGHT POLES MAY BE USED IN PLACE OF SIGN POSTS WHERE PROPERLY SITUATED, WITH SIGN FACES MOUNTED ACCORDINGLY.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		SIGN MOUNTING DETAILS		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-54
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

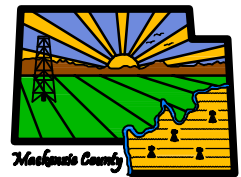


NOTES:

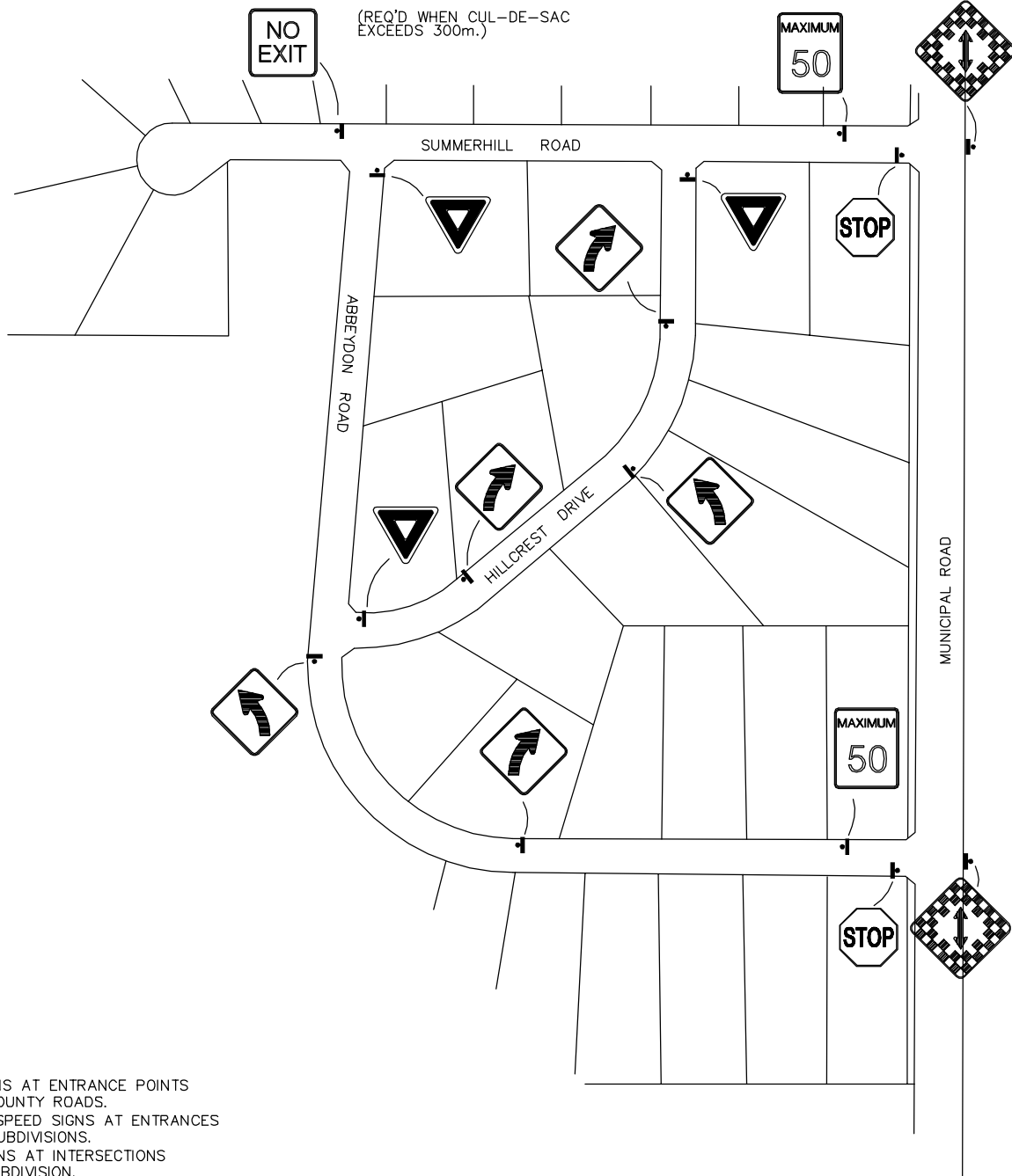
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		SIGN POST ANCHOR DETAIL		Approved:	Figure G-55
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-55	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

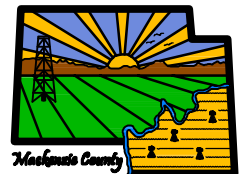


NOTES:

1. STOP SIGNS AT ENTRANCE POINTS TO ALL COUNTY ROADS.
2. 50Km/h SPEED SIGNS AT ENTRANCES TO ALL SUBDIVISIONS.
3. YIELD SIGNS AT INTERSECTIONS WITHIN SUBDIVISION.
4. TURNING SIGNS AT BEGINNING OF CURVE.
5. ANY OTHER TRAFFIC SIGNS DEEMED NECESSARY BY THE MUNICIPALITY.
6. STANDARD AND INSTALLATION SHALL CONFORM TO RTAC.
7. ALL SIGNS SHALL BE REFLECTORIZED.
8. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

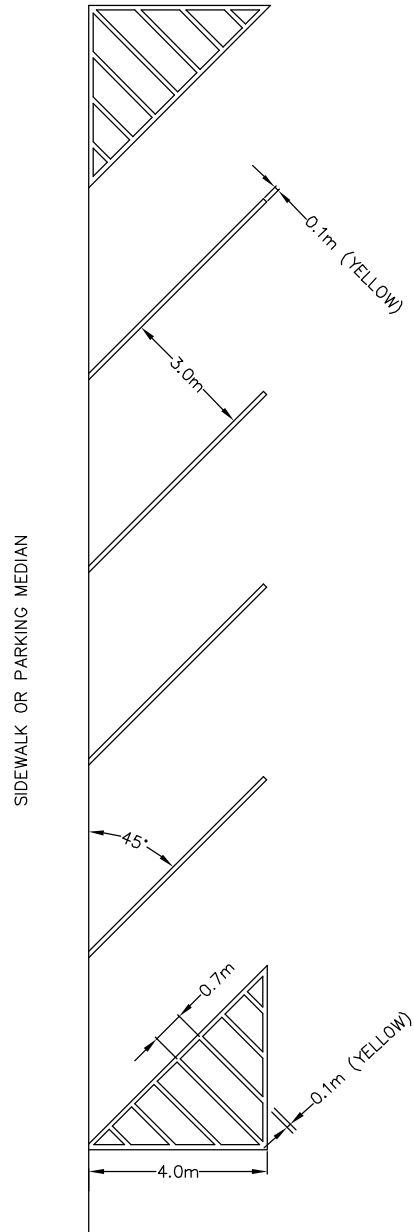
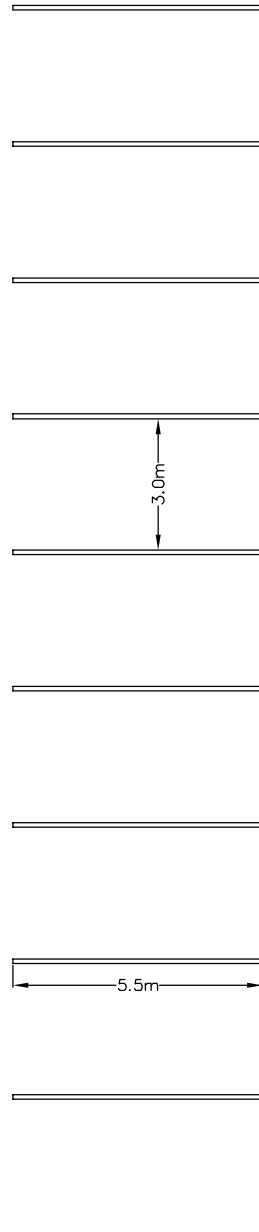
General Municipal Improvements Standards



Rev.		TYPICAL TRAFFIC SIGN LAYOUT RURAL STANDARD		Approved:	Figure G-56
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-56	
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			

TYPE 1 – 90 DEGREE

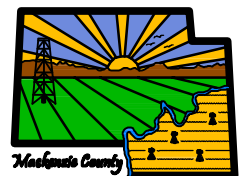
TYPE 2 – ANGLE



NOTE:
ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

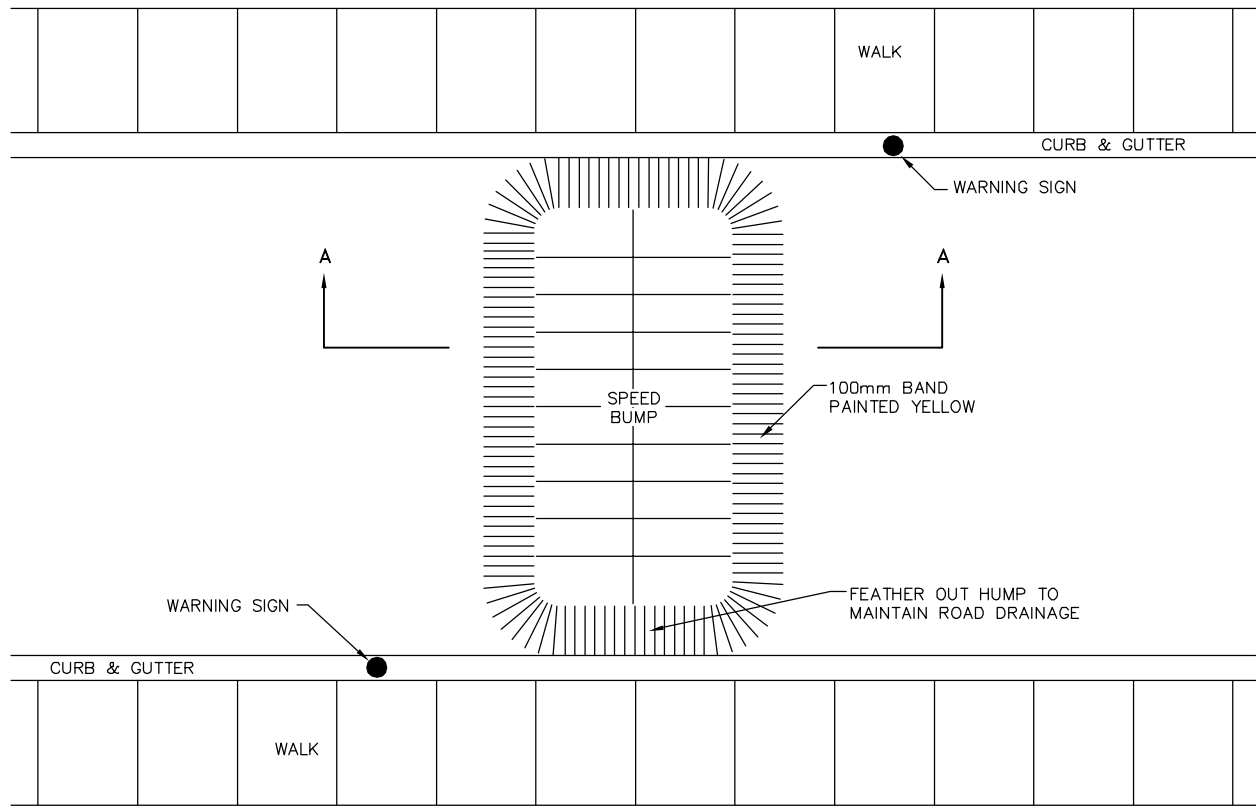


File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

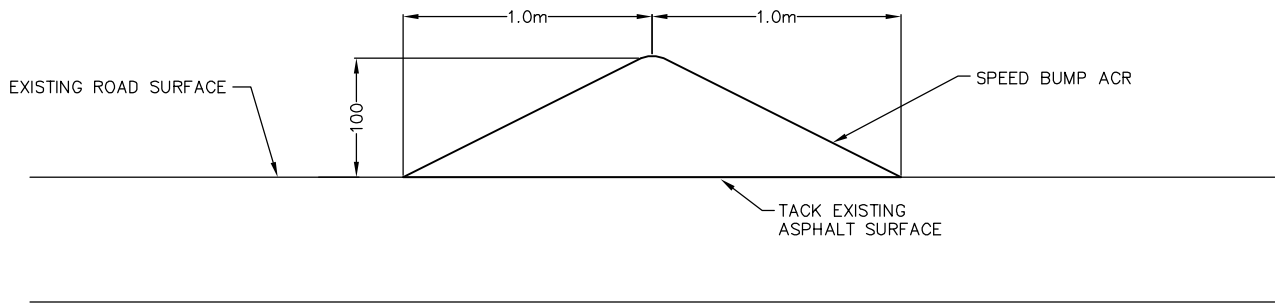
PARKING LOT MARKINGS TYPE 1 & 2

Approved:

Figure **G-57**



PLAN

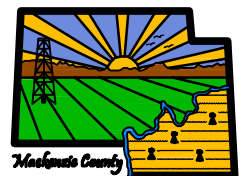


SECTION A-A

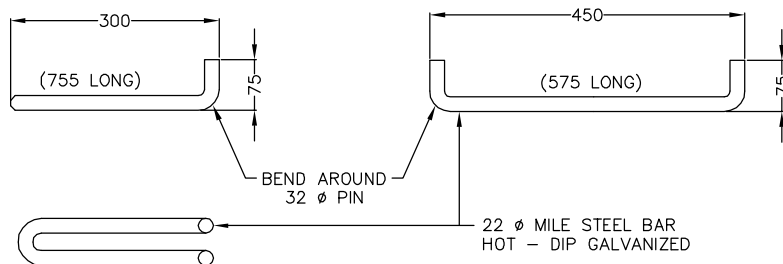
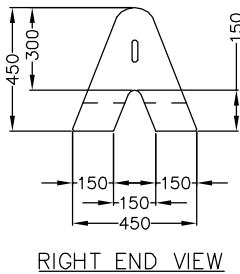
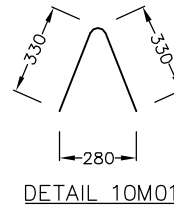
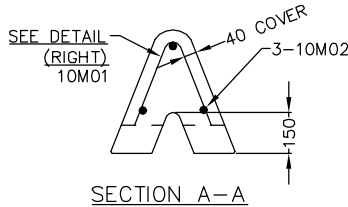
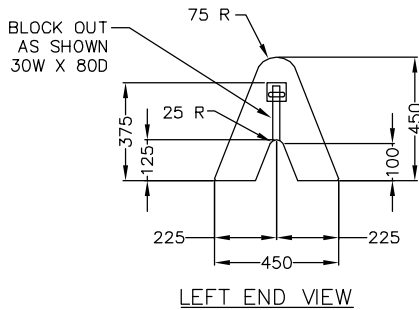
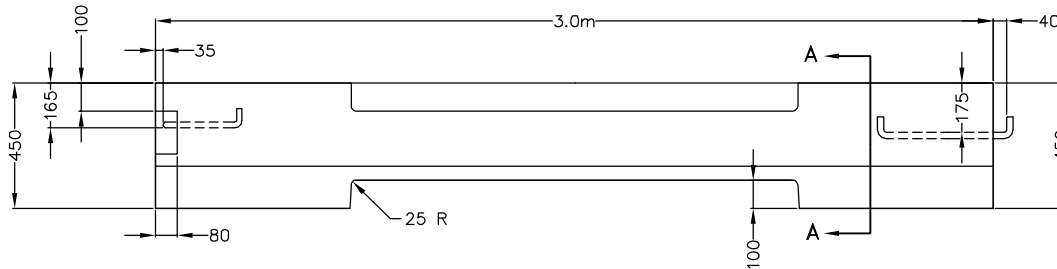
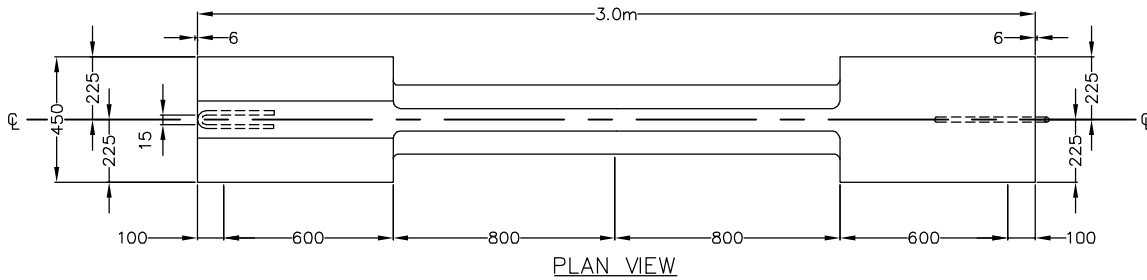
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		ASPHALT SPEED BUMP		Figure G-58
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-58
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

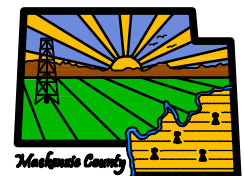


NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.
3. REFER TO STANDARD FIGURE G-60 (END UNITS).

MACKENZIE COUNTY

General Municipal Improvements Standards



MINI BARRIER DETAIL

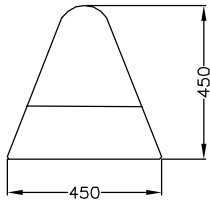
Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L

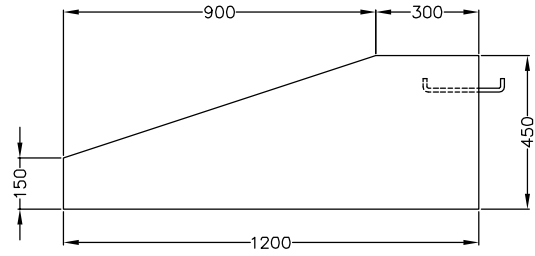
Design:
Scale: N.T.S

Approved:

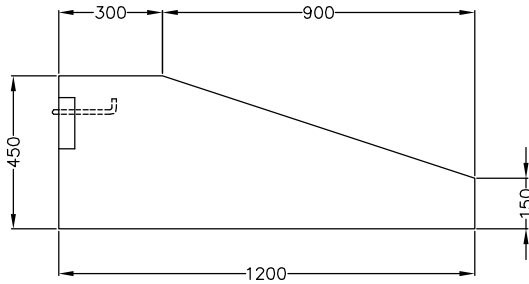
Figure G-59



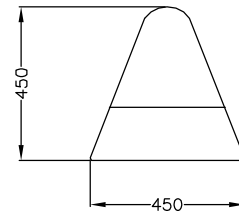
LEFT END VIEW



ELEVATION



ELEVATION



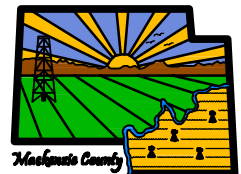
RIGHT END VIEW

NOTES:

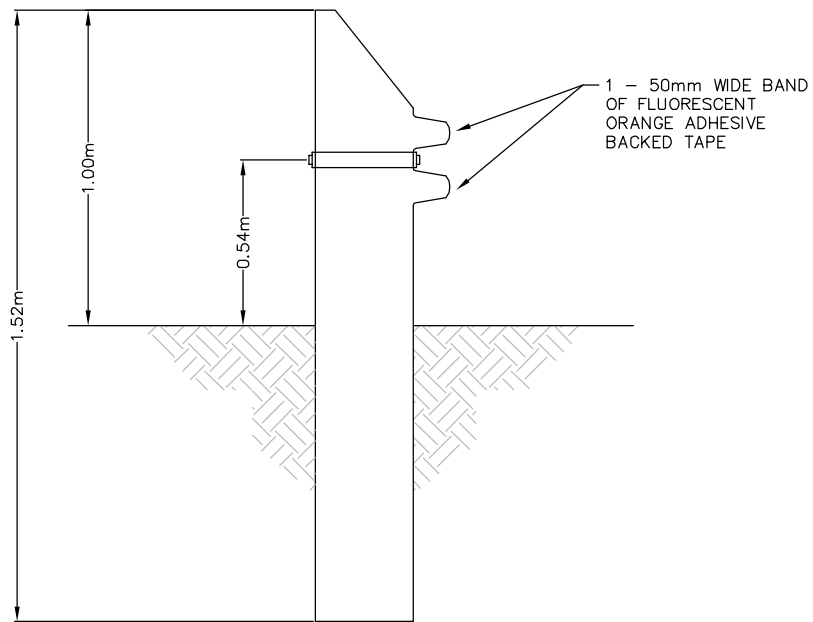
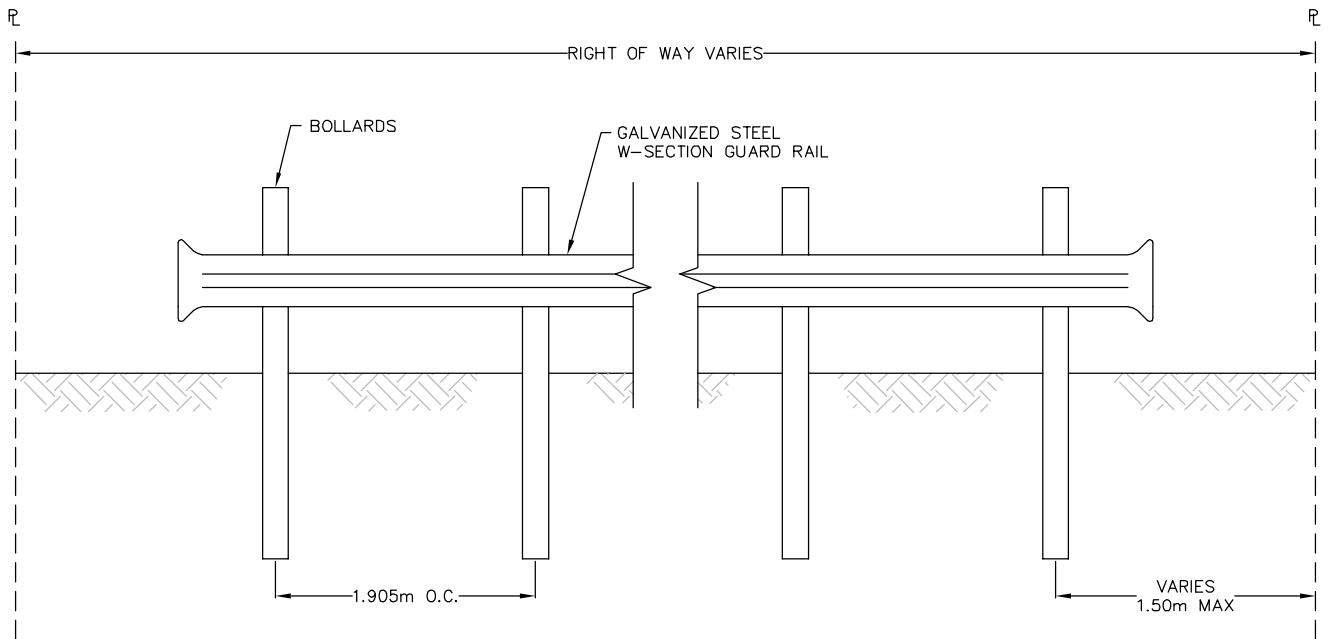
1. FOR STEEL DETAIL SEE STANDARD FIGURE G-59.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



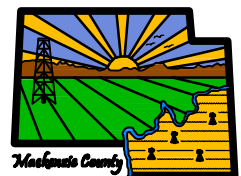
Rev.		<p>MINI BARRIER END UNITS DETAIL</p>		<p>Approved:</p>	<p>Figure G-60</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-60	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



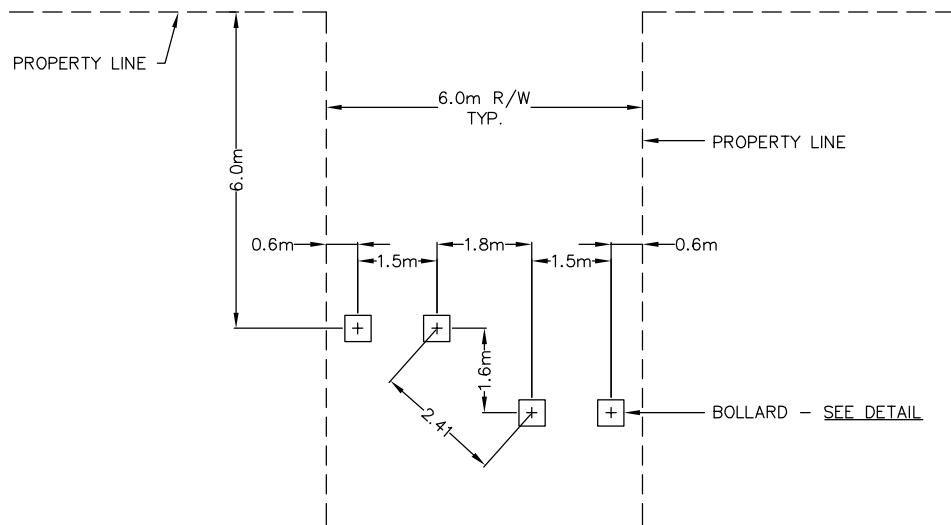
NOTES:
 1. ALL HARDWARE TO BE GALVANIZED.
 2. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards

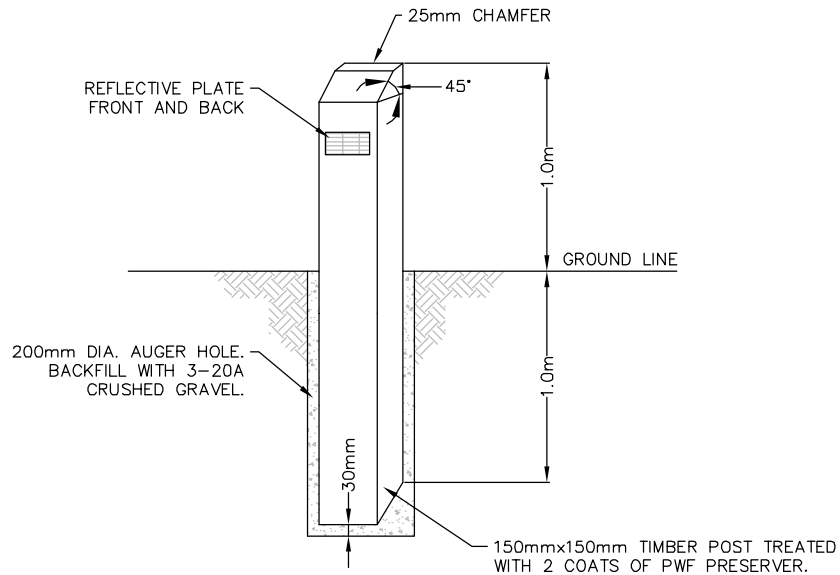


Rev.		TYPICAL BOLLARD WITH GALVANIZED STEEL W-SECTION		Approved:	Figure G-61
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			G-61



TYPICAL BOLLARD LAYOUT

HAND TREAT ALL CUTS WITH PWF PRESERVER.



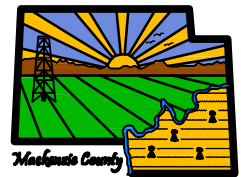
BOLLARD DETAIL

NOTES:

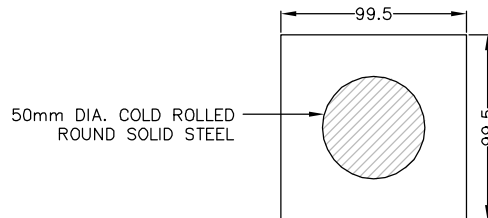
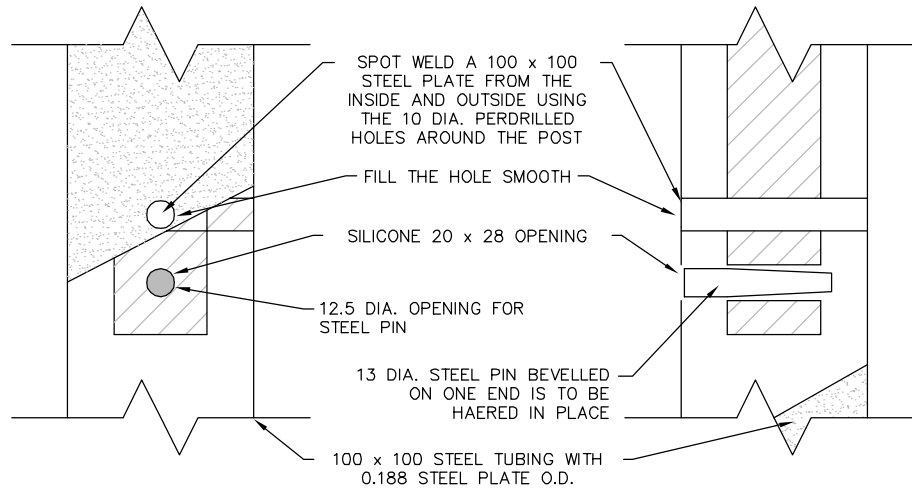
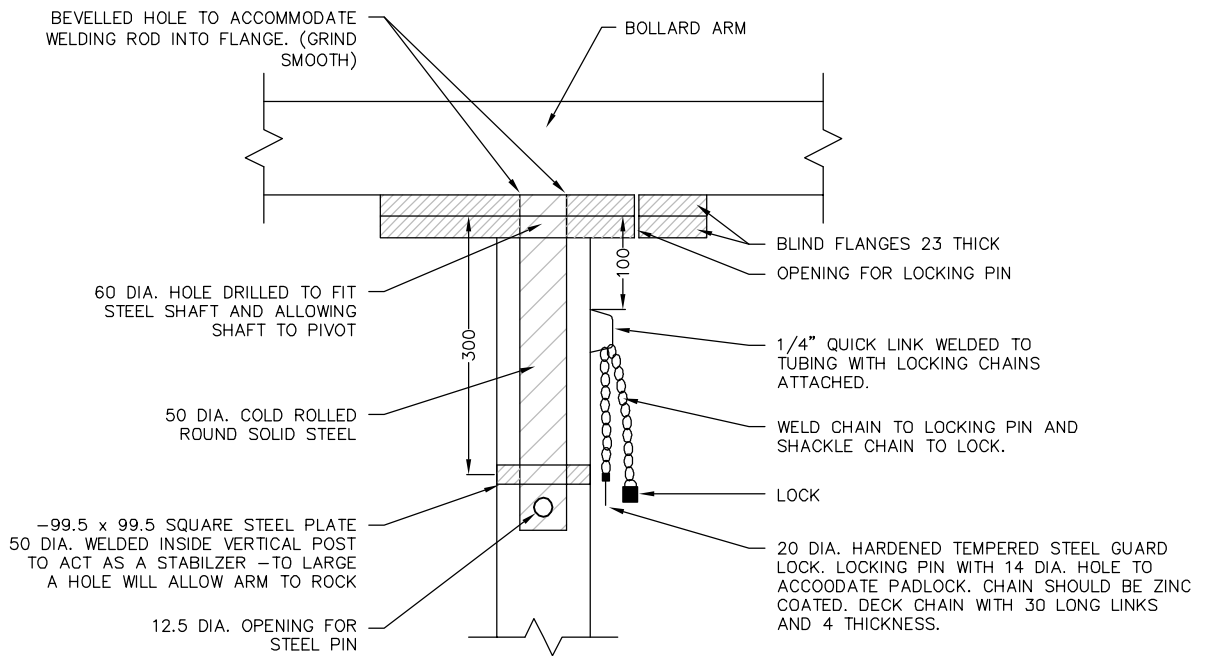
1. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>TYPICAL BOLLARD LAYOUT AND INSTALLATION</p>		<p>Approved:</p>	<p>Figure G-62</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-62	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

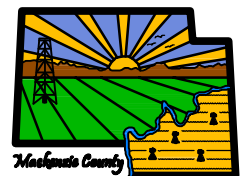


* NOTE: ALL METAL TO BE GALVANIZED POWDER COATING OPTIONAL. COLOUR TO BE APPROVED BY MACKENZIE COUNTY.

NOTE:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

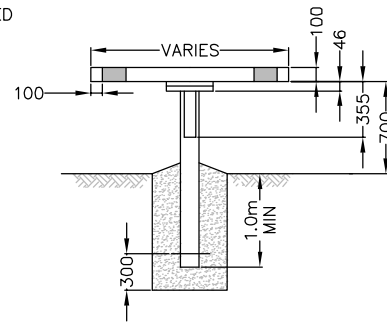
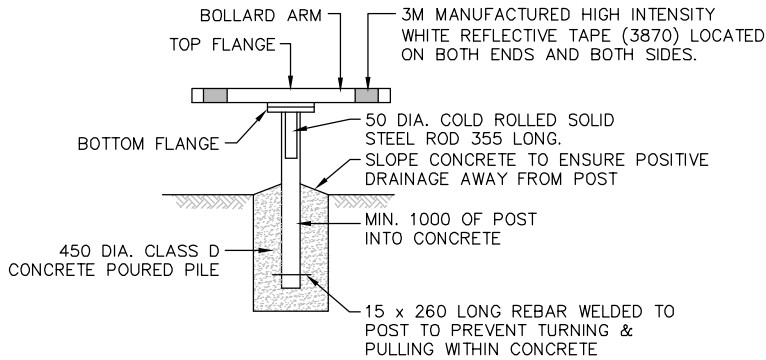
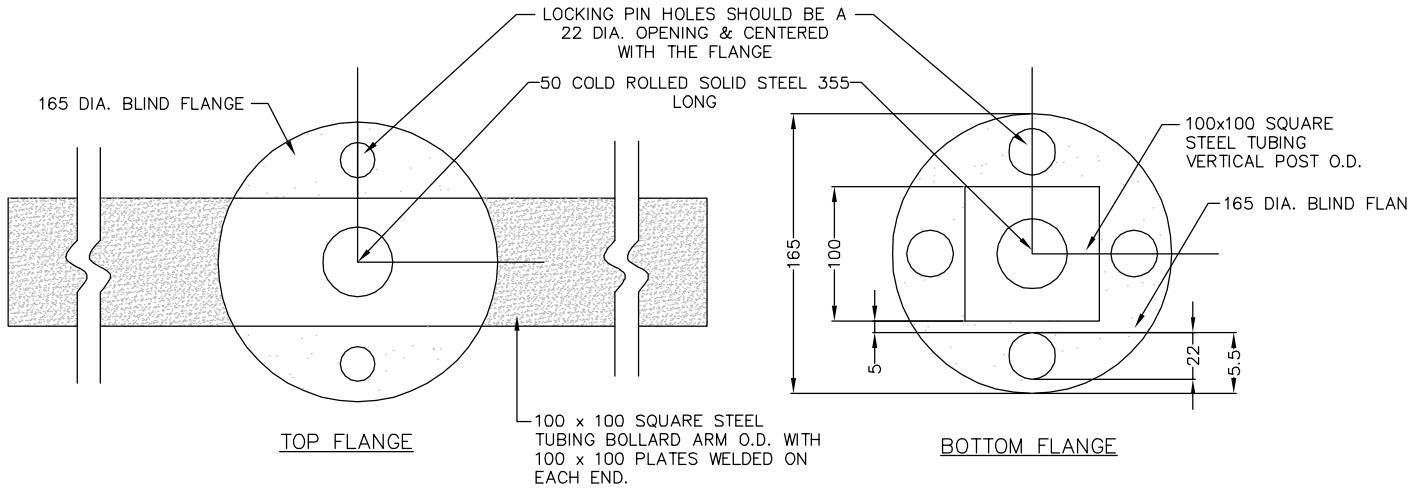
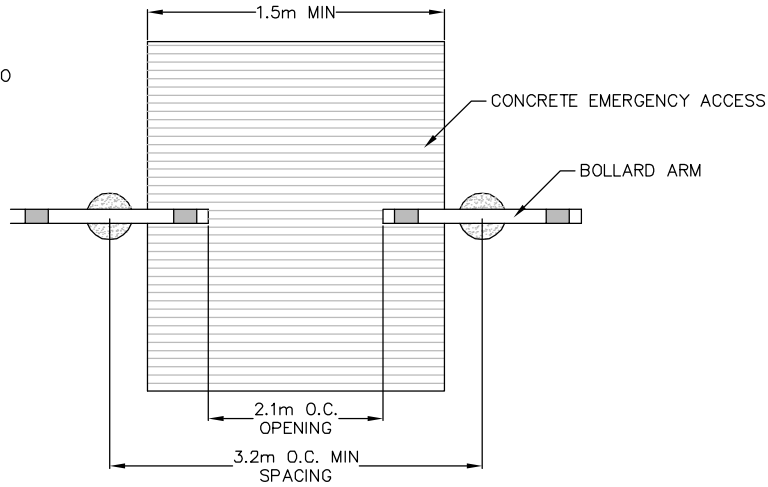
MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	T-BOLLARD ASSEMBLY DETAIL		Approved:	Figure G-63
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-63	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

NOTE: ALL METAL TO BE GALVANIZED
POWDER COATING OPTIONAL. COLOUR TO
BE APPROVED BY MACKENZIE COUNTY.

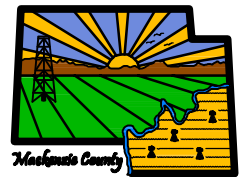


NOTES:

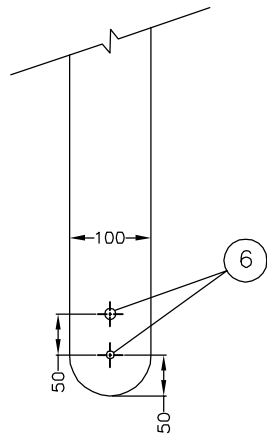
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

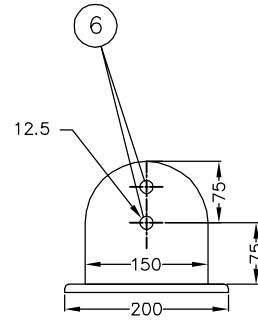
General Municipal Improvements Standards



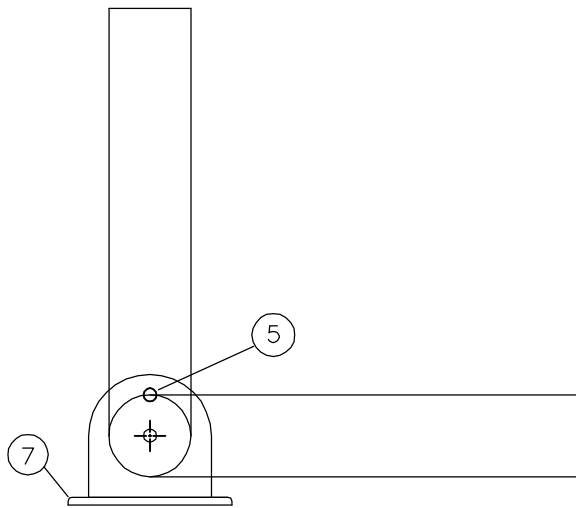
Rev.		T-BOLLARD IN EMERGENCY ACCESS	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	Figure G-64



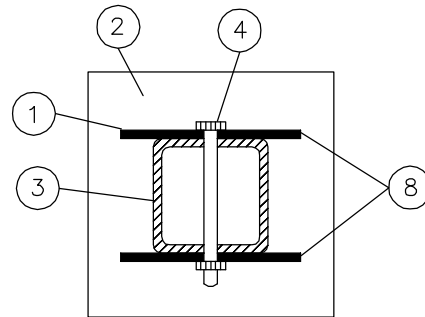
BOLLARD SECTION



BASE DETAIL



SIDE ELEVATION



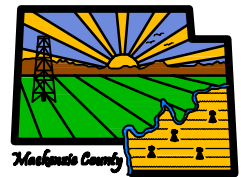
BASE CROSS SECTION

NOTES:

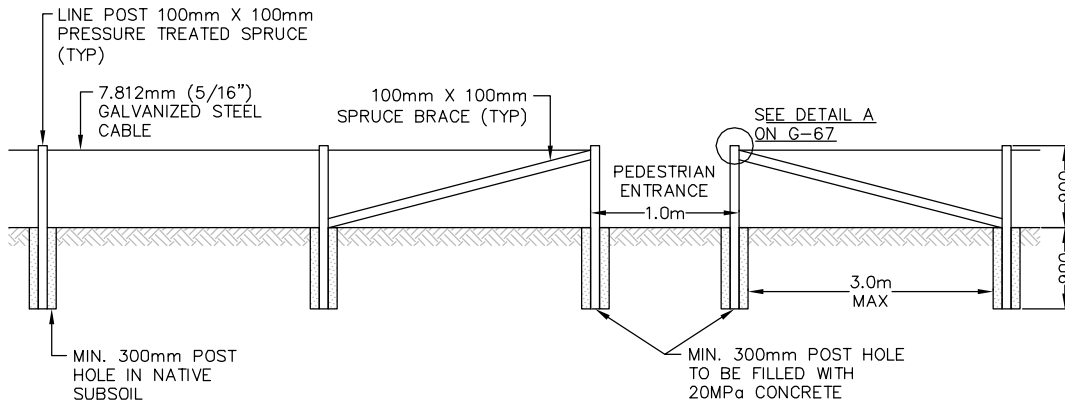
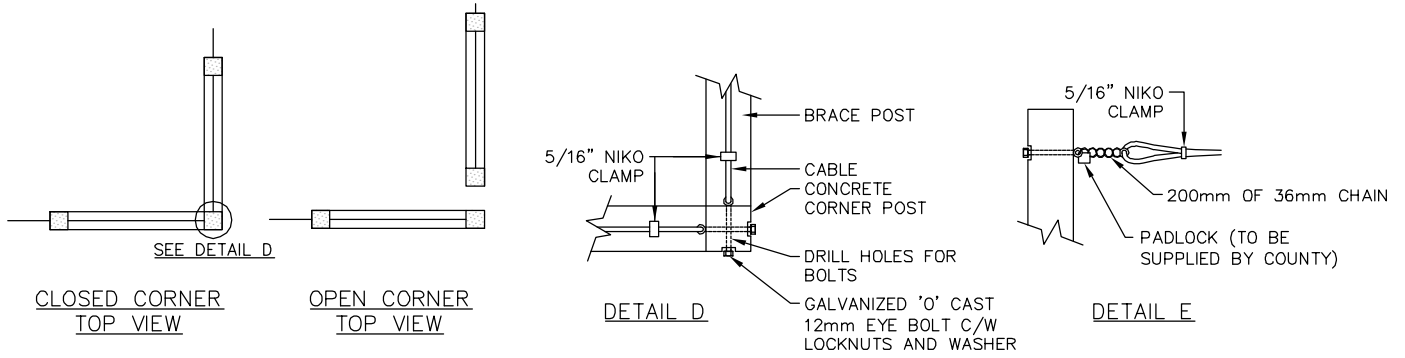
1. 12mm STEEL FLANGES WELDED TO BASE PLATE.
2. 200mm x 200mm x 12mm STEEL BASE PLATE c/w 4-19mm x 250mm STEEL ANCHOR OR TUBE WELDED TO BOTTOM.
3. 100mm x 100mm STEEL BOLLARD c/w TOP PLATE. 760mm IN LENGTH (YELLOW IN COLOR).
4. 12mm x 150mm BOLT c/w WASHERS AND NYLON LOCKING NUT.
5. 20mm x 150mm CLEVIS PIN.
6. HOLES DRILLED AS SHOWN.
7. CHAMFER TOP EDGES OF BASE PLATE.
8. TACK WELD.
9. SPECIFIC ANCHORING TO BE PRESCRIBED BY ENGINEER.
10. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

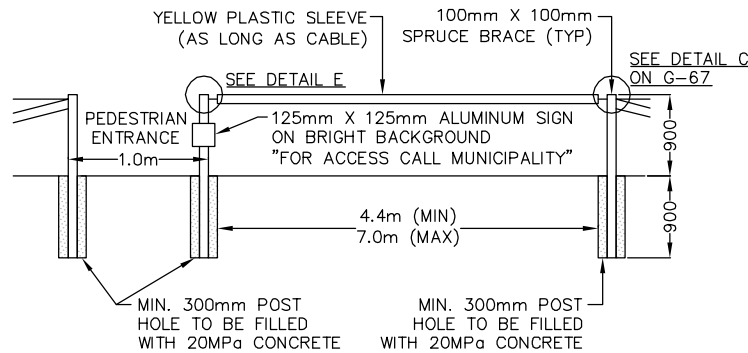
General Municipal Improvements Standards



Rev.		<p>COLLAPSIBLE BOLLARD</p>		<p>Approved:</p>	<p>Figure G-65</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure G-65</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



TYPICAL LONGITUDINAL SECTION
C/W PEDESTRIAN ENTRANCE



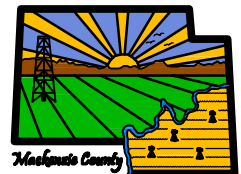
TYPICAL VEHICLE ENTRANCE GATE

NOTES:

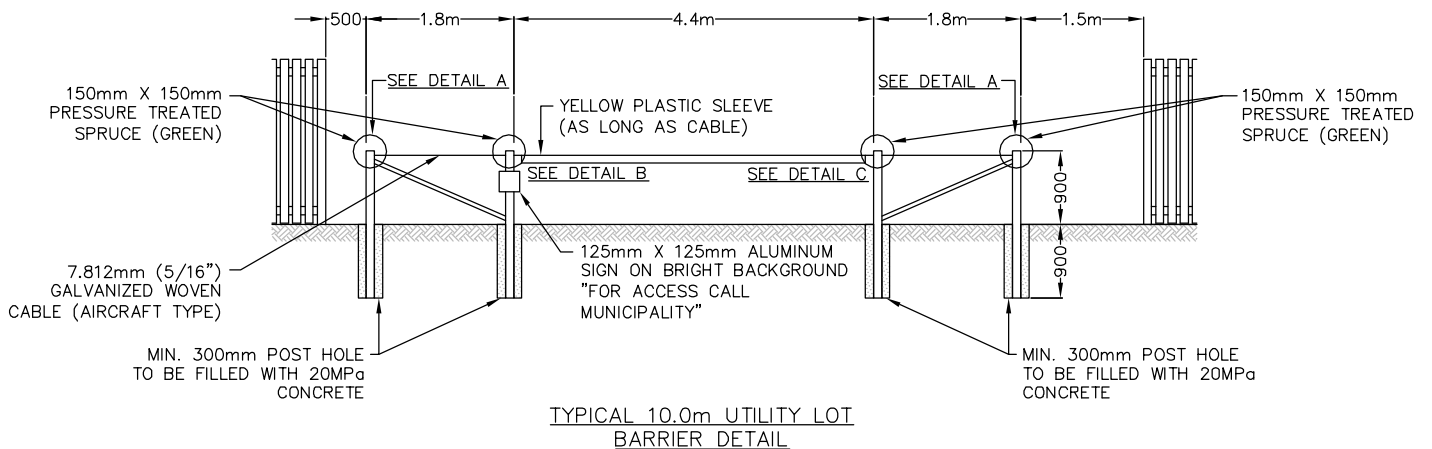
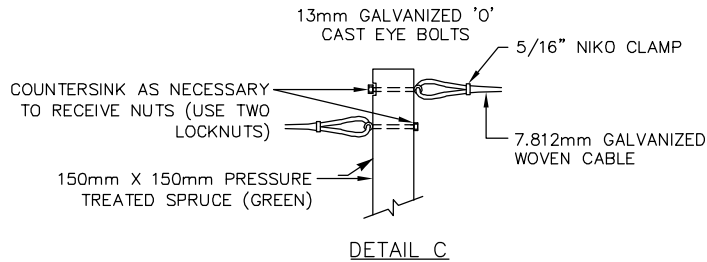
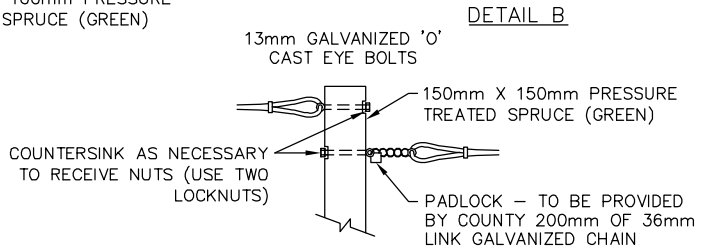
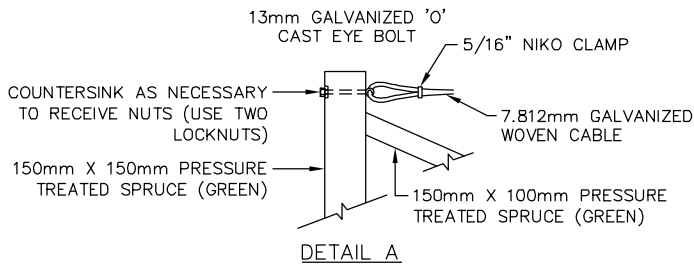
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		<p>POST & CABLE DETAIL</p>		<p>Approved:</p>	<p>Figure G-66</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-66	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

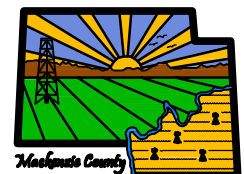


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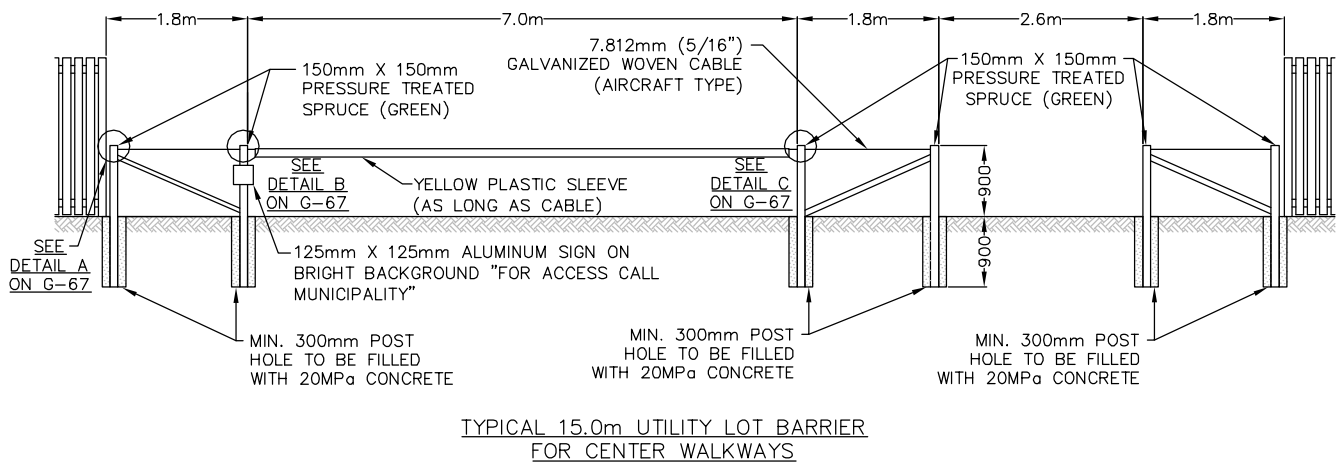
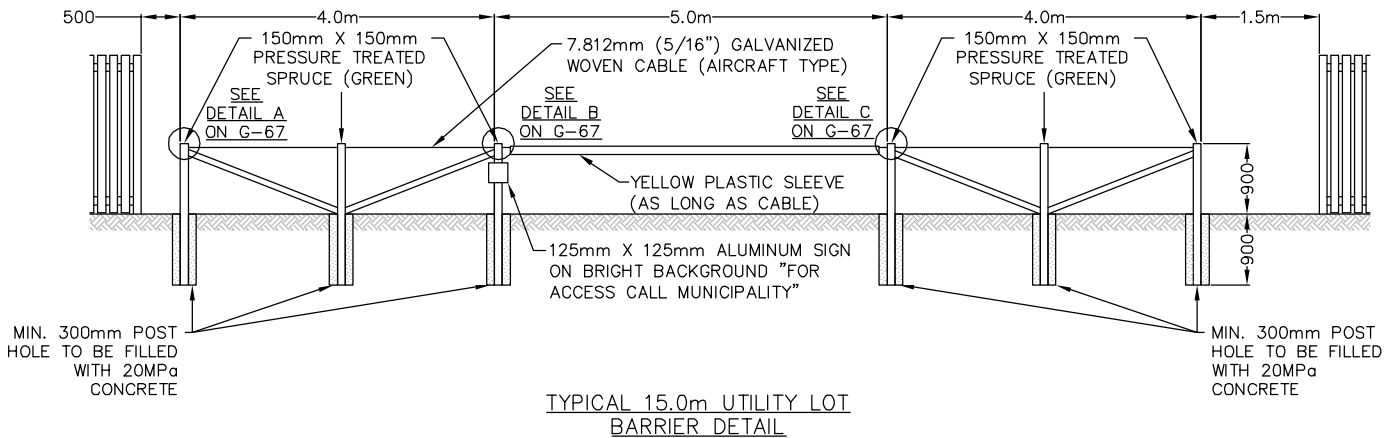
1. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.
3. 'O' BOLTS AND CABLE CLAMPS TO BE GALVANIZED EQUIVALENT TO PREVENT CORROSION.
4. DOUBLE LOCKNUTS ON 'O' BOLTS AND LOCKNUTS ON CABLE.
5. BARRIER DETAILS ARE TYPICAL AND MAY VARY SLIGHTLY DEPENDING ON ACTUAL FIELD DIMENSIONS.
6. PADLOCK TO BE SUPPLIED AT COST BY THE MUNICIPALITY.
7. SIGN TO BE INSTALLED.
8. FOR ACCESS CALL MUNICIPALITY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		UTILITY LOT BARRIER (10 METRE)		Approved:	Figure G-67
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

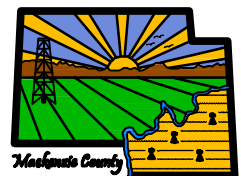


NOTES:

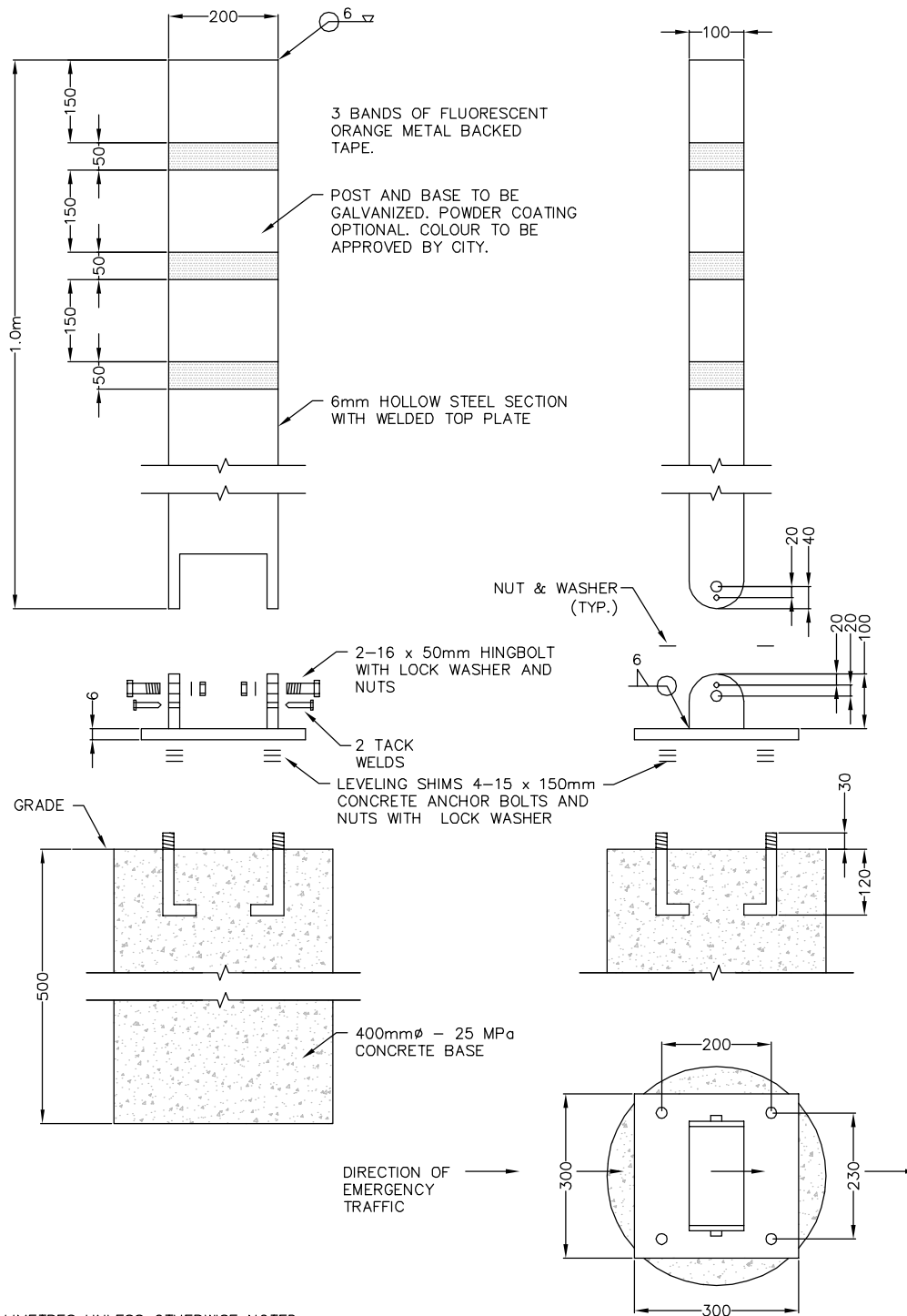
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		UTILITY LOT BARRIER (15 METRE)		Figure G-68
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

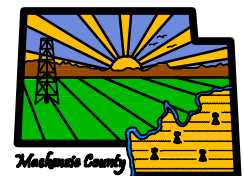


NOTES:

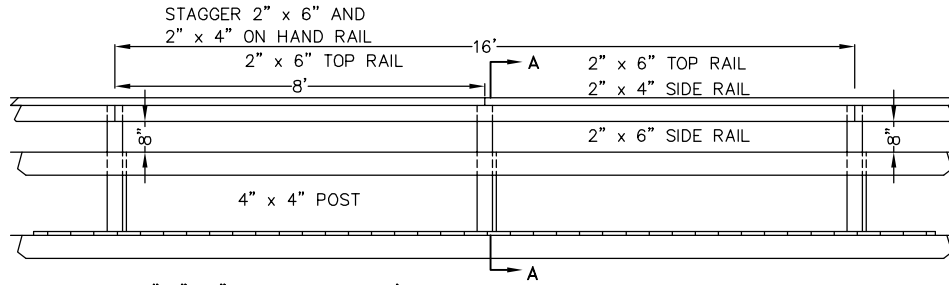
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

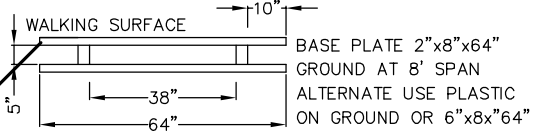
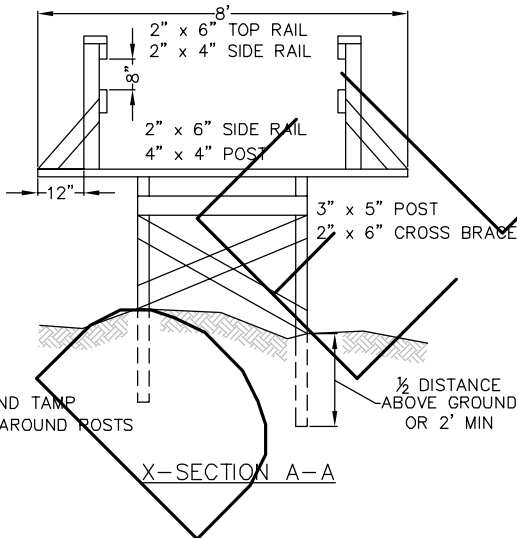
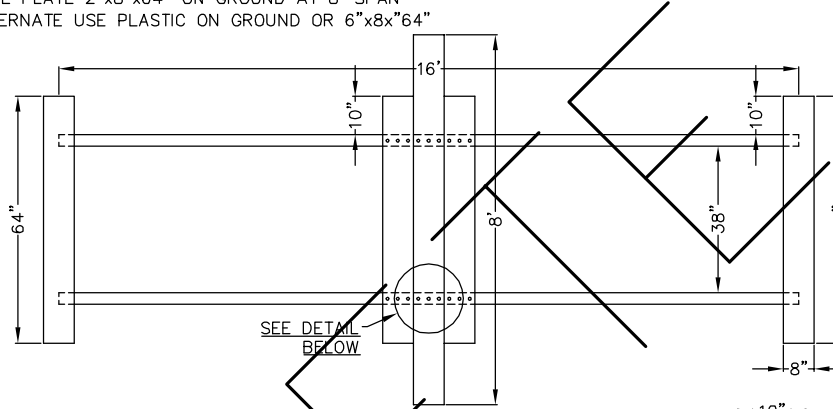
General Municipal Improvements Standards



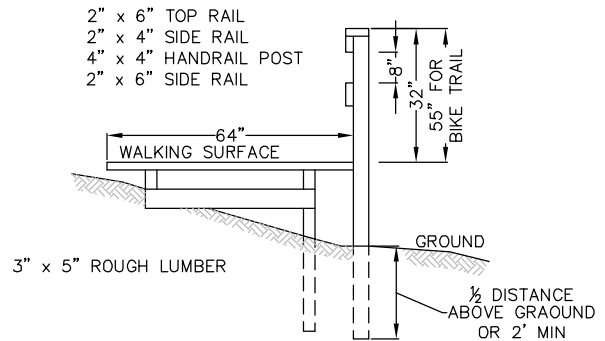
Rev.		EMERGENCY KNOCK-DOWN POST (RETROFIT)		Approved:	Figure G-69
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-69	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



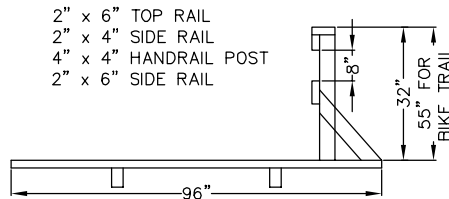
BASE PLATE 2"x8"x64" ON GROUND AT 8' SPAN
ALTERNATE USE PLASTIC ON GROUND OR 6"x8"x64"



HAND RAIL POST OPTION #1



HAND RAIL POST OPTION #2

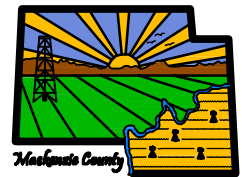


NOTES:

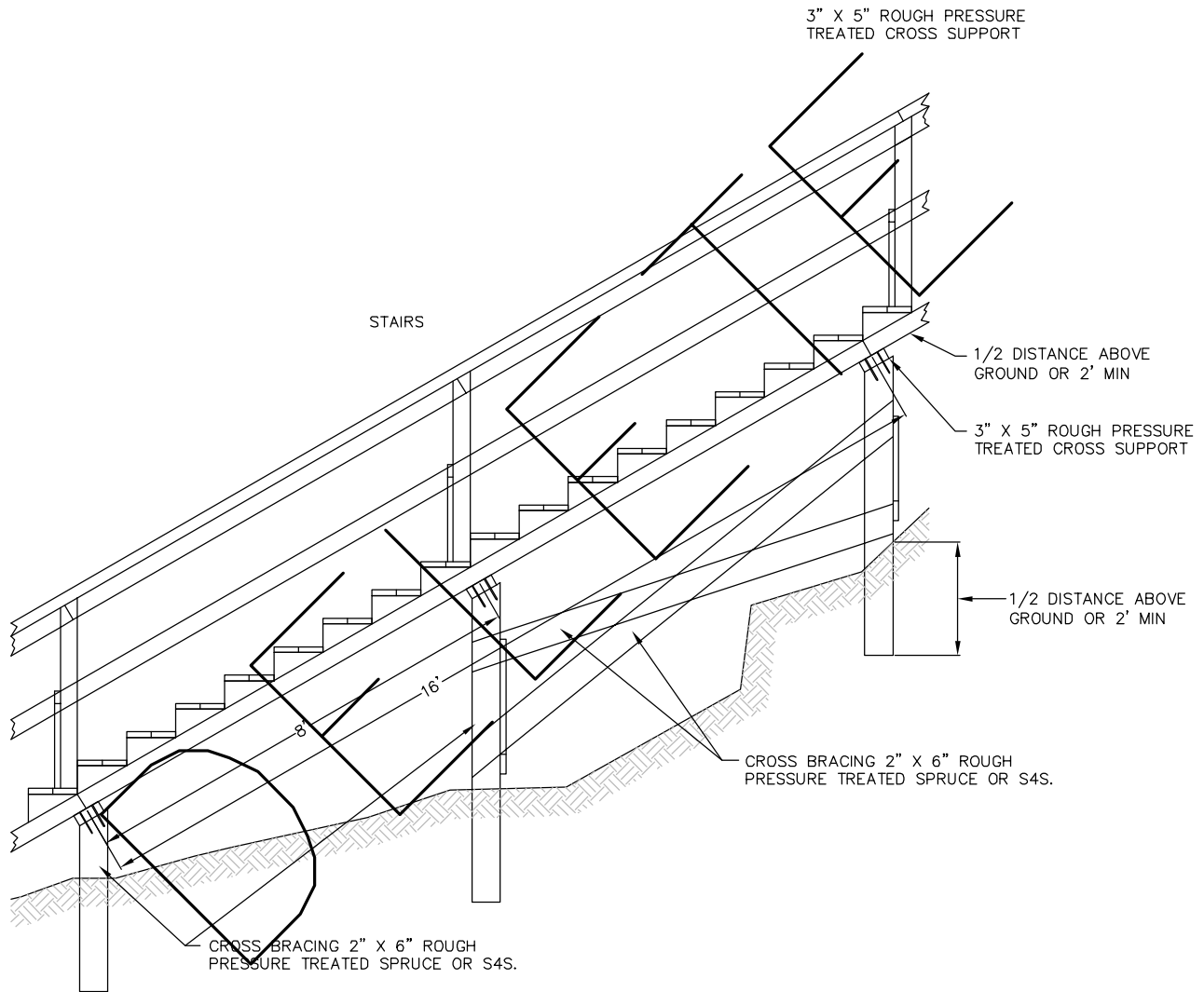
1. STRINGERS ARE 3"x5"x16' ROUGH PRESSURE TREATED.
2. BASE PLATE: A: 2"x8"x64" ROUGH PRESSURE TREATED.
B: 2(3/8)"x5(1/5)" PLASTIC WOOD.
C: 6"x8"x64" PRESSURE TREATED.
3. TOP BOARDS OR WALKING SURFACE 2"x8"x64" ROUGH PRESSURE TREATED.
4. HANDRAIL: A: 2"x4"x16' S/4/S PRESSURE TREATED (SIDE RAIL).
B: 2"x6"x16' S/4/S PRESSURE TREATED (TOP RAIL).
C: 4"x4"x32" S/4/S PRESSURE TREATED (HANDRAIL POST.)
5. BRACES 2"x8" ROUGH PRESSURE TREATED OUTLOOK TO HOLD HAND RAIL.
6. USE 4" SPIRAL NAILS.
7. ALL DIMENSIONS ARE NOMINAL IMPERIAL UNITS TO CORRESPOND TO STANDARD LUMBER SIZES.

MACKENZIE COUNTY

General Municipal Improvements Standards

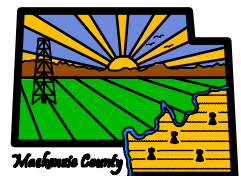


Rev.	Stewart Weir Naturally Resourceful	WOODEN WALK		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		G-70

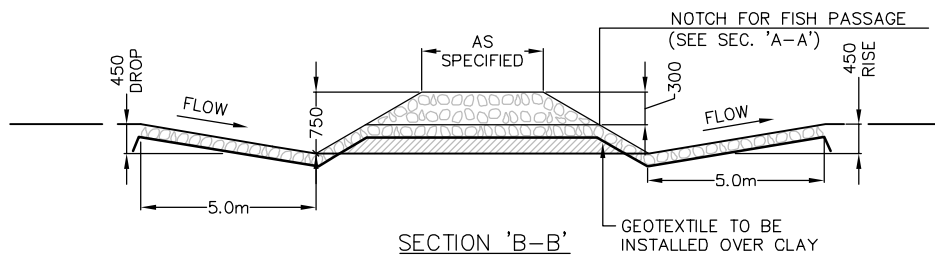
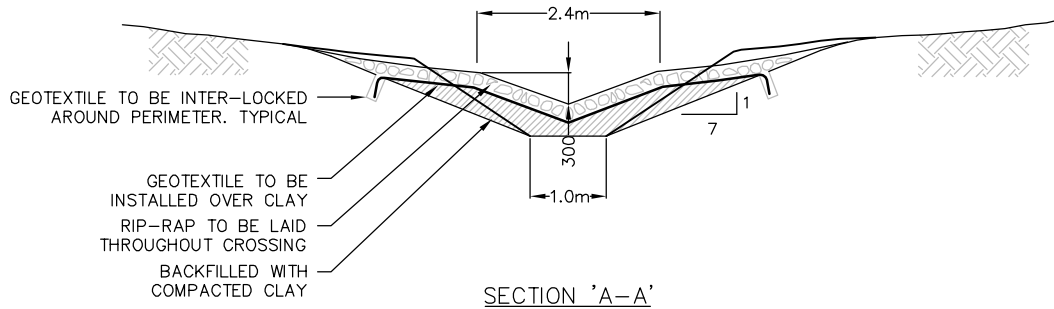
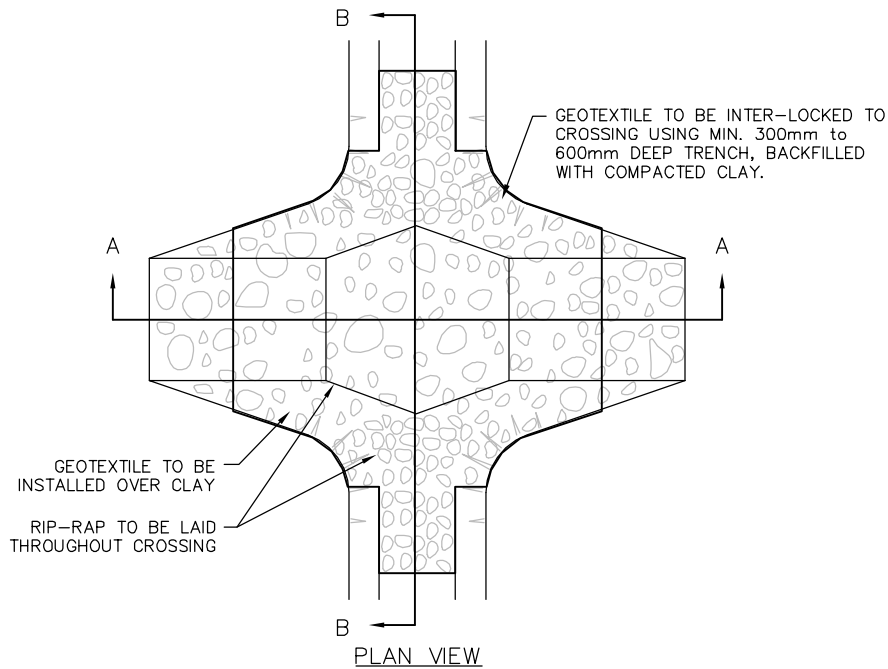


MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	WOODEN STAIRS AND SUPPORT STRUCTURE		Approved:	Figure G-71
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure	
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			

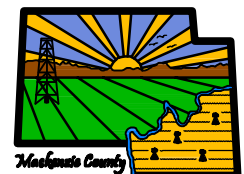


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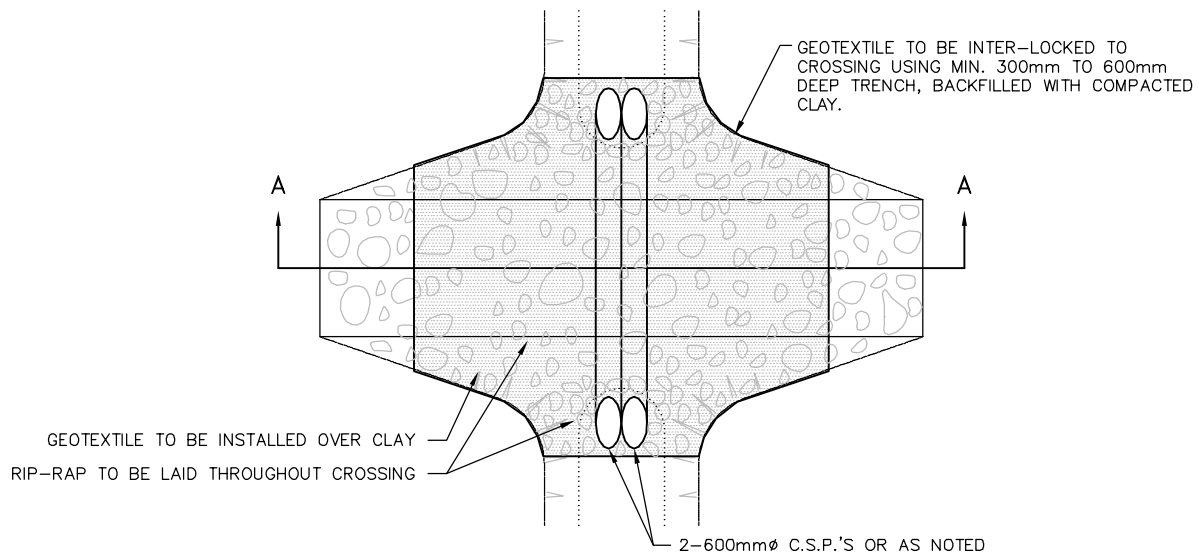
1. GEOTEXTILE OVERLAPS TO BE A MIN. OF 300mm.
2. ROCKED LINED CROSSING: USE 150mm-200mm ROCK, MAT THICKNESS 300mm.
3. EXTEND TO FULL WIDTH, LENGTH & SIDESLOPE OF CROSSING AS WELL AS UPSTREAM & DOWNSTREAM. SPRAY SLURRY MIX CONCRETE (5MPa) TO FILL VOIDS (TOP ONLY).
4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards

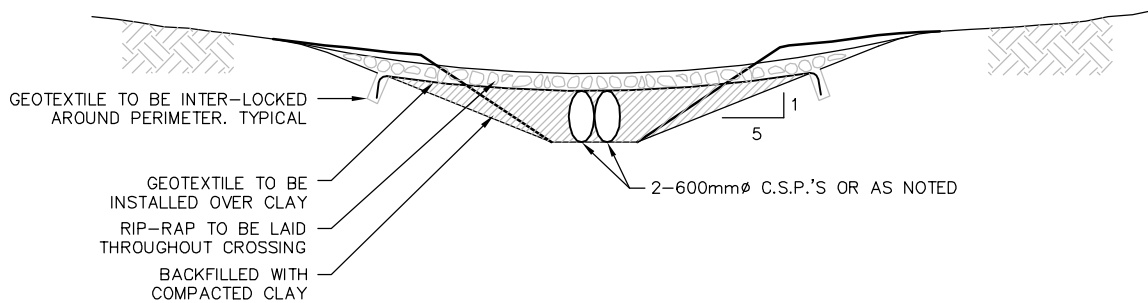


Rev.	Stewart Weir Naturally Resourceful	LOW LEVEL X-ING NO CULVERT	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure G-72



NOTE: GEOTEXTILE OVERLAPS TO BE A MIN. OF 300mm

PLAN VIEW

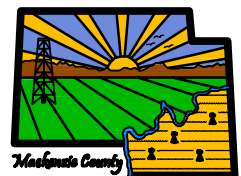


SECTION A-A

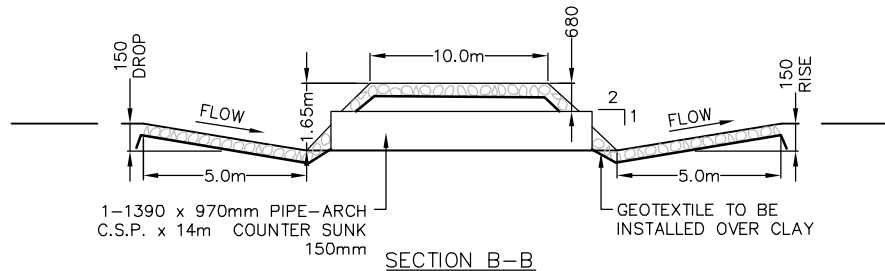
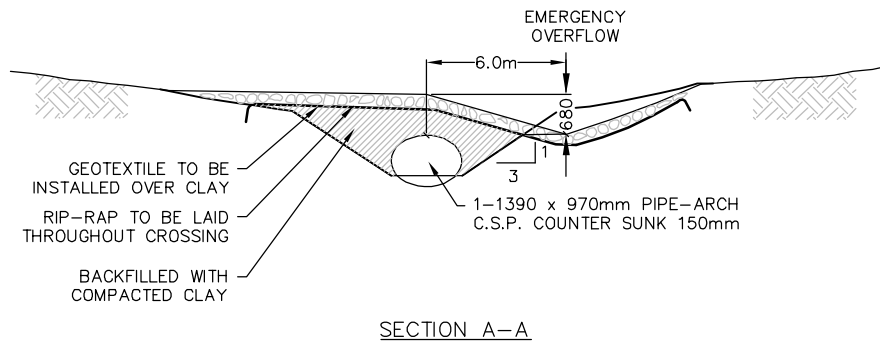
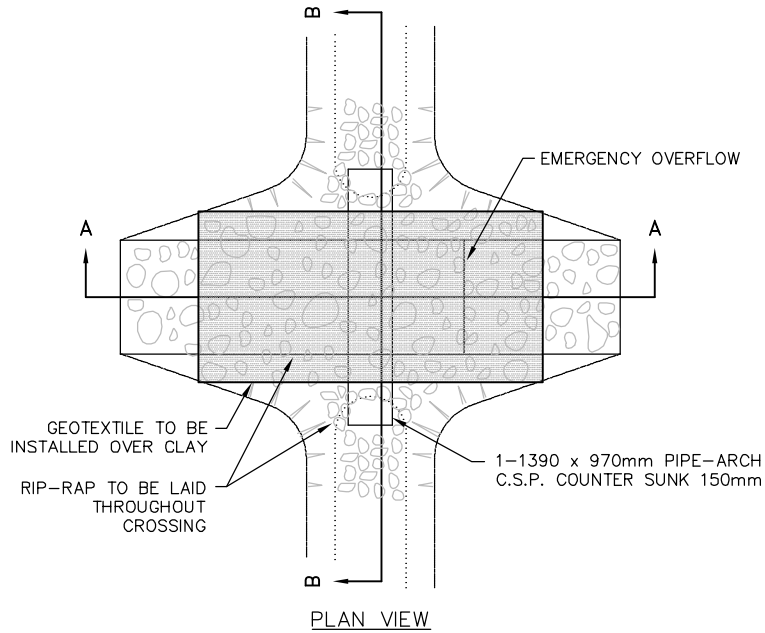
NOTE:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		LOW LEVEL X-ING WITH CULVERT		Figure G-73
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

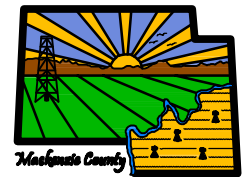


NOTES:

1. GEOTEXTILE OVERLAPS TO BE A MIN. OF 300mm.
2. ROCK LINED CROSSING: USE 150mm - 200mm ROCK, MAT THICKNESS 300mm.
3. EXTEND TO FULL WIDTH, LENGTH & SIDESLOPE OF CROSSING AS WELL AS UPSTREAM & DOWNSTREAM AND OVERFLOW CHANNEL.
4. SPRAY SLURRY CONCRETE (5MPa) TO FILL VOIDS (TOP ONLY).
5. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



LOW LEVEL X-ING WITH CULVERT

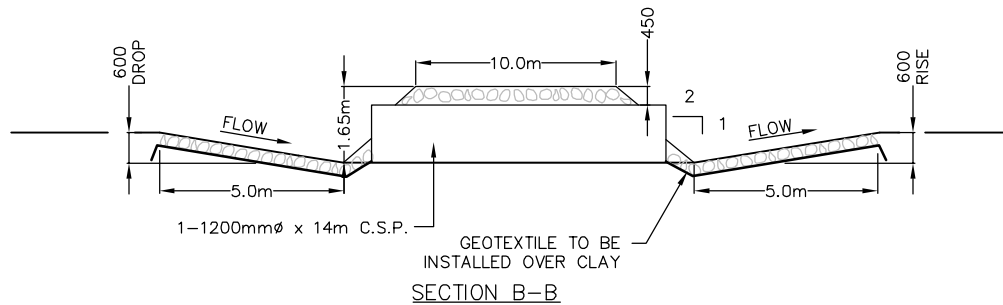
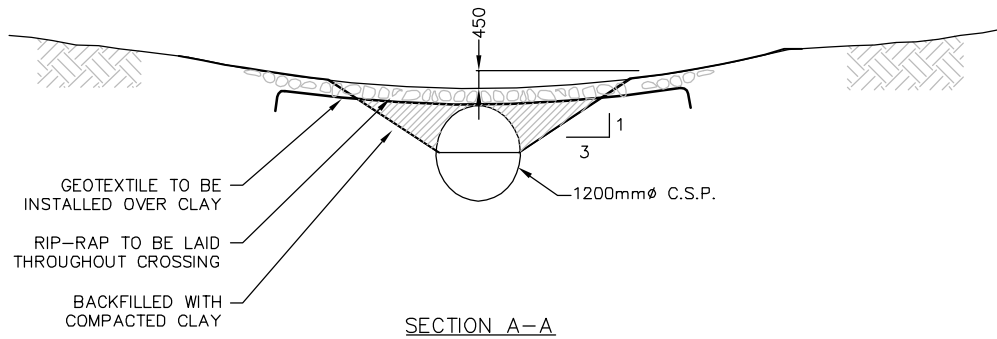
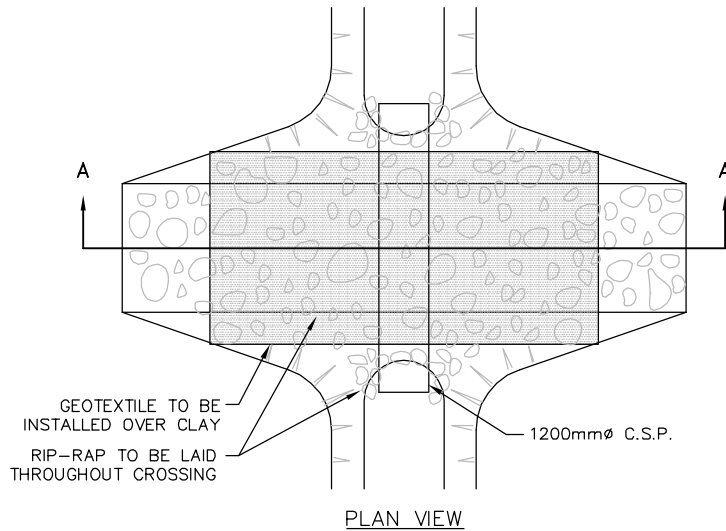
Rev.	
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Rev.	
Date:	2010-AUG-31

File No.: GP60.33682

Design:
Scale: N.T.S

Approved:

Figure
G-74

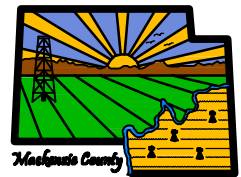


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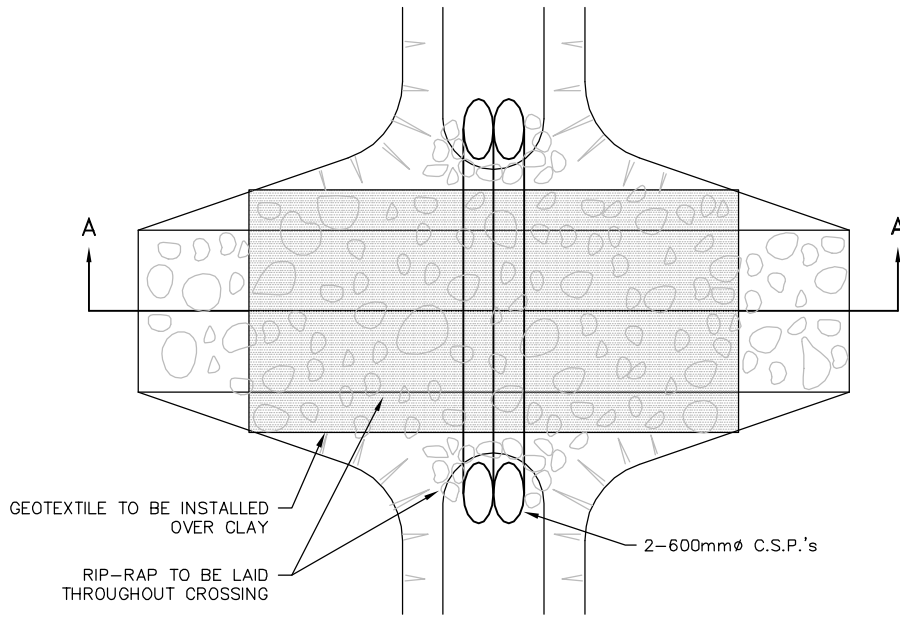
1. GEOTEXTILE OVERLAPS TO BE A MIN, OF 300mm.
2. ROCK LINED CROSSING: USE 150mm - 200mm ROCK, MAT THICKNESS 300mm.
3. EXTEND TO FULL WIDTH, LENGTH & SIDESLOPE OF CROSSING AS WELL AS UPSTREAM & DOWNSTREAM. SPRAY SLURRY MIX CONCRETE (5MPa) TO FILL VOIDS (TOP ONLY).
4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

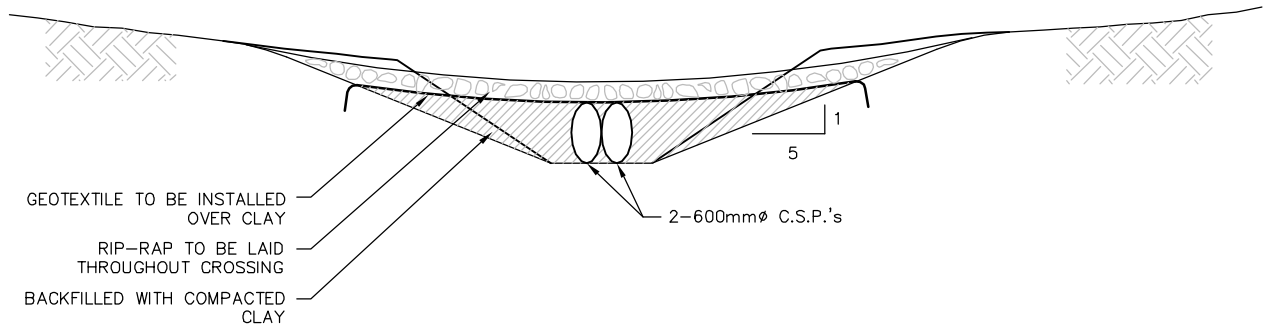
General Municipal Improvements Standards



Rev.		<p>LOW LEVEL X-ING WITH CULVERT</p>		<p>Approved:</p>	<p>Figure G-75</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure G-75	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



PLAN VIEW



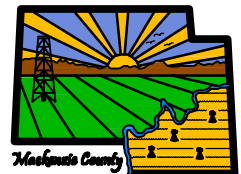
SECTION A-A

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

MACKENZIE COUNTY

General Municipal Improvements Standards



LOW LEVEL X-ING WITH CULVERT

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Date: 2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L

Design:
Scale: N.T.S

Approved:

Figure G-76

SECTION H LANDSCAPING AND STREET LIGHTING

H.1 LANDSCAPING

H.1.1 Scope

- i. The Developer shall prepare and submit to the Municipality for review and approval the Landscaping Plan of the proposed subdivision which shall include up to three alternative names for each street or roadway. At its sole discretion, the Municipality reserves the right to select or reject proposed street names.
- ii. Work under landscaping shall include, but is not necessarily limited to, the following:
 - a. site preparation,
 - b. seeding and/or sodding,
 - c. planting.

H.1.2 Landscaping Plans

- i. The Developer shall submit the Landscaping Plan detailing the proposed improvements, such as areas to be seeded or sodded, locations and names of all trees and shrubs, locations of planting beds, fencing and any park furniture or playground equipment proposed for installation. The Landscaping Plan shall utilize the overall road, sidewalk, and walkway plans as a base template drawing. The underground utilities shall be also shown on the Landscaping Plan.
- ii. The Developer shall submit detailed drawings of proposed park furniture and playground equipment for approval by the Municipality.
- iii. No landscaping work shall commence until the Landscaping Plan has been approved by the Municipality.

H.1.3 Landscape Design Requirements

- i. General requirements:
 - a. All landscaping materials and features shall be as shown on the Landscaping Plan approved by the Municipality.
 - b. Trees shall be set back a minimum of 1 m from the back of curb, sidewalk or verge. Shrubs shall be set back a minimum of 0.5 m from the back of curb, sidewalk, and verge or back of turf landscape edging.
 - c. Locations of planting beds shall be laid out in such a way as to allow for the access of the Municipality maintenance personnel and equipment. Annual plantings shall not be used in planting beds.

- d. Uniform or screen fences shall be located wholly on adjacent private properties and shall meet the standards as specified herein.
 - e. No landscape features, including trees and shrubs, or other similar obstructions to visibility which extends to a height more than 1 m above the top of roadway finished surface shall be allowed within 30 m of the centre of intersecting roadways.
 - f. Landscape furniture shall meet the Municipality standards and shall be anchored to concrete bases. The following setbacks for landscape furniture shall apply:
 - Benches shall be 1 m from the back of any walkway.
 - Waste receptacles shall be 0.25 m from the back of any walkway.
 - Picnic tables shall be located in clusters to the satisfaction of the Municipality.
- ii. Residential roadway boulevards:
 - a. Residential roadway boulevards shall be graded, top soiled and sodded between the back of curb and the nearest edge of the sidewalk.
 - b. Boulevards shall be designed with a minimum boulevard tree spacing as specified in the Table H.1.3-1.
 - c. Minimum deciduous tree caliper shall be 60 mm.
 - iii. Collector roadway boulevards:
 - a. Collector roadway boulevards must be graded, top soiled, sodded, and landscaped. Boulevard landscaping design may include planting beds, shrubs and ground cover.
 - b. Minimum tree spacing for boulevards shall be 8 - 10 m depending on tree species proposed for planting. Minimum deciduous tree caliper shall be 60 mm. Minimum coniferous tree height shall be 2.5 m. A tree species mix of 60 % coniferous and 40 % deciduous is preferred.
 - c. Minimum shrub size shall be five (5) gallon potted. Shrubs spacing shall be 1 m on centre. Minimum shrub height and spread shall be 0.6 m.
 - iv. Major route entrance boulevards:
 - a. Major route entrance boulevards shall be designed with minimum tree spacing of 8 - 10 m depending on tree species proposed for planting. Boulevards shall be designed to include continuous large planting beds that contain trees, shrubs and ground cover.
 - b. Minimum deciduous tree caliper shall be 80 mm. Minimum coniferous tree height shall be 3 m. A tree species mix of 60 % coniferous and 40 % deciduous shall be preferred.

- c. Minimum shrub size shall be five (5) gallon potted. Shrubs spacing shall be 1 m on centre. Minimum shrub height and spread shall be 0.6 – 1.2 m.

Table H.1.3-1 Boulevard Tree Species and Spacing Guidelines

Tree Species (Common Name)	Minimum Spacing (m)
Poplar Brooks, Poplar N/W	10
Summit Ash, Patmore Ash, Black Ash, Manchurian Ash, Oak	8
Linden, Birch, Mountain Ash, Pear	6
Flowering Crab Apple (dependant on species), Cherry Trees (dependant on species), Pine (dependant on species), Spruce (dependant on species)	4 - 8
Swedish Columnar Poplar, Tower Poplar	3 - 6

Note: The Developer may suggest other trees for boulevards depending on specific site constraints.

- v. Medians and entry features.
- a. Landscaped roadway islands, medians and entry features shall be top soiled, sodded, and planted with trees and/or shrubs and ground cover. All roadway islands, medians, and entry feature landscaping shall be designed as low maintenance for the Municipality. Tree and shrub planting proposed locations shall not obstruct vehicular traffic sight lines.
 - b. Minimum deciduous tree caliper shall be 60 mm. Shrubs shall be massed within planting beds. Minimum shrub size shall be five (5) gallon potted. Shrubs spacing shall be 1 m on centre. Minimum shrub height and spread shall be 0.6 m.
 - c. Planting beds shall incorporate weed liners and landscape edging. Planting beds shall have a wood chip mulch topping, decorative crushed granular rock topping or shale topping as approved by the Municipality. Minimum topping thickness shall be 0.1 m.
 - d. If sodded areas are to be contained within road islands and medians, the total consolidated sodded area shall be greater than 75 m². Sodded areas shall be designed free from any standing architectural features such as signs, sculptures, light poles, entrance gates, etc.
 - e. Planting cross section and plan details shall be cross referenced to the engineering plans and profiles with the details shown such as limits of the road base and subbase; limits of the compacted verge base materials in relation to the organic soils, mulches, and root zones of the trees and shrubs; curb face, back of curb, verge or walkway, tree and shrub setbacks; proposed planting and spacing, landscape edging, mulches, and freestanding features.

- f. Lighting features shall be as specified by the Municipality.
- vi. Walkways.
 - a. Walkway rights-of-way shall be graded, top soiled, seeded or sodded and planted with trees and ground cover. Low maintenance hardy plant species common to northern Alberta shall be used. Plant materials with sucker-type root systems shall not be permitted to avoid encroachment into adjacent private property.
 - b. Minimum tree spacing shall be 4 trees per 35 m of walkway right-of-way. Where possible, trees shall be set back a minimum of 1 m from adjacent property lines. Trees shall be placed and grouped in rows. Tree groupings shall be positioned on either side of the walkway in staggered arrangement. Minimum deciduous tree caliper shall be 60 mm. Minimum coniferous tree height shall be 2.5 m. Tree species mix of 60 % coniferous and 40 % deciduous shall be preferred.
 - c. Year round sight lines through the walkway rights-of-way shall be maintained for pedestrian safety and security. Suggested minimum branching height shall be 2 m for all trees to allow adequate pedestrian clearance beneath tree branches. Pyramidal or columnar trees shall not have branches that overhang into adjacent properties.
 - d. Minimum shrub size shall be three (3) gallons potted. Shrub spacing shall be 0.75 m on centre.
 - e. Planting beds shall incorporate weed liners and landscape edging. Planting beds shall have wood chip mulch topping with a minimum thickness of 0.1 m. Decorative crushed granular materials shall not be accepted by the Municipality as a substitute for wood mulch.
 - f. Landscape furniture shall be placed at pre-approved locations as shown on the Landscaping Plan. Uniform or screen fences shall be located wholly on adjacent private properties and shall meet the standards as specified herein.

Table 1.3-2 Planting Materials for Walkway Rights-of-Way

Tree Species (Common Name)	Minimum Spacing (m)
Lodgepole Pine, Pin Cherry, Schubert Chokecherry, Pyramidal Flowering Crab, Japanese Tree Lilac, Columnar Aspen	4
Linden 6	6
Black Ash 8	8

Note: The Developer may suggest other trees, tree form shrubs, and ground cover depending on specific site constraints.

- vii. Utility corridors and rights-of-way:
- a. 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 owner or the operator of 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.
 - b. Utility corridors shall be graded, top soiled, seeded or sodded and landscaped to the satisfaction of the Municipality. Existing healthy or vigorous trees within, or abutting the utility corridor, shall be preserved wherever possible.
 - c. Trees shall be planted in major utility corridors with a minimum of 30 trees planted per acre and massed into major groupings. Minimum deciduous tree caliper shall be 50 mm. Minimum coniferous tree height shall be 2 m. A tree species mix of 60 % coniferous and 40 % deciduous shall be preferred.
 - d. Shrubs may be substituted for trees at a substitution ratio of 5 shrubs to 1 tree. The maximum number of trees that can be substituted for per acre shall be 15. Shrubs shall be massed within large planting beds. Minimum shrub size shall be five (5) gallon potted. Shrub spacing shall be 1 m on centre. Minimum shrub height and spread shall be 0.6 m.
 - e. Minimum widths of sodded areas between planting beds shall be 2 m. Planting beds shall incorporate weed liners. There shall be no requirement for landscape edging. Planting beds shall have wood chip mulch topping with a minimum thickness of 0.1 m. Decorative crushed granular materials shall not be accepted by the Municipality as a substitute for wood mulch.
 - f. Landscape furniture shall be placed at pre-approved locations as shown on the Landscaping Plan. Uniform or screen fences shall be located wholly on adjacent private properties and shall meet the standards as specified herein.
 - g. Lighting features shall be as specified by the Municipality.

Table H.1.3-3 Utility Corridor Planting Materials**Hedge materials suitable for planting near power lines:**

Species (Common Name)		Height at Maturity (m)
Caragana	Common	3
	Globe, Pygmy	1
Cranberry	Nannyberry	5
	Wayfaring Tree	3
Honeysuckle	Clavey's Dwarf	1
	Tartarian	3
	Zabels	2
Lilac (Common, Late), Prinsepia		3
Red Osier Dogwood, Nanking Cherry, Cotoneaster Hedge		2
Potentilla		1

Trees - May plant near power lines with caution:

Species (Common Name)	Minimum Spacing (m)
Black Cherry, Tartarian Maple, Mugo Pine	6
Pincherry, Western Chokecherry, Flowering Crabapples, Showy Mountain Ash, Green's Mountain Ash, French Pussy-Willow, Pyramidal White Cedar, Nannyberry, Lilac, Hawthorns	5
Amur Maple, Elder, Saskatoon	4
Montgomery Blue Spruce, Caragana, Highbrush Cranberry, Dogwood, Honeysuckle	3
Cotoneaster Hedge	2

Trees - Do not plant within 8 m of power lines:

Species (Common Name)	Minimum Spacing (m)
Plains Cottonwood	30
Balsam Poplar, Northwest Polar, American Elm, Cut-Leaved Weeping Birch	20
White Spruce, Colorado Blue Spruce, Laurel Leaved Willow, Golden Leaved Willow, Green Ash, Patmore Green Ash, Brandon Elm	15
Manitoba Maple	14
Siberian Elm, Paper Birch, European White Birch, Slender Weeping Birch	12
Sharp Leaf Willow	10
Trembling Aspen	8

Table H.1.3-4 Utility Corridor Minimum Planting Requirements

Coniferous Trees - Suitable for planting	
Species (Common Name)	Minimum Height Size (m)
Pines, Spruce, Fir	2
Large Deciduous Trees - Suitable for planting	
Species (Common Name)	Minimum Caliper (mm)
Silver Maple, Black Ash, Patmore Green Ash, Summit Green Ash, Larch, American Elm, Harbin Chinese Elm, Linden Laurel Leaf Willow	50
Small Deciduous Trees - Suitable for planting	
Species (Common Name)	Minimum Caliper (mm)
Armur Maple, Crabapple, Amur Cherry, Pincherry, Schubert Chokecherry, Bur Oak, Mountain Ash, Lilac	50

viii. Storm water management facilities:

- a. Storm water management facilities shall be graded, top soiled, seeded or sodded and landscaped to the satisfaction of the Municipality. Consideration shall be given to the hydrological and soil saturation characteristics of the storm water management facility when selecting planting materials.
- b. Public lands associated with storm water management facilities shall have a minimum of 30 trees planted per acre above the normal water line. Trees shall be massed into major groupings. Minimum deciduous tree caliper shall be 60 mm. Minimum coniferous tree height shall be 2.5 m. A tree species mix of 60 % coniferous and 40 % deciduous shall be preferred.
- c. Shrubs may be substituted for trees at a substitution ratio of 5 shrubs to 1 tree. The maximum number of trees that can be substituted for per acre shall be 15. Shrubs shall be massed within large planting beds. Minimum shrub size shall be five (5) gallon potted. Shrub spacing shall be 1 m on centre. Minimum shrub height and spread shall be 0.6 m.
- d. Minimum widths of sodded areas between planting beds shall be 2 m. Planting beds shall incorporate weed liners and landscape edging in formal shrub beds. Use of weed liners for planting beds located in flood prone areas is strongly recommended. Planting beds shall have a wood chip mulch topping, decorative crushed granular topping or shale topping in flood prone areas. Minimum topping thickness shall be 0.1 m.

- e. Major storm water outlets and inlets shall be landscaped with plant materials and rock.
 - f. Dry ponds shall be designed in such a manner as to encourage active recreational uses.
 - g. Landscape furniture shall be placed in the dry pond at pre-approved locations as shown on the Landscaping Plan. Lighting features and their locations shall be as specified by the Municipality. Special architectural and structural features (artificially pumped dry streams, special play courts, bridges, etc.) shall be designed by an accredited landscaping design professional.
- ix. Natural areas:
- a. The Developer shall be responsible for contacting all Provincial and Federal authorities that may have jurisdictional interest in any natural areas that are affected by the proposed subdivision. The Developer shall be responsible for securing all required approvals and permits prior to any construction activities in natural areas.
 - b. Existing natural areas shall be protected. Any natural area that is impacted by construction activities must be re-naturalized with native planting materials and restored. The Developer shall be responsible for the design of an appropriate mix of native trees, shrubs, ground cover and wild seed mixes to rehabilitate impacted natural areas, as approved by the Municipality. The Developer shall also be responsible for the design of any subsurface and surface drainage, or erosion control measures required for the rehabilitation of natural areas. The Developer shall, if required, coordinate rehabilitation work with other consultants and professionals to ensure proper restoration.
 - c. The Landscape Plan shall identify all planting communities to be established and all other information necessary to implement the proposed rehabilitation work. The Landscape Plan and specifications shall be designed and produced by an accredited Professional Landscape Architect.
 - d. The design shall specify all tree, shrub, and ground cover. Minimum or maximum sizes of planting features to be used in natural area restoration work are not specified in these Standards. A tree species mix of 60 % coniferous and 40 % deciduous shall be preferred. Forestry stock, seedlings, deciduous tree whips, and propagated or rooted cuttings shall be acceptable for use. All plant materials shall be nursery stock. Other sources of materials may be considered in consultation with the Municipality.
 - e. Approved herbicides may be used to eradicate nuisance vegetation on natural slopes prior to planting trees and shrubs. Herbicides shall be applied by a licensed applicator and their use shall be approved by the Municipality prior to application.

H.1.4 Site Preparation

- i. Materials:
 - a. Fill materials, where required, shall be free of stones, clods, sticks, roots, concrete and any other deleterious material or substance. Any deleterious materials and substances shall be properly removed from the site and disposed of in a manner acceptable to the Municipality.
 - b. Topsoil shall be natural fertile agricultural soil capable of sustaining vigorous plant growth. The topsoil shall be weed free and shall be approved by the Municipality prior to use.
- ii. Sub-grade preparation:
 - a. Sub-grade shall be graded and rolled to a firm even surface. All sub-grade areas prepared for planting shall be completely free of live quackgrass roots.
 - b. Final sub-grade shall be constructed to 150 mm below the adjacent top of curb and/or sidewalk.
 - c. Final surfaces shall be sloped so that surface runoff flows from one property do not flow onto any adjacent properties.
- iii. Existing utility appurtenances and features.
 - a. All existing utility appurtenances shall be adjusted prior to commencing of landscaping work to properly match final finished grade elevations.
 - b. All existing features such as trees, shrubs, monuments, curbs, sidewalks and landscape furniture shall be protected against any damage. It shall be the Developer's responsibility to replace all existing features which may be damaged during construction.

H.1.5 Placing of Topsoil

- i. All ditches, swales, boulevards and any areas where ground surface has been disturbed during construction activities of the proposed subdivision, shall be topsoiled, fertilized and seeded to grass or sodded, as shown on the Contract Drawings and Specifications. The topsoil shall be removed from areas requiring leveling, filling, excavation or grading before landscaping work commences. The topsoil shall be stockpiled and replaced following the completion of the grading works. The topsoil shall be placed and compacted uniformly to a degree specified by the Municipality. The upper 50 mm of topsoil shall be of fine texture and free of stones or lumps that are 6 mm or larger. Sufficient allowance shall be made for any settlement. Minimum thickness of placed and compacted topsoil shall be 150 mm.

- ii. Finished topsoil elevations for boulevards shall conform to the adjacent curb and sidewalk elevations and shall provide adequate surface drainage. Finished topsoil elevations for buffer strips shall slope uniformly from the property line towards the back of the sidewalk at a minimum grade of 2 %. Finished topsoil elevations for median strips and traffic islands shall establish a constant grade from top of curb to top of curb.
- iii. For sidewalks, a swale shall be provided at a minimum distance of 1 m from either side of the sidewalk. Finished topsoil grades shall be sloped away from the sidewalk at a minimum grade of 1 %.
- iv. Parks and environmental reserves shall be rough graded to required elevations that are ready to receive the proposed surface treatments. Slopes shall be blended into adjacent level areas. Contours shall be uniform.
- v. Prepared seed beds shall be inspected and approved by the Municipality prior to seeding.

H.1.6 Seeding

- i. Seeding materials:
 - a. Fertilizer shall be 27-14-0.
 - b. 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 submitted to the Municipality.
 - c. Grass seed for general seeding shall be a certified seed composed of the following species of grasses:
 - Kentucky Blue Grass 35 %.
 - Creeping Red Fescue 65 %.Crested Wheat Grass seed may also be used subject to approval by the Municipality prior to application.
 - d. Grass seed for road side seeding shall be a certified seed composed of the following species of grasses:
 - Fall Rye 60 %.
 - Creeping Red Fescue 16 %.
 - Brome 12 %.
 - Timothy 5 %
 - Alsike Clover 7 %A zero tolerance for Sweet Clover shall be enforced by the Municipality.

- e. The fertilizer and seed shall be applied at a rate of 112 kg and 65 kg per hectare respectively. Certified documentation verifying the seed mixture composition shall be submitted to the Municipality for approval prior to application.
- ii. Seeding procedures:
 - a. The area to be seeded shall be fine graded to a smooth uniform grade with a loose textured surface free of stones, branches and roots that are 20 mm or larger in diameter. All areas shall ensure positive drainage away from buildings and structures.
 - b. Seeding shall be done immediately after the application of fertilizer, provided the bed remains in good and friable condition and has not become muddy or hard. If the bed has become hard, it shall be tilled to friable condition.
 - c. The seed may be sown by one of the following methods:
 - Hand application using a cyclone type seeder. Seed shall be applied in two directions in equal amounts.
 - Mechanical application using a calibrated grass seeder and compaction roller. This is the preferred method for parks and other large areas.
 - Hydro seeding by applying an approved turf-fibre at a rate of 1,350 kg of dry matter per hectare.

H.1.7 Sodding

- i. Sodding materials:
 - a. Fertilizer shall be 27-14-0.
 - b. All sod shall be certified and composed of the following varieties of grass:
 - Kentucky Blue Grass 35%.
 - Creeping Red Fescue 65%.
 - c. Sod shall be well rooted, vigorous and healthy, free from disease, insect pests, weeds or other grasses, stones or other extraneous material.
 - d. Sod shall be machine stripped to a uniform thickness of 25 mm (+/- 5 mm). The thickness shall be determined at the time of stripping and shall exclude top growth and thatch.
 - e. Wooden pegs, if necessary, shall have dimensions of approximately 25 mm x 50 mm x 300 mm. Metal pegs shall not be accepted by the Municipality.

- ii. Sodding procedures:
 - a. The area to be seeded shall be fine graded to a smooth uniform grade with a loose textured surface free of stones, branches and roots that are 20 mm or larger in diameter. All areas shall ensure positive drainage away from buildings and structures.
 - b. Fertilizer shall be applied to the finished topsoil surface by mechanical distributor. Fertilizer shall be thoroughly and evenly incorporated into the topsoil to a maximum depth of 75 mm below the graded surface. The application rate for fertilizer shall be 3 kg/100 m² of the area to be sodded.
 - c. Sodding shall be done immediately after the application of fertilizer, provided the bed remains in good, friable condition and has not become muddy or hard. If the bed has become hard, it shall be tilled to friable condition. Sod shall be placed such that the long side of the sod roll is parallel to the direction of the slope. Joints shall be alternated. Sod shall be fitted tightly together with no visible joints or gaps. The finished surface of the sodded area shall be true to line and grade, firm, and free of irregularities and voids. Sod placed on slopes, where the slope is 2:1 or greater, shall be held in place by wooden pegs. Pegs shall be installed so that they are flush with the sod.
- iii. Sod maintenance:
 - a. The maintenance period for seeded or sodded areas shall be two (2) years from the date of issuance of a Construction Completion Certificate. The maintenance period shall end when the Final Acceptance Certificate is issued by the Municipality. Sod maintenance shall include all measures necessary to establish and maintain all seeded and sodded areas into a healthy, vigorous growing condition. Sod maintenance shall include the erection and removal of necessary temporary protection fences, barriers, signs and other work incidental to proper maintenance.
 - b. At the time of Construction Completion Inspection all seeded or sodded areas shall have a healthy, even, vigorously growing stand of grass that is free of disease and weeds.
 - c. First cutting shall occur not before the grass is a minimum of 75 mm high and covers 100 % of the seeded or sodded areas. Grass shall be cut as required to maintain grass at a minimum height of 65 mm. When required, sufficient amounts of water shall be applied to the seeded or sodded areas to ensure germination and prevent grass and the underlying soil from drying out. Initial and subsequent fertilizer applications shall be required as necessary to establish a vigorous growing stand of grass.

- d. Weed and nuisance vegetation control shall be carried out as required to maintain the seeded and sodded areas in a reasonably weed free condition. When herbicides are used, they shall be applied in accordance with manufacturer's recommendations and as approved by the Municipality. Any damage resulting from the use of herbicides shall be remedied at the Developer's expense.
- e. Areas which are deteriorating, bare, burned out or thin shall be re-seeded or re-sodded. All damage resulting from erosion and wash-outs shall be remedied at the Developer's expense during the maintenance and warranty period following the completion of construction work.
- f. The Municipality shall inspect the seeded and sodded areas upon written request from the Developer. The request shall be received at least 10 days prior to the anticipated date of inspection. The Municipality reserves the right to reject the seeded or sodded areas if not satisfied with the craftsmanship and appearance. The Developer shall be responsible for correction of the deficiencies at their own expense.
- g. Whenever necessary, additional erosion control measures shall be designed, approved by the Municipality and implemented in order to prevent the erosion of topsoil and other landscaping features. Appropriate erosion control measures shall be considered for installation until new vegetation is fully established. The Developer shall be responsible for the maintenance of the landscaping features as stated in the Contract Documents.

H.1.8 Trees and Shrubs

- i. Tree and shrub materials:
 - a. 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.
 - b. The Developer shall furnish and plant all planting materials shown on the approved drawings and specifications. All planting material shall conform to the horticultural standards of the *Canadian Nursery Landscape Association*. The Municipality, at its own discretion, may request planting requirements exceeding those contained in these standards depending upon the location and type of the proposed subdivision. Any requirements for water shall be arranged by the Developer at their expense. All proposed trees and shrubs shall be tolerant to the climatic conditions of the Municipality.

- c. All trees and shrubs shall be healthy and vigorous, well branched, and densely foliated when in leaf. They shall be free from disease and insect pests, eggs, or larvae. All trees and shrubs shall have healthy well developed root systems. All plants shall be nursery grown unless specifically authorized by the Municipality. Substitutions for the approved plantings shown in the landscape plans shall not be permitted without prior approval from the Municipality.
 - d. Tree species at maturity shall have an average spread of crown greater than 3 m. Deciduous trees shall be at least 60 mm caliper at the time of planting. Deciduous shrubs shall have a minimum height of 0.5 m at the time of planting. Coniferous trees shall have a minimum spread of 0.8 m at the time of planting. Coniferous shrubs shall have a minimum spread of 0.5 m at the time of planting.
 - e. Bare root (B/R) shrubs shall have their root systems adequately protected at all times. Balled and bur lapped (B/B) plants shall be dug with firm natural balls of earth of sufficient diameter and depth to include most of the fibrous roots. Container growth stock shall have well developed root systems. Plant materials that are loose in their containers shall not be accepted. Trees and shrubs with undersized root systems shall be rejected.
 - f. All planting materials shall be delivered to the project site, stored and handled in the proper manner with all labels intact. All damaged, sick or diseased plants shall be immediately removed from the site and replaced.
 - g. Tree stakes shall be 2.1 m in length and be of the steel U-bar or T-bar type. Tree ties shall be 10 gauge galvanized wire. Plastic polythene tubing 200 mm long and 10 mm in diameter shall be used to protect the tree from the tie wire. Wire for tree guying shall be a double strand of 9 gauge galvanized wire.
 - h. Mulch shall be wood chips, ground bark, bark peelings, peat, hay, or straw.
- ii. Site preparation:
- a. All necessary earthworks and sub-grade preparation shall be completed prior to commencement of planting. Boulevards shall be excavated to the required depth and made ready to receive topsoil for tree and shrub planting.
 - b. At least 24 hours notice shall be given to the Municipality prior to commencement of planting activities. The Developer shall stake and identify the proposed locations of all plantings as approved by the Municipality and present the area for inspection. All plantings are at the correct elevations and alignments. Topsoil filling of boulevards and medians shall not be permitted until tree and shrub locations have been approved by the Municipality.

- c. Existing trees and shrubs that are to be retained within the subdivision shall be protected to the furthest extent. Final grading of the site shall not impact the root zone by more than 0.2 m.
- iii. Planting operations:
 - a. Individual tree pits shall be 0.3 m greater in diameter than the size of the tree bulb or root spread. Tree pits shall also be sufficiently deep to allow for a 150 mm layer of planting mixture beneath the bulb or roots.
 - b. Individual shrubs shall be planted in pits that are 0.3 m greater in diameter than the spread of the roots. Shrub pits shall be excavated to a depth of 0.5 m below the finished grade or, as necessary, to properly set the shrub to the specified finished grade.
 - c. All pits that are backfilled with planting mixture prior to planting shall have their locations marked by stakes. Minimum depth of planting mixture beneath all bulbs and roots in planting beds shall be 225 mm. Plants shall be placed in the centre of pits, plumb and straight, and at such a level that after settlement the crown of the plant will be 25 mm lower than the surrounding finished grade. No plantings, except ground cover, vines and herbaceous plant material shall be placed closer than 0.6 m to the edge of shrub beds, hard surfaces or building foundations.
 - d. When $\frac{2}{3}$ of the plant pit has been backfilled with soil mix, 8-24-24 fertilizer shall be applied at the following rates:
 - Shade trees: 0.5 kg per 25 mm of caliper
 - Small trees: 0.25 kg per 25 mm of caliper
 - Shrubs: 0.06 kg per 300 mm of height
 - Coniferous trees: 0.03 kg per 300 mm of height or spread
 - Vines, ground cover: 0.03 kg per plantThe fertilizer shall be distributed evenly over the pit area. The pit shall be filled with water and the soil and allowed to settle around the root system.
 - e. When trees are first set in the pits, the soil mixture shall be compacted around the base of the tree bulb to fill all the voids. All burlap, ropes, and wires shall be removed from the tops of the bulb. Trees with bare root systems shall have their roots properly spread out and the topsoil mixture carefully worked in. Any broken or frayed roots shall be cleanly cut off and removed from the pit.

- f. Plant pits shall be filled with soil mix after the initial water has been absorbed. Immediately after the plant pit is backfilled, a shallow basin that is approximately 100 mm deep and slightly larger than the pit, shall be formed with a ridge of soil to facilitate water retention. After the surface of the tree pit has sufficiently dried, the top of the pit shall be spaded to a depth of approximately 25 mm to avoid evaporation.

iv. Staking and guying:

- a. For deciduous trees less than 1 m in height, the following procedure shall be used:
 - Each tree shall be supported with a tree stake. Tree stakes shall be driven into the ground 0.45 – 0.6 m below grade in a vertical position. All stakes shall be placed at a distance of 150 mm from the tree on the northwest side.
 - Trees shall be supported with 1 tie. The tie shall be placed around the tree and the stake, as close as possible to the top of the stake.
- b. For coniferous trees less than 2.45 m in height, deciduous trees greater than 1 m in height, and with calipers less than 75 mm, the following procedure shall be used:
 - Each tree shall be supported by 2 steel U or T-bars driven securely into the ground without injury to the root bulb.
 - Trees shall be fastened at the top of the stakes with 2 tree ties.
- c. For deciduous trees over 75 mm in caliper, and coniferous trees exceeding 2.45 m in height, the following procedure shall be used:
 - Trees shall have three (3) guy wires installed such that they are equally spaced around each tree. Each guy wire shall be attached to the tree trunk at an angle of 60° and anchored to the ground by means of a wooden stake.
 - Wooden stakes shall be 50 mm x 50 mm x 450 mm and shall be driven securely into the ground.
- d. For deciduous tree over 100 mm in caliper, and coniferous trees exceeding 4.3 m in height, the following procedure shall be used:
 - Trees shall be staked with a wooden stake 50 mm x 100 mm x 750 mm in length.
 - Trees may also be staked with 15 mm diameter steel reinforcing bars that are 760 mm in length.

- v. Pruning:
 - a. Plantings shall be pruned after planting to remove dead or injured branches. Pruning shall be done in such a manner as to preserve the natural characteristics of the plantings. Leaders shall not be removed.
 - b. Only clean sharp tools shall be used and all cuts shall be clean and flush, leaving no stubs. Cuts, bruises, or scars on the bark shall be traced back to living tissue and removed. The affected areas shall be shaped so that they do not retain water and painted with approved tree paint.
- vi. Digging of plants:
 - a. All plants shall be dug and delivered to the site as specified on the approved Landscape Plans and Specifications.
 - b. Plants specified "B/R" shall be moved with bare roots. They shall be dug and moved to the site while dormant, with a major portion of the fibrous root system included. Immediately after digging, the root system shall be wrapped or puddled and kept moist until planting.
 - c. All plants specified "B/B" shall be moved with solid bulbs wrapped in burlap.
 - d. Plants shall not be used when the bulb has been cracked or broken during planting operations. Plants shall not be used when the burlap, staves or ropes have been removed prior to planting.
 - e. Minimum root size shall be specified by the Municipality and shall be adjusted according to the growth habits of the individual trees and shall be sufficiently large so that they contain at least 75 % of the root system. Plant materials different than those specified may be used if prior approval is obtained from the Municipality and the bulb size is adjusted in proportion to the size of the plant material.
 - f. All plants shall be measured when their branches are in their normal position. Caliper measurements shall be made at a location on the trunk that is 0.3 m above the ground. For deciduous trees with a caliper greater than 0.25 m, the root bulb diameter shall be increased by 0.15 m for every additional 25 mm of caliper size. For coniferous trees over 2.75 m in height, the root bulb diameter shall be increased by 0.15 m for every additional 0.3 m in height.
- vii. Tree and shrub maintenance and warranty:
 - a. Maintenance of trees and shrubs shall include protective or preventative spraying when required.
 - b. Maintenance of trees and shrubs shall include the repair and/or replacement of all deficient materials. Deficiencies shall be corrected as soon as possible after they are discovered and when weather permits.

- c. The warranty period for all planted materials shall be two (2) years from the date of issuance of the Construction Completion Certificate. Within the warranty period specified in the Development Agreement, unsuccessful trees and shrubs shall be replaced at the Developer's expense.
- d. Any planting material that is not as specified or is not in satisfactory condition shall be removed from the site. Upon approval by the Municipality, the Developer may choose to allow defective planting to remain through another complete growing season, in an attempt to re-establish the plant. Should the plant material not re-establish, it shall be replaced at the Developer's expense.

H.2 FENCING

- H.2.1** The Landscaping Plan shall show the proposed fencing design details, including alignment, elevations, materials, foundations, coatings and construction details. Fencing shall comply with all setback and height requirements specified in the Municipality Land Use Bylaw.
- H.2.2** Wherever possible, proposed fencing shall be designed and installed to match or compliment existing fencing on adjacent properties.
- H.2.3** Fencing shall be designed to be maintenance free for a minimum period of 15 years past the completion of construction.
- H.2.4** Fencing, including foundations, shall be located entirely within legal limits of the property it is proposed for.
- H.2.5** As required by the Municipality, the uniform fencing shall be constructed adjacent to, and at the following locations:
 - i. county property and arterial roadways,
 - ii. public parks, playgrounds, walkways and utility lots,
 - iii. schools and family sites,
 - iv. commercial and institutional sites.
- H.2.6** Wooden fencing shall be installed where residential property adjoins one of locations listed above. The Municipality may approve the use of chain link fencing where facilities such as playgrounds, parks or school sites are adjacent to arterial roadways. Wooden rail fencing may be required for selected park or walkway areas.
- H.2.7** Gates shall be installed as part of residential lot fencing where the properties back onto public parks. Gates shall be located at the mid-point of the property line and shall open inwards into the residential lot.
- H.2.8** The warranty period for the uniform fencing shall be two (2) years from the date of issuance of the Construction Completion Certificate.

H.3 LANDSCAPE BERMS

- H.3.1** The Landscaping Plan shall show the proposed berm design and construction details, including alignment, elevations, dimensions and slopes.
- H.3.2** Berms required for noise attenuation purposes shall be designed by a Professional Engineer or licensed Landscape Architect. The Developer shall provide design information including projected traffic volumes and noise exposure.
- H.3.3** Berm side slopes shall not be steeper than 4:1 to facilitate future maintenance. Minimum width of the flat top of the proposed berm shall be 1 m.
- H.3.4** All berms shall be top soiled and grass seeded or sodded as specified in these Standards.

H.4 PARKING FACILITIES

- H.4.1** A parking and loading area within a commercial or industrial subdivision in a prominent location requiring 2 – 20 parking spaces and which is adjacent to a residential district shall have a landscaped buffer between properties.
- H.4.2** A parking and loading area for a commercial or industrial use in a prominent location requiring 20 or more parking spaces shall include landscaped areas within the parking lot.
- H.4.3** The parking facilities landscaping, including location, planting type and construction specifications and details, shall be designed by a Professional Engineer and shall be submitted to the Municipality for review and approval prior to commencing of construction. The minimum required landscaped area shall be 1 m² per one parking space. Landscaped areas shall be provided in more than one location throughout the parking lot.

H.5 COMMUNITY MAILBOXES

- H.5.1** 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 proposed subdivision,
 - iv. at a minimum of 10 m away from a fire hydrant, bus stop, streetlights, power poles and other permanent features, and as shown on the Contract Drawings,
 - v. not directly above existing or proposed underground utilities and conforming to minimum site specific requirements obtained from the utilities owners or operators,

- vi. not to obscure minimum specified safe sight distances for pedestrians and roadway users.

H.5.2 The Developer shall submit a plan of the proposed subdivision to Canada Post requesting approval of mailbox locations. It is the Developer's responsibility to ensure that the mailbox locations conform to the Postal Delivery Standards Manual, Planning for Postal Service.

H.5.3 Easements allowing encroachment onto private property shall be provided only if the mailbox pad extends beyond the right-of-way boundaries.

H.6 STREET LIGHTING

H.6.1 General

- i. The street lighting design shall be in accordance with the current 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). IES standards are acceptable within local road areas only. Arterial/Collector roads shall be to TAC guidelines.
- ii. Street lighting for existing developments and subdivisions, access roads and playgrounds shall conform to these Standards. All roadway lighting systems shall be installed in strict compliance with the Canadian Electrical Code.
- iii. It is the Developer's responsibility to ensure that design and construction conform to all current requirements and to arrange with the local power utilities operators for necessary approvals and power connections.
- iv. The Developer shall submit the design drawings and specifications prepared by a qualified Professional Engineer showing the layout, spacing, types and heights of light poles, luminary wattages and other relevant information. The Street Lighting Plan shall include all surface and underground features and utilities, both existing and proposed for installation. The layout, as well as products and materials proposed for supply and installation are subject to approval by the Municipal Engineer prior to commencing the work.

H.6.2 Design and Installation

- i. It is the Developer's responsibility to work with the power 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 approved manufacturer.

- ii. 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. Street lights shall be so located as to not interfere with proposed driveways, lanes and motorist's lines of vision, and shall be located in line with the extension of common property lines, wherever possible.
- iii. 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.
- iv. Lots configuration and roadways pattern shall dictate the light poles layout. Wherever possible, light poles shall be located at the projection of lot lines. Light pole locations shall not conflict with other utilities, features or approaches. Locations, spacing and light pole setbacks shall be determined by a Professional Engineer based on the optimum spacing/height/light distribution combination and shall conform to the minimum standards published by the TAC.
- v. Corrosive resistant street light poles complete with fixtures and concrete pedestals only shall be used unless otherwise approved in writing. Pole types shall be consistent with adjacent subdivisions. All poles within a proposed new subdivision shall be of the same type and height. All poles shall be resistant to climatic and environmental conditions encountered within the Municipality. The use of decorative poles shall be subject to approval by the Municipality. Proposed decorative poles and luminaries shall share common optical systems and components as other decorative items found in existing subdivisions within the Municipality. A submission of samples may be required by the Municipality prior to approval.
- vi. Breakaway poles shall not be required for design speeds of less than 80 km/h. Yielding poles are recommended for all roadways with a design speed less than 80 km/h and pole setback of less than 4 m from edge of pavement. Steel poles shall be galvanized and powder coated. Aluminum poles shall be powder coated. Composite poles shall be manufactured by the pultrusion method.
- vii. Pole foundations shall be designed based on the site specific soil conditions. The foundations shall be designed to withstand all loading, wind loading in particular.
- viii. Wherever possible, street light cables shall be installed underground. Cables crossing all roadways or driveways shall be placed in direct-burial type rigid plastic pipe using one pipe per individual cable unless noted otherwise.
- ix. Where roadways are designated for widening within five years of the proposed light poles installation, the poles setback shall allow for such widening avoiding or minimizing the future light poles removal and re-installation.

- x. Luminaries requirements shall be as follows:
 - a. complete with IP66 Certified Sealsafe optical chamber,
 - b. luminaries' optical systems shall have a seal value R rating of greater than 600,
 - c. luminaries shall be tool free type, and
 - d. luminaries shall be complete with a ¼ turn shutter system for lamp replacement.

H.6.3 Operations

The responsibility for energizing the street lighting system shall be with the Municipality upon completion of construction, testing, inspection and acceptance of the work. 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. The operating cost of the street lighting system shall be the responsibility of the Developer until the proposed subdivision is 75 % percent occupied. The Developer shall cover 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 proposed subdivision is 75 % percent occupied, whichever occurs first.

H.7 LIST OF DRAWINGS

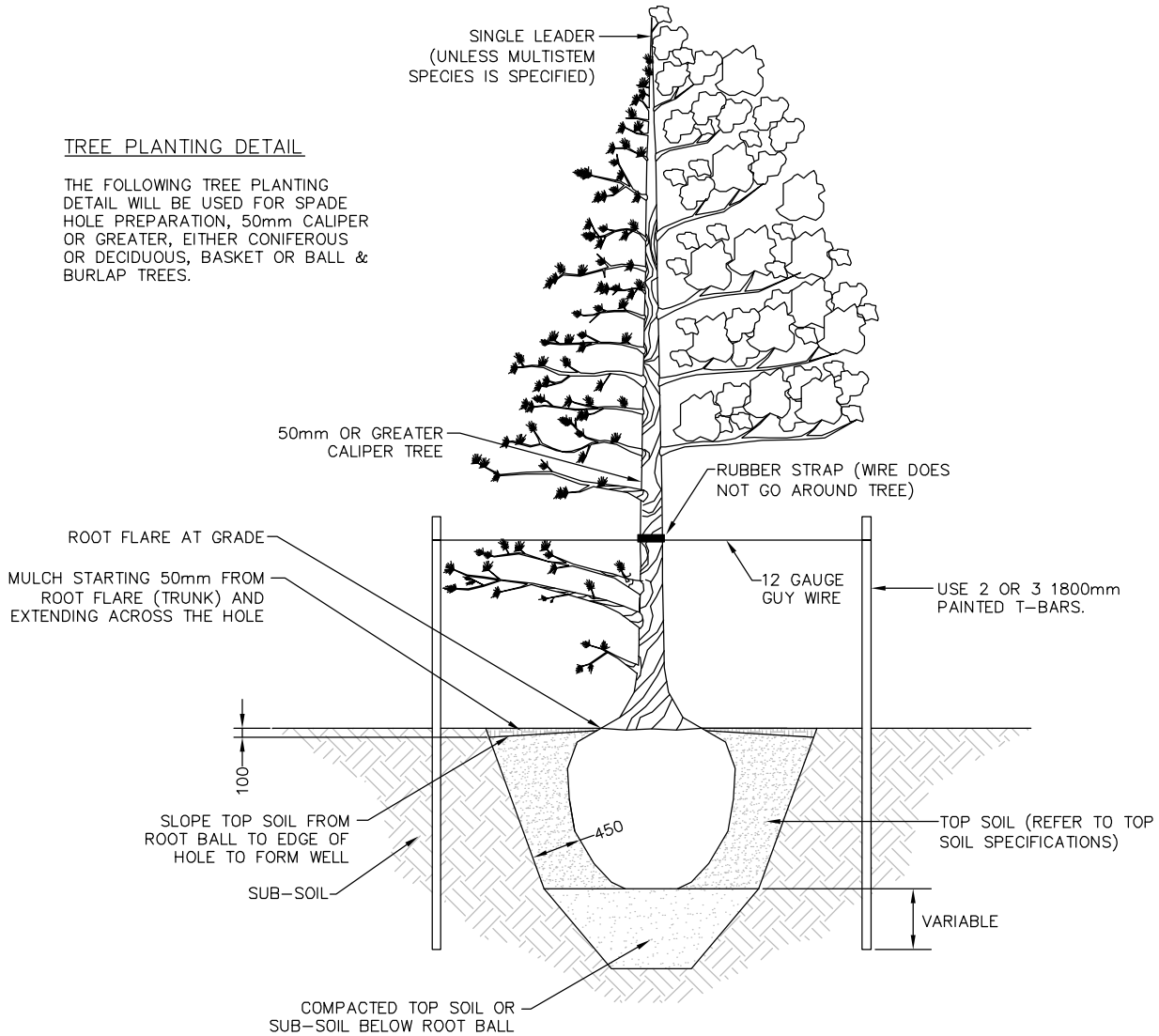
- H-01 Tree Planting Detail 50mm or Greater Caliper Trees (Spade Dug)
- H-02 Tree Planting Detail 50mm or Greater Caliper Trees (Backhoe Dug)
- H-03 Tree Grate Detail
- H-04 Shrub Planting Detail
- H-05 Chain Link Fence Detail
- H-06 Chain Link Fence, Barbed Detail
- H-07 Chain Link Single Gate Detail
- H-08 Chain Link Double Gate Detail
- H-09 Noise Fence Detail
- H-10 Wood Screen Fence Detail
- H-11 Timber Fence for Open Space Areas
- H-12 Survey Monument Cover Detail
- H-13 Typical Lot Grading Plan
- H-14 Typical Lot Grading Plan
- H-15 Campground Layout Details
- H-16 Electrical Receptacle for R.V. Hook-up
- H-17 Water Riser for R.V. Hook-up
- H-18 R.V. Sani-Dump Station
- H-19 Single Vault Toilet

END OF SECTION

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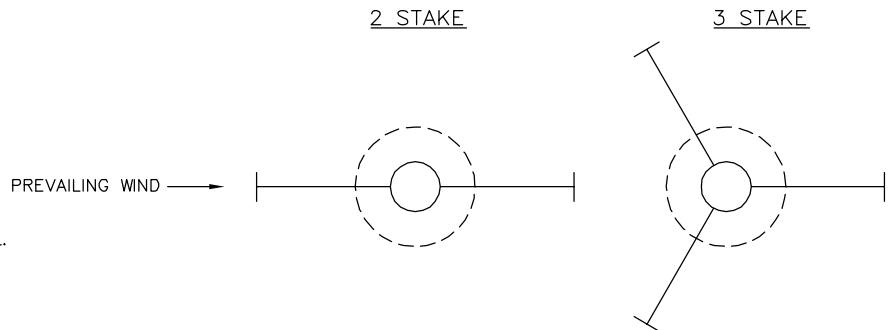
TREE PLANTING DETAIL

THE FOLLOWING TREE PLANTING DETAIL WILL BE USED FOR SPADE HOLE PREPARATION, 50mm CALIPER OR GREATER, EITHER CONIFEROUS OR DECIDUOUS, BASKET OR BALL & BURLAP TREES.



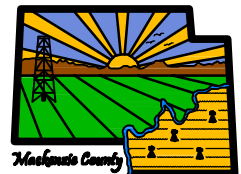
NOTES:

1. DO NOT ALLOW AIR POCKETS TO FORM WHEN BACK FILLING.
2. STAKE BEYOND EDGE OF ROOT BALL.
3. TREE SHOULD BE PLANTED 25-50mm BELOW GROUND LEVEL. FOR HEAVY CLAY SOILS, PLANT AT GROUND LEVEL AND CONSTRUCT A SOIL WELL ABOVE GRADE.
4. IF TREE IS IN WIRE BASKET, CUT STRAPPING AND PULL BURLAP AND BASKET BACK FROM TOP 1/3 OF ROOT BALL.
5. USE RUBBER STRAPS AT END OF ALL GUY WIRES TO PROTECT THE TREE AT POINT OF CONTACT.
6. PRUNE DEAD BRANCHES TO MAINTAIN NATURAL FORM OF TREE.
7. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.



MACKENZIE COUNTY

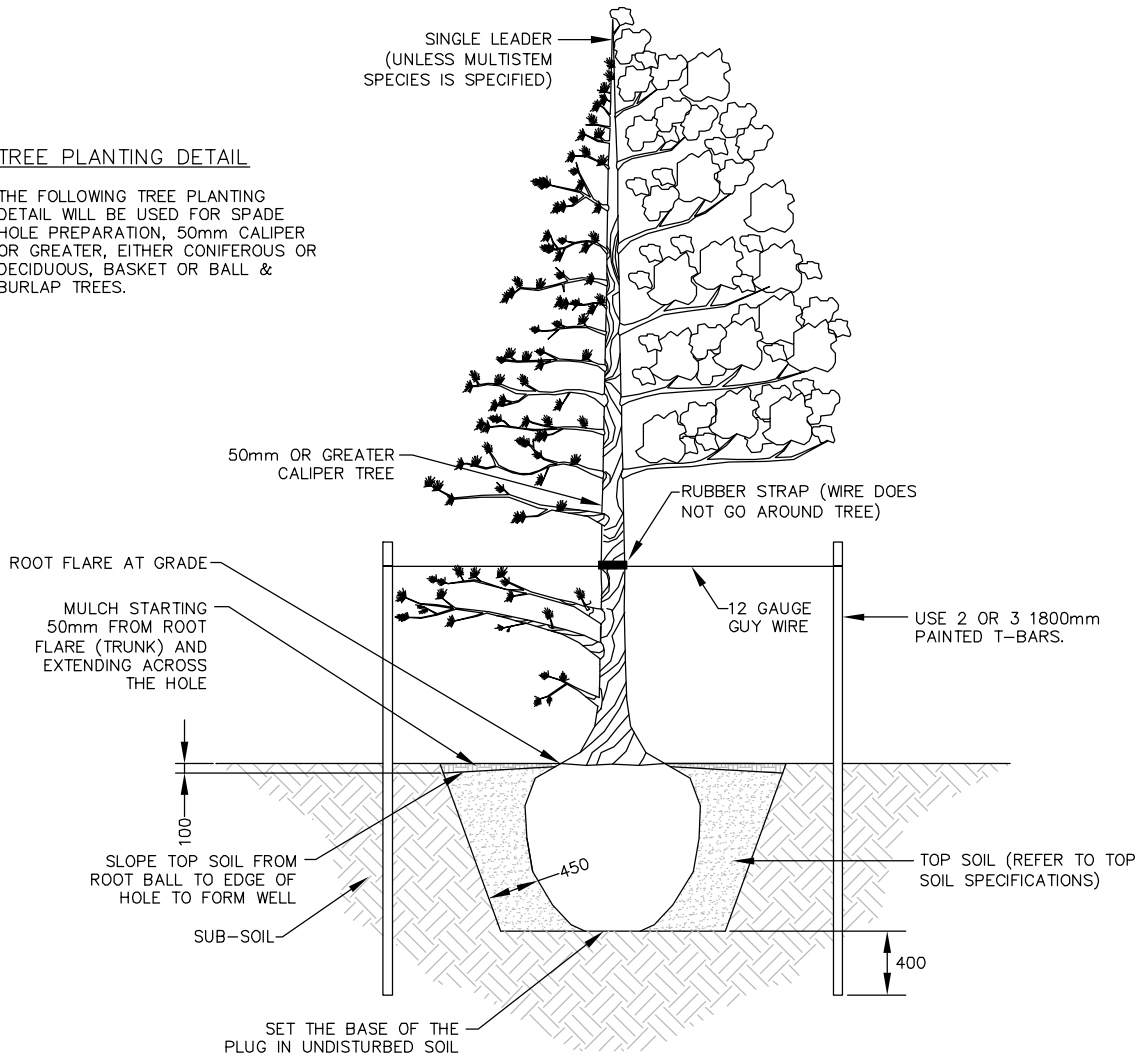
General Municipal Improvements Standards



Rev.		TREE PLANTING DETAL 50mm OR GREATER CALIPER TREES (SPADE DUG)	
Rev.		File No.: GP60.33682	Design:
Rev.		Drawn: K.P.L	Scale: N.T.S
Date: 2010-AUG-31		Approved:	Figure H-01

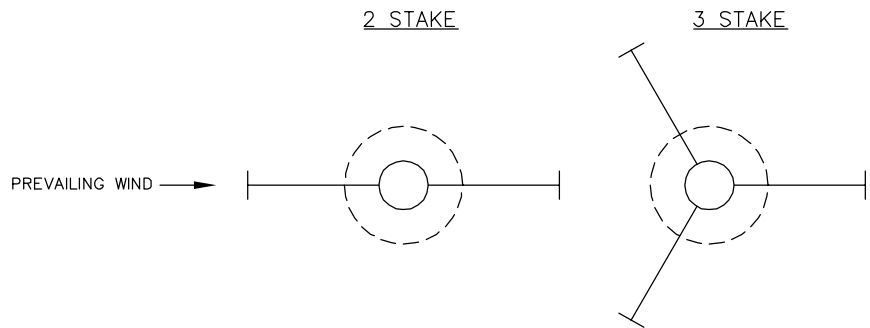
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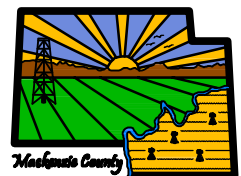
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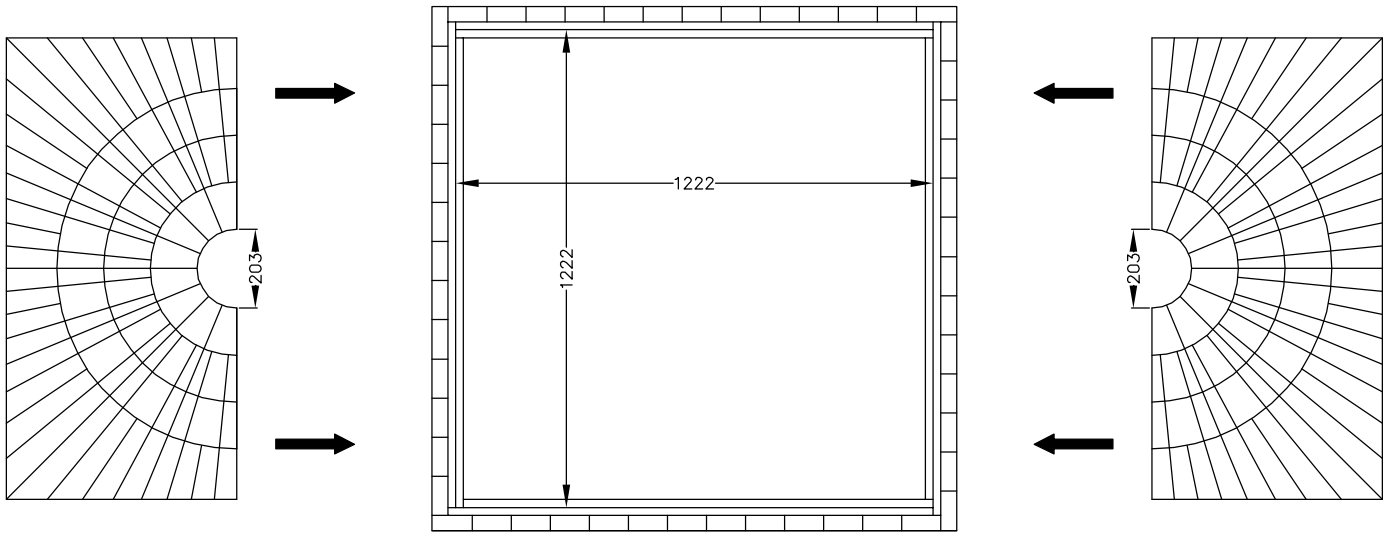
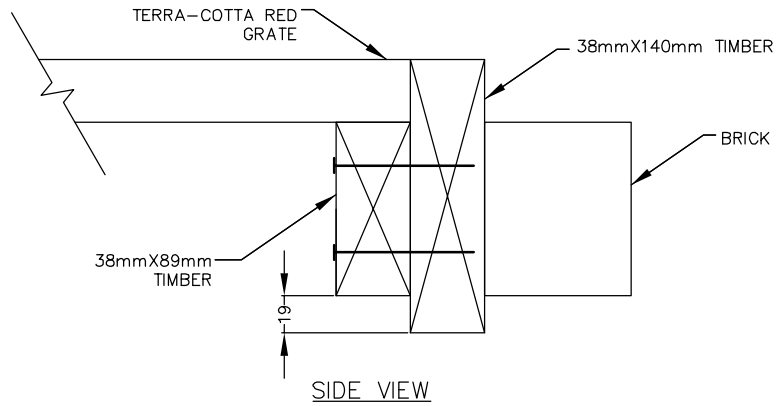


MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		TREE PLANTING DETAIL 50mm OR GREATER CALIPER TREES (BACKHOE DUG)			
Rev.		File No.: GP60.33682	Design:	Approved:	Figure
Rev.		Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	



CONCRETE CURB

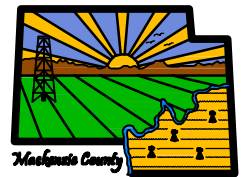
TOP VIEW

NOTES:

1. 1222mm OPENING IS CRITICAL TO ACCOMMODATE TREE GRATE.
2. 38mm X 89mm TIMBER TO BE NAILED ONTO 38mm X 140mm, TWO NAILS EVERY 300mm O/C.
3. ALL TIMBER IS TO BE PRESSURE TREATED.
4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



TREE GRATE DETAIL

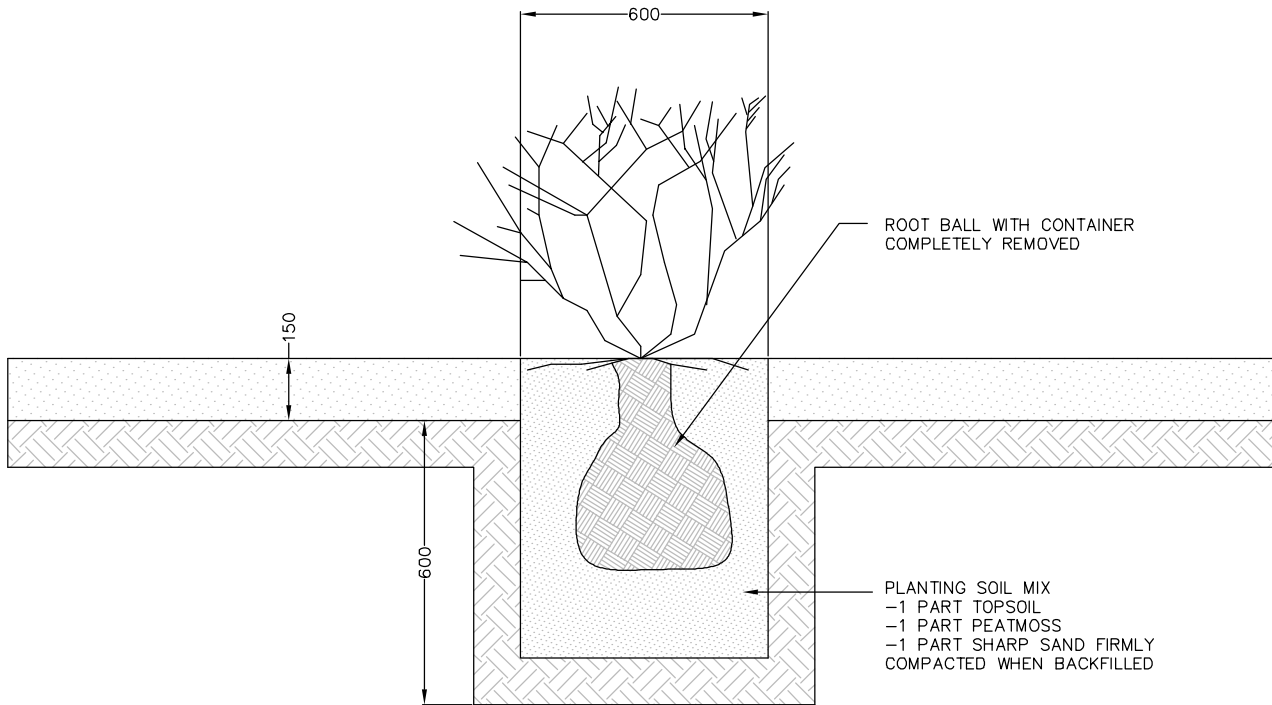
Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L.

Design:
Scale: N.T.S.

Approved:

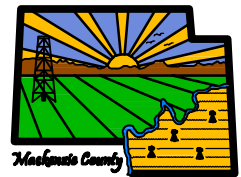
Figure H-03



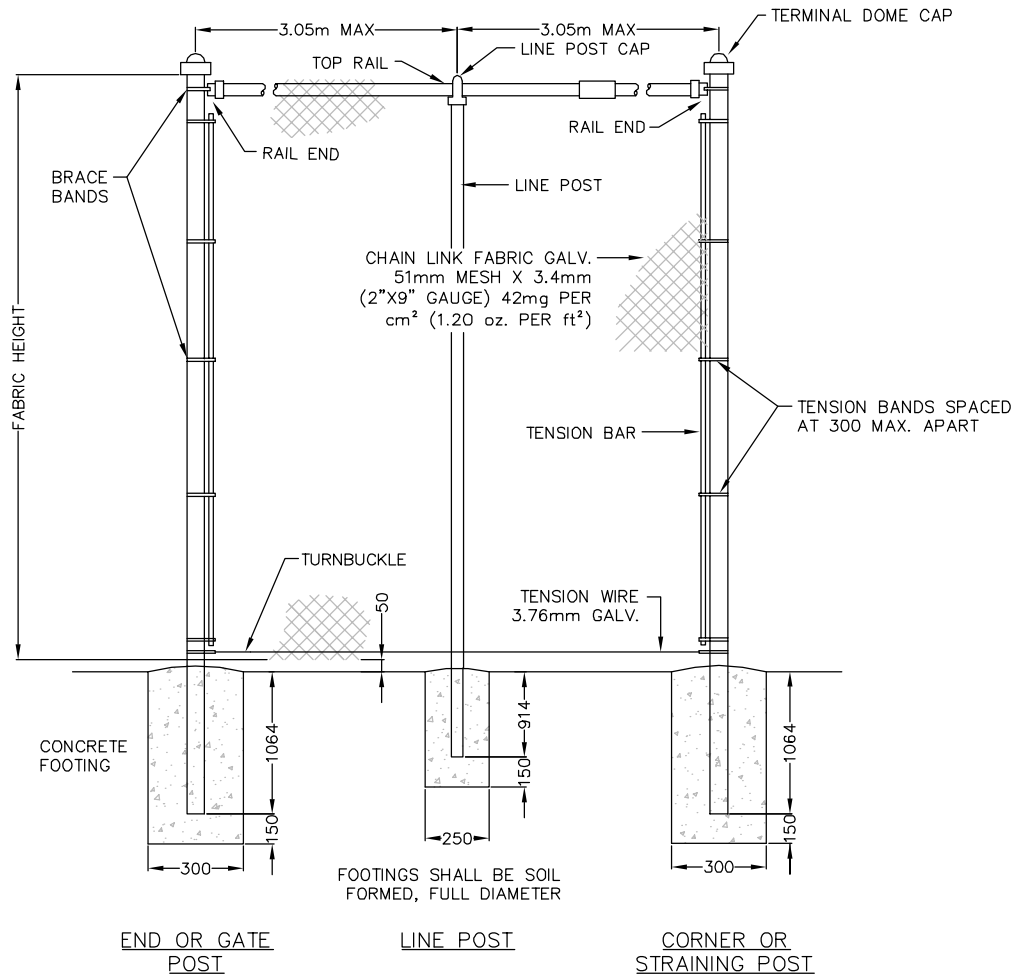
NOTE:
 ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	SHRUB PLANTING DETAIL		Figure H-04
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure H-04
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

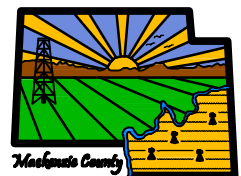


NOTES:

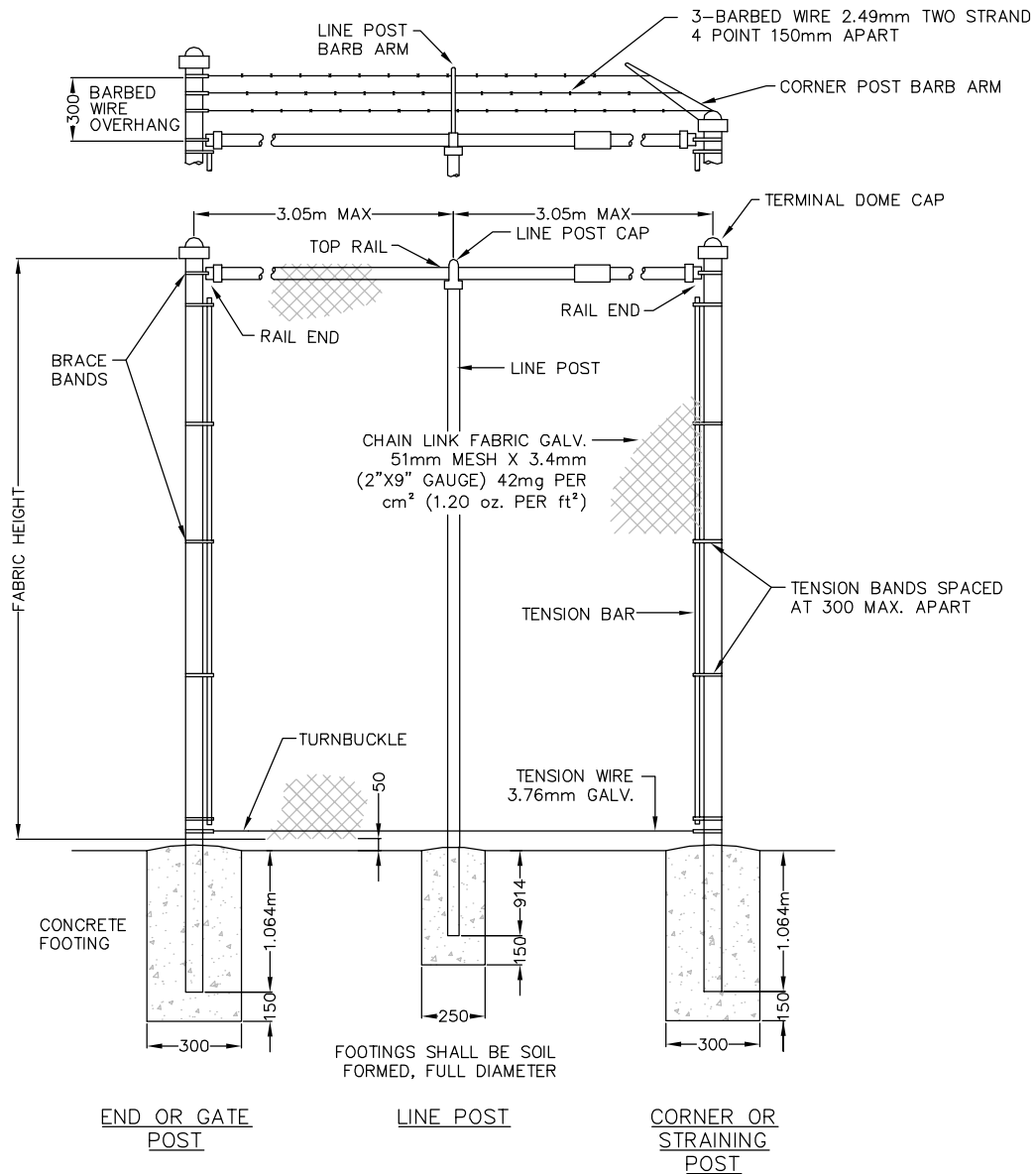
1. TOP RAIL: 33.4mm O.D. GALVANIZED STEEL. RAILS TO BE CONNECTED BY SLIP-ON SLEEVES.
2. LINE POSTS: 48.3mm O.D. GALVANIZED STEEL. SPACED 3.05m MAX. APART. STRAINING POSTS SHALL OCCUR AT MIN. 152m.
3. GATE POST: 88.9mm O.D. GALVANIZED STEEL FOR PANELS UP TO 3.05m (6.1m DOUBLE SWING GATE).
4. END OR CORNER POST: 88.9mm O.D. GALVANIZED STEEL.
5. CONCRETE: 30 MPa STRENGTH IN 28 DAYS.
6. TIE WIRE: 3.55mm (9 GAUGE) ALUMINUM WIRE EVERY 305mm FOR LINE POSTS, EVERY 457mm FOR TOP RAIL.
7. ALL PIPES TO BE SUFFICIENT STRENGTH TO SUPPORT FABRIC WEIGHT AND TENSION, AND TO SUPPORT WEIGHT OF GATE.
8. ALL FITTINGS TO BE DESIGNED AND MANUFACTURED OF MATERIALS HAVING SUFFICIENT STRENGTH TO PERFORM THE NECESSARY FUNCTIONS.
9. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
10. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		CHAIN LINK FENCE DETAIL		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure H-05
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

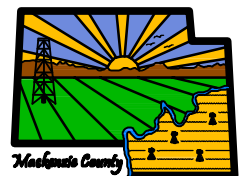


NOTES:

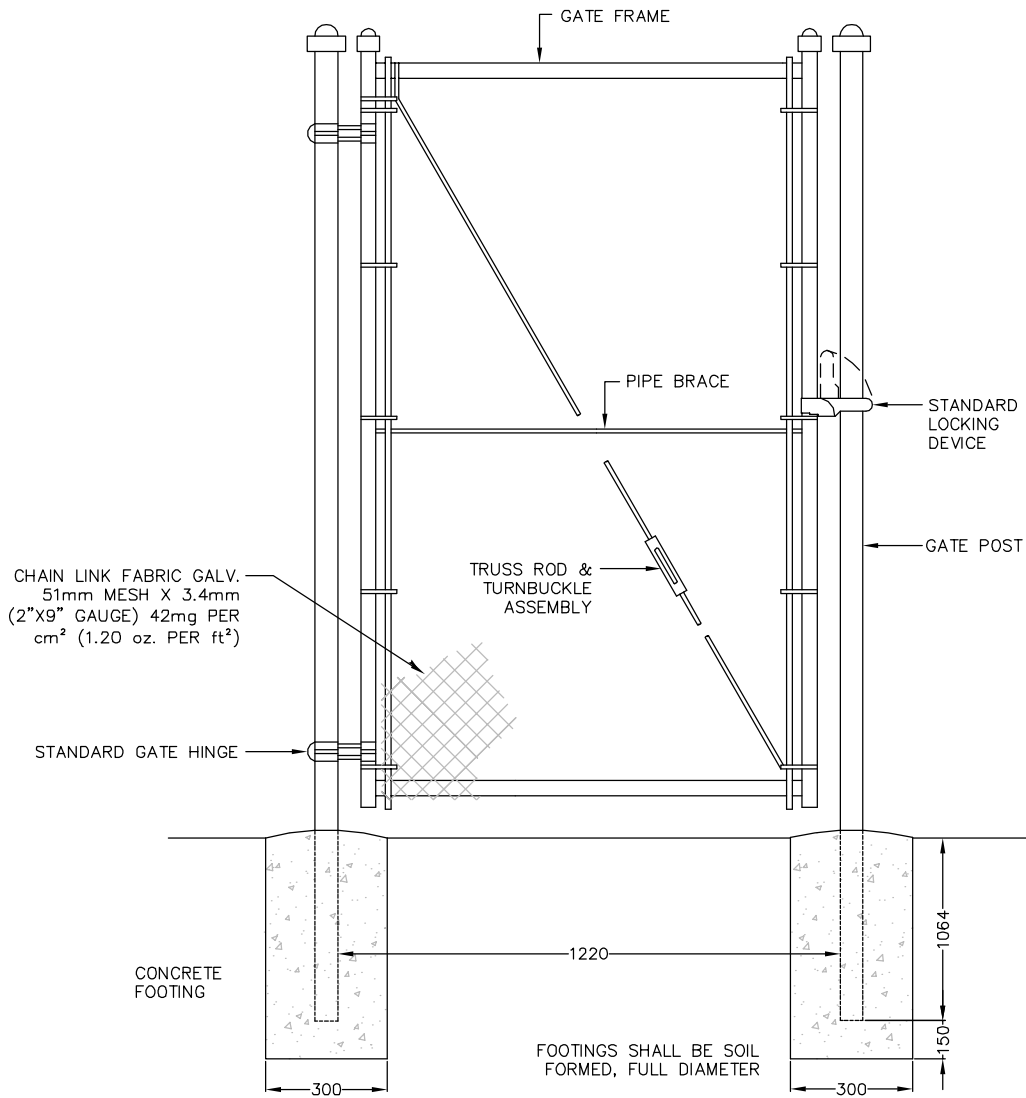
1. TOP RAIL: 33.4mm O.D. GALVANIZED STEEL. RAILS TO BE CONNECTED BY SLIP-ON SLEEVES.
2. LINE POSTS: 48.3mm O.D. GALVANIZED STEEL. SPACED 3.05m MAX. APART. STRAINING POSTS SHALL OCCUR AT MIN. 152m.
3. GATE POST: 88.9mm O.D. GALVANIZED STEEL FOR PANELS UP TO 3.05m (6.1m DOUBLE SWING GATE).
4. END OR CORNER POST: 88.9mm O.D. GALVANIZED STEEL.
5. CONCRETE: 30 MPa STRENGTH IN 28 DAYS.
6. TIE WIRE: 3.55mm (9 GAUGE) ALUMINUM WIRE EVERY 305mm FOR LINE POSTS, EVERY 457mm FOR TOP RAIL.
7. ALL PIPES TO BE SUFFICIENT STRENGTH TO SUPPORT FABRIC WEIGHT AND TENSION, AND TO SUPPORT WEIGHT OF GATE.
8. ALL FITTINGS TO BE DESIGNED AND MANUFACTURED OF MATERIALS HAVING SUFFICIENT STRENGTH TO PERFORM THE NECESSARY FUNCTIONS.
9. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
10. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.		CHAIN LINK FENCE, BARBED DETAIL	
Rev.			
Rev.			
Rev.	File No.: GP60.33682	Design:	Approved:
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S	Figure H-06

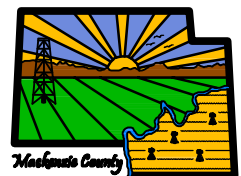


NOTES:

1. GATE POST: 88.9mm O.D. GALVANIZED STEEL FOR PANELS UP TO 3.05m (6.1m DOUBLE SWING GATE).
2. GATE FRAME: 41m O.D. GALVANIZED STEEL. WELDS TO BE ZINC PAINTED AFTER WELDING.
3. CONCRETE: 30 MPa STRENGTH IN 28 DAYS.
4. ALL PIPES TO BE SUFFICIENT STRENGTH TO SUPPORT FABRIC WEIGHT AND TENSION, AND TO SUPPORT WEIGHT OF GATE.
5. ALL FITTINGS TO BE DESIGNED AND MANUFACTURED OF MATERIALS HAVING SUFFICIENT STRENGTH TO PERFORM THE NECESSARY FUNCTION.
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
7. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

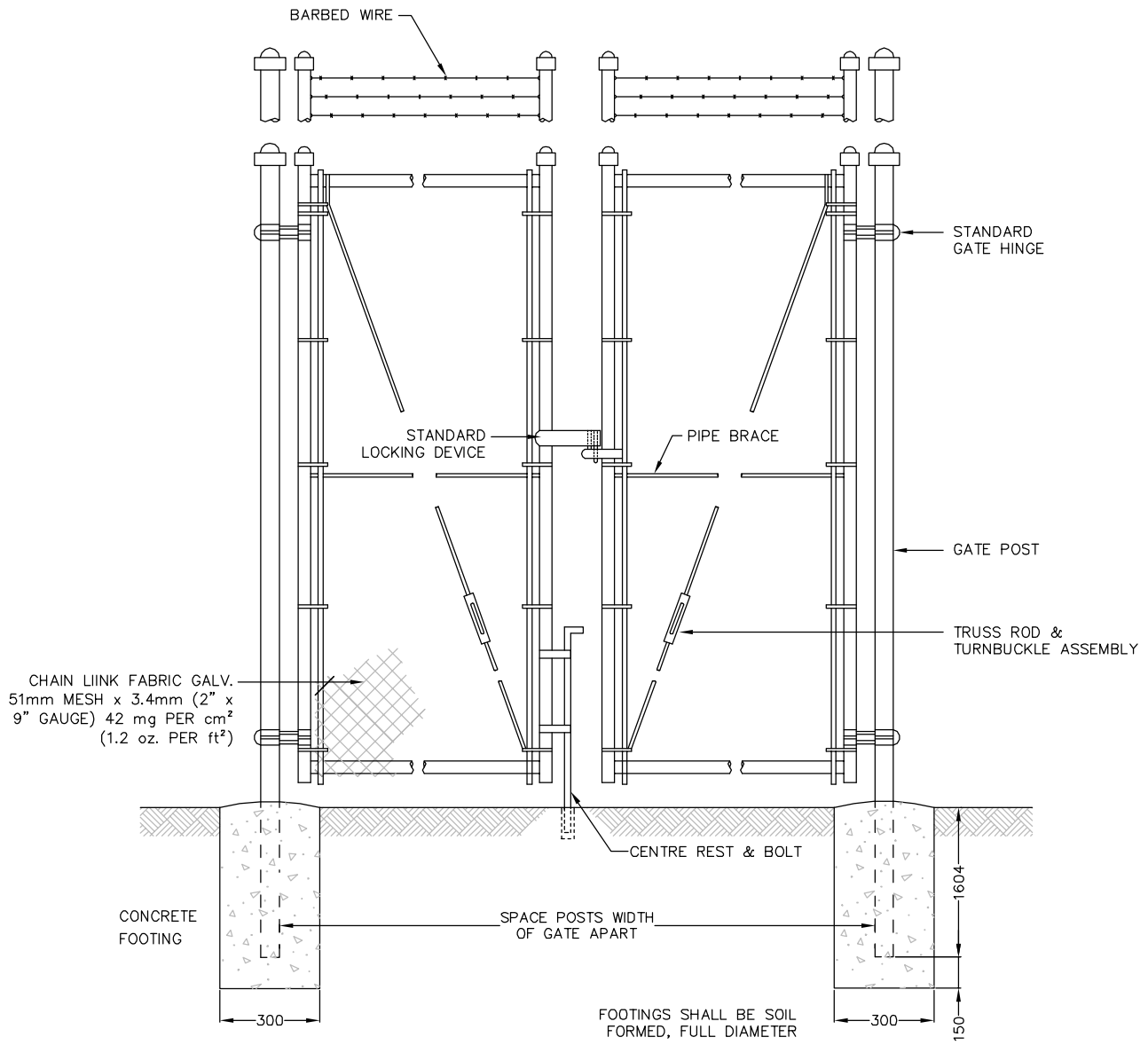
MACKENZIE COUNTY

General Municipal Improvements Standards



CHAIN LINK SINGLE GATE DETAIL

Rev.			Approved:	Figure H-07
Rev.				
Rev.			Approved:	Figure H-07
Rev.				
Date: 2010-AUG-31	File No.: GP60.33682	Design:	Approved:	Figure H-07
	Drawn: K.P.L	Scale: N.T.S		

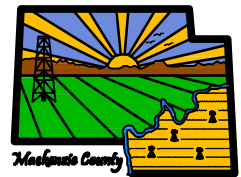


NOTES:

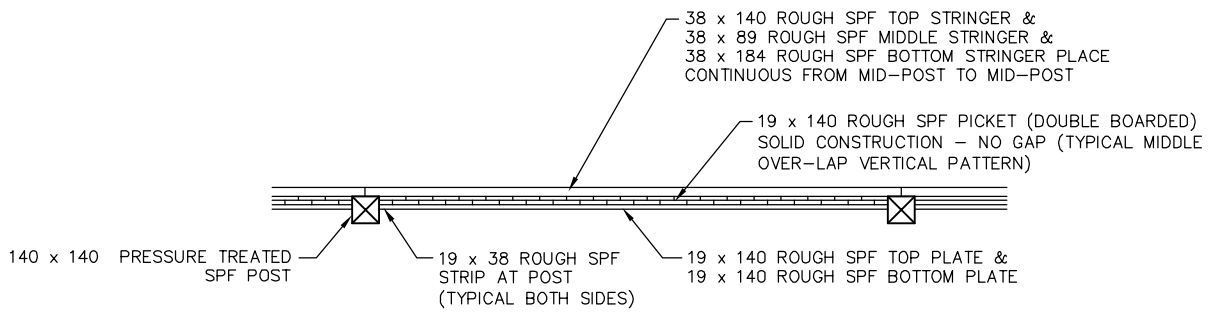
1. GATE POST: 88.9mm O.D. GALVANIZED STEEL FOR PANELS UP TO 3.05m (6.1m DOUBLE SWING GATE).
2. GATE FRAME: 41m O.D. GALVANIZED STEEL. WELDS TO BE ZINC PAINTED AFTER WELDING.
3. CONCRETE: 30 MPa STRENGTH IN 28 DAYS.
4. ALL PIPES TO BE SUFFICIENT STRENGTH TO SUPPORT FABRIC WEIGHT AND TENSION, AND TO SUPPORT WEIGHT OF GATE.
5. ALL FITTINGS TO BE DESIGNED AND MANUFACTURED OF MATERIALS HAVING SUFFICIENT STRENGTH TO PERFORM THE NECESSARY FUNCTION.
6. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
7. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

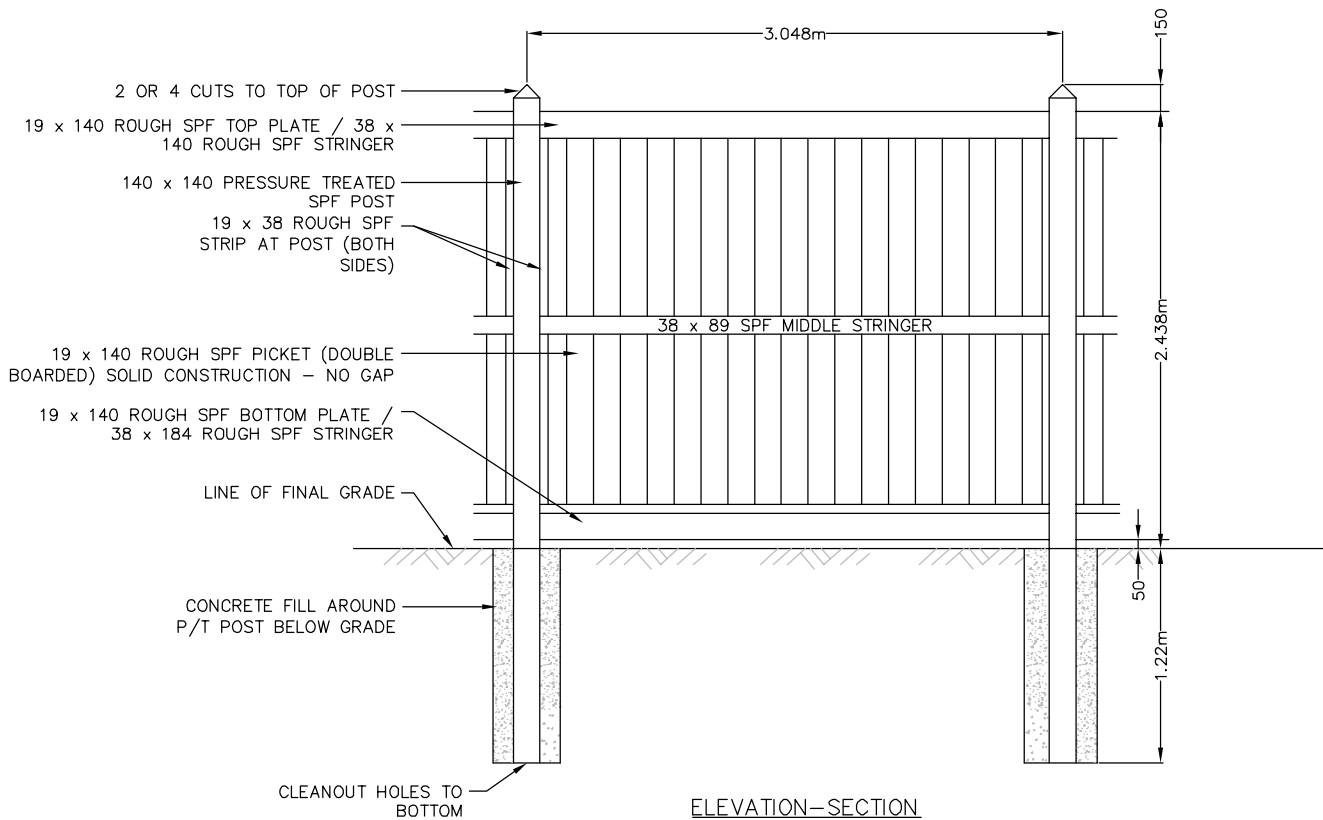
General Municipal Improvements Standards



Rev.		<p>CHAIN LINK DOUBLE GATE DETAIL</p>		<p>Approved:</p>	<p>Figure H-08</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure H-08</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



PLAN VIEW



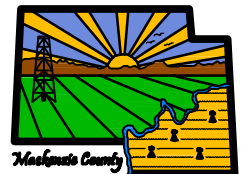
ELEVATION-SECTION

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



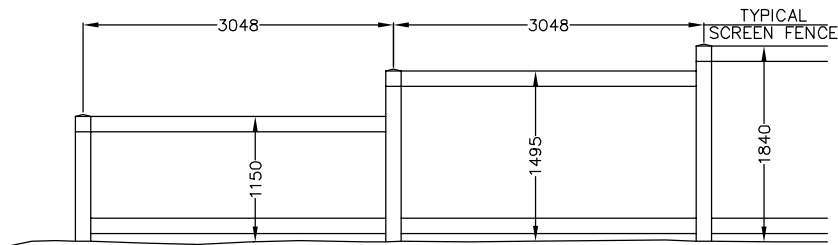
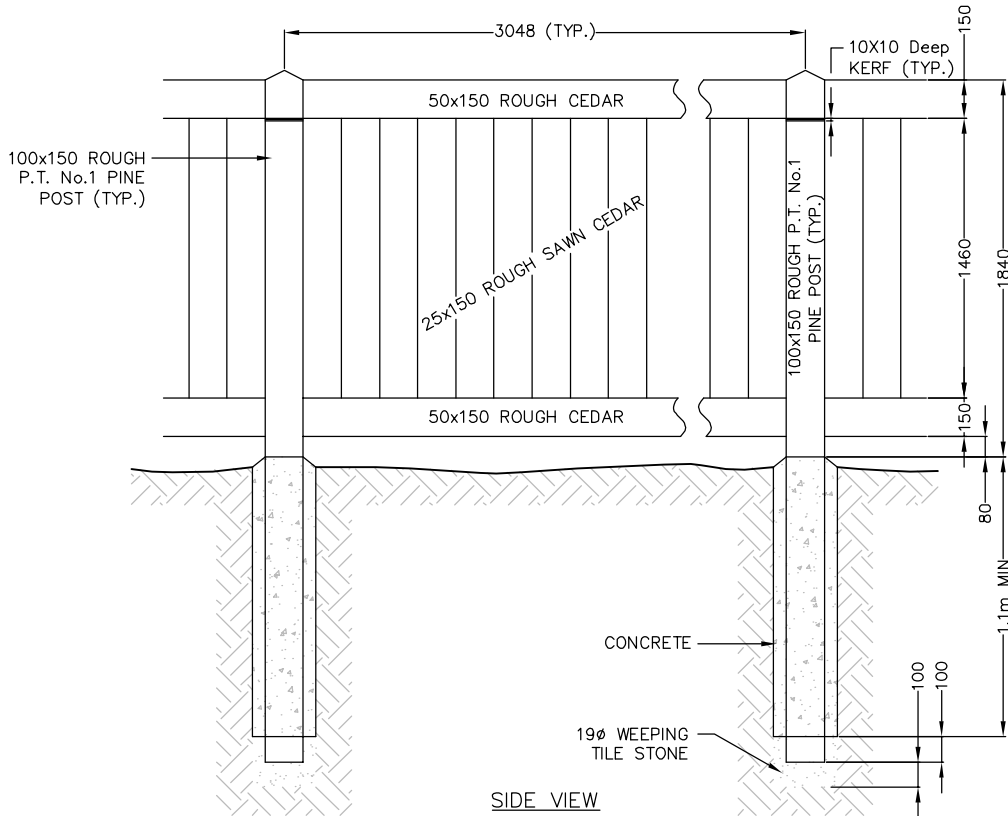
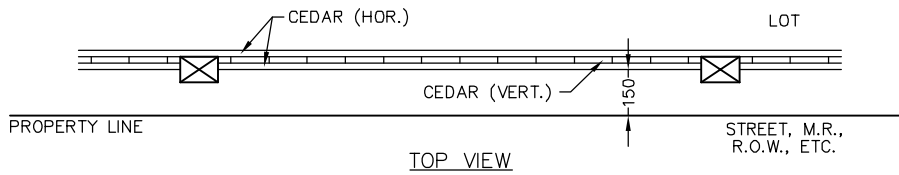
NOISE FENCE DETAIL

Rev.	
Rev.	
Rev.	
Rev.	
Date:	2010-AUG-31

File No.:	GP60.33682	Design:	
Drawn:	K.P.L	Scale:	N.T.S

Approved:	
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Figure	H-09
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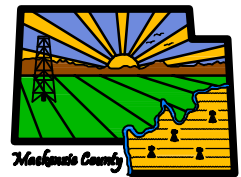


NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. PROPORTIONING AND PRODUCING QUALITY CONCRETE AS WELL AS ACCEPTANCE TESTS FOR THE CONSTITUENT MATERIALS ARE SPECIFIED IN CSA STANDARDS A23.1 AND A23.4 FOR CAST-IN-PLACE AND PRECAST CONCRETE RESPECTIVELY.

MACKENZIE COUNTY

General Municipal Improvements Standards



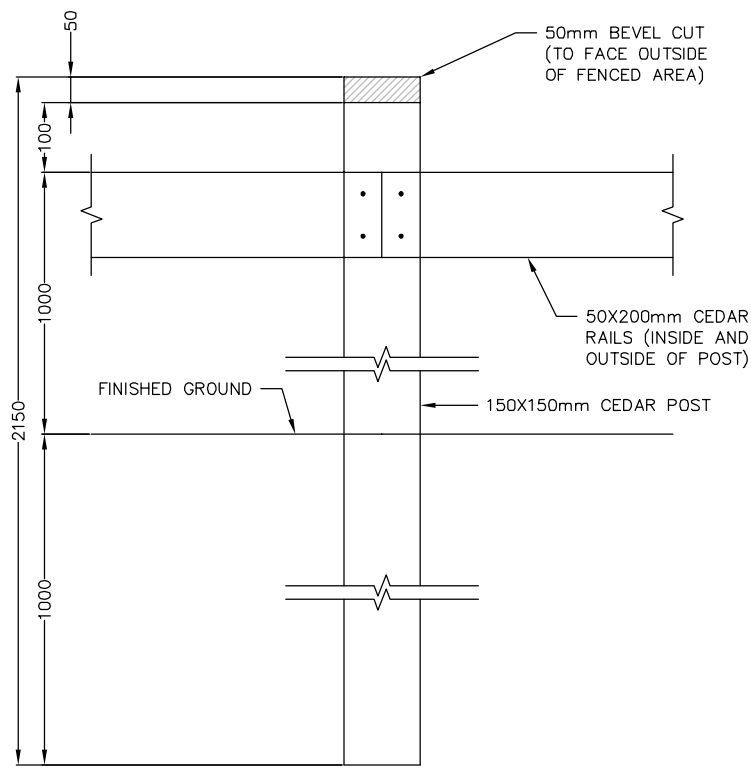
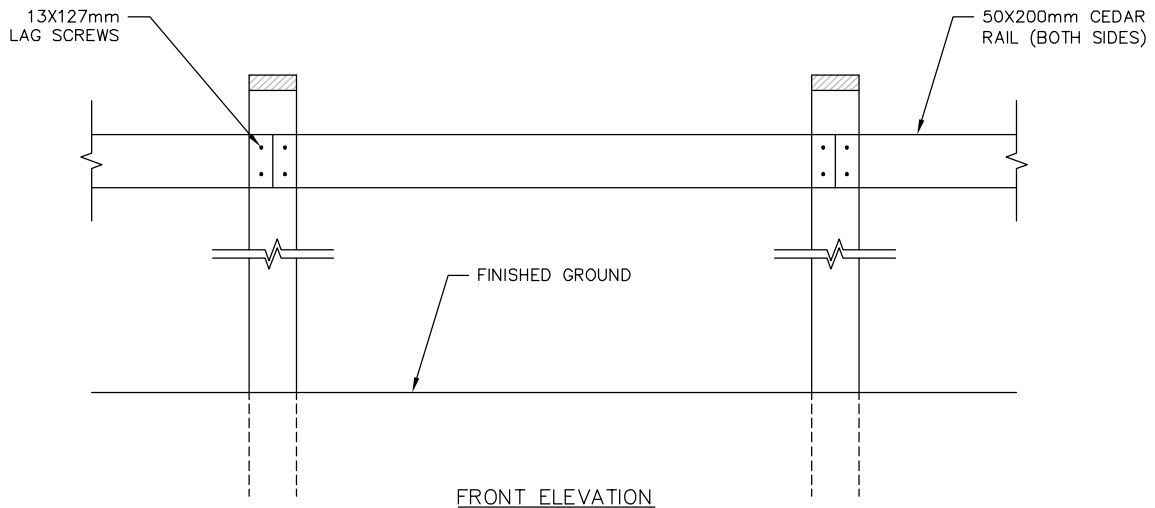
WOOD SCREEN FENCE DETAIL

Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682	Design:
Drawn: K.P.L	Scale: N.T.S

Approved:

Figure H-10

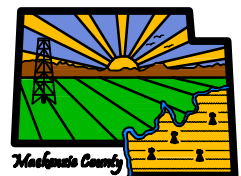


NOTES:

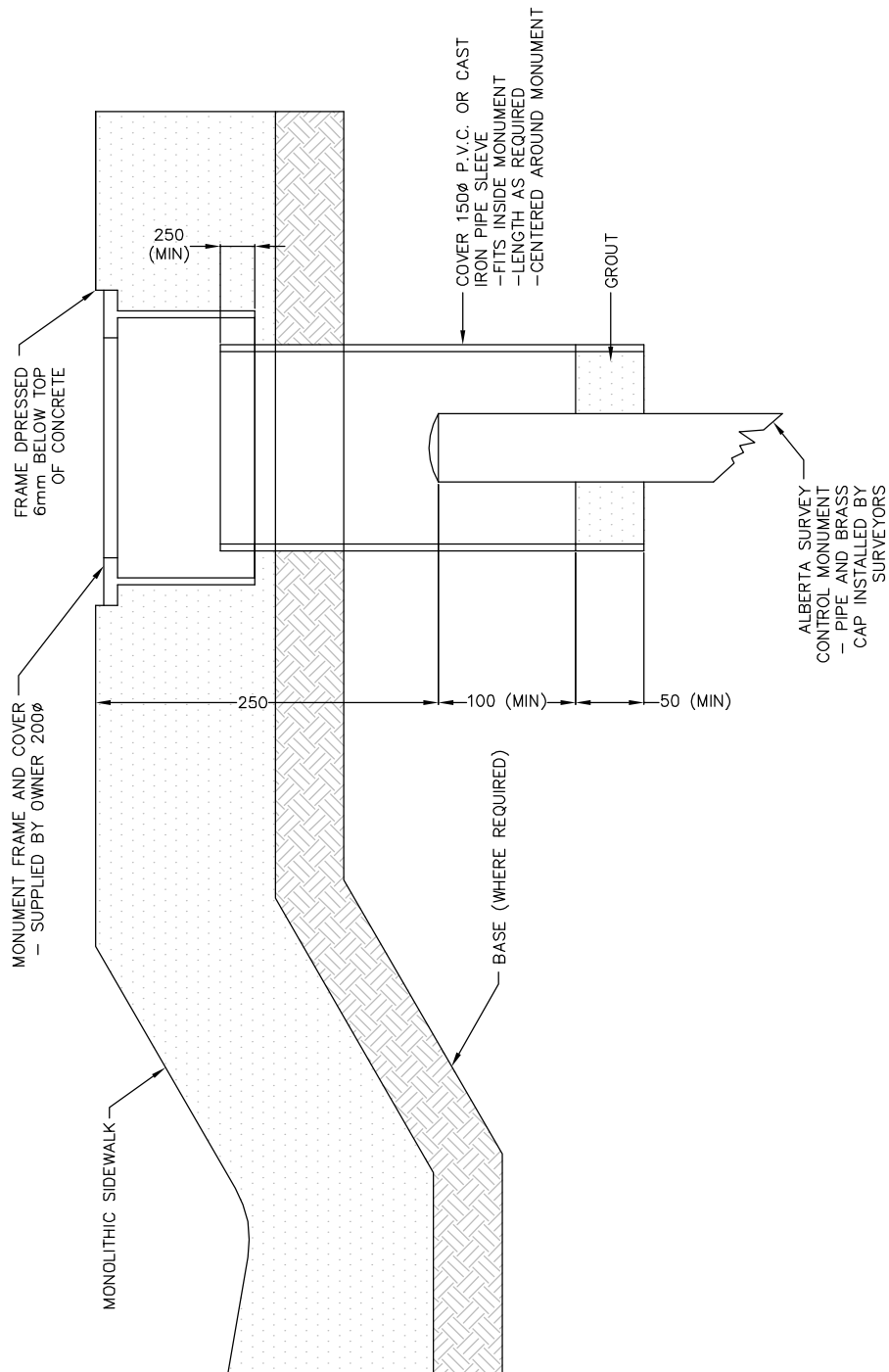
1. ALL LUMBER TO BE C.C.A. PRESSURE TREATED.
2. WHEN FENCE LINE CURVES, POSTS SHALL BE DOTTED SUCH THAT 50X200mm RAILS LAY FLUSH TO POSTS.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



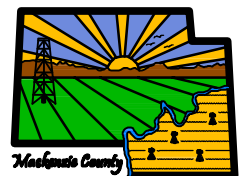
Rev.		<p>TIMBER FENCE FOR OPEN SPACE AREAS</p>		<p>Approved:</p>	<p>Figure H-11</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure H-11	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



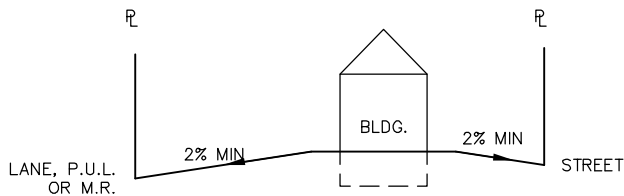
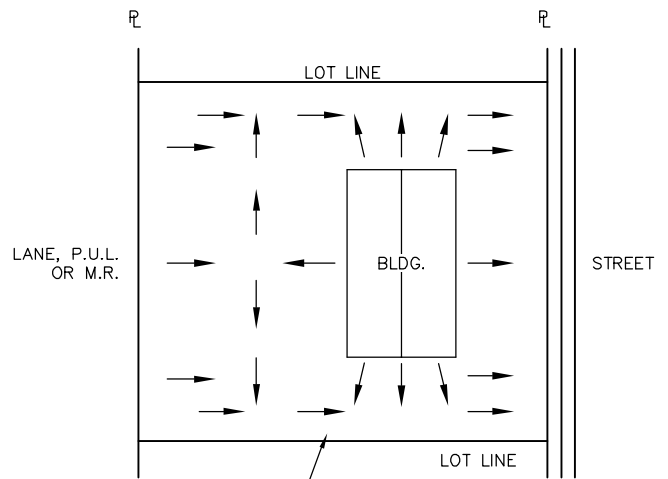
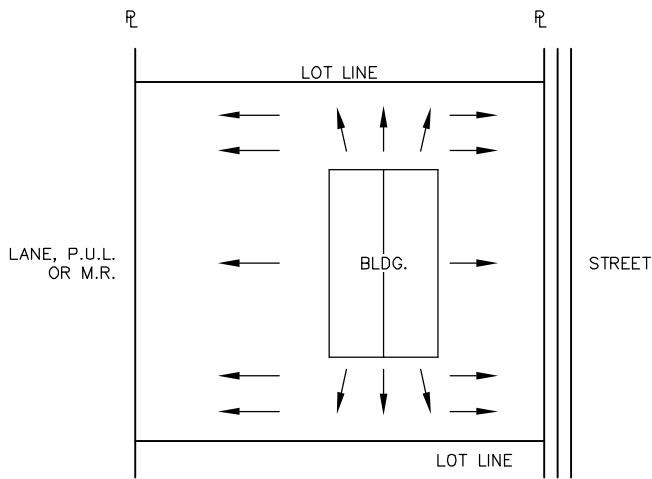
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

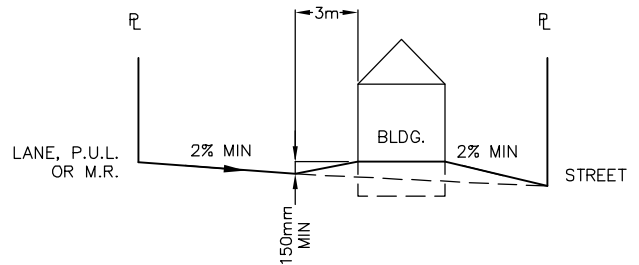
General Municipal Improvements Standards



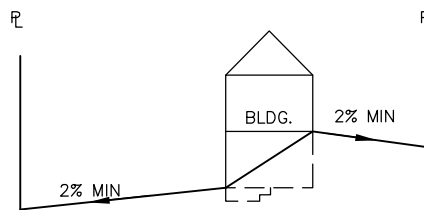
Rev.		<p>SURVEY MONUMENT COVER DETAIL</p>		<p>Approved:</p>	<p>Figure H-12</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	<p>Approved:</p>	<p>Figure H-12</p>	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			



SPLIT DRAINAGE



BACK TO FRONT DRAINAGE

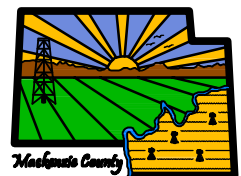


REAR YARD
BASEMENT WALKOUT
SPLIT DRAINAGE

NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

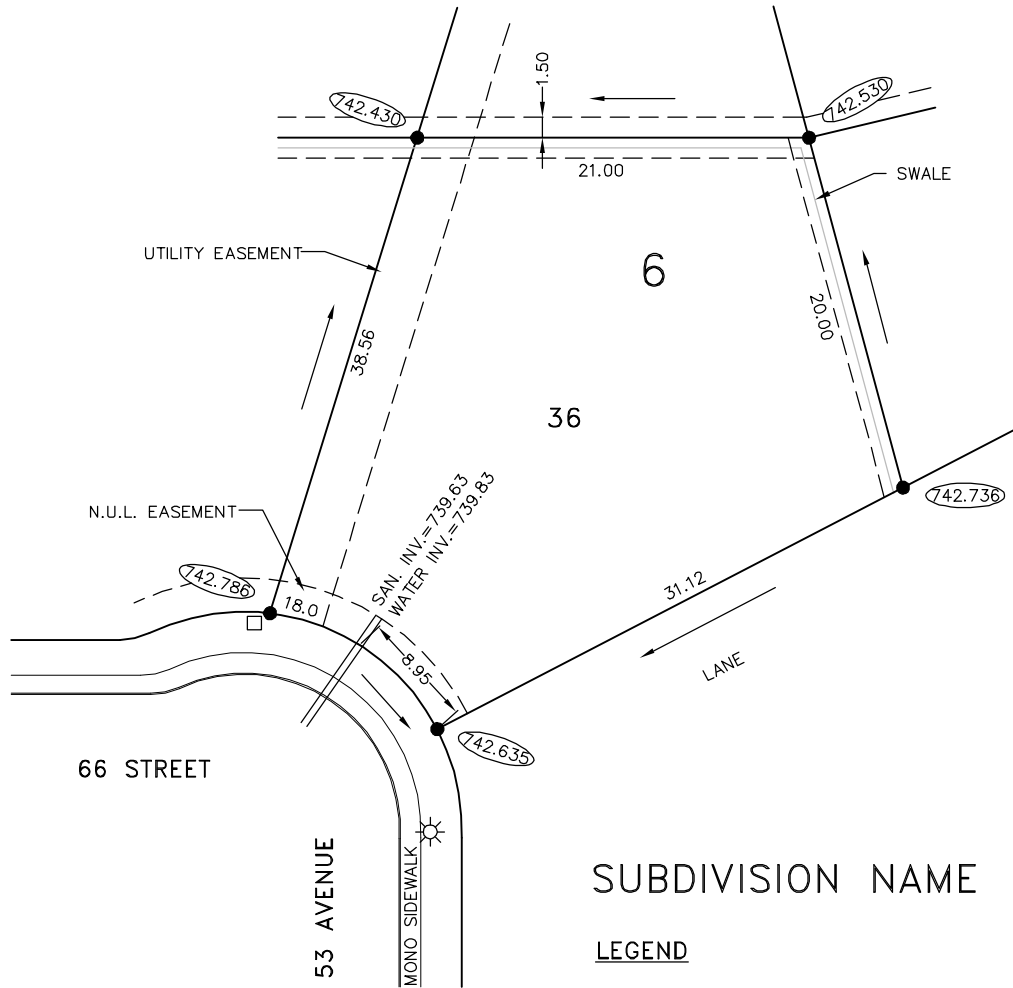
MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	TYPICAL LOT GRADING PLAN		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure H-13
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.		

LOT 36
 BLOCK 6
 PLAN 832-2553
 EASEMENT PLAN 832-2554



SUBDIVISION NAME

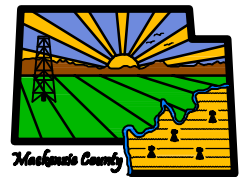
LEGEND

- DESIGN LOT CORNER ELEVATIONS
- IRON PINS
- DIRECTION OF DRAINAGE
- FIRE HYDRANT
- MAIL BOXES
- CATCHBASINS
- LIGHT STANDARD
- POWER

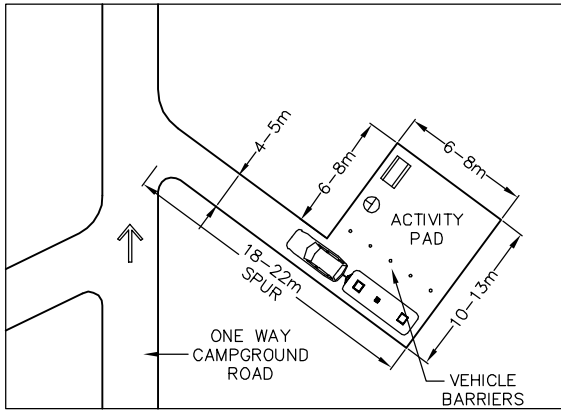
NOTE:
 ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

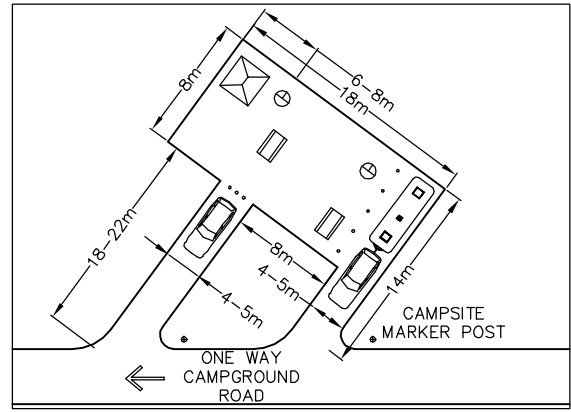
General Municipal Improvements Standards



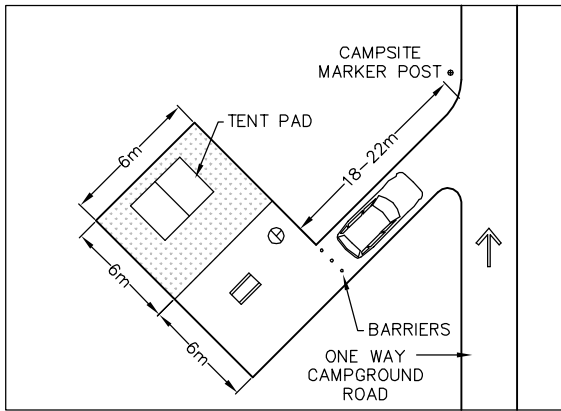
Rev.		TYPICAL LOT GRADING PLAN		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure H-14
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		



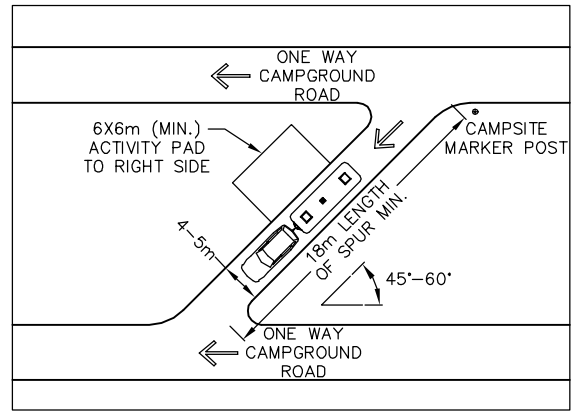
SINGLE BACK-IN CAMPSITE DESIGN



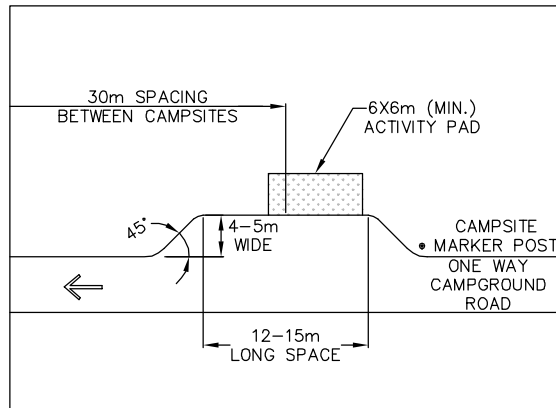
DIMENSIONS OF A DOUBLE BACK IN CAMPSITE



CAMPGROUND LOCATED AT REAR WITH TENT PAD PROVIDED



DIMENSIONS OF A PULL-THROUGH CAMPSITE

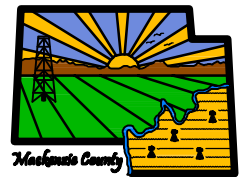


PULL-OVER CAMPSITE DESIGN

NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



CAMPGROUND LAYOUT DETAILS

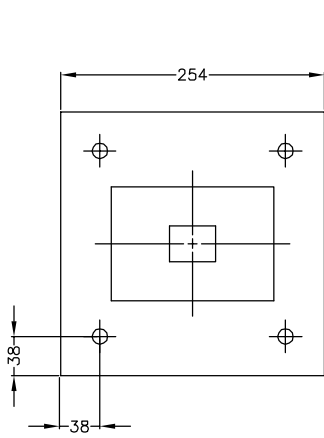
Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

File No.: GP60.33682
Drawn: K.P.L.

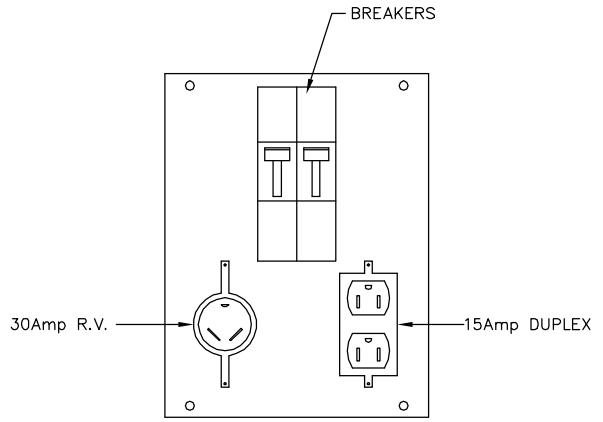
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Scale: N.T.S.

Approved:

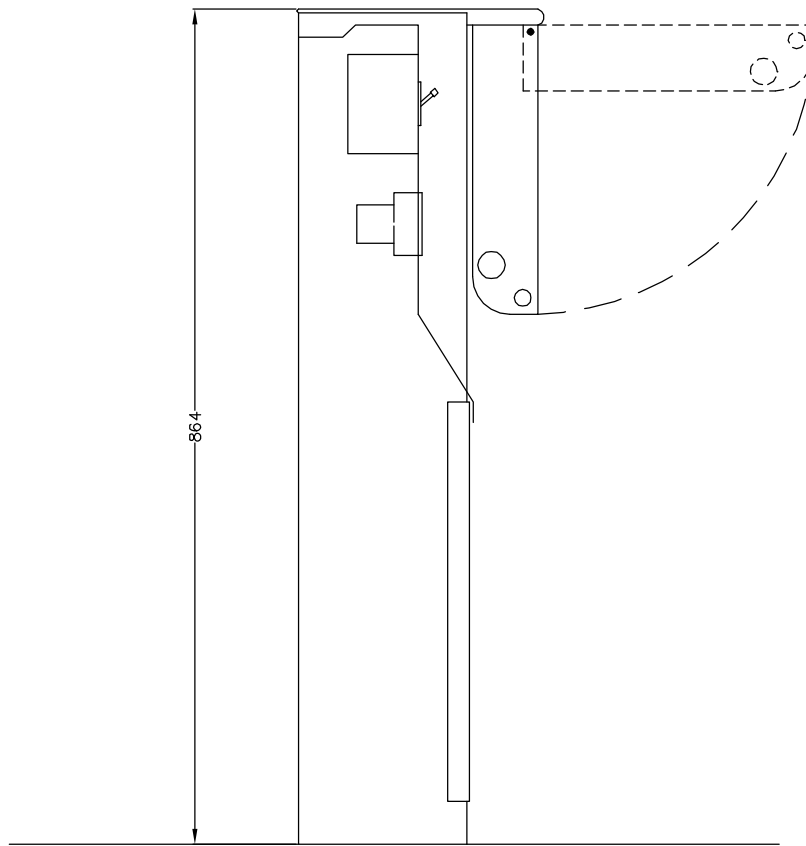
Figure H-15



TEMPLATE



APR-3 INSERT

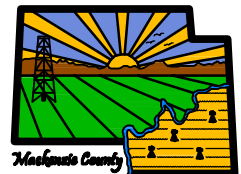


SIDE VIEW

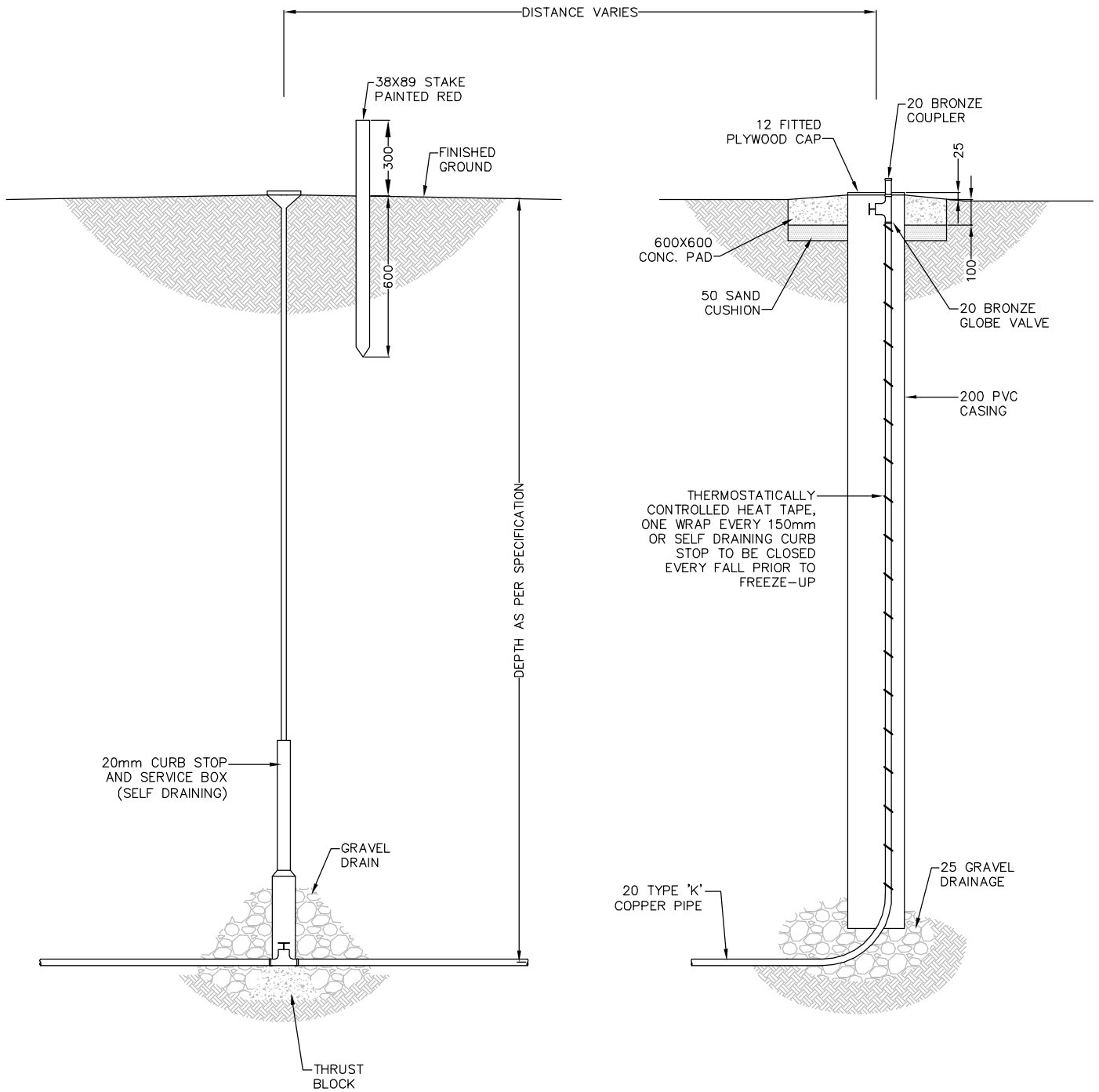
NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



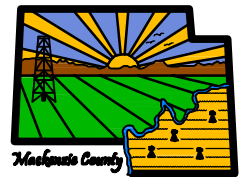
Rev.		ELECTRICAL RECEPTACLE FOR R.V. HOOK-UP		Approved:	Figure H-16
Rev.					
Rev.		File No.: GP60.33682	Design:		
Date: 2010-AUG-31	Drawn: K.P.L.	Scale: N.T.S.			



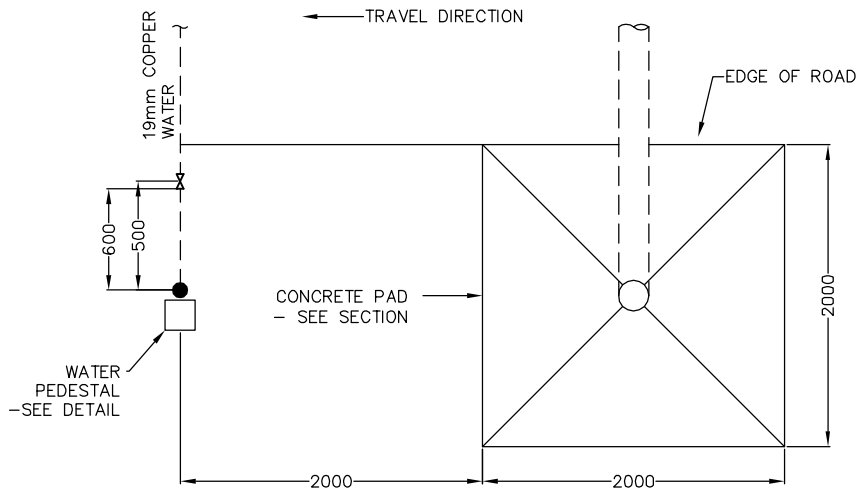
NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

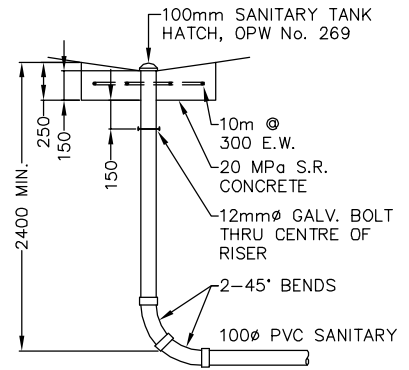
General Municipal Improvements Standards



Rev.		<p>WATER RISER FOR R.V. HOOK-UP</p>		<p>Approved:</p>	<p>Figure H-17</p>
Rev.					
Rev.					
Rev.	File No.: GP60.33682	Design:	Approved:	Figure H-17	
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S			

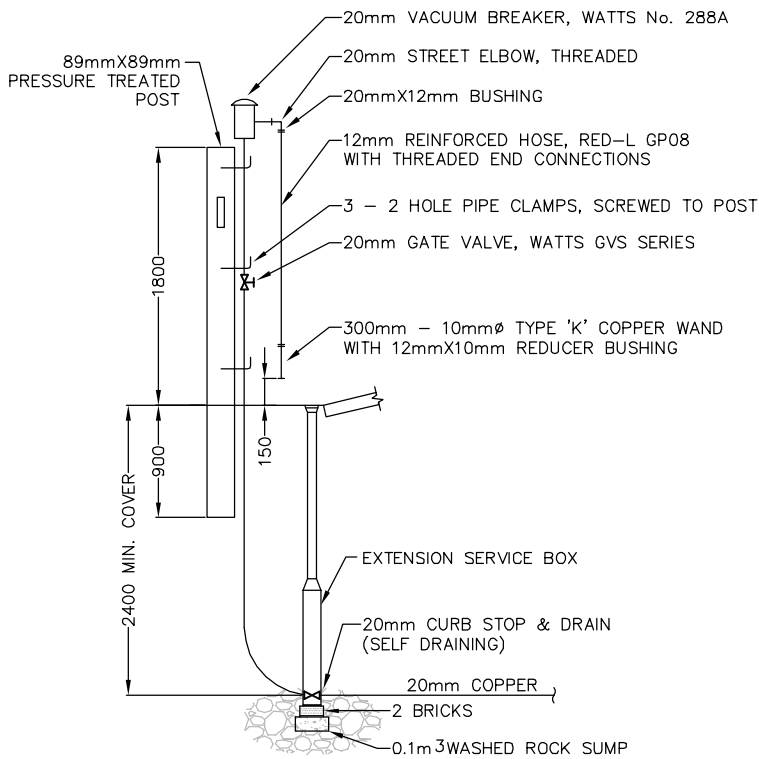


SANI-DUMP SITE

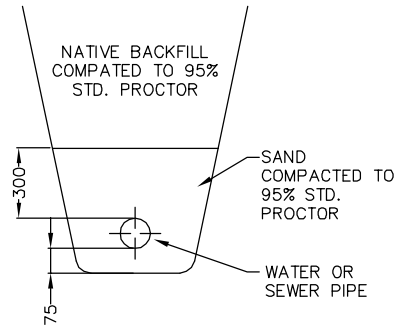


SANITARY PAD SECTION

*NOTE: ALL BACKFILL 95% STD. PROCTOR



WATER PEDESTAL DETAIL

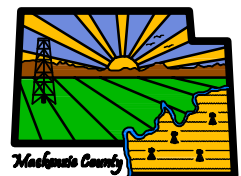


TYPICAL TRENCH SECTION

NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



R.V. SANI-DUMP STATION

Rev.
Rev.
Rev.
Rev.
Date: 2010-AUG-31

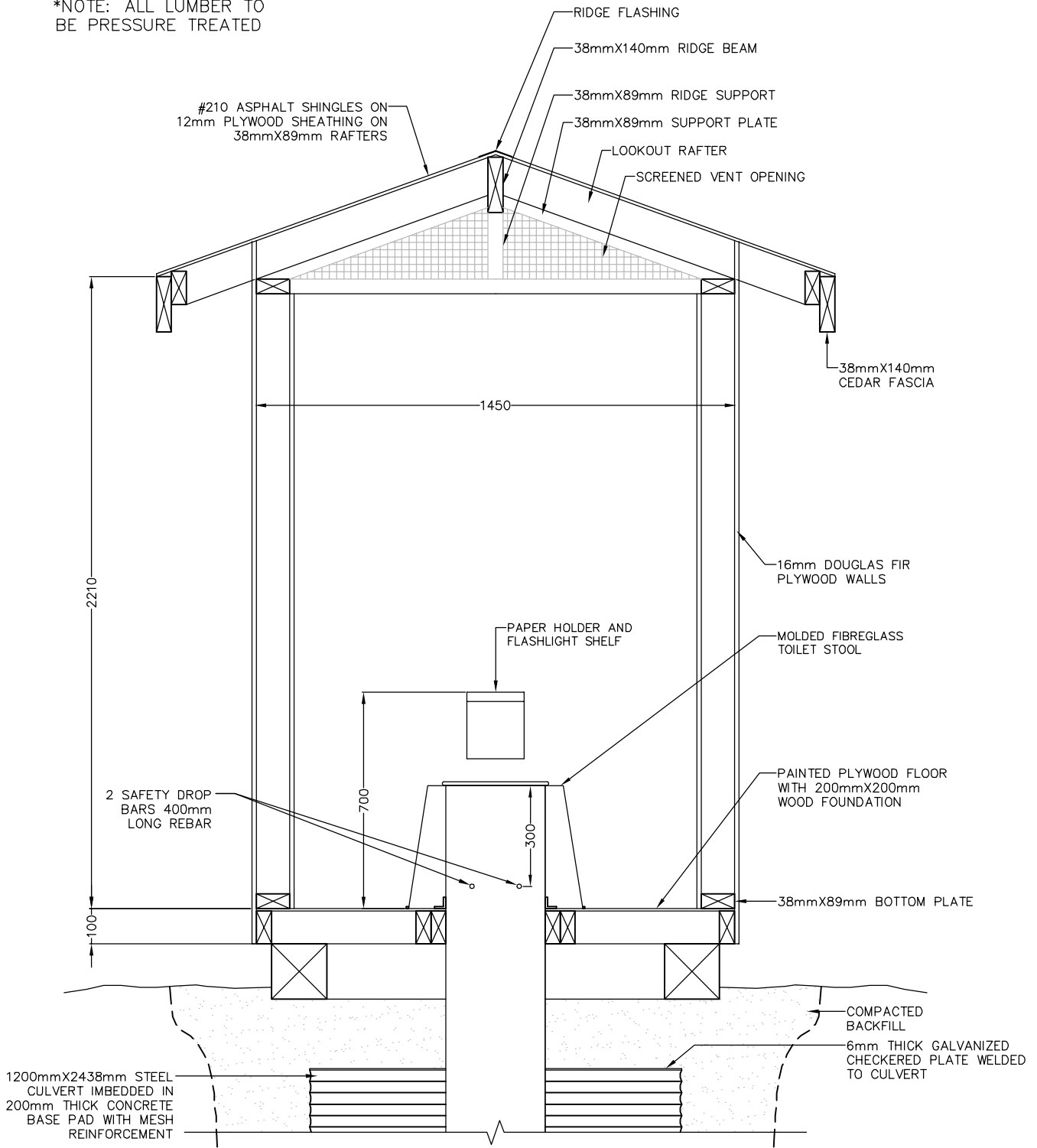
File No.: GP60.33682
Drawn: K.P.L.

Design:
Scale: N.T.S.

Approved:

Figure H-18

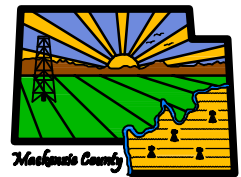
*NOTE: ALL LUMBER TO BE PRESSURE TREATED



NOTE:
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

MACKENZIE COUNTY

General Municipal Improvements Standards



Rev.	Stewart Weir Naturally Resourceful	SINGLE VAULT TOILET		
Rev.				
Rev.				
Rev.	File No.: GP60.33682	Design:	Approved:	Figure H-19
Date: 2010-AUG-31	Drawn: K.P.L	Scale: N.T.S		

SECTION I REFERENCES

The following reference materials were predominantly used with in the preparation of these Servicing Standards:

“The City of Edmonton Design and Construction Standards”, July 1999.

“Standard Specifications for Highway Construction” Alberta Transportation, Edition 14, 2010

Additionally the following reference materials were used in the preparation of these Standards:

“Engineering Servicing Standards”, Strathcona County, 1999.

“Municipal District of Northern Lights Land Use Bylaw”

“The City of Grande Prairie Design and Construction Standards”

“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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