ENGINEERING SERVICING STANDARDS

July 2006

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SECTION A – GENERAL CONDITIONS

A.~~2~~1.0. DEFINITIONS

The following words shall have the meaning hereinafter assigned to them:

"Applicant" or "Developer"	shall mean a person who has applied for approval of a proposed 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.
"Consulting Engineer", ~~or~~ "Engineer",	shall mean a professional engineer,~~ or~~ "or "Consultant" licensed to practice Engineering in Alberta, retained by the applicant, responsible for the design, layout and supervision of installation, recording of as-built information, certifying the installation is in conformity with the standards, design drawings and specifications, and performing those duties in connection with the provision of Municipal services as set out in these design standards.
"Contractor"	shall mean any person, persons or corporation, which shall undertake the installation of Municipal Services on behalf of either the Applicant or the Municipality.
"Manager~~, Planning and Public Works~~"	shall mean the Chief Administrative Officer (CAO) ~~Manager, of the Planning and Public Works Ddepartment~~ of the Village of Thorsby~~City of Fort Saskatchewan~~ or ~~his~~ his / her authorized representative who is responsible for the supervision and approval of all duties related to the provision of engineering and other duties for all Municipal services.
"Municipal", ~~or~~ "Municipality", or "Village~~City~~"	shall refer to the Village of Thorsby~~City of Fort Saskatchewan~~.

A.32.0. ENGINEERING DESIGN

1. The Applicant shall retain a ~~Professional~~ Consulting 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 be responsible for the design and preparation of drawings and specifications for all services required by the Village~~City~~~~required within the City of Fort Saskatchewan~~. These services shall be designed in accordance with the Servicing Standards & Specifications, which are available from the ~~City of Fort Saskatchewan's Planning and Public Works Department~~Village of Thorsby at~~,~~ at 4917 Hankin Street or Box 297 ~~11121 - 88 Avenue,~~ Thorsby~~City of Fort Saskatchewan~~, Alberta, T0C 2P0~~8L 2S5~~.~~ and found on-line at www.fortsask.ca/….~~
2. The Design Drawings shall display all existing and proposed services. It shall be the Consulting Engineer's responsibility to coordinate with the utility companies to establish the location of their existing and proposed services, and the specifications for their installation.

A.43.0. SUBMISSION AND REVIEW OF ENGINEERING DESIGN

1. Two (2) complete sets of plans and specifications for the proposed subject shall be submitted to the CAO~~Manager, Planning and Public Works~~ including the following:
   a. Calculations of storm ~~sanitary~~ and sanitary ~~storm~~ sewer capacity and pipe loading~~;~~ as specified in sections C and D;
   b. Water distribution analysis as specified in Section E; and
   c. A print of the registerable plan(s) of the subdivision.
2. All proposed streets~~,~~ shall be named on the drawings.~~,~~ ~~with the n~~Names are to be approved by the Village of Thorsby~~City of Fort Saskatchewan Planning and Public Works Department~~ prior to the submission of drawings.
3. The Consulting Engineer shall bring to the attention of the Applicant the need for any rights-of-way outside the area to be serviced. 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.
4. All design drawings, specifications, and relevant data will be reviewed by the Village~~City~~ and all necessary revisions shall be incorporated in the final design drawings. Upon completion of all revisions, the Consulting Engineer shall submit ~~three~~ two (~~3~~2) sets of Contract Drawings to the ~~Manager, Planning and Public Works~~ CAO for final review.

   Following the review the Village~~City~~ will return one signed set to the Consulting Engineer.
5. A digital copy of construction drawings shall be provided to the Village~~City~~ to update the Village~~City~~'s infrastructure drawings.~~No work shall commence until the City has certified the Contract Drawings and Plans.~~

A.~~5~~4.0. CONSTRUCTION APPROVAL

1. ~~Upon receipt of the Certified drawings and specifications, t~~The Applicant may proceed to install municipal services provided that ~~a~~Development Agreements ha~~ves~~ been entered into and ~~a~~Development Permits have been obtained.
2. No work shall commence without a Development Permit or completed Development Agreement. Development Permits will not be issued until the Village~~city~~ has certified the Contract Drawings and Plans. Approv~~ed~~al or certification of Contract Drawings and Plans does not imply that a Development Permit has been issued; other conditions may apply.
3.

A copy of all approved drawings and specifications shall be maintained at the construction site during the installation of these services. ~~Underground subdivision services shall not be permitted to operate as part of the existing municipal services until the respective subdivision services have been inspected, tested and approved in writing by the City.~~

A.~~6~~5.0. ENGINEERING SUPERVISION

1. The Applicant's Engineer shall be responsible for the layout, inspection and approval of all materials and/or the supervision of the installation of all services~~, which~~ that are the Applicant's responsibility. The Consulting Engineer, or an authorized representative, shall be in attendance at all times on the site during the installation of services.
2. The Consulting Engineer shall be responsible for obtaining field surveys from which services not the responsibility of the Applicant may be installed, if such installations are to be made before the acceptance of the Applicant's work.
3. In addition to supervision carried out by the Applicant's Engineer, the ~~City~~Village will periodically inspect the work and assist in coordinating the subdivision works with any other related Municipal works. The ~~City~~Village shall bring the use of any unacceptable materials or practices to the attention of the Consulting Engineer or Contractor. If remedial action is not taken to the satisfaction of the ~~City~~Village, it may terminate the work until such time as the required corrective action is taken.
4. If the Consulting Engineer wishes to make any changes in the design prior to or during the execution of the work, he shall first submit a marked print showing the proposed revision(s) to the ~~City~~Village. If approval is granted for revision, the original drawing shall be immediately revised and new prints issued.

A.~~7~~6.0. TESTING

It shall be the responsibility of the Consulting Engineer to ensure that all improvements are tested and found to meet the ~~City~~Village's minimum test standards for such improvements prior to acceptance by the ~~City~~Village. Copies of all test

results must be forwarded to the ~~City~~Village. A summary report is to be submitted to the ~~City~~Village upon completion of the project. (See Table A.1.0)

TABLE A.1 - TEST FREQUENCY

Specification	Type of Test	Recommended Test Frequency	Remark:
Trenching, Backfilling Trenching, Backfilling & Compaction for Electrical Installation	Density Test: - Trench longer than 15 m - Trench shorter than 15 m	2 tests per 600 mm of depth for every 100 m of trench length 3 tests per trench	Testing will vary with location of project and consequences of trench settlement.
Roadway Excavation, Backfill & Compaction	Grading/Fill Compaction: Subgrade Preparation Proof Rolling:	1 density test per 2000 sq. m of compacted lift 1 density test per 1000 sq. m of compacted subgrade lift Entire project	
Aggregate: General Granular Sub-base Granular Base	Source Sampling: Compaction: Proof Rolling:	1 sieve analysis per 1000 tonnes of asphalt aggregate for crushing control 1 sieve analysis per 1000 tonnes of base and subbase aggregate 1 density test per 1500 sq. m of compacted granular lift of road Entire project	Required 2 weeks prior to commencing work
Stabilization: Lime	Source Sampling: Test Area: Proof Rolling:	400 sq. m to establish and demonstrate work methods and timing At completion of curing period	Required 2 weeks prior to commencing work
Soil Cement	Source Sampling (aggregate): Mix Design: Thickness Test: Compaction Test: Strength Test:	1 sieve analysis per 1000 tonnes 1 core sample per 1000 sq.m of soil cement in place 1 density test per 1000 sq. of soil cement in place 17-day compressive strength test per 1000 tonne of soil cement	Required 2 weeks prior to commencing work Required 2 weeks prior to commencing work Areas suspected to have inadequate thickness
Topsoil	Topsoil Analysis: - On-site Sources - Contractor Supplied	1 analysis report for each topsoil source Contractor to supply 1 litre sample of each topsoil type for testing	Required 4 weeks prior to commencing work
Asphaltic Concrete Paving	Mix Design Density/Thickness Test: Mix Proportions	3 cores per 1000 sq.m of asphalt pavement 1 Marshall core per 1000 tonnes mix, with a minimum of 1 test from each full day's production	Required 2 weeks prior to commencing work
Hydrants	Pressure/Leakage Test* Flow Test*	Minimum of one hydrant per development	Provide Engineer at least 24 hours notice
Watermain	Hydrostatic/Leakage Test: * Bacteria/Chlorine Test *	Test section not exceed 365 m in length	Provide Engineer at least 24 hours notice
Storm Sewer Sanitary Sewer	Television and Photographic Inspections	Upon completion of sewer installation, after backfilling	Performed by Contractor
Forcemains	Hydrostatic/Leakage Test: *	Test section not exceed 365 m in length	Provide Engineer at least 24 hours notice
Concrete Curbs & Gutters, Walks, Medians, Driveways & Swales General Concrete Slip Formed Concrete	Mix Design: Slump Test: Air Content Test: Strength Test:	1 per 60 cu.m for each class of concrete poured, min. 1 per day 1 per 60 cu.m for each class of concrete poured, min. 1 per day 1 per 60 cu.m for each class of concrete poured, min. 1 per day	Required 2 weeks prior to commencing work Every truck until consistency is established Every truck until consistency is established

* Tests to be witnessed by Village

A.~~8~~7.0. RECORD (AS-BUILT) DRAWINGS

1. Within two (2) months of the completion of all of the services to be installed, the Consulting Engineer shall deliver two printed sets ~~one set of of~~mylar record ~~"as-built"~~ drawings~~, one set of bound prints~~ and one set of digitized drawing files (as per B.5.0) to the ~~City~~Village ~~which and~~ subject to review and approval.~~–~~
2. Once approved, the ~~c~~Consulting ~~e~~Engineer shall deliver one set of approved Mylar record drawings and one approved set of digitalized drawings as outline in section B.

A.~~9~~8.0. MUNICIPAL ACCEPTANCE

~~A.~~8.1. CONSTRUCTION COMPLETION

1. Once the Applicant or Applicant's Engineer is satisfied that the project is complete it shall be their responsibility to notify the ~~City~~Village, arrange for inspection, and submit the required paperwork. The Engineer shall note any deficiencies determined during the inspection and arrange to have them corrected.~~a Construction Completion inspection shall be arranged. It shall be the Applicant's responsibility to arrange the inspection with the City and the contractors. During the inspection the City will determine if there are any deficiencies and the Engineer shall note these and arrange to have them corrected.(Refer to … for deficiencies)~~
2. Upon the satisfactory completion of the project, ~~and after all of the~~ the correction of all deficiencies ~~have been corrected~~, and once all other requirements are met, the ~~City~~Village shall issue a Construction Completion Certificate (C.C.C.) to the Applicant, noting the acceptance of the work by the ~~City~~Village and the duration of the maintenance period. ~~to the Applicant, noting the acceptance of the work by the City and the duration of the maintenance period.~~–
3. Underground subdivision services shall not be permitted to operate as part of the existing municipal services until the respective subdivision services have been inspected and a C.C.C. issued.–

~~A.~~8.0.~~2~~. MAINTENANCE AND FINAL ACCEPTANCE

1. The A~~a~~pplicant shall be responsible for and, ~~at his own~~ without expense to the ~~City~~Village, remedy any defect, fault or deficiency in the completed work during the maintenance period, in accordance with the terms and conditions of the Development Agreement.
2. Upon ~~completion~~ expiration of the maintenance period~~–~~, the Applicant or the Applicant's Engineer shall be responsible for notifying the ~~City~~Village and arranging for final inspection. ~~and a~~After the final inspection and the correction of all deficiencies ~~thereof~~and outstanding issues, the ~~City~~Village shall issue a Final Acceptance Certificate (F.A.C.).~~ The~~

~~Applicant shall be responsible for notifing the City of the experiration of the maitenance period and arranging final inspection with the City and Contractors.~~

A.~~10~~9.0. ~~—~~BUILDING PERMITS

Building permits shall not be issued until the subdivision plan is registered and all essential services have been provided as specified in the Development Agreement or Development Permit unless otherwise approved, in writing, by the ~~City~~Village's CAO ~~Manager of Planning & Public Works~~.

SECTION B - ENGINEERING PLANS & DRAWINGS

B.1.0. GENERAL DRAWING GUIDELINES

1.1. SUBMISSION

1. All detailed engineering plans submitted to the Village of Thorsby for review must comply with the following standards and specifications.
2. The Village requires two complete sets of drawings with one set unbounded and the first draft should be submitted a minimum of 42 days (6 weeks) before anticipated start of construction. The Village shall return one set of drawing with comments and the consultants are free to discuss the revisions with the Village. The revised set of drawings should be re-submitted along with the Village's commented set. The process will continue until no revisions are required.
3. A digital copy of construction drawings shall be provided to the Village to update the Village's infrastructure drawings.

1.2. DRAWING FORMAT

1. Title Block

   Title Block should contain:

   - The Village of Thorsby's Logo
   - Project Name
   - Description of Drawing
   - Drawings Numbers
   - Consultant's Name
   - Consultants Permit Stamp
   - Engineers Stamp
   - Designer's & Draftsperson Names
   - Checks and Approvals Names
   - Scales
   - Revisions List and Dates

2. Size

   Paper size should be approximately 22" x 34" (559mm x 864 mm)

3. Scale

Type	Typical Scale
Overall Plans	1:1000
Plan/Profile	Horizontal 1:500, Vertical 1:50
Cross Sections	Horizontal 1:100, Vertical 1:50

All drawings should be scaled to show an appropriate level of detail. Whenever possible typical scales as seen in the table above should be used. If typical scales are not used then standard scales shall be used and clearly indicated which scale is used. If a scale is not used then it shall be indicated to be Not To Scale.

4. Dimensions
   a. Dimensions and units shall be metric format
   b. Elevations are to be presented to 3 decimal accuracy.
   c. Grading to be presented to 2 decimal accuracy.
   d. Dimensions should be given from an iron pin, lot line, chainage station, a centerline or any other reference that can be readily established.
5. Lettering

   Lettering to be upper case simple format, legible and uniform.
6. Elevations

   All elevation shall be relative to a Geodetic Datum with all reference benchmarks and elevations shown on the drawing. Benchmark numbers, location and elevation can be obtained form the Village office.
7. Legend

   Line-types, symbols, colours, hatch patterns and abbreviations to be used in a consistent manner and to aid in the interpretation of the drawing. Specific line-types, etc. may be used at the discretion of the consultant. Suggested symbols and abbreviations are found in Tables B-1, B-2 and B-3.

   A north arrow shall be placed on every drawing as a direction reference.
8. Survey Plan

   Drawing to be in real – world coordinates in an established ASCM system (preferably 3TM-NAD83). If done in ground units, combined factor must be given to translate to Mercator. The Village will provide a sample of our legal base to a consultant if they would like to tie-in directly to our base drawing.

B.2.0. DIGITAL DRAWING REQUIREMENTS

All digital drawings shall be submitted in a format compatible with the latest version of Autocad.

2.1. LINEWORK

1. Polylines are to be used to represent all network features (e.g. pipes, curbs, etc.) and blocks are to be used to represent all point features (e.g. manholes, valves, etc.)
2. Polylines are to be continuous and broken only at physical intersections or nodes.
3. Different line-types and colours assist in the interpretation of the drawing.

2.2. LAYERS

1. Each utility or other physical feature is to be drawn on its own separate layer. It is recommended that various components (e.g. manholes, valves, etc.) and related text be further separate onto their own layers.
2. Suggested Layering Scheme:
    - Storm Mains
    - Storm Main Text
    - Storm Manholes
    - Storm Manholes Text
    - Storm Catch Basins
    - Storm CB Text
    - Storm CB Lead-to-Main
    - etc.
3. Layers are to be named in a descriptive manner. Where numbers or codes are used, a document describing each layer is to be provided.

B.3.0. DRAWINGS REQUIREMENTS

All plans should include the property lines, lot-block numbers, street names and construction limits. Drawings and/or drawing elements may be combined at the discretion of the Engineer. Distinction shall be made between existing, proposed, and future features.

3.1. COVER SHEET

This sheet should show the following:

1. The Village of Thorsby logo
2. Name and/or logo of the Developer(s) and Consultant(s)
3. Name of the project or subdivision
4. Location of project with key plan
5. Stage, phase, and year of the project or development
6. Type of drawings
7. Submission date

3.2. INDEX PLAN

This Plan shall indicate which portion of the development that relates to a particular plan/profile sheet. A complete list of the drawing set(s) is to be included.

3.3. LEGAL PLAN

This Plan shall indicate parcel, ROW, easement, and PUL dimensions; relevant control stations and benchmarks.

3.4. CONTOUR AND LOT GRADING PLAN

This Plan shall indicate the following:

1. The existing contours and elevations at a maximum of 0.5metre intervals, all existing topographical features such as trees, buildings, utilities, etc., and the date and method of survey
2. Proposed finished lot corner elevations and lot grades (section C.13.2)
3. Proposed finished elevation of the building (e.g. floor elevation(s))
4. Proposed swale locations (section C.12.0)
5. Directions of surface drainage flow
6. Ponding areas

3.5. ROAD, SIDEWALK & WALKWAY PLAN

This Plan shall indicate the following:

1. All locations, dimensions, and alignments of roads, lanes, ditches, walkways, curb ramps, temporary access connections, signs, and other proposed topographical features
2. BC and EC locations and radii of curvature

   (see Table G-1: Summary of Recommended Design Standards for Urban Streets)
3. Date and authour of geotechnical report specifying pavement structure

3.6. SANITARY AND STORM SEWER AND WATERMAIN OVERALL PLAN

This plan shall indicate the following for all mains and related components/ appurtenances:

1. The location, alignment, and offsets (sections C.4.0 and D.3.0)
3. Network type
4. Size (sections C.3.0 and D.1.0)
5. Material (sections C.3.0 and D.2.0
6. Direction of flow

3.7. BASIN PLAN

This plan shall indicate the following:

1. Contributing storm and sanitary sewer catchment boundaries and areas in square metres or hectares (sections C.2.2 and D.1.1)
2. Direction of flow and discharge point through each catchment
3. Fire hydrant service radii in metres (see section E.3.0)
4. Calculations for design flows, flow restrictors, pipe/channel capacities, and storage requirements and capacities
5. Date and author of report or outline plan used as a reference

3.8. LANDSCAPING PLAN

This plan shall indicate:

1. Locations, dimensions, and offsets of turf areas and planting beds
2. Locations and offsets of trees and shrubs outside of planting beds
3. Quantities, species, and specifications of plants
   (section H: 2.1, 2.4, 2.5, 2.7, 2.8, 2.9)
4. Location and description of other landscaping material
   (section H: 2.2, 2.3, 2.6)
5. Alignment, offset, and type of fencing
   (sections G.17.3, H: 5.0, 7.0. Standard Drawings H.1.1 to H.1.10)
6. Planting, entry signage, fencing and architectural elements details and specifications

3.9. FRANCHISE UTILITIES OVERALL PLANS

This plan shall indicate the alignments, offsets, and installation details of all franchise utilities including but not limited to power, gas, telephone, and cablevision and the locations of related components and appurtenances.

3.10. DETAILED PLAN / PROFILE DRAWINGS

1. Plan Requirements
   a. Sewers
      - Alignment and offset of sanitary sewer and storm sewer mains
      - Location of services and lead connections
      - Location of manholes, catchbasins, outfalls, and other appurtenances
      - Size and type of pipes
      - Manhole numbers

   b. Water
      - Alignment and offset of water distribution mains
      - Location of service connections and curb stops.
      - Location of hydrants, valves, fittings, and other appurtenances
      - Size and type of pipes
      - Degree of bends

   c. Roads and Walks
      - Alignment , offset, and width of roads, lanes, curb & gutter, medians, sidewalks, and trails
      - Chainages of all BC's and EC's of horizontal curves with the delta angle, radius, tangent and arc lengths for each curb
      - Elevation at all road and walk intersection and grade changes
      - Grade for all roads and drainage channels

2. Profile Requirements

   a. Sewers

      - Size, type, pipe material and class of pipe
      - Manhole numbers, stations, length and percentage grade between manholes
      - Invert elevations at all inlets and outlets, including grade between manholes
      - Invert elevations at all inlets and outlets, including drop manholes
      - Manhole rim elevations and safety platform elevations
      - Catch basin cover elevations for storm sewers
      - Pipe crossing with vertical separation dimensions
      - Source of tie in information, including As-Built date and author

   b. Water

      - Size, type, grade, pipe material, class of pipe and class of bedding
      - Required depth of bury
      - Invert elevations and stationing at all grade changes, valves and fittings
      - Pipe crossing with vertical separation dimensions

   c. Roads

      - Existing ground profile
      - Designed vertical alignments (Centre line or lip of gutter) shall include:
        - % grade
        - chainage & elevation of BVC, PVI and EVC
        - Extend 'e' value
        - 'K' value
        - length of vertical curve
        - station & elevation of low point or high point for all vertical curves
        - on superelvation section curves and crossfall sections show percent crossfall and transition length

3.11. PAVEMENT MARKING AND SIGNAGE PLAN

This plan will indicate:

1. Street name signs
2. Traffic control signage
3. Details of sign types, installation, construction, etc.
4. Pavement markings

   (section G.14.0)

3.12. SECTIONS AND DETAILS PLAN

Sections and details shall be in accordance with detail drawings included in other sections of this manual. If additional items are relevant to the project,

but not included in this manual, sections and details of the items shall be included in this plan, and are subject to the approval of the City.

B.4.0. DESIGN REVISION AFTER APPROVAL

For any reason, if changes to the design drawings must be made after they have been approved; two prints of each of the original drawings affected shall be submitted with the proposed changes shown in red, accompanied by a letter outlining the reasons for the required changes. If the proposed changes meet with the approval of the Village, one copy will be signed and returned, accompanied by a letter authorizing the changes to be made on the original.

B.5.0. AS-BUILT DRAWINGS

The following pertain to the as-built drawings of the following services: storm and sanitary sewers, watermains, roads, curbs, sidewalks, walkways, culverts, ditches, and other miscellaneous structures.

5.1. GENERAL

The as-built drawings shall comply with the requirements and the above-mentioned guildelines and accurately reflect the services as installed with the date of completion, name of contractor and date on which the as-built details were added on each drawing. All as-built drawings are to be submitted within two (2) months after issuance of the Construction Completion Certification. The drawing should be professionally re-stamped, signed and dated to indicate the as-built information.

5.2. LAYOUT

The as-built (record) drawings will be of the same requirements as the original construction drawings with all changes noted. The as-built drawings represent the following layout, at minimum:

1. Text and line work shall represent as-built data
2. All hydrants, valves, manholes and catchbasins are to be dimensioned in two directions
3. The completion date of all services and the name of the contractor are to be noted on each plan/profile
4. A detailed description of all fittings shall be noted
5. Revision data shall be carried throughout all drawings in the set
6. The Legal Plan shall represent the plan registered with Land Title

5.3. FORMAT

All as-built drawings shall be submitted in the following formats:

1. Digital copy: Submit a AutoCad 2004 compatible digital copy in CD format or by electronic mail: and
2. Mylar copy: One 3 mil thick Mylar copy shall be submitted; and

3. Two blue-print copies with one redline (Field markup) copy.

Private single – lot developments and buildings may be submitted on paper and a digital set is not required. In some exceptional cases, electronic formats other than CAD files may be submitted.

TABLE B-1 - ABBREVIATIONS

Term	Abbreviation	Term	Abbreviation
Access Manhole	**A.M.H**	Polyethylene	**PE**
Abandoned	**Aband.**	Polyvinyl Chloride	**PVC**
Adaptor	**Adapt.**	Pressure Reducing Valve	**PRV**
Asbestos Cement Pipe	**A.C.P.**	Property Line	**℄**
Asphaltic Concrete	**A.C.**	Radius	**R**
Begin Horizontal Curve	**BC**	Right-of-Way	**R.O.W**
Begin Vertical Curve	**BVC**	Ring Tite	**R.T.**
Bench Mark	**BM**	Sanitary	**San.**
Bell Tite	**B.T.**	Soil Cement	**S.C.**
Block	**Blk.**	Sprinkler	**Spr.**
Cast Iron	**C.I.**	Station	**Sta.**
Catch Basin	**CB**	Steel	**Stl.**
Catch Basin Lead	**C.B.L.**	Storm	**ST**
Catch Basin Manhole	**CBMH**	Street	**St.**
Center Line	**L**	Survey Monument	**S.M.**
Class	**Cl.**	Tangent	**T**
Concrete	**Conc.**	Tapping Valve & Sleeve	**T.V.S.**
Copper	**Cu**	Test Hole	**T.H.**
Corrugated Steel Pipe	**C.S.P.**	Vertical	**Vert.**
Coupling	**Cplg.**	Vertical Curve	**VC**
Curb Cock	**C.C.**	Vitrified Clay Tile	**V.C.T.**
Curb Face	**C.F.**		
Drop Manhole	**D.M.H.**		
End Horizontal Curve	**EC**		
End Vertical Curve	**EVC**		
Fluid Tite	**F.T.**		
Galvanized	**G.I.**		
Horizontal	**Hor.**		
Hydrant	**Hyd.**		
Invert	**Inv.**		
Iron Pin	**I.P.**		
Length	**L**		
Length of Curve	**LC**		
Main Stop	**M.S.**		
Manhole	**MH**		
Not to Scale	**N.T.S.**		
Point of Intersection	**PI**		
Point of Intersection Vertical Curve	**PVI**		

SECTION C – STORM DRAINAGE SYSTEM

C.1.0 STORMWATER MANAGEMENT PLAN

Stormwater runoff generated from within the development area shall be routed through a storm water management facility as required to regulate the rate of outflow prior to discharge. Prior to submission of any detailed design, the Developer shall prepare a stormwater management plan that is acceptable to the Village.

The storm water management plan shall:

1. Identify the impact of the proposed development on the watershed.
2. Identify and quantify the amount of upstream drainage entering onto the proposed development land.
3. Identify all existing flow channels, drainage patterns or routes and containment areas.
4. Identify the points of discharge from the lands, as well as the type and calculated capacity of the receiving drainage facility(s), natural, man-made or a combination of both.
5. Provide details of required stormwater retention/detention facilities.
6. Provide details of water quality enhancement facilities.
7. Identify all licensing requirements that may be required.

C.2.0. DESIGN FACTORS

2.1. DRAINAGE SYSTEMS

The storm sewers shall be designed as a separate system and shall be of sufficient capacity to carry storm sewer runoff from the ultimate development the area is zoned for. The storm sewer should be designed considering both the minor and major drainage systems.

1. Minor

   The minor system comprises piping, manholes, catch basins and outfall structures. The minor system shall convey runoff from snowmelt and rainfall events to an adequate receiving water (river, stream, lake or pond) without sustaining any surface ponding or excessive surface flows for events up to and including a 1 in 5-year return period. Where required by the Village Engineer, high value commercial areas shall have their minor systems designed to accommodate the 1 in 10-year return period event.

2. Major

   The major system comprises the street system, detention facilities, parkland and any other land required to convey runoff from events up to and including a 1 in 100-year return period to the receiving water. The major system shall be evaluated in a manner sufficient to determine that no flooding that may cause significant property damage (e.g. flooding of buildings) occurs during the 100-year event.

2.6. DESIGN FLOWS

The following criteria shall be used in the design of the minor storm sewer system:

1. For areas less than 65 ha the Rational Method of storm sewer system i.e.
   a. Q = 2.78 CIA

      Where Q = the design peak flow rate in litres per second
      I = the intensity of rainfall in millimetres per hour corresponding to the time of concentration
      A = the contributing area in hectares
      C = the runoff coefficient

   b. The five-year rainfall intensity table shall be used as shown on Table 5-1.
   c. Runoff coefficients shall be according to Table C-2.
   d. The weighted average of pervious and impervious area runoff coefficients shall be estimated from the following equation:

      $$C = \frac{C_p A_p + C_i A_i}{A_p + A_i}$$

      Where the subscripts p and i indicate the pervious and impervious surfaces, respectively. In these standards Cp = 0.10 and Ci = 0.95.
   e. The duration of rainfall used to determine the intensity is equal to the time of concentration. The time of concentration is comprised of the overland time to the storm sewer inlet and the time of travel in the conduit. The overland flow time to curbside in residential and commercial areas shall not exceed 10 minutes in duration (specific overland flow times shall be computed separately for industrial and undeveloped areas). Gutter flow time shall not exceed 5 minutes and shall be estimated based on methods outlined in "Modern Sewer Design" (AISI, 1980). The time of travel in the conduit shall be based on the pipe flow velocity.
2. For areas greater than 65 ha:
   a. Computer models shall be used to determine design flows and the sizing of systems that contain non-pipe stormwater management facilities (e.g. detention ponds) or systems that include a significant amount of undeveloped land.
   b. The selection of an appropriate computer model shall be based on an understanding of the principles, assumptions, and limitations in relation to the system being designed. Acceptable computer models are ILLUDAS, USEPA, SWMM, OTTSWM, HVM, HYMO and OTTHYMO.
   c. Wherever possible, the computer model shall be calibrated. In all analyses, the parameters used, the drainage boundaries, the pipe network and its connectivity shall be clearly identified on an overall drawing, computer printouts and a design summary report.

d. The duration of event that is critical for systems comprised of pipes only shall be one hour. The duration of the design rainfall event for the systems with storage shall be at least 12 hours. Longer durations shall be used, if necessary, to properly assess the post-event drainage of the detention facility.

2.3. VELOCITY REQUIREMENTS

The minimum velocity shall be 1.0 m/s. Where velocities in excess of 3 m/s are attained, special provisions shall be made to protect against displacement by erosion or impact.

2.4. PIPE SIZE

1. Pipe sizing shall be determined by utilizing the Manning's Formula, using "n" value of 0.013.
2. Storm sewer pipe shall be designed to convey the design flow when flowing full with the hydraulic gradeline at the pipe crown. All pipe crown elevations shall match at manhole junctions.

2.5. SURFACE RUNOFF

1. Surface water shall not be permitted to run a distance greater than 150 m along local roadways without provision for interception by the first catch basin. Within the piped drainage system, or on Collectors or Arterial roadways, surface runoff shall not run a distance greater than 120 m without interception.
2. Surface water shall be intercepted with a sufficient number of catch basins such that the inlet capacity is sufficient to receive the design storm water flow.
3. Minimum gutter grade shall be at least 0.60%.

2.6. ROOF DRAINAGE

1. Roof drainage from one-family and two-family dwellings shall discharge to grassed or pervious areas. The point of discharge shall be a sufficient distance (i.e. at least 1.5 m) to ensure the water flows away from the building.
2. Roof drainage from apartment buildings, commercial areas, and industrial areas may discharge to the storm sewer if approved by the Village Engineer.

2.7. PONDING

Ponding of runoff on roofs, parking lots or landscaped areas to reduce runoff rates must be approved by the Village Engineer.

2.8. DISCHARGE

1. Effluent from sanitary sewers and any drainage from industrial, agricultural or commercial operations that may potentially be contaminated shall not be discharged to the storm sewers.

2. Control 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, sediment control structures at pond and lake inlets, or other means where appropriate.

2.9. SUMP PUMPS & SOAKAWAYS

1. All developments shall provide sump pumps to discharge weeping tile water to the surface.
2. Soakaways permitted only upon approval by the Village.
3. Under no circumstances shall weeping tile, a sump pump, or a soakaway be discharged to the sanitary system.

C.3.0 STORM SEWER MAINS – CHARACTERISTICS

3.1. SEWER MAINS

1. The minimum size of storm sewer mains shall be 300 mm diameter.
2. Pipe for storm sewer main may be:
   a. Reinforced sulphate resistant concrete pipe to ASTM C76
   b. PVC pipe conforming to ASTM F794 minimum Class DR35
   c. Ultra Rib PVC pipe to ASTM D3034 minimum Class DR35
3. Pipe joints shall be rubber ring conforming to CSA A257.3 and/or ASTM C443 for concrete and ASTM 03212 for PVC Pipe.
4. Pipe classes shall be determined to withstand subsequent superimposed loadings.
5. Various factors affecting the pipe class shall be taken into account, and pipe class shall be evaluated as per standard engineering practice.

3.2. MANHOLES

1. Manhole section shall be pre-cast reinforced concrete sections conforming to ASTM C478, latest revision thereof.
2. All manholes shall be 1200 mm inside diameter for all pipe 900 mm diameter and less. For pipe exceeding 900 mm diameter, manhole diameter shall be pipe diameter plus 600 mm.
3. Manhole frames and covers shall be cast iron conforming to Class 20 ASTM A48, latest revision thereof. Manhole frame and covers to be type NF-39 in landscaped areas and type NF-80 in paved areas. In paved areas, manhole covers to be set approximately 5 mm below finished asphalt grade.
4. Manhole steps shall be standard safety type, of epoxy coated extruded aluminium.
5. Manhole bases shall be pre-benched base with pre-cored connection holes, pre-cast slabs, concrete poured bases, vaults or pre-cast tees.
6. Aluminium safety platforms shall be required in all manholes with a depth of 6.0m (vertical distance from rim to invert) or greater.

7. Refer to Section C - Standard Drawings

3.3. CATCH BASINS

1. Catch basin barrels with precast base and precast slab top shall be:
   a. 900 I.D. pipe barrel conforming to ASTM C478, latest revision thereof; 600 I.D. can be used subject to approval by the Village Engineer.
   b. Catch basin manholes – see standard drawing for details.
   c. Catch basin sump to be 500 mm deep.
2. Catch basin frames and covers shall be:
   a. Standard inlet for rolled curb and gutter equal to Norwood K-7 or DK-7.
   b. Standard frame, grate, and side inlet for use with 900 mm barrel equal to Norwood F51 for straight faced curb and gutter.
   c. Top inlet standard round top equal to Norwood F38 for swales or lanes.
   d. Top inlet standard round top equal to Norwood F39 Grate for landscaped area.
3. Catch basin leads:
   a. shall be non-reinforced concrete pipe ASTM C14 - Class 3 or approved PVC pipe.
   b. The minimum size of catch basin lead shall be 300 mm diameter with a minimum grade of 1.0%.
   c. The maximum length of a catchbasin lead without using a catchbasin manhole shall be 30 m.

C.4.0. INSTALLATION AND LOCATION

4.1. STORM SEWER

1. Mains shall be installed to provide a minimum depth to pipe obvert of 1.85 m below final finished grade.
2. Mains shall be located within the road right-of-way in accordance with the Roadway Cross Sections (Refer to Section G – Standard Drawings)
3. Pipe bedding shall be provided for all mains in accordance with Standard Drawings.

4.2. MANHOLES

1. Manholes shall be located at the end of each line, at all changes in pipe size, grade and alignment.
2. The maximum distance between manholes shall not exceed 120 m. Manhole spacing on storm sewers greater than 750 mm in diameter may exceed 120 m, if approved by the Village Engineer.
3. Manholes shall be installed as shown on per standard Drawing C2.21.
4. All joints shall be watertight.

5. Compact backfill around manholes with mechanical tampers to at least 98% of the SPD.
6. Benching in manholes shall be provided to minimize hydraulic losses. The downstream invert in a manhole shall be a minimum of 30 mm lower than the lowest upstream invert. At a change in direction, the drop shall be at least 60 mm. If an influent pipe diameter is greater than 525 mm and the bend is greater than 45° or if the outflow pipe velocity exceeds 1.5 m/s, then minor losses shall be considered (see AISI, 1980).
7. Tee riser manholes may be utilized on lines 900 mm diameter and larger. Tee riser manholes must be bedded in concrete to the spring line of the pipe.

4.3. CATCH BASINS

1. Catch basins shall be not connected in series; if it is necessary to install multiple catch basins in series, a catch basin manhole shall be used.
3. If a lead of over 30 m in length is required, a catchbasin manhole shall be installed at the upper end.
4. Catchbasin leads shall have minimum cover of 1.5m to invert.
5. All joints shall be watertight.

C.5.0 CURVED SEWERS

Curved sewers will be permitted with the following restrictions:

1. The sewer shall be laid as a simple curve with a radius equal to or greater than 90 m or the manufacturers minimum recommended radius, whichever is larger.
2. Manholes shall be located at the beginning and end of the curve.
3. Manholes shall be located at intervals not greater than 90 m along the curve.
4. The main shall run parallel to the curb or street centreline.
5. The minimum grade for sewers on curve shall be 50% greater than the minimum grade required for straight runs of sewers.

C.6.0. TRENCHING AND BACKFILLING

1. Trenching and backfilling to be carried out in accordance with Occupational Health and Safety Guidelines.
2. Minimum width - single pipe

Pipe Diameter	Minimum Trench Width
Less than 750 mm diameter	O.D. + 450 mm
750 mm diameter or larger	O.D. + 600 mm

3. Backfilling shall be carried out with selected native material in 300 mm layers to a minimum of 98% SPD.
4. In existing hard surfaced areas backfilling shall be carried out with granular material in 150 mm layers to a minimum of 98% SPD.

C.7.0. INSPECTION AND TESTING

7.1. REQUIREMENTS

The Developer shall employ a CSA approved material testing firm to complete the tests as outlined in C.7.2. One copy of the results shall be submitted to the Village for their review. (See also Table A.1.0)

7.2. TESTING

Prior to initial and final acceptance of the project, all sewer mains shall be tested as follows:

1. Leakage Test
    a. The Village may require each section of storm sewer main and service connections to be tested for water tightness by an exfiltration test and/or infiltration test.
    b. Infiltration or exfiltration shall not exceed 5.0 litres per day, per mm of pipe diameter, per 1 km of sewer line for PVC pipe or 20.0 litres per day, per mm of pipe diameter, per 1 km of sewer line for concrete pipe. If service connections exist along the testing section, include the addition leakage allowance calculated by use of the same formula above.
    c. Repair and retest sewer line as required until test results are within limits specified.
    d. Repair visible leaks regardless of test results.
2. Closed Circuit Television Inspection
    a. All sections of storm sewers shall be inspected with closed circuit television camera equipment.
    b. A written report and a videotape in VHS format shall be submitted to the Village for their approval and records.
    c. All work to be completed, to full WRC[(1)] standards, by a certified NAAPI[(2)] operator.

[(1)] Water Research Centre
[(2)] North American Association of Pipeline Inspectors

C.8.0 DETENTION FACILITIES

8.1. DESIGN

1. Detention facilities shall be designed as part of both the minor and major drainage systems. They must control the peak runoff conditions for events up to the 100-year return period.
2. Detention facilities and the entire area that would be submerged by the 100-year event shall be contained on Village property. The need for a specific detention facility shall require the approval of the Village Engineer. In assessing the need for specific detention facilities, the

applicant must consider the impacts of uncontrolled drainage as well as the capital and operating costs of providing control.

3. Where a detention facility is to have multiple functions, its design shall consider the implications of shape, grading and landscape features on aesthetics and usability for other functions.
4. An emergency overflow system shall drain to a receiving stream, if possible, for storms greater than the 100-year event.
5. The effects of the maximum pond water levels shall be considered in the design of the minor system and lot grading. The hydraulic grade line elevations for the minor system piping shall be calculated starting from the maximum pond level during the 5-year storm event.
6. The maximum water level fluctuation for detention ponds in residential areas during the 100-year storm event shall be 1.5 m. The pond's outlet capacity shall be that the pond shall drain and reach normal water level within 72 hours of reaching maximum water level during the 100-year event.
7. The lowest basement footing and weeping tile of any building on a lot adjacent to a detention facility shall be a minimum of 300mm above the 1:100 year high water level and minimum distance of 6m shall be maintained from any basement wall to the 1 in 100 year high water level.

8.2. SOIL CONDITIONS

1. Soils investigation specific to the detention facility shall be undertaken to determine appropriate design factors. Where the facility is sited above a shallow aquifer the potential for groundwater contamination must be minimized.
2. Wet pond detention facilities shall be constructed in impervious soils to minimize water losses during dry weather periods. Intruding silt or sand seams shall be sealed off.

8.3. OVERFLOW CHANNEL AND OVERLAND DRAINAGE ROUTE

An overflow channel and overland drainage route must be provided to the satisfaction of the Village Engineer.

8.4. WET POND REQUIREMENTS

1. The lowest manhole invert shall be at or above the normal water level elevation.
2. The pipe obvert at the lowest manhole immediately upstream of the pond shall be above the high water level during a one in five year storm event.
3. The minimum surface area at normal water level shall be 2ha.
4. The minimum depth of the pond, at normal water level, shall be 2m.
5. The pond bottom and side slopes shall be composed of an impervious material.
6. No dead bay areas shall be permitted.

7. Shoreline improvements and erosion protection shall be subject to review and approval by the Village Engineer.
8. Any property situated below the 1:100 year high water level shall become the property of the Village.
9. The design shall incorporate a semi-annual turnover at average annual precipitation.
10. Pond geometrics shall be approved by the Engineer, based on Standard Drawing.
11. Submerged inlets/outlets are preferred and shall be constructed such that the tops are a minimum of 0.6 m below normal water level.
12. Inlets/outlets not submerged shall require fencing along adjacent shoreline for 5.0m in each direction from the centre line of pipe. All inlets/outlets shall be provided with a grate or thrash bars permanently fixed to the structure.
13. Every pond shall be sterilized during construction to prevent weed growth.
14. Minimum width of the water surface at the normal water level shall be 25m.
15. A silt trap shall be provided at the inlet of each pond.

8.5. DRY POND REQUIREMENTS

1. Depth of water shall not exceed 1.5m during the 1 in 100 year event.
2. A bypass for flows from minor events is required.
3. Minimum longitudinal slope at bottom of pond shall be 1%.
4. Minimum lateral slope at bottom of pond shall be 1%.
5. A French drain is required where longitudinal slopes are less than 2%.
6. Side slopes shall be flatter than 7 (horizontal) to 1 (vertical).
7. Pond geometrics shall be approved by the Engineer, based on Standard Drawing.
8. Bottom and sides sodded or grassed as per Section 8.
9. All inlets/outlets shall be provided with a grate or thrash bars permanently fixed to the structure to preclude access.
10. All safety issues, particularly during operation, shall be addressed.

8.6. STORAGE

1. Underground Storage Tanks

   Underground storage tanks shall be considered only if no other economical alternative means of storage is feasible.

2. Parking Lot and Roof Top Storage

   Parking lot and rooftop storage shall be considered only for developments where the facilities are part of the project and must be approved by the

Village Engineer. Proposals that rely on third party implementation will not be accepted.

8.7. INFILTRATION AND EVAPORTATION FACILITIES

Infiltration and evaporation facilities require studies that involve site-specific measurements of infiltration, knowledge of the groundwater regime, and an evaluation of the water balance for the system.

C.9.0 OUTFALLS

9.1. STRUCTURES

1. Outfall structure shall be placed at the end of all storm sewers discharging to an open channel, watercourse, river or other receiving water body such as a lake. The purpose of the structure is to reduce velocities and prevent erosion. All outfall structures must receive approval of Alberta Environment, Water Resources and Forestry. It is the responsibility of the Developer to obtain the necessary approvals and permits from the aforementioned Authorities.
2. The outfall structure may be a chute, spillway, stilling basin or plunge pool with headwall. A cut off wall is required at the end of the outfall apron to prevent undermining of the structure.

9.2. DESIGN

1. Obverts of outfall pipes shall be at least 150 mm above the 5-year flood level in the receiving stream. Inverts of outfall pipes shall be above winter ice level. Otherwise, outfall pipes shall be submerged below the bottom of ice level. In addition, outfalls shall be located to avoid damage from moving ice during breakup.
2. If the downstream channel is relatively flat, the apron shall be 150 mm to 225 mm above the channel invert to prevent collection of debris on the apron.
3. Outfalls shall be landscaped to blend in with surrounding areas.

9.3. ACCESSORIES

1. Approved rip-rap and a filter layer shall be placed downstream of the outfall structure where required to prevent erosion.
2. Weeping tile shall be placed under the structure to reduce any water pressure behind the headwall.
3. All storm sewer outlets shall be provided with a grate or thrash bars permanently fixed to the structure to preclude access..
4. Railings shall be placed along the headwall and wingwalls of the outfall structure.

C.10.0. RECEIVING WATERS

10.1. GENERAL REQUIREMENTS:

1. Measures shall be incorporated in new developments to prevent any increase in the amount of downstream erosion.
2. If a development will cause downstream erosion despite the use of on-site peak run-off rate controls, appropriate measures shall be constructed in the downstream areas.
3. Preservation of watercourse aesthetics and wildlife habitat shall be considered in erosion and bank stability work.

C.11.0. CULVERTS AND BRIDGES

Culvert and bridge designs should consider backwater effects over a range of flows. The design of a hydraulic structure requires assessment of both its nominal design "capacity" and its performance during the 100-year event.

C.12.0. SURFACE DRAINAGE SWALES

12.1. GENERAL REQUIREMENTS:

1. Drainage swales, whether on municipal or private property (through drainage easements), shall be constructed completely prior to any development of subdivision lots. Drainage swales running between adjacent private lots shall be constructed of concrete to ensure lots are graded to the correct elevation. On approval by the Village, grass swales with a minimum slope of 2% may be acceptable.
2. Design and construction shall be of an acceptable quality to Village requirements. A detailed design shall be submitted to the Village including a brief explaining:
   a. materials to be used
   b. design calculations
   c. explanation of design features which eliminate or minimize the possibility of damage to the drainage swale by activities within the subdivision.

C.13.0. MAJOR DRAINAGE SYSTEM ANALYSIS

The major drainage system shall be assessed with respect to the 1 in 100 year return period event. The depth of peak flows and ponding in developed area streets, conveyance channels and swales, are to be limited so that major system flow will not constitute significant hazard to the public, or result in significant erosion or other property damage.

13.1. LAYOUT

The grading of streets and the layout of the major drainage system shall be assessed, relative to the following guidelines, during the 100-year event:

1. No building shall be inundated at its ground line.
2. Continuity of the overland flow routes between adjacent developments shall be maintained.
3. Arterials should have at least two lanes which are not inundated parallel with the direction of flow. Where the major system crosses an arterial, the depth of flow should be less than 0.05 m.
4. Collectors should have at least one lane which is not inundated parallel with the direction of flow. Where the major system crosses a collector; this depth of flow should be less than 0.10 m.
5. Local roads should have a depth of water no more than 0.05 m above the crown. Where the major system crosses a local road, the depth of flow should be less than 0.15 m.
6. The depth of flow and ponding are less than 0.35mm in roadways and other public rights-of-way.

13.2. LOT GRADING

A Lot Grading Certificate for residential lots shall be provided to the Village upon completion of landscaping. The grading of lots shall meet the following requirements:

1. The minimum slope in the back and front yards shall be 2%.
2. If the back yard area slopes toward the house, provision must be made to keep the runoff at least 3 m from the house and direct it to the street.
3. Reverse driveways shall not be permitted unless the runoff can be directed away from the structure and off the property in a controlled fashion.
4. Lot grading must not direct drainage onto adjacent lots.

TABLE C-1 - IDF CURVES – INTENSITY TABLE

IDF Curves – Intensity Table

Edmonton Municipal Airport – IDG Period: 1914 – 1995
Max Years of Record 63

IDF Intensity Table (mm/hr)

Time		Return Frequency					
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1		120	182	223	275	313	350
2		97.1	147	179	221	251	281
3		82.8	125	152	187	213	238
4		72.9	109	134	164	187	209
5		65.5	98.2	120	147	167	187
6		59.8	89.5	109	134	152	170
7		55.2	82.5	101	123	140	157
8		51.4	76.7	93.5	115	130	146
9		48.2	71.9	87.6	107	122	137
10		45.5	67.7	82.5	101	115	129
11		43.1	64.2	78.1	95.7	109	122
12		41.0	61.0	74.3	91.0	103	116
13		39.2	58.3	70.9	86.8	98.7	110
14		37.5	55.8	67.9	83.1	94.4	106
15	0.25	36.0	53.5	65.1	79.8	90.6	101
16		34.7	51.5	62.7	76.7	87.2	97.5
17		33.5	49.7	60.4	74.0	84.0	94.0
18		32.4	48.0	58.4	71.5	81.2	90.8
19		31.3	46.5	56.5	69.1	78.5	87.9
20		30.4	45.1	54.8	67.0	76.1	85.1
21		29.5	43.7	53.2	65.0	73.9	82.6
22		28.7	42.5	51.7	63.2	71.8	80.3
23		27.9	41.4	50.3	61.5	69.8	78.1
24		27.2	40.3	49.0	59.9	68.0	76.1
25		26.6	39.3	47.8	58.4	66.3	74.2
26		25.9	38.4	46.6	57.0	64.7	72.4
27		25.3	37.5	45.5	55.7	63.2	70.7
28		24.8	36.7	44.5	54.4	61.8	69.1
29		24.3	35.9	43.6	53.2	60.4	67.6
30	0.5	23.8	35.1	42.6	52.1	59.2	66.2
31		23.3	34.4	41.8	51.1	58.0	64.8
32		22.8	33.7	41.0	50.1	56.8	63.5
33		22.4	33.1	40.2	49.1	55.7	62.3
34		22.0	32.5	39.4	48.2	54.7	61.1

IDF Curves – Intensity Table (cont'd)

Edmonton Municipal Airport – IDG Period: 1914 – 1995
Max Years of Record 63

IDF Intensity Table (mm/hr)

Time		Return Frequency					
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
35		21.6	31.9	38.7	47.3	53.7	60.0
36		21.2	31.3	38.0	46.5	52.7	59.0
37		20.9	30.8	37.4	45.7	51.8	58.0
38		20.5	30.3	36.8	44.9	51.0	57.0
39		20.2	29.8	36.2	44.2	50.1	56.0
40		19.9	29.3	35.6	43.5	49.3	55.2
41		19.6	28.9	35.0	42.8	48.6	54.3
42		19.3	28.4	34.5	42.1	47.8	53.5
43		19.0	28.0	34.0	41.5	47.1	52.7
44		18.7	27.6	33.5	40.9	46.4	51.9
45		18.5	27.2	33.0	40.3	45.8	51.2
46		18.2	26.9	32.6	39.8	45.1	50.4
47		18.0	26.5	32.1	39.2	44.5	49.8
48		17.7	26.1	31.7	38.7	43.9	49.1
49		17.5	25.8	31.3	38.2	43.3	48.4
50		17.3	25.5	30.9	37.7	42.8	47.8
51		17.1	25.2	30.5	37.2	42.2	47.2
52		16.9	24.9	30.1	36.8	41.7	46.6
53		16.7	24.6	29.8	36.3	41.2	46.1
54		16.5	24.3	29.4	35.9	40.7	45.5
55		16.3	24.0	29.1	35.5	40.2	45.0
56		16.1	23.7	28.7	35.1	39.8	44.5
57		15.9	23.4	28.4	34.7	39.3	44.0
58		15.8	23.2	28.1	34.3	38.9	43.5
59		15.6	22.9	27.8	33.9	28.5	43.0
60	1.00	15.4	22.7	27.5	33.6	38.1	42.5
61		15.3	22.5	27.2	33.2	37.7	42.1
62		15.1	22.2	26.9	32.9	37.3	41.6
63		15.0	22.0	26.6	32.5	36.9	41.2
64		14.8	21.8	26.4	32.2	36.5	40.8
65		14.7	21.6	26.1	31.9	36.1	40.4
66		14.5	21.3	25.9	31.6	35.8	40.0
67		14.4	21.1	25.6	31.3	35.4	39.6
68		14.3	20.9	25.4	31.0	35.1	39.2
69		14.1	20.8	25.1	30.7	34.8	38.9
70		14.0	20.6	24.9	30.4	34.5	38.5
71		13.9	20.4	24.7	30.1	34.1	38.2

IDF Curves – Intensity Table (cont'd)

Edmonton Municipal Airport – IDG Period: 1914 – 1995
Max Years of Record 63

IDF Intensity Table (mm/hr)

Time		Return Frequency					
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
72		13.8	20.2	24.5	29.8	33.8	37.8
73		13.6	20.0	24.2	29.6	33.5	37.5
74		13.5	19.8	24.0	29.3	33.2	37.1
75	1.25	13.4	19.7	23.3	29.1	33.0	36.8
76		13.3	19.5	23.6	28.8	32.7	36.5
77		13.2	19.3	23.4	28.6	32.4	36.2
78		13.1	19.2	23.2	28.3	32.1	35.9
79		13.0	19.0	23.0	28.1	31.9	35.6
80		12.9	18.9	22.9	27.9	31.6	35.3
81		12.8	18.7	22.7	27.7	31.4	35.0
82		12.7	18.6	22.5	27.4	31.1	34.8
83		12.6	18.4	22.3	27.2	30.9	34.5
84		12.5	18.3	22.1	27.0	30.6	34.2
85		12.4	18.2	22.0	26.8	30.4	34.0
86		12.3	18.0	21.8	26.6	30.2	33.7
87		12.2	17.9	21.7	26.4	29.9	33.4
88		12.1	17.8	21.5	26.2	29.7	33.2
89		12.0	17.6	21.3	26.0	29.5	33.0
90	1.5	11.9	17.5	21.2	25.8	29.3	32.7
120	2	9.94	14.5	17.6	21.4	24.3	27.1
180	3	7.67	11.2	13.5	16.5	18.6	20.8
240	4	6.37	9.28	11.2	13.6	15.4	17.2
300	5	5.52	8.03	9.69	11.8	13.3	14.9
360	6	4.91	7.13	8.60	10.5	11.8	13.2
420	7	4.45	6.45	7.77	9.45	10.7	11.9
480	8	4.08	5.91	7.12	8.66	9.79	10.9
540	9	3.78	5.48	6.60	8.02	9.06	10.1
600	10	35.53	5.11	6.16	7.48	8.45	9.42
660	11	3.32	4.80	5.78	7.03	7.94	8.85
720	12	3.14	4.54	5.46	6.64	7.50	8.36
780	13	2.98	4.31	5.18	6.30	7.11	7.93
840	14	2.84	4.10	4.94	6.00	6.77	7.55
900	15	2.72	3.92	4.72	5.73	6.47	7.21
960	16	2.61	3.76	4.52	5.49	6.20	6.91
1020	17	2.51	3.62	4.35	5.28	5.96	6.64

IDF Curves – Intensity Table (cont'd)

Edmonton Municipal Airport – IDG Period: 1914 – 1995
Max Years of Record 63

IDF Intensity Table (mm/hr)

Time		Return Frequency					
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1080	18	2.42	3.48	4.19	5.08	5.74	6.39
1140	19	2.34	3.36	4.04	4.91	5.54	6.17
1200	20	2.26	3.25	3.91	4.74	5.35	5.96
1260	21	2.19	3.15	3.79	4.59	5.18	5.77
1320	22	2.12	3.06	3.67	4.45	5.03	5.60
1380	23	2.09	2.97	3.57	4.33	4.88	5.44
1440	24	2.01	2.89	3.47	4.21	4.75	5.29

TABLE C-2 – STORM RUNOFF COEFFICIENTS AND IMPERVIOUSNESS ACCORDING TO LAND USE

Land Use	**Runoff Coefficient**	**Imperviousness**
	C'	**(%)**
Asphalt, concrete, roof areas	0.95	90-100
Industrial, commercial	0.60	50-100
Single Family residential	0.50	40-60
Predominant grassed area, parkland	0.10	10-30

- Minimum values to be used without specific area analysis.
- To be used only for calculation of peak flow rates by rational method

STANDARD DRAWINGS

C.1.0 TRENCHING

C.1.1 Trenching Details – Under Roadway and Paved Area
C.1.2 Trenching Details – Under Grassed and Sodded Area
C.1.3 Trench Bedding Types
C.1.4 Class 'B' Bedding – For Pipes in Common Trench
C.1.5 Typical Pipe Insulation

C.2.0 CATCH BASIN AND MANHOLE DETAILS

C.2.1 Standard 900 dia. Catch Basin with Type F-51 Grating and Frame with Side Inlet
C.2.2 900 dia. Catch Basin with Standard DK-7, NF-38, or NF-39 Frame and Grating
C.2.3 Pressure Pipe Passing Sewer Manhole
C.2.4 Standard 1200 dia. Manhole – Benching Detail
C.2.5 Interior Manhole Drop Structure
C.2.6 Typical Perched Manhole for Pipes – 600 to 900 dia.
C.2.7 Standard 1200 dia. Precast Manhole for Pipes up to 600 dia.
C.2.8 T-Riser Manhole
C.2.9 Vault Manhole for Pipes 1200 to 1800 dia.
C.2.10 Manhole Marker in Parks/Row Locations
C.2.11 Typical Precast Manhole Sections & Top
C.2.12 Typical Precast Concrete Safety Platform
C.2.13 Manhole Backfill Details
C.2.14 Soak Away Pit Detail
C.2.15 Typical Force Main Connection

C.3.0 MISCELLANEOUS DRAWINGS

C.3.1 Ladder Rungs Details
C.3.2 Typical Skid Block Set-up
C.3.3 Outfall Bar Screen Detail
C.3.4 Recommended Cross Section – Stormwater Retention Lakes

SECTION D – SANITARY SEWER SYSTEM

D.1.0 DESIGN CRITERIA

1.1. DESIGN FLOW

The sanitary sewerage system shall be of sufficient capacity to carry peak flows plus infiltration and inflow. The following factors shall be used in design of sanitary sewage systems:

1. Residential

   Population Density - 40 persons/hectare
   Average Sewage Flow - 360 L/persons/day
   Peaking Factor - 2.6P-0.1 (minimum 1.5)
   Where P equals the tributary population in 1,000's

2. Commercial, Industrial and Institutional

   Average Sewage Flow - 0.2L/s/ha
   Peaking Factor - $10Q^{-0.45}$ (minimum 2.5; maximum 25)

3. Infiltration / Inflow

   Infiltration Allowance - 0.28L/s/ha
   Subject to the Village' Engineer approval, infiltration allowance shall be reduced.
   Inflow Allowance - 0.4L/s/manhole
   Any manholes in "sag" locations are subject to an addition inflow allowance.

1.2. PIPE SIZE

1. Pipe sizing shall be determined by utilizing the Manning's Formula using "n" value of 0.013.
2. All sanitary sewers shall be designed to carry the design flow at a flow depth no more than 80% of the sewer diameter.
3. Required full flow sewer capacity = $\frac{\text{estimated total design peak flow rate}}{0.86}$
4. Minimum pipe diameter
   a. Residential - 200mm
   b. Commercial / Industrial - 250mm
   c. Service Connections - 100mm
5. Sanitary sewers may have to be oversized to conform to the Village's Master Sanitary Sewer Plan.

1.3. VELOCITY REQUIREMENTS

1. Minimum Velocity - 0.6 m/s
2. Maximum Velocity - 3.0m/s

1.4. SLOPE REQUIREMENTS

1. The recommended slope for all sanitary sewers is 0.4% or greater.
2. Minimum pipe slopes are as follows:

Pipe Size (Diameter in mm)	Min. Slope (%)
200	0.40
250	0.28
300	0.22
375	0.15
450	0.12
525	0.10
600	0.10

3. The minimum slope of the first upstream leg shall not be less than 1.0%.
4. The minimum allowable slope of any sanitary sewer shall not be less than 0.10%.

D.2.0 SANITARY SEWER MAINS - CHARACTERISTICS

2.1. PIPE

All sanitary sewer pipe and fittings shall be PVC to ASTM. D3034 - minimum Class DR35.

2.2. MANHOLES

1. Manhole section shall be precast reinforced concrete sections conforming to ASTM. C478 and CSA 257.4.
2. All manholes shall be 1200 mm inside diameter for all pipe 900 mm diameter and less. For pipe exceeding 900 mm diameter, manhole diameter shall be pipe diameter plus 600 mm.
3. Manhole frames and covers shall be cast iron conforming to Class 20 ASTM. A48, latest revision thereof. Manhole frame and covers to be type NF-39 in landscaped areas and type NF-80 in paved areas. In paved areas, manhole covers to be set approximately 5mm below finished asphalt grade. In sag conditions, manhole frame and covers to be type NF-90.
4. Manhole steps shall be standard safety type, of epoxy coated extruded aluminum.

5. Aluminium safety platforms shall be required in all manholes with a depth of 6.0m (vertical distance from rim to invert) or greater.
6. Manhole bases shall be pre-benched base with pre-cored connection holes, precast slabs, concrete poured bases, vaults or precast tees.
7. Refer to Section D - Standard Drawings.

2.3. CONCRETE FOR MANHOLES AND APPURTENANCES

1. Cement - 30 MPa Sulphate Resistant cement (Type 50)
2. Maximum Slump - 75 mm

C.3.0. INSTALLATION AND LOCATION

3.1. PIPE

1. Pipe shall be installed to provide minimum depth of 2.8m from proposed ground surface elevation to obvert of pipe or shall be insulated to the satisfaction of the Village Engineer.
2. Pipe shall be installed of sufficient depth to satisfy the following requirements:
3. To provide adequate sewer service connection depth at the property line
4. To give complete frost protection
5. To provide minimum separation between other underground utilities
6. Mains shall be located within the road right-of-way in accordance with the Roadway Cross Section Standard Drawings
7. Pipe bedding shall be provided for all mains in accordance with Standard Drawings.

3.2. MANHOLES

1. Manholes shall be located at the end of each line, at all changes in pipe size, grade and alignment
2. The maximum spacing between manholes shall be:
   a. 120 m for pipe size up to 600mm diameter
   b. 150 m for pipe size from 675 to 1200mm diameter
3. Inverts in manholes at changes in direction shall have at least 60 mm fall across manhole.
4. Manholes shall be installed as shown on Standard Drawings
5. All joints shall be watertight

D.4.0 CURVED SEWERS

Curved sewers will be permitted with the following restrictions:

1. The sewer shall be laid as a simple curve with a radius equal to or greater than 90 m or the manufacturers minimum recommended radius, whichever is larger.
2. Manholes shall be located at the beginning and end of the curve.
3. Manholes shall be located at intervals not greater than 90 m along the curve.
4. The main shall run parallel to the curb or street centreline.
5. The minimum grade for sewers on curve shall be 50% greater than the minimum grade required for straight runs of sewers.

D.5.0 TRENCHING AND BACKFILLING

1. Trenching and backfilling to be carried out in accordance with Occupational Health and Safety Guidelines or a professional geotechnical engineer's recommendations.
2. Minimum width - single pipe

Pipe Diameter	Minimum Trench Width
Less than 750 mm diameter	O.D. + 450 mm
750 mm diameter or larger	O.D. + 600 mm

2. Backfilling shall be carried out with selected native material in 300 mm layers to a minimum of 98% Standard Proctor Density.
3. In existing hard surfaced areas backfilling shall be carried out with granular material in 150 mm layers to a minimum of 98% Standard Proctor Density.

D.6.0. INSPECTION AND TESTING

6.1. REQUIREMENTS

The Developer shall employ a CSA approved material testing firm to complete the tests as outlined in D.6.2. One copy of the results shall be submitted to the Village for their review. (See also Table A.1.0)

6.2. TESTING

Prior to initial and final acceptance of the project, all sewer mains shall be tested as follows:

1. Leakage Test
   a. The Village may require each section of sewer main and service connections to be tested for water tightness by an exfiltration test and/or infiltration test.

b. Infiltration or exfiltration shall not exceed 5.0 litres per day, per mm of pipe diameter, per 1 km of sewer line for PVC pipe, or 20.0 litres per day, per mm of pipe diameter, per 1 km of sewer line for concrete pipe. If service connections exist along the testing section, include the addition leakage allowance calculated by use of the same formula above.

c. Repair and retest sewer line as required until test results are within limits specified.

d. Repair visible leaks regardless of test results.

2. Closed Circuit Television Inspection

a. All sections of sanitary sewers shall be inspected with closed circuit television camera equipment.

b. A written report and a videotape in VHS format shall be submitted to the Village for their approval and records.

c. All work to be completed, to full WRC[(1)] standards, by a certified NAAPI[(2)] operator.

[(1)] Water Research Centre
[(2)] North American Association of Pipeline Inspectors

D.7.0 LIFT STATIONS

7.1. STATIONS

1. Pumping

Pumping stations shall be of a permanent nature, whether long-term or short-term in nature. Stations are to be constructed of reinforced concrete, in conformance with standard engineering practice.

2. Sewage Lift Stations

Sewage Lift Stations must be readily accessible by road, with sufficient area immediately adjacent for vehicle parking to facilitate any required work or maintenance. Area is to be enclosed, as required by the Village.

7.2. WELLS

1. Below Grade

Pump wells entirely below grade require adequate drainage to prevent ponding on or near the entrance. All roof-opening covers must have sufficient overhang to prevent water from entering. Screens should be provided for the replacement of the regular roof covers while work crews are inside. “Air tight/Water tight” sealed units are not acceptable as doors between wet and dry wells. Separate entrances must be provided.

2. Roof Entry

   Roof entry pump wells require extension ladders placed sufficiently away from walls to be pulled up through the opening and extended to a height of at least one metre above the roof.

3. Wet

   Wet wells shall have a holding capacity equivalent to the volume of the downstream force main. Holding time shall be minimized. The wet well floor shall be sloped to prevent build-up of solids and grit.

4. Dry

   The dry well must be equipped with a sump pump which will discharge into the wet well, 300mm above the top of the overflow. The sump pump must have its own discharge pipe with check valve to the wet well, and enter the wet well at a point above the overflow.

7.3. GATES

Watertight gates (isolation valves) are necessary on the inlet to the wet well, for cleaning and maintenance. An overflow should be built in conjunction with this gate to prevent excessive head.

7.4. ACCESS

Suitable and safe means of access must be provided to all dry wells and all wet wells containing bar screens or mechanical equipment requiring regular maintenance. All ladders, platforms, etc. must comply with WCB safety regulations and situated such that pumping equipment and piping accessories can be removed. A man lift is to be provided.

7.5. CONTROLS

Two or more pumps must be provided in each pump well and provision shall be made to automatically alternate between pumps. The control panel must be so located that it cannot be flooded under any circumstance. All pumps must be capable of handling 75mm solids and shall be of a “non-clog” type. Pumps are to be placed to work under a positive suction head. For safety, motors shall be placed above the overflow point of the wet well. Where only two pumping units are provided, they should have the same capacity, each capable of handling flows in excess of the expected maximum flow. Where three or more pumps are provided, they should be designed to fit actual flow conditions and be of such capacity that with any one pump out of service, the remaining units will have capacity to handle maximum sewage flows. The pumping cycle (max. 6 cycles per hour) shall be long enough to ensure that all sewage in the force main will be replaced during one cycle. Each pump shall have its own individual intake and all piping shall be minimum 100mm diameter. Shut-off valves shall be placed on both suction and discharge lines of each pump. A check valve must be placed on the discharge line between each pump and the shut-off valve. Each pump must have a separate vent pipe with check valve.

7.6. PROVISIONS

1. Water supply with fittings and hose must be provided for wash-down purposes.
2. One extra set of seals and bearings must be provided when the Construction Completion Certificate is granted. Two complete sets of O&M manuals must be provided with each new pump.

7.7. CLEARENCE

A 0.6 m clearance is recommended as the working area required around each pump.

7.8. ELECTRICAL

All electrical work must be in accordance with the Canadian Electrical Code and the Provincial and Municipal amendments thereto. Permanent lighting and outlets shall be provided on alternate floors. Lighting is required around pumps and motors. Interior-mounted control panel units, in weatherproof cases, are preferred over above-ground units in below ground pumping stations. Where inside-mounted panels are used, adequate ventilation must be provided to prevent excessive moisture build-up. For larger pumps (over 55kW), part wind motors are recommended.

7.9. MECHANICAL

Continuous mechanical ventilation is required for all drywells at the rate of six (6) complete air changes per hour. Multiple air inlets shall be provided in pits over seven metres deep and the heating of cold air in winter is required. Fresh air inlets are to be kept remote from control equipment to prevent freeze-up. All heating, ventilation and electrical equipment shall be in accordance with all applicable standards for non-hazardous locations. Screens are to be provided over all vent openings.

D.8.0 FORCE MAINS

1. 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.
2. The minimum permissible velocity shall be 0.60m/s. Where velocities in excess of 3.0m/s are attained, special provisions shall be made, as required by the Engineer. At “high spots” in the line, gas relief shall be provided.
3. Force mains shall be constructed of PVC pipe, unless otherwise approved by the Village.

STANDARD DRAWINGS - SANITARY (REFER TO SECTION “C” FOR DETAILS)

SECTION E – WATER DISTRIBUTION SYSTEM

E.1.0. DESIGN REQUIREMENTS

1.1. SIZE

The minimum size of distribution main shall be:

1. 200 mm diameter for single family residential
2. 200 mm for multi-family development
3. 250 mm for industrial/commercial
4. 150 mm diameter water mains may be allowed in cul-de-sacs upon approval of the Village Engineer.
5. Oversizing may be required by the Village.

1.2. ROUGHNESS COEFFICIENT

P.V.C. Pipe shall be used and the value of "C" in the Hazen-Williams formula shall be 120 for sizes less than 400 and 130 for sizes larger than 400.

1.3. WATER DEMAND

Per capita consumption shall be:

1. Average Daily Demand - 360 L/person/day
2. Maximum Daily Demand - 2.0 x Average Demand
3. Peak Hourly Demand - 3.0 x Average Demand

The design population shall be the ultimate for the area under consideration. (See Section D.1.1 for population densities).

1.4. PRESSURE

1. An analysis shall be made for Peak Hour Demand and mains shall be sized such that there will be a minimum residual pressure of 275 kPa (40 psi) at ground level at any location in the system.
2. Separate analysis shall be made for Maximum Demand plus Fire Flow. The residual pressure at any location at the ground level shall not be less than 140 kPa (20 psi).

1.5. FIRE FLOW

Fire Flow requirements shall be in accordance with the Insurer's Advisory Organization Standards, latest revision thereof. Generally, these are:

1. Single Family Residential 76 L/s (1000 igpm)
2. Multi-Family / Institutional 114 - 227 L/sec (1500 - 3000 igpm)
3. Industrial 227 L/s (3000 igpm)
4. Commercial 265 L/s (3500 igpm)

1.6. NETWORK ANALYSIS

Where the size of the area to be developed warrants, or if required by the Village, a network analysis shall be carried out and all relevant information shall be submitted with the design documents.

E.2.0. WATERMAINS

2.1. WATERMAINS - MATERIALS

1. Pipe for the watermain shall conform to Polyvinyl Chloride (PVC) Class 1035 (150) DR 18 A.W.W.A. pressure pipe
2. Rubber rings for the couplings shall conform to A.S.T.M. D1869, latest revision thereof; control lubrication of pipe joints to prevent taste and odour concerns
3. Cast iron fittings shall be in accordance with A.W.W.A. Specification C110, latest revision thereof and shall be cathodically protected, with test station; cast iron tees, elbows and crosses will only be allowed if the fitting is not readily available in moulded PVC
4. Polyvinyl Chloride (PVC) moulded fittings to CSA B137.2 (class 150)

2.2. WATERMAINS - LOCATION

1. Mains shall be installed to provide a minimum depth of cover of 2.75m below final finished surface grade.
2. Mains shall be located within the road right-of-way in accordance with the Roadway Cross Section Standard Drawings.
3. A minimum of 3.0 m horizontal and 0.5 m vertical separation shall be maintained between a watermain and any sewer main.
4. The minimum requirement for pipe bedding shall be Class "B" bedding. (See Standard Drawing)

3.0. HYDRANTS

3.1. HYDRANTS - MATERIALS

1. Hydrants shall be Canada Valve Century
2. Hydrants shall conform to A.W.W.A. Specification C502, latest revision thereof, and shall include the following supplementary requirements:
   a. four-section breakaway flange
   b. stainless steel trim (nuts and bolts)
   c. compression type shut off
   d. designed for working pressure of 1035kPa
   e. two 63 mm hose nozzles with Alberta Mutual Aid Thread

f. one steamer port with 146 mm (5.745") outside major diameter, 142 mm (5.58") pitch diameter of threads, 114 mm (4.5") inside diameter, 4 threads per inch

g. size 12 pentagon operating nut and caps, 33 mm (1 5/16") from tip to midpoint of flat base

h. self draining

i. 150 mm diameter riser barrel with a 125 mm bottom valve

3.2. HYDRANTS – INSTALLATION AND LOCATION

1. The maximum allowable spacing between fire hydrants shall be 150 m in single-family residential areas, 120 m in multiple-family residential and school areas and 90 m in industrial/commercial areas.
2. Hydrant locations shall be such that the distance to any building shall be not greater than 75 m.
3. Hydrants on the distribution mains shall be installed at the projection of property lines except:
   a. Where the hydrants are installed at the intersections, they shall be installed at the beginning of curb returns
   b. Where the hydrants are installed on a cul-de-sac, they shall be installed at the intersection of the cul-de-sac and adjacent collector roadway.
4. Hydrants shall be located to conform to curb and sidewalk design and shall be located as follows:

a. Areas with no sidewalk – No less than 1.5m and no more than 2.0m from back of curb

b. Separate Sidewalk – 1.5m from back of curb

5. Additional hydrants shall be installed at high value properties if deemed necessary by the Village.
6. All hydrants shall be on a minimum of 150mm lead. Such lead shall be a maximum length of 7.5m from the main, otherwise a larger diameter lead shall be considered.
7. Gate valve shall be provided on each hydrant lead
8. Hydrants shall be installed in accordance with Standard Drawing, with the following requirements:
   a. flange to be no less than 100mm and no more than 200mm above final grade.
   b. minimum 0.5m: washed gravel drainage sump adjacent to hydrant base; top of sump to be 150mm above hydrant drain holes and covered with 2 mm polyethylene sheet to prevent intrusion of clay or silt into the gravel
   c. Cathodically protected with a 4.1kg Magnesium anode; test station to be installed
   d. all hydrants shall be painted Chrome Yellow

e. tops and nozzle caps painted in accordance with the NFPA colour coding system as outlined in Table 3.2

9. A blue plastic ring shall be used to flag hydrants not in service.

4.0. VALVES

4.1. VALVE - REQUIREMENTS

2. Gate valves shall conform to AWWA Specification C500, latest revision thereof, and shall include the following supplementary requirements:
   a. iron body
   b. bronze mounted with grade of bronze used completely resistant to de-zincification by water having a pH of 9.0
   c. designed for working pressure of 1200kPa
   d. stainless steel trim (nuts and bolts)
   e. 51 mm square operating nut
   f. type 304 stainless steel stem for valves 250 mm and larger; 150 mm and 200 mm valves may be supplied with either bronze or type 304 stainless steel stems
   g. "O" - ring stem seal
   h. open by turning counter-clockwise
   i. non-rising stem
   j. double-disc or solid wedge type
   k. resilient seated
   l. external epoxy coating
1. Mueller-brand valves are preferable.

4.2. VALVE - LOCATION

1. Valves on the distribution mains shall be installed:
   a. At the projection of property lines with 3 valves at cross intersections.
   b. At the projection of property lines with 2 valves at tee intersections.
   c. Valves to be installed at the projection of property lines at mid-block are subject to the Village's approval.
   e. Valves shall be installed in accordance with Standard Drawing.
1. Distribution main valves shall be located such that during a shutdown:
   a. No more than two hydrants are taken out of service.
   b. No more than three valves are required to affect a shutdown (four if a cross intersection is involved).
   c. No more than 25 single-family units or more than one multi-family or commercial site are taken out of service.
   d. No more than one standard Village block is taken out of service by a shutdown.

4.3. VALVE BOXES

a. two section, bituminous coated, Type A, cast iron adjustable type complete with a cast iron lid
b. internal operating rod to a maximum of 600 mm from the ground surface
c. sufficient length to provide for adjustments of 300 mm in up or down direction
d. extensions shall be cast iron suitable for use with the valve boxes to be installed
e. Norwood Foundry Type B screw type valve box permitted subject to Village approval

E.5.0. TRENCHING AND BACKFILLING

1. Trenching and Backfilling shall be done in accordance with Occupational Health and Safety Guidelines.
2. Minimum trench width - outside diameter of pipe plus 450 mm.
3. Bedding & Backfill - Sand bedding is to be placed over the full width of the trench and tamped in maximum compacted lifts of 100 mm to a level 300 mm above the crown of the highest service point in the trench. The balance of the backfill shall be machine placed native or imported material in maximum compacted lifts of 300 mm. The backfilling around curb stops shall be done by hand to the finished grade. Backfilling and bedding shall be carried out to a minimum of 98% SPD.
4. In existing hard surfaced areas, backfilling shall be carried out with granular material in 150 mm layers compacted to a minimum of 98% SPD.

E.6.0. THRUST BLOCKS

Thrust blocks shall be provided as per Standard Drawing.

E.7.0. CATHODIC PROTECTION

1. Cathodic protection to be applied to all iron fittings, based upon recommendation by the Engineer.
2. As minimum, cathodic protection shall be provided for:
   a. Valves
      - Install one 4.1 kg packaged magnesium anode
      - Attached anode to valve body via thermit weld process
      - Install one #10 or 12 AWG test lead to valve body and route to surface

b. Hydrant
   - Install one 4.1 kg packaged magnesium anode
   - Install two #10 or 12 AWG test leads using thermit weld process and route to surface
   - Install cathodic test station adjacent to hydrant and terminate all three leads therein.

c. Watermain – Cast / Ductile
   - Install one – 9.1 kg magnesium anode
   - Install two # #10 AWG test leads using thermit weld process
   - Install cathodic test station (flush mount) above line at street level and terminate leads therein
   - If watermain "broken, install 2 #8 AWG bond cables across repair joint using thermit weld process to attach leads to both sides

d. Services
   - Install one 4.1 kg magnesium anode
   - Attach anode directly to valve or saddle using solder (on copper) or thermit weld (on steel)

3. A record of the installation and the test results; including soil resistivity values, anode and the line potential and anode current, should also be submitted along with a drawing or site sketch.

E.8.0. DISINFECTION

1. All the watermains shall be disinfected in accordance with A.W.W.A. Specification C651, latest revision thereof.
2. The Village shall be notified at least 24 hours prior to testing so they may witness the residual chlorine test and the sampling for the bacteriological test.
3. Minimum residual chlorine after 24 hours shall be 25 mg/L.
4. The line shall be flushed and the chlorine residual of the water being disposed neutralized prior to discharge.
5. The bacteriological test results must be reviewed and approved by the Village Engineer prior to the waterline being placed into public service.

E.9.0. TESTING

The Developer shall employ a CSA approved testing firm to complete the tests outlined below. One copy of the results shall be submitted to the Village for their review. (See also Table A.1.0.)

Prior to initial acceptance of the project, all watermains shall be tested as follows:

1. All watermains shall be tested in accordance with AWWA C605, latest revision thereof. The Village shall be notified a minimum of 24hours prior to testing and the Village Engineer shall be a witness to the tests.

2. Chlorination and Bacteriological
   a. See Section E.8.0
3. Hydrostatic Leakage Test
   a. Test pressure shall be 1035 kPa (150 psi) or 1.5 times the normal operating pressure (based upon the elevation of the lowest point in the main and corrected to elevation of the test gauge), whichever is greater, for a period of two hours.
   b. For PVC pipe, the overall leakage for the section of line tested shall not exceed the rate of leakage specified in Table 3.1.
4. Hydrant Tests

   Hydrants are to undergo pressure, leakage and flow testing and shall be tested in accordance with AWWA M17, latest revision thereof.

   a. Under the supervision of the Village, the hydrants shall be tested to ensure that the flows and pressures from design are being realized in the field. Where the actual flows do not meet the fire and service requirements, all hydrants in the project must be tested and corrective action taken where necessary.

   b. It is preferred to perform leakage testing against the hydrant valve with the main shutoff valve open. The test is described as follows:

   - Remove the highest nozzle cap and open the hydrant valve a few turns. Allow the water to rise to the bottom of the nozzle.
   - Replace the nozzle cap securely, but leave it loose. Continue to fill the hydrant slowly, expelling the air through the loose cap.
   - Open the hydrant valve completely. Failure to do so would cause significant water flow through the drain holes, undermining the hydrant.
   - Visually check for leakage at the flanges, nozzles, operating stem, and at any joints on the hydrant body. Also use a listening device to detect any leaks below grade.
   - No leaks are permitted, and all faults are to be repaired.

TABLE 3-1

Maximum Allowable Leakage (L/100 Joints/Hour) For P.V.C. Pipe

	Test Pressure								
	345	515	690	860	1035	1380	1550	1724	**Kpa**
Pipe Dia.	50	75	100	125	150	200	225	250	**psi**
100 mm (4")	1.46	1.77	2.00	2.28	2.46	2.90	3.07	3.28	
150 mm (6")	2.17	2.65	3.07	3.43	3.76	4.34	4.60	4.82	
200 mm (8")	2.90	3.54	4.09	4.57	5.02	5.79	6.14	6.46	
250 mm (10")	3.62	4.42	5.12	5.71	6.27	7.34	7.67	8.10	
300 mm (12")	4.34	5.30	6.14	6.86	7.52	8.69	9.20	9.7	
350 mm (14")	5.07	6.19	7.16	8.00	8.77	10.13	10.74		
400 mm (16")	5.79	7.07	8.19	9.14	10.03	11.58	12.27		
450 mm (18")	6.51	7.96	9.21	10.28	11.28	13.03	13.80		

Allowable leakage calculation is based upon the following formula:

$$\text{PVC pipe } L = \frac{ND(p^{0.5})}{128{,}320}$$

L - allowable leakage in litres per hour
N - number of joints
D - nominal diameter (mm)
P - test pressure (kPa) (1.0 PSI = 6.9 kPa)

TABLE 3-2

National Fire Protection Association - Recommended Practice for Colour Coding Hydrants

Barrel - Chrome Yellow

Tops and Nozzle Caps

Class AA	- Flow > 90 l/s	-	Light Blue
Class A	- 60 l/s < Flow < 90 l/s	-	Green
Class B	- 30 l/s < Flow < 60 l/s	-	Orange
Class C	- Flow < 30 l/s	-	Red

STANDARD DRAWINGS - WATER DISTRIBUTION SYSTEM

SECTION F – SERVICE CONNECTIONS

F.1.0. GENERAL

The requirements for sewer and water service connections shall be dependent upon the size and type of building and development to be serviced. The sizes and locations of all services shall be subject to the approval of the Village. No installation of services shall be permitted until approved in writing by the Village. The scope of the work described here pertains only to that portion of the service from the connection at the main to the property line. If this specification does not cover an area of concern regarding sewer and water services, the onus 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 Village. All specifications and standards noted herein shall refer to the latest revision thereof.

F.2.0. MINIMUM REQUIREMENTS FOR SEWER & WATER SERVICE CONNECTIONS

2.1. SIZE OF SERVICE

1. The minimum diameter of service connections to a single-family dwelling shall be as follows:
   a. Sanitary Service 150 mm
   b. Water Service 19 mm
   c. Services of sizes larger than these will be required where deemed necessary by the Village as the length of service pipe (> 20 meters) or other conditions warrant. Where more than one service is required, the sizes and locations must be approved by the Village.
2. Non-residential or apartment service connections shall be sized according to anticipated users requirements.
3. No water service intermediate in size between 50 mm and 100 mm in diameter shall be permitted unless approved otherwise.

2.2. GRADE

The minimum grade on a sewer service shall be 2.0%, unless approved otherwise.

2.3 TIE-IN TO MAIN

1. Sewer service

   The sewer connection shall be by means of an in-line "wye" or "tee" for new installations, or by means of a saddle at the top gradient of the main for tie-ins to existing lines.
2. Water service
   a. Water services 50 mm and smaller shall be tapped at the top gradient of the water main, under pressure.
   b. The maximum size of tapping without the utilization of service clamps shall be 25 mm tap on 150 mm and on 200 mm main.

2.4. BENDS

The long radius type or a combination of 22-1/2 degree bends and straight pipe shall be used when bends are required.

F.3.0 MATERIALS

All materials used shall be of the approved standards as listed herein -- all unapproved materials shall be removed and replaced with acceptable materials at the Developer's expense.

3.1. SEWER SERVICE

1. Pipe and Joints

   Sewer pipe shall be Polyvinyl Chloride (PVC) pipe shall be SDR 35 service pipe conforming to ASTM Specification D3034.

2. Fittings

   Sewer fittings shall conform to the pipe material being used and shall be in accordance with the corresponding manufacturer's recommended standards and specifications.

3. Plugs

   The ends of the pipe at the edge of the easement shall be sealed with plastic plugs fitted to the bell end of the pipe and braced. Blue painted marker posts shall be placed from the invert of the pipe and extend 600 mm from the design (or final) ground surface to identify the location of all plugged ends.

3.2. WATER SERVICE

1. Pipe & Joints
   a. Type "K" copper tubing conforming to AWWA Specification C800 for services of size 50 mm and under. Couplings, if required, shall be the standard brass compression type.
   b. Polyvinyl Chloride (PVC) pipe conforming to AWWA Specification C900, Class 150 using flexible Elastomeric Seals for services of size 100 mm and larger.
   c. Alternative pipe materials may be considered by the Village and shall be approved in writing prior to installation.
2. Fittings

   The following water service fittings shall be used and employ non-corrosive material inclusively:
   a. Corporation Stops - Mueller, A220, 110.
   b. Curb Stops - Mueller Oriseal Mark II H15204 – Non-Draining.
   c. Service Boxes - Epoxy coated cast iron extension type (maximum of 3 m) with stainless steel 304 operating rod and manganese bronze clevis and brass cotterpin for connection Curb Stop.

d. Service Clamps - Bronze double strap (stainless steel) or approved equal.

e. Valves - Valves for service lines 100 mm and larger in size see Section E – Standard Drawings

3. Cathodic Protection

   See section E.7.0.

F.4.0. INSTALLATION REQUIREMENTS

4.1. LOCATION

1. Each lot or multi-family unit must have a separate service.
2. Where the water service is 50 mm or smaller in size (continuous length), it shall be laid in the same trench as the sanitary service to the right of the sanitary service when facing the property. Water services 100 mm or larger in size, shall be laid in a separate trench and at a minimum separation of 3.0 m from any sewer service (typical) and 1.8 m from any other utility.
3. Sanitary and water services shall be extended 1.0 m past shallow utility easement unless otherwise specified.
4. Where possible, services shall be located so as not to conflict with driveway locations.
5. Service connections for commercial, industrial and multi-family, unless otherwise approved by the Village, shall be made after the service requirements have been determined and a permit, approving the installation, is issued by the Village.

4.2. DEPTH

1. The minimum depth of cover at the property line shall be 2.60 m. Where services are required to connect to mains in excess of 4.25 m in depth, risers shall be installed and properly plugged. The risers shall be firmly supported and anchored to the trench wall in all cases.
2. Sanitary and water services are to be at the same elevation at the end of the pipe at the outside edge of the utility easement, if possible.

4.3. BEDDING

See Section C - Standard Drawing

4.4. BACKFILL

1. Sand bedding is to be placed over the full width of the trench and tamped in maximum compacted lifts of 100 mm to a compaction level of 300 mm above the crown of the highest service point in the trench.
2. The balance of the backfill shall be machine placed native or equivalent imported material in maximum compacted lifts of 300 mm.

3. The backfilling around curb stops shall be done by hand to the finished grade. Backfilling shall be carried out to a minimum of 98% Standard Proctor Density.

4.5. MARKER POST

A blue painted stake 58 X 89 X 1200 mm in size with 600 mm protruding above final ground elevation shall be placed directly behind the curb stop and/or sanitary stub.

4.6. TAPPING

The utmost care shall be exercised in tapping the mains for the connection of services. Water mains shall be drilled and tapped under pressure by means of a tapping machine and the corporation main threaded in by a tapping machine. The minimum allowable distance between adjacent main stops shall be 600 mm and the minimum allowable distance between a main stop and an adjacent coupling or collar shall be 300 mm.

4.7. BENDS

On sanitary services long radius type bends or a combination of 22-1/2° bends and straight pipe shall be used. This is to facilitate rodding in case of blockage. For a water copper service, there shall be a minimum of one gooseneck bend near the main stop and an additional gooseneck at each sewer crossing. The circular cross-section of the pipe is to be maintained.

4.8. CURB STOPS

1. All residential service valves to pre-serviced residential lots shall be installed 150mm back from the property edge of the utility easement, complete with curb stop, box, rod, and 1.0 m of pipe extending past the property edge of the utility easement (crimped at the end). Curb stops are to be placed according to the indicated direction of flow. Curb stop and valve casings shall be placed plumb over the curb stop or valve and a check shall be made after backfilling that the curb stop or valve is operational. Caps for the casings shall be placed so as to be flush with the finished grade.
2. The symbol CC shall be stamped in sidewalks or face of curbs (where no sidewalk exists) directly opposite the location of the curb stop.

STANDARD DRAWINGS - SERVICE CONNECTIONS

F.1 .0 SEWER SERVICE CONNECTIONS

F.2.0 WATER SERVICE CONNECTIONS

SECTION G - TRANSPORTATION

G.1.0. DESIGN STANDARDS

1. Road classification and designation shall be in accordance with the geometric design standards outlined in the most recent addition of the "Geometric Design Guide for Canadian Roads" - Transportation Association of Canada (TAC), 1999 Edition, or revisions thereof.
2. Roads will be designed to the geometric standards noted in Table **G-1**: Summary of Recommended Design Standards for Urban Streets.
3. General cul-de-sac's requirements are as follows:
   a. The normal maximum length of a cul-de-sac is 120m from the street curb line to the start of the bulb. Cul-de-sac in excess of 120m and less than 170m will require an additional hydrant. Watermain looping will be required if the cul-de-sac of more than 120m. Where cul-de-sac in excess of 170m are proposed, provision must be made for a 6.0m wide Public Utility Lot (PUL) for emergency vehicle access and water service looping. Emergency vehicle access PUL's shall be developed to a standard acceptable to the Village Engineer.
   b. Cul-de-sacs with steep grades are to be avoided. If cul-de-sacs cannot be graded to drain towards the intersection then an outlet for the overland flow must be provided by way of a PUL.
   c. The minimum radius of cul-de-sac bulbs is 11m to face of curb.
   d. Cul-de-sac road surface is to be crowned except the bulb portion which may be crossfall.
3. Developers are required to address noise levels for roadways operating at capacity. Noise attenuation structures shall be used where a noise level of 55 dB is measured or calculated at a distance of 5.0 m from the nearest residential dwelling.
4. Developers are responsible for restoration of all survey control markers and legal pins removed or disturbed during construction. Restoration shall include replacing fill over markers that required excavation for access. If frequent access to a buried marker is required, the Village Engineer should be advised so that a permanent cover can be installed.

G.2.0. CLEARING AND GRUBBING

All work shall be done within the limits of rights-of-way and permanent and working easements, and shall include the complete disposal of all buildings, fences, vegetation and other debris. All work shall be in accordance with existing Provincial and Village fire; public safety, and environmental regulations and laws, and be done in accordance with the "approved" drawings and specifications.

G.3.0. EARTHWORK

3.1. 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.

3.2. COMMON EXCAVATION

All excavation shall occur within the limits of the proposed work to the lines, grades and dimensions as shown on the contract drawings or noted in the contract documents, unless directed otherwise by the Engineer. Surplus or unsuitable material shall be disposed of at a site approved by the Engineer.

3.3. EMBANKMENT CONSTRUCTION

1. Fill material shall be placed in maximum 300 mm (loose) successive uniform layers, each compacted to a minimum of 98% Standard Proctor Density at optimum moisture content unless stated otherwise. Where required, the area receiving fill material will be cleared and grubbed, unsuitable material removed and the area scarified prior to placing fill material. Only material approved by the Engineer shall be used.
2. Testing shall occur at a minimum of one density test for each 2000 m2 of compacted lift, or as otherwise approved by the Engineer, using ASTM D1556, ASTM D2167 or ASTM D2922. For comparison, the maximum density is determined according to ASTM D698 Method A. If a test is below the required density the area represented by the test shall be reworked to the depth of the lift, moisture content adjusted if necessary and compacted to the specified density.

3.4. BORROW

Where a sufficient quantity of suitable fill material is not available from excavation on the site, additional fill may be borrowed from other sources. In no case shall Village-owned areas be undercut for borrow.

3.5. GRADE TOLERANCE

1. All graded surfaces shall meet a grade tolerance of ±25mm from designated grade elevations unless otherwise approved by the Engineer. Crossfalls and ditch bottoms shall be graded to allow for a positive flow of water. High areas shall be trimmed to within the tolerance. Low areas shall be scarified, filled with approved material, compacted to the required density and graded to within tolerance.
2. On finished surfaces, localized high and low points or other obstructions that inhibit drainage, will not be tolerated.

3.6. EQUIPMENT

All proposed routes for hauling equipment other than trucks must be approved by the Engineer prior to commencement of the work. Rubber-tired motor scrapers shall not be used to haul over improved streets. Traffic must be controlled by flagmen and sufficient warning signs to ensure the safety of the public when any travelled roadway is being entered or crossed by hauling equipment to the satisfaction of the Village. Road closures and detours must be submitted to and approved by the Village a minimum of 48 hours prior to scheduled work. Haul routes must be kept clear and free from dust. Trucks shall be loaded in such a manner that no spillage occurs.

G.4.0. SUBGRADE CONSTRUCTION

4.1. EXCAVATED AREAS

The areas under future road structure and curb and gutter shall be scarified to a minimum depth of 300 mm below the surface and compacted in 150 mm lifts to a minimum of 100% of Standard Proctor Density. For areas under walks, curb ramps and slabs the surface shall be scarified to a minimum depth of 150 mm and compacted to 97% Standard Proctor Density.

4.2. EMBANKMENT AREAS

The top 300 mm of fill under future road structure and curb and gutter, shall be placed in two 150 mm compacted lifts and compacted to a minimum density of 100% of Standard Proctor Density. For walks, curb ramps and slabs, each of the 150mm lift shall be compacted to 97% Standard Proctor Density.

4.3. GRADE TOLERANCE

The elevation of excavated and embankment areas shall conform to the lines, grades and dimensions required. The finished subgrade surface shall have a maximum variation of 6mm above and 25mm below the designated elevation. High areas shall be trimmed to within the tolerance. Low areas shall be scarified, filled with approved material, compacted to the required density and graded to within tolerance. As an alternative, low areas may be filled with the same material used in the next layer of road structure above the subgrade.

4.4. DENSITY TESTING

Testing shall occur at a minimum of one density test for each 1000 m^2 of compacted lift, or as otherwise approved by the Engineer, using ASTM D1556, ASTM D2167 or ASTM D2922. For comparison, the maximum density is determined according to ASTM D698 Method A. If a test falls below the required density, two more tests will be taken in the area represented by the failed test and the three test average used as the density for the area. If this average is below the required density the area represented by the tests shall be reworked to the depth of the lift, the moisture content adjusted as necessary, compacted to the specified density and trimmed to grade. Failed sections to be re-tested, at the Contractor's expense.

4.5. DRAINAGE WORKING AREAS

All work shall be carried out so that excavated areas will drain to catch basins, manholes, or to a natural drainage course during construction or by pumping.

NOTE: In certain situations, the use of cement or lime to stabilize the subgrade below the granular base course may be used. Approval must be obtained from the Village Engineer prior to construction.

G.5.0. GRANULAR BASE COURSE

5.1. MATERIALS

Granular materials shall consist of crushed gravel free from vegetation, clay or other extraneous material and meet the following specifications:

1. 20 mm (3/4") Crushed Gravel
   a. The gravel shall meet the following grading requirements and be uniformly graded between the given limits:

Sieve Size, mm	% Passing by Weight
20.0	100
12.5	60 – 92
5.0	37 – 62
2.0	26 – 44
0.4	12 – 27
0.16	7 – 18
0.08	2 - 10

   b. The Liquid Limit shall not exceed 25 and the Plasticity Index (< 0.4 mm sieve) shall not exceed 6.
   c. A minimum of sixty percent (60%) by weight of material retained on the 5.0 mm sieve shall have at least two (2) crushed faces. The percent passing the 0.08 mm sieve shall not exceed 2/3 of the fraction passing the 0.4 mm sieve.
2. 63 mm (3") Minus
   a. The gravel shall be crushed and meet the following grading requirements:

Sieve Size, mm	% Passing by Weight
63.0	100
5.0	25-50
0.08	0 - 10

b. At least twenty percent (20%) by weight of material retained on the 5.0 mm sieve shall have at least one fractured face.

3. Sand

a. The sand shall be free from all organic material and meet the following grading requirements:

Sieve Size, mm	% Passing by Weight
5.0	95
0.08	10 (Max)

b. The Liquid Limit shall not exceed 25 and the Plasticity Index shall not exceed 6.

5.2. CONSTRUCTION

1. Surface Preparation

The subgrade shall be finished to conform to the required section, grade and density prior to the placement of base course material. Prepared subgrade shall be inspected by the Engineer before placing the granular material.

2. Placement

The granular material shall be placed on prepared subgrade or the preceding course in a uniform manner to ensure the ultimate planned compacted thickness is achieved. Crushed gravel and 63mm minus gravel shall be placed in horizontal layers of not more than 150 mm compacted thickness. The finished granular course shall be free of segregation.

3. Water

If the material requires water to attain the specified density, water shall be added and the material bladed continually until a uniform mixture is obtained. If the gravel contains an excessive amount of moisture, it is to be scarified and aerated until the Optimum Moisture specified is obtained.

4. Compaction

Not less than one hundred percent (100%) of maximum density shall be obtained in compaction tests. Compaction shall be reached by the use of pneumatic tire rollers, vibrating drum packers or other approved types of compaction equipment.

5.3. TESTING AND INSPECTION

1. Densities

A minimum of one density test shall be carried out for each 1,500m^2 (per layer) of granular base course or at least one test per day of placing operations. Density testing shall conform to ASTM D1556, ASTM D2167 or ASTM D2922. For comparison, the maximum density is determined according to ASTM D698 Method A. If a density test falls below the

required density, two more tests will be taken in the area represented by the failed test and the three test average used as the density for the area. If this average is below the required density the area represented by the test shall be reworked to the depth of the lift, moisture content adjusted as necessary and compacted to the specified density. Failed sections to be re-tested, at the Contractor's expense.

2. Surface Tolerance

   The surface shall be such that when tested with a 3 m straight edge, the maximum deviation of the surface from the edge of the straight edge shall nowhere exceed 15 mm.

3. Grade Tolerance

   The finished surface shall have a maximum variation of 6 mm above and 15 mm below the designated elevation. High areas shall be trimmed to within the tolerance. Low areas shall be scarified, filled with approved material, mixed, compacted to the required density and graded to within tolerance. As an alternative, low areas may be filled with the same material used in the next layer above.

4. Appearance

   The gravel base shall be free of loose or deleterious material. No segregation of rock or fines shall exist in the completed base. Segregation in crushed gravel base shall be repaired by blading and thoroughly mixing the material prior to recompacting and grading. Segregated material in 63 mm gravel shall be removed and replaced.

   NOTE: The source of the aggregate must be approved by the Village Engineer prior to commencing operations.

G.6.0. ASPHALTIC CONCRETE PAVEMENT

6.1. PAVEMENT DESIGN

1. Paved roadways shall be designed in accordance with the Asphalt Institute method of pavement design using minimum design loadings of 8165 kg (18,000 pound) single axle loads for local streets and 10,886 kg (24,000 pound) axle loads for collector streets. All industrial / commercial roads shall be designed using a minimum design loading of 10,886 kg (24,000 pound) single axle loads. The design parameters such as traffic count, percentage of trucks, California Bearing Ratio (CBR), etc., are to be outlined to the Village Engineer. The Village reserves the right to request the Developer to engage a geotechnical engineering agency to carry out CBR tests on the subgrade prior to paving to confirm adequacy of design.
2. Staged construction for any asphalt work is the preferred method of construction with the final lift of asphalt placed during the construction season prior to FAC.

6.2. MATERIALS

Asphaltic concrete pavements shall consist of aggregate, mineral filler and asphalt cement, and shall be laid and compacted to the specified thickness, conforming to the approved lines, grades and typical cross-sections.

1. Mixes Used:

Asphalt Concrete Surface	**ACS**	surface course for freeways, arterials and industrial/commercial roadways and base course for collectors.
Asphalt Concrete Base	**ACB**	base course for freeways, arterials, industrial/commercial roadways and collector roadways.
Asphalt Concrete Residential	**ACR**	paving local and non-bus route collector roadways.
Asphalt Concrete Overlay	**ACO**	resufacing arterial and collector roadways.

Alternative mixes may be considered by the Village and shall be approved in writing prior to installation.

2. Aggregates
   a. When tested by means of laboratory sieve, the combined aggregates in the mix shall meet the following gradation:

Sieve Size, mm **% Passing by Weight**

	ACR / ACO	**ACS**	**ACB**
25.0			100
20.0			80 - 95
12.5	100	85 – 95	
5.0	60 – 80	45 – 65	40 – 60
0.16	7 – 12	7 – 12	9 – 14
0.08	4 – 8	3 – 7	4 - 8

   b. A minimum of 75% of the ACR, ACO and ACS and 70% of the ACB material on the 5.0 mm sieve shall have at least two (2) crushed faces.
   c. Fine aggregates (passing 5.0 mm sieve) shall contain manufactured or crushed fines at a percentage by mass of aggregate as follows:

	ACO	**ACS**	**ACB**
Minimum Manufactured Fines, %	75	75	60
Maximum Manufactured Fines, %	85	85	

3. Asphalt Cement

   The asphalt cement shall be uniform in character, shall not foam when heated to 175° C and shall meet the following requirements:

Designation	150/200(A)
Penetration at 25º C, 100 g, 5 sec, dmm.	150
Ductility at 25º C (cm), maximum	100
Solubility in Trichlorethelene (%), minimum	99.5
Flash Point, Cleveland Open Cup, °C minimum	205
Tests on Residue from Thin Film Oven Test: Ratio of Absolute Viscosity of Residue from Thin Film Oven test to Original Absolute Viscosity, Maximum:	4.0

4. Mineral Filler

   a. Should the grading of the mineral aggregates supplied to the plant not meet the required gradation, mineral filler shall be added in such quantities as will be required to meet the specifications.

   b. Mineral filler shall consist of Portland cement, fly ash, commercially ground stone dust or other mineral dust approved by the Village.

   c. Mineral filler shall have a zero plasticity index and shall conform to the following gradation requirements:

Sieve Size, mm	**% Passing by Weight**
0.4	100
0.16	90
0.08	70
0.045	62

6.3. COMPOSITION AND PROPORTIONING

1. Mix Design

   a. A mix design shall be based on the Marshall Method of Mix Design as set out in the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2) and shall conform to the following criteria:

Mix Type	**ACS**	**ACB**	**ACR**	**ACO**
No. of blows	75	75	50	75
Minimum stability, kN	6.7	6.7	4.5	6.7
Min retained stability, %	75	75	75	75
Flow value, 0.254 mm units	6 – 12	6 – 12	8 – 16	6 - 12
Air voids, % of total mix	4.0±0.2	4.0±0.4	3.0±1.0	4.0±0.4
Voids filled, %	65 – 78	67 – 78	73 – 85	68 - 80
Min film thickness, μm	7.0	6.0	7.0	7.0

   b. The mix design shall be performed by an accredited testing agency and shall be submitted to the Village for approval at least one (1)

week prior to the commencement of field paving. Changes to the job-mix formula must have written approval from the Village prior to use.

c. A separate and complete mix design shall be required for any change in the nature of the source of the material.

2. Tolerances

a. Allowable variation in extracted aggregate from the approved job-mix gradation is as follows:

Sieve Size, mm **% Passing by Mass**

	Individual Sample	Average of Last 10 Samples
5.0	◊5.0	◊3.0
1.25	◊4.0	◊2.5
0.63	◊3.0	◊2.0
0.315	◊3.0	◊2.0
0.160	◊3.0	◊1.5
0.08	◊1.5	◊1.0

b. The amount of bituminous material designated for the job shall be within 0.3 percentage points.

c. The tolerance for air voids in the mix is 4.0◊1.0 % for ACS, ACB and ACO mixes, and 3.0◊1.0 % for ACR mix.

e. The mixing temperature of materials shall not vary from those specified by more than 9°C.

3. Asphalt Plant

a. The latest edition of the Asphalt Plant Manual, Asphalt Institute Manual Series No. 3 (MS-3) should be used as guidance in mix production and material handling.

b. The asphalt plant must be capable of producing a mix conforming to ASTM D995.

c. All plant scales must be certified prior to the start of the construction season by Weights and Measures, Canada Consumer and Corporate Affairs.

d. Asphalt plants must be operated in accordance with Alberta Environment Code of Practice.

6.4. QUALITY ASSURANCE

1. Thickness

The Village may request one or more sets of cores taken from asphalt pavement suspected of being deficient in total thickness. Each set will consist of three cores and will represent not more than 1000 m^2 of asphalt pavement.

2. Density

Asphalt pavement density will be determined based on the ratio of the core density to the density of the Marshall specimen. A minimum frequency of one Marshall density will be taken for each 1000 tonnes of asphalt produced or one day's production, which ever is less. Cores will

be taken in the compacted mat from the same load as the Marshall specimen. Each core represents not more than 1000 m^2 of mat. If a core density is below the specified requirement, three new cores will be taken from the same area. The average density of the three cores will represent the area.

3. Tests Conducted

   The following tests shall be carried out for each 1000 tonnes of asphalt pavement or at least once during each placing shift:

   a. Marshall Stability (ASTM D1559)
   b. Sieve Analysis (ASTM C136 & C117)
   c. Bulk Specific Gravity (ASTM D2726)
   d. Bitumen Content (ASTM D2172)
   e. % Voids in the Mineral Aggregate (VMA) (ASTM D2726)
   f. Air Voids (ASTM D3203)

6.5. CONSTRUCTION METHODS

1. Good Practice

   Refer to the latest edition of the Asphalt Paving Manual, Asphalt Institute Manual Series No. 8 (MS-8) for guidance in good paving practice.

2. Staged Asphalt Work

   Second (final) lift of asphalt to be placed 2 years after installation of the first lift of asphalt. Contractor is to remedy any problems existing on the first lift of asphalt, prior to placing the second lift.

3. Transport of Mix

   a. The mix shall be transported in vehicles equipped with protective covers and clean, tight, smooth-sided boxes. The inside surface of the box may be lubricated with a light coating of soap or detergent solution. Petroleum derivatives shall not be permitted.
   b. Any accumulation of asphaltic material, which has collected in the box, shall be thoroughly cleaned before loading with hot mix.
   c. Trucks shall have an easily accessible 12 mm hole in the side of the box, at a distance of 300 mm from the bottom, for the purpose of checking temperatures of the mixture.
   d. Trucks shall be maintained perfectly clean of mud or any substance that could contaminate the working area

4. Preparation

   a. The surface to be paved shall be dry and clean of all loose or foreign materials prior to paving.
   b. Tack coat shall be applied to all surfaces intended to contact the hot-mix asphalt. Where tack coat is applied, it shall be thoroughly cured prior to placing the mix.

c. Where existing pavements are to be overlaid, a levelling course of hot-mix asphalt may be required prior to placing the overlay to bring the surface to the desired elevation. Unless otherwise approved by the Engineer, this course shall be laid using a paver and shall meet all of the requirements of this Section. Each filler lift of asphalt shall not exceed 75 mm of compacted thickness.

d. All surface joints matching to existing asphalt shall be ground to a depth of 50 mm to provide a straight, vertical edge. No feathering of the edge of asphalt will be permitted unless approved by the Engineer.

e. Catchbasins, manholes, water valves, and other fixtures shall be brought to final grade prior to placing the final lift of hot-mix asphalt.

5. Weather Limitations

Hot-mix asphalt paving will not be permitted during these conditions unless permission is given by the Engineer:

a. During periods of rain or snow, or when rain or snow is imminent.

b. When the surface to be paved is wet, icy, snow-covered or frozen.

c. During excessive winds.

d. When air temperature is:

- 7o C or cooler for a mat 40 mm or less thick
- 4° C or cooler for a mat 40 mm to 50 mm thick
- 2° C or cooler for a mat greater than 50 mm thick

6. Spreading

a. Hot-mix asphalt shall be spread at temperatures not lower than 125° C or higher than 150° C as measured in the mat immediately behind the paver.

b. Unless otherwise permitted by the Engineer, the mix shall be spread by a mechanical self-powered paver, with an automatic leveling device, capable of spreading the mix without segregation or tearing.

c. The hot-mix asphalt shall be placed in a continuous operation with the paver moving at a uniform speed compatible with the rate of rolling.

d. The hot-mix asphalt shall be spread uniformly in one or more lifts to depths sufficient to obtain the following compacted thicknesses:

Mix Type	Minimum (mm)	Maximum (mm)
ACS	50	100
ACR	30	75
ACB	65	125
ACO	30	75

e. Prior to roller compaction, all fat spots, sandy accumulations, high and low spots and any other irregularities shall be removed and replaced with satisfactory material. Before the addition of material to any mat,

the surface shall be broken with the tynes of a rake to ensure proper bonding.

f. The complete pavement shall have a tightly knit structure and be free from segregation. If segregation occurs the paving operation will be suspended until the cause is determined and corrected.

g. Edges against which additional pavement is to be placed shall be straight and approximately vertical. A lute or rake shall be used immediately behind the paver, when required, to obtain a true line and vertical face.

7. Hand Spreading

   a. Hot-mix asphalt may be hand spread in small areas where the use of a paver is not practical and where permitted by the Engineer. Hand placement shall be performed carefully to avoid segregation of the coarse and fine aggregates. Broadcasting of material shall not be permitted. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed by lutes or rakes. Material that has formed into lumps and does not break down readily shall be rejected. Following placing and before rolling, the surface shall be checked with straight edges and all irregularities corrected.

   b. Heat hand tools to keep them free from asphalt. Caution shall be exercised to prevent high heating temperatures that may burn the material. The temperature of the tools shall not be greater than the temperature of the mix being placed.

8. Compaction

   a. Compact the hot-mix asphalt mat using rollers in good working order and operated by competent operators. The number, type and mass of rollers must be sufficient to achieve the required compaction.

   b. Develop and follow the best rolling pattern to obtain the most uniform compaction across the mat.

   c. Complete final rolling before the mat temperature reaches 80° C.

   d. In small areas inaccessible by rollers, approved vibratory plates or hand tampers shall be used to achieve the required compaction.

9. Joints

   a. Transverse Joints

      Transverse joints shall be carefully constructed and thoroughly compacted to provide a smooth-riding surface. Joints shall be straight-edged or string-lined to assure smoothness and true alignment and shall be offset at least one metre from joints of adjacent mats. Prior to placing an adjacent mat, transverse joints shall be made straight and vertical and painted with tack coat material.

   b. Longitudinal Joints

      - Surface longitudinal joints shall not occur in the wheel paths of a travel lane. Mats shall be offset by not more than 150 mm from the

center of a line marking. The Engineer may permit a joint to occur in the center of a travel lane.

- Longitudinal joints in successive lifts shall be offset a minimum of 150 mm.
- Compaction of two adjacent mats, forming a longitudinal joint, shall only occur if the temperature of the edge of each mat is above 80°C. If the edge temperature of a mat falls below 80°C prior to placement of the adjacent mat, carefully roll the edge of the first mat, form or cut a clean vertical face to the full depth of the mat, paint the face with tack coat, and then place the second mat.

6.6. QUALITY CONTROL

1. Smoothness Tolerances
   a. Surface Variation

      The maximum variation in the asphalt surface under a 3 m straightedge is:

      - Longitudinal to the direction of travel:3 mm
      - Transverse to the direction of travel: 6 mm

   b. Grade Variation
      - The maximum variation in grade from the designated elevations is 6 mm.

   c. Texture
      - The finished surface texture shall be tight knit and free of visible signs of poor workmanship including, but not limited to, segregation, areas of excess or insufficient asphalt, poorly matched longitudinal and transverse joints, roller marks, cracking, and tearing.
      - If the surface and grade tolerances are exceeded, or the texture is not met, grind out and resurface the defective areas as directed by the Engineer.

2. Thickness Tolerances
   a. If the average core thickness is deficient, that area of asphalt pavement will be assessed a pay factor according to the following table and be applied to the price of the quantity of hot-mix asphalt in that mat area.

Thickness Deficiency (%)	**Pay Factor (%)**
10.0	100
11.0	97.0
12.0	93.7
13.0	90.0
14.0	85.5

15.0	80.5
16.0	75
17.0	68
18.0	60
19.0	50
19.0 and over	Grind and Resurface

b. Asphalt pavement with excess thickness may be accepted if surface and grade tolerances and textures are met, but no additional payment is due.

3. Density Tolerances

a. Each mat of hot-mix placed shall be compacted to the following minimum density (% Marshall density) for the type of paving, or as indicated in Special Provisions.

Minimum Density	Type of Paving
98%	New paving and all staged paving except 2nd stage residential ≤ 40 mm thickness
96%	2nd stage residential ≤ 40 mm mat thickness
97%	Lane paving
97%	Overlays > 40 mm mat
96%	Overlay ≤ 40 mm mat

b. If the average core density is below specified, the represented area of mat may be accepted subject to the following pay factor being applied to the price of the quantity of hot-mix asphalt in that mat area:

Actual Density	Pay Factor		
%	98% Required	97% Required	96% Required
98.0	100.0		
97.9	99.9		
97.8	99.8		
97.7	99.6		
97.6	99.4		
97.5	99.1		
97.4	98.7		
97.1	97.2		
97.0	96.5	100.00	
96.9	95.8	99.9	
96.8	95.0	99.7	
96.7	94.2	99.4	
96.6	93.3	99.1	
96.5	92.3	98.7	
96.4	91.1	98.2	
96.3	89.8	97.7	
96.2	88.5	97.1	
96.1	87.1	96.3	

96.0	85.5	95.5	100.0
95.9	83.8	94.6	99.7
95.8	82.0	93.6	99.3
95.7	80.0	92.5	98.9
95.6	77.7	91.3	98.4
95.5	75.4	89.9	97.8
95.4	73.0	88.4	97.1
95.3	70.3	86.7	96.4
95.2	67.2	84.8	95.6
95.1	63.7	82.7	94.6
95.0	60	80.3	93.4
94.9	Under 95.0 Reject	77.6	92.2
94.8		74.3	90.7
94.7		70.6	89.1
94.6		66.0	87.3
94.5		60	85.1
94.4		Under 94.5 Reject	82.6
94.3			79.5
94.2			75.5
94.1			69.7
94.0			60.0
			Under 94.0 Reject

G.7.0 PRIME COATS AND TACK COATS

1. "Prime coats" shall be the application of bituminous material to subgrade or previously prepared gravel base course, prior to placing bituminous surfacing material.
2. "Tack Coats" shall be the application of bituminous material to a previously constructed paving surface, of any type, and against curb gutter faces, manholes, valves and other appurtenances in the area to be paved, in preparation for placing bituminous surfacing materials.

7.1. PRIME COAT (OVER SUBGRADE OR CEMENT STABILIZED BASE)

The asphalt types may vary from M.C. 30 to M.C. 250; from SS-l to SS-lh or an emulsified asphalt primer to suit the conditions of the base. The rate of application may vary from 0.50 to 1.50 litres/square metres. The materials' temperature at application shall fall within the following limits:

Medium Curing Asphalt:	**Emulsified Asphalt:**
M.C. 30 - (50 - 70°C)	S.S. 1 - (24 - 54°C)
M.C. 70 - (75 - 90°C)	S.S. 1h - (24 - 54°C)
M.C. 250 - (100 - 110°C)	Emulsified Asphalt Primer - (15 - 50°C)

7.2. TACK COAT (OVER ASPHALT BASE)

The asphalt for the tack coat may vary from SS-1 to SS-1h; from R.C. 30 to R.C. 250, depending on conditions to suit the base. The rate of application shall be 0.25 to 0.90 litre/square metre. Temperatures of application shall fall within the following limits:

Rapid Curing Asphalts:

R.C. 30 - (50 - 70°C)

R.C. 70 - (75 - 90°C)

R.C. 250 - (100 - 110°C)

G.8.0. SEAL COATS AND FOG COATS

1. "Seal coats" 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.
2. When a seal coat is applied without cover then it shall be referred to as a "Fog Coat". Fog coat shall be a light application of slow-setting asphalt emulsion diluted with water. The emulsion is diluted with an equal or greater amount of water and sprayed at the rate of 0.45 to 0.70 litres/square metre. Fog coating may be used to renew old asphalt surfaces.

8.1. APPLICATION

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 Engineer and shall be promptly terminated in the event of unfavourable road or weather conditions.

1. Sweeping

   All dust, dirt and foreign matter will be carefully swept from the surface of the pavement for the full width to be seal-coated immediately prior to the application of the binder.

2. Asphaltic Binder

   The selected bituminous material shall be uniformly applied on the properly prepared surfaces at a rate specified by the Engineer and within the following ranges:

   a. Fog Coat - 0.23 to 0.70 litres/square meter, with a distributor having special fog nozzles for the purpose of applying a light spray.
   b. Sand Seal - 0.50 to 1.4 litres/square metre.
   c. Chip Seal - 0.90 to 1.8 litres/square metre.

8.2. MATERIALS

1. Bituminous Material
   a. The liquid asphalt used for seal coating shall be rapid curing or emulsified asphalt; the actual grade and type shall be determined to suit the surface condition and shall be approved by the Village.
   b. Temperatures of applications shall fall within the following ranges:

Rapid Curing Asphalt:	**Emulsified Asphalt:**
R.C. 30 - (50 - 70°C)	R.S. 1k - (15 - 50°C)
R.C. 70 - (75 - 90°C)	R.S. 2k - (15 - 50°C)
R.C. 250 - (100 - 110°C)	

2. Mineral Aggregate
   a. Chip Seal
      - Chip seal aggregate shall be free from soft shale, organic or other deleterious matter and shall have at least one crushed face.
      - When tested by means of laboratory sieves, it shall meet the following gradation:

Sieve Size Passing	**Cumulative % by Weight**
10 mm	100
Retained on Sieve	95 - 100

      - The maximum amount of moisture content in the chips shall be 1% for an R.C. asphalt and 3% for an R.S. asphalt.

   b. Sand Seal
      - When tested by means of laboratory sieves, the following gradation:

Sieve Size Passing	**Cumulative % by Weight**
5,000	100
400	0 – 15
63	Less than 2

      - The maximum amount of moisture content in the sand shall be 2% for an R.C. asphalt and 5% for an R.S. asphalt.

   c. Application of Mineral Aggregates
      - The application of bituminous material shall not proceed until a supply of aggregate sufficient to cover the entire application is immediately available for covering the bitumen in less than five (5) minutes. The bitumen application shall be promptly covered with specified mineral aggregate at a rate of 5.5 to 11.0 kg/m^2 for sand, and from 8.0 to 16.0 kg/m^2 for chips.
      - Special care must be taken in the spreading of mineral aggregates in order that the uniformity of cover will be secured. If, in the

opinion of the Engineer, uniform distribution of the aggregate is not being obtained the cover aggregate shall be alternately drag boomed and rolled until it is uniformly bonded over the full width of the application.

- Longitudinal overlap 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 overlapping at transverse junctions, building paper or metal sheets shall be spread over the treated surface for sufficient distance back from the joint on cover aggregate so that sprayers are operating at full force upon reaching the surface to which application is to be made. The bitumen application shall be stopped or shut-off on paper or metal sheets. Any paper used for covering joints shall be removed and destroyed in a safe and environmentally responsible manner.

d. Rolling

- 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 such weight that crush the mineral aggregate shall not be used. The Developer may use steel wheel, pneumatic-tired or vibratory rollers. The minimum number of five (5) complete coverings by the rollers shall be carried out within thirty (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 eight (8) kilometres/hour, whichever is less.

e. Traffic

- 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 Engineer. In no case shall traffic be permitted on the sealed roadway until at least twenty-four (24) hours after the application of the bituminous material.

G.9.0. RECYCLED ASPHALT

9.1. COLD MIX RECYCLING

1. Cold-Mix recycling is a process in which reclaimed asphalt pavement materials and/or reclaimed aggregate materials are combined with new asphalt and/or recycling agents to produce a cold-mix base mixture.
2. Cold-mix recycling involves ripping, scarifying, pulverizing or crushing the old pavement which is then either hauled to a central site and upgraded with asphalt cement or emulsified or it is treated in-place. Prior to construction, representative samples should be obtained and the asphalt content, asphalt consistency and aggregate gradation determined. The

materials should then be blended and a minimum design developed. An asphalt surface course is optional.

9.2. HOT MIX RECYCLING

1. Reclaimed asphalt pavement materials and/or aggregate materials are combined with new asphalt and/or recycling agents and/or new aggregate as necessary to produce a hot-mix paving mixture which conforms to the asphaltic concrete pavement standards under this section of the manual.
2. The old pavement may be scarified and the material removed to a crushing plant to be sized, or the material may be sized in-place with rotating drum milling equipment or hammermills and hauled to a central location. The scarified material contains both asphalt and aggregate. The gradation of the aggregate and the consistency of the extracted asphalt should be determined. Amount and type of asphalt and new aggregate to be blended into the reclaimed asphalt pavement is then determined. It may be necessary to use a soft asphalt or recycling agent to enhance the weathered asphalt in the reclaimed asphalt pavement.

G.10.0. CURB AND GUTTER, SIDEWALK AND APRONS

10.1. DESCRIPTION

1. This specification covers the manufacture and placement of concrete, reinforced concrete, and related work for the construction of curbs and gutters, sidewalks & aprons placed to conform to the approved lines, grades, and typical cross-sections. (See Standard Dwgs. & Appendix 1).
2. Curb, gutter, and sidewalk shall be placed as follows:
   a. Local Streets

      Rolled face curb, gutter and separate sidewalk on both sides unless otherwise approved by the Village.

   b. Collector Streets

      Rolled face curb and gutter with separate sidewalk on both sides. (Vertical face curb is required in front of industrial, commercial, school, church, park and storm water detention/retention areas).

   c. Arterial Streets

      Vertical face curb and gutter with separate sidewalk on both sides.
3. Curb (Wheelchair) ramps are to be used at all curbed intersections and aligned to allow straight through movement of pedestrians.
4. The minimum radius for curb returns shall be 7.5 meters, for cul-de-sacs 11.0 meters.

10.2 MATERIALS

Portland Cement	Portland Cement shall conform to CSA-A3000 and shall be of the following types: Normal Type 10 High Early Strength Type 30 Sulfate Resistant Type 50 Type 10 cement shall be used in all concrete mixes unless otherwise specified. Type 50 cement shall be used when recommended by testing of the existing soil conditions. Type 50 cement will not be used during the season between October 15 and May 1. Type 30 cement may be substituted for Type 10 cement.
Aggregates	Concrete aggregates shall conform to clause 5, CSA-A23.1. Maximum aggregate size shall be 20 mm.
Water	Water used shall conform to clause 4, CSA-A23.1 and be clean and free from injurious amounts of oils, acids, alkalis, organic material, sediment and other deleterious materials.
Air-Entraining Agent	Air-entraining agents shall conform to ASTM C260.
Chemical Admixtures	Admixtures shall conform to ASTM C494, including water-reducing agents, retarders and accelerators. Chemical admixtures shall not be used unless approved by the Village
Calcium Chloride	To enhance cold weather protection, calcium chloride conforming to ASTM Specification D98 may be used with the Village's approval. The maximum amount permitted will be 2.0% by estimate of weight of cement.
Fly Ash	Fly ash shall conform to CSA-A23.5, pozzolan type C. Not more than 10% of the specified minimum cement content may be replaced with fly ash. No portion of the specified minimum cement content may be replaced with fly ash during the season between October 15 and May 1.
Reinforcement	Reinforcement shall conform to the following requirements: Reinforcing Steel – billet steel, Grade 400R, deformed bars to CSA-G30.18, unless indicated otherwise. Tie Bars – billet steel, Grade 300, deformed bars to CSA-G30.18. Steel Dowels – shall be clean, straight, free from flattened or

	burred ends to CSAG30.18. Tie Wire – cold-drawn annealed steel to CSA-G30.3. Welded Steel Wire Fabric - wire reinforcement shall conform to CSA-G30.5M.
Curing Compound	Resin based, white pigmented, liquid membrane-forming compound conforming to ASTM C309, type 2, class B.
Preformed Joint Filler	Shall conform to ASTM D1751.
Joint Sealant	Hot-poured elastic type to ASTM D1190.
Granular Base	The granular base shall consist of approved material meeting the gradation for 20mm (3/4") crushed gravel included in Section G5.1.a.

10.3. COMPOSITION AND PROPORTIONING

1. Concrete mix designs shall be preformed by a qualified laboratory. No concrete production shall occur until the applicable mix design has been approved by the Engineer.
2. Concrete production shall be to CSA-A23.1, clause 18 and conforming to the approved mix design.
3. All concrete used on street rights-of-way shall meet the following requirements:
   a. Compressive Strength
      - The minimum compressive strength required is based on the percentage of air content in the plastic concrete.

Air Content (%)	**28-Day Minimum Compressive Strength (MPa)**	**7-Day Minimum Compressive Strength (MPa)**
5.5 – 6.0	30.0	27.0
7.0	28.0	25.0
8 or greater	26.0	23.0

      - During the season between October 30 and May 1, concrete placed shall obtain a minimum compressive strength of 27.0 Mpa in 7 days and shall be provided with cold weather protection in accordance with clause 21.2.3 of CSA-A23.1M.

   b. Slump
      - For hand-placed concrete the allowable slump is 60 ± 20 mm. The slump may be reduced for slipformed concrete to 20 ± 10 mm for curb and gutter and 30 ± 10 mm for walk.

c. Entrained Air Limits
   - The limit minimum air content, by % volume, is 5.5%.

d. Aggregate Size
   - The maximum aggregate size is 20 mm.

e. Maximum Water to Cementing Materials Ratio
   - The maximum water to cementing materials ratio (by mass) is 0.45.

f. Cement Content
   - The minimum Type 10 cement content is 335 kg/m^3.

10.4. QUALITY ASSURANCE

1. Slump, air content and compressive strength tests shall be made on the concrete for each 60 m^3 placed or at least one test for each day of placing concrete. Slump and air content tests will be taken with every strength test.
2. Sampling and testing shall be performed in accordance with the following:

Slump	CSA-A23.2-1C CSA-A23.2-5C
Air Content	CSA-A23.2-1C CSA-A23.2-4C or CSA-A23.2-7C
Compressive Strength	CSA-A23.2-3C CSA-A23.2-9C

10.5. CONSTRUCTION

1. Subgrade Preparation

   The subgrade for curb and gutter, walk, monolithic walk, curb ramps and crossings shall be prepared to the density and grade requirements outlined in Section G4 - Subgrade Construction.

2. Granular Base

   A 150 mm granular base course of 20 mm (3/4”) aggregate shall be placed under concrete walk, curb ramps, and crossings as detailed on the drawings.

3. Hand Forming

   Curbs with a radius less than 40 m shall be constructed with flexible forms, well staked and braced to the established line and grade.

   The Engineer will not allow the use of forms that are out of shape, dented, rough or otherwise unsuitable.

4. Slipforming

In areas not accessible to slipform equipment, hand form and place concrete concurrently with the slipforming operation. Where concurrent work is not practical complete this work within 7 days of the slipforming of the adjacent work.

5. Delivery of Concrete
   a. Delivery of concrete to the jobsite shall be according to CSA-A23.1, Clause 18.4. Only rotating drum trucks capable of mixing or agitating the concrete mix shall be used.
   b. Rotate the drum on the jobsite for 3 minutes immediately before discharge.
   c. Retempering with water is not allowed after the initial mixing at the plant unless the following conditions are met:
   d. The slump at the jobsite is less than specified and the addition of water is approved by the Engineer.
   e. The amount of water required to bring the slump to within acceptable limits does not exceed 12 litres/m^3.
   f. The drum is rotated a minimum of 30 rotations at mixing speed and a uniform mix is obtained.
   g. Water is added only once on the jobsite.
   h. Retempering with air is allowed only if the following conditions are met:
   i. Retempering is done on site using an approved air-entraining agent, by a quality control technician working for either the concrete supplier or the Contractor.
   j. An air content test is performed on each load of retempered concrete and the results are provided to the Engineer prior to placement.
   k. The concrete shall be completely discharged from the truck prior to the elapse of 1.5 hour, from the time of the start of the initial mixing at the plant.
   l. A delivery ticket with the following information is supplied to the Engineer: batch plant location, supplier's name, ticket and truck numbers, a mechanically punched date and time of the initial mixing at the plant, class and mix design designation, cement type, aggregate size, type and amount of admixtures, if water was added, volume of concrete, site arrival time, discharge time, and any other information requested by the Engineer.
6. Placing Reinforcement

   Reinforcement shall be of the type, size, and spacing detailed on the drawings.

   a. Separate Walks
      - Place 10 M reinforcing steel, parallel to each contraction and surface joint spaced at 300 mm on either side of the joint with a minimum cover of 25 mm unless shown otherwise on the plans.

b. Crossings

- Welded wire fabric shall be placed in all crossings.

c. Curb and Gutter

- A 10 M reinforcing bar shall be placed in the curb section of all curb returns and small radius curves.
- Any concrete base is to be tied to the gutter or curb and gutter by placing 10 mm diameter rods, minimum two (2) meters in length, alternately at maximum 1.5 metre centres with a minimum of two rods per gutter or curb and gutter section.

7. Placing Concrete
   a. Concrete shall be placed only after the prepared base and formwork or string lines have been inspected and approved by the Engineer.
   b. The handling, placing, and consolidation of the concrete shall be according to CSA-A23.1, Clause 19 and supplemented by the following:
   c. Moisten the surface of the base before placing the concrete.
   d. Ensure the formwork and reinforcement is clean and wetted before concrete placement.
   e. Do not place concrete during rain, when rain is imminent or if the weather, in the opinion of the Engineer, is not suitable.
   f. Use 50 mm pencil vibrators or approved vibrating screeds to consolidate concrete.
   g. The interval between placing successive loads shall not exceed 30 minutes. If the discharge interval is greater than 30 minutes a construction joint shall be placed between the loads
8. Finishing
   a. Working the surface during finishing shall be the minimum amount necessary to produce the specified finish with no exposed aggregate or entrapped air. Brush finish shall be done with an approved nylon bristle brush lengthwise along the curb and gutter and transversely across the walk and slabs.
   b. Do not apply water to the surface of the concrete to facilitate finishing.
9. Joints

   Contraction, construction, and longitudinal joints shall be constructed where required as shown on the plans or as specified.

   Tool all joints to a width of 50 mm and round edges to a 6 mm radius. Joints will have a width of 3 mm to 5 mm.

   a. Contraction Joints
      - Contraction joints shall be placed (formed or sawn) a maximum every 3 m. Joints in curb and gutter shall be a minimum depth of 50 mm to a maximum of 25% of the gutter depth. In walk and slabs

the minimum depth is 25 mm to a maximum of 25% of the walk or slab thickness.

b. Surface Joints

- A surface or "dummy" joint shall be constructed every 3 m alternating with the contraction joint in sidewalks, to a depth of 10 mm and width of 5 mm. For monolithic curb, gutter and walk structures, a longitudinal joint for the purpose of marking the back of curbs shall be made. This joint shall continue through all driveways and lane crossings.

c. Construction Joints

- A construction joint is required between concrete pours or when matching new concrete to existing. The edges of existing concrete that are not straight and vertical shall be saw cut a minimum of 50 mm deep and removed.
- Transverse construction joints shall have 10 m deformed tie bars placed at 300 mm spacing, extending 300 mm minimum into both sides of the joint. Longitudinal construction joints shall have 10 M deformed tie bars placed at 1 m spacings, extending 300 mm minimum into both sides of the joint.

d. Isolation Joints

- Shall be constructed where specified on the drawings. Isolation joints are to be lined to full depth, with fibreboard material.

10. Protection and Curing

a. Protect freshly placed concrete from premature drying, temperature extremes, adverse weather and physical disturbance. Refer to CSA-A23.1, Clause 21.

b. Exposed concrete surfaces shall be sprayed using curing compound applied with a pressurized nozzle. The entire surface shall be covered with a uniform film at a rate of not less than 1 litre per 4 m^2 of surface area. Sealer is to be applied to surface of the concrete, at a rate not less than 1 litre per 4 m^2.

11. Backfilling

At all locations the Contractor shall backfill the concrete edges as soon as possible after the placement of the concrete. The backfill shall extend at least 300 mm behind all curb and gutter, sidewalks and slabs. It shall be mechanically tamped in two lifts behind curb and gutter and one beside sidewalks and slabs, to a minimum of 97% Standard Proctor density. Care shall be taken to avoid damaging the concrete.

10.6. COLD WEATHER CONCRETE

1. Concrete Strength - After October 30, all concrete shall attain the specified strength in seven (7) days.
2. Base Condition - No concrete shall be placed on frozen subgrade or base.
3. Concrete Temperature - 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 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 straw, insulation or other approved insulating material. If a temperature of 18° C for 72 hours after placing cannot be maintained using insulation, then concreting shall cease.

10.7. HOT WEATHER CONCRETE

1. Hot weather shall be considered to be an air temperature in the shade of 23°C or above.
2. 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.
3. Retarding admixtures shall be approved by the Engineer prior to use in the concrete.

10.8. CURB STAMPING

1. Name Plate

   The name of the contractor and year of construction shall be placed in the surface of the sidewalk or curb and gutter by the use of an approved plate at least once in each block constructed.

2. Curb Stop Location

   The symbol "CC" is to be stamped into the sidewalk perpendicular to the curb stop location. Where only curb and gutter exist, stamp “CC” on the top or face of curb.

10.9. CATCH BASIN / MANHOLE COVERS

The adjustment of catch basin or manhole frames to meet the curb and gutter or sidewalk grades shall be done by means of extension rings and a bedding of mortar.

10.10. QUALITY CONTROL

1. Concrete Mix
   a. Deficient Slump

      If the measured slump is outside the specified limits, another test will be taken on another portion of the load, or a retest will be done if retempering with water is permitted. If the second test fails, the

Engineer may reject that load of concrete including the removal of the portion already poured.

b. Deficient Air Content

If the air content of a load is found to be below 5.5%, all concrete from the load, including that already placed, shall be discarded. Concrete with high air content will be accepted if the specified minimum strength is met.

c. Deficient Strength

- The concrete work represented by a test that did not meet the required strength may be accepted subject to the following pay factors. If strength deficiencies continue, changes in the mix design will be required.

Cylinder Strength (% of Specified Strength)	Pay Factor (% of Contract Price)
97.0	100.0
96.0	99.2
95.0	98.2
94.0	96.9
93.0	95.4
92.0	93.6
91.0	91.7
90.0	89.4
89.0	86.7
88.0	83.5
87.0	79.7
86.0	75.5
85.0	70.0

- No payment shall be made for cylinder strengths below 85% of specified strength.

2. Field Work

a. Surface Tolerances

- Walk or Slab:

Max. variation under a 3 m straightedge	6 mm
Max. variation walk crossfall Total crossfall	$\pm$ 1% $\geq$ 1% and $\leq$ 4%

- Gutter Surface and Curb Top:

Max. variation under a 3m straightedge	6 mm

- Grade of Gutter and Walk:

Max. variation at any surveyed station	6 mm
Max. variation between 2 consecutive surveyed stations	12 mm

- Lip of Gutter Alignment:

Max. deviation	±12 mm in 30 m

- If tolerances are exceeded the concrete work will be corrected as directed by the Engineer.

b. Thickness Tolerances

The Engineer may request sets of cores from walk and slabs suspected of being deficient in thickness. Each set will consist of 3 cores, the average of these cores will represent not more than 500 m^2 of walk or slab. If the average thickness is deficient, that area will be assessed a pay factor as follows:

Thickness Deficiency (mm)	Pay Factor (% of Contract Price)
6	100.0
7	97.0
8	93.7
9	90.0
10	85.5
11	80.5
12	75.0
13	68
14	60
15	50
15 and over	Remove and Replace

G.11.0. INTERLOCKING "UNI-STONE" BLOCKS

11.1. MATERIALS

1. Concrete Paving Blocks

Conforming to ASTM Specification C936, "Solid Concrete Interlocking Paving Units", with particular requirements as follows:

a. Cement

- Type 50 Portland cement conforming to CAN3-A5-M77.

b. Aggregates

- Normal density aggregates, conforming to CAN3-A23.1-M77.

c. Air-entraining Agent
   - Conforming to CAN3-A23.1-M77.

d. Tolerance
   - Manufactured blocks shall be true to shape and shall not differ from manufacturer's standard dimensions by more than ◊ 2 mm in length and width and ◊ 3 mm in thickness.

e. Shape
   - Type A: Block is dentated and interlocks on all four faces, resists joint spreading in either direction, and can be laid in a herringbone pattern (According to manufacturer's specific shape, subject to Village's approval). The Village may also specify or accept shapes other than Type A.

f. Colour
   - As required; subject to Village's approval.

2. Bedding Sand

   Clean, sharp sand free of deleterious soluble salts and other contaminates likely to cause efflorescence, graded as follows:

Sieve Size Passing	**Cumulative % by Weight**
10,000	100
5,000	95 – 100
2,500	80 – 100
1,250	50.85
630	25 - 60
400	10 – 30
160	5 - 15
63	0 - 10

3. Joint Sand

   Sharp sand free of deleterious soluble salts and other contaminants likely to cause efflorescence and reduced skid resistance, and graded as follows:

Sieve Size Passing	**Cumulative % by Weight**
2,500	100
1,250	85 – 100
400	25 – 60
160	12 – 30
63	10 – 15

4. Edge Restraint

   As shown on plan or as approved by the Village. This can be concrete curb, gutter, curb and gutter, walk, existing structure, pressure treated lumber, or other approved method of preventing movement of edge blocks.

5. Other Materials

   Weed barrier, insulation, and other materials specified or shown on plan, subject to approval by the Village.

11.2. CONSTRUCTION

1. Pavement Structure

   Construct the pavement according to the cross-section shown on the plans or drawings. Accordingly, the pavement structure will consist of the prepared subgrade; a granular base/sub-base, and the interlocking concrete blocks laid on a bedding of sand. A weed barrier or insulation material may also be specified. The sidewalk shall be designed so that full bricks are utilized for the width of the sidewalk and the requirement for cut bricks is minimized.

2. Subgrade/Base/Sub-base Preparation
   a. Grade and prepare the subgrade/base/sub-base according to sections G 4.0 and 5.0, extending to the rear face of edge restraints.
   b. The finished surface shall not deviate by more than 15 mm from the bottom edge of a 3 m straightedge laid in any direction, and shall be on a correct grade or not more than 10 mm below grade.
   c. Under no circumstances shall further construction proceed until the subgrade has been inspected and approved by the Village.

3. Laying of Paving Blocks
   a. Place paving blocks on the screened sand bed (30 mm thick minimum) to the pattern shown on the plans or as approved by the Village. Maintain the laying pattern taking care to leave joints between adjacent units not exceeding 3 mm wide.
   b. Lay full units first in each row commencing from a straight starting edge. Fill edge gaps with edge units, or cut infill pieces using suitable equipment to produce true fitting, even edges without cracks or chips.
   c. Use boards overlaying the laid blocks for foot and other traffic to prevent disturbance of units prior to tamping. Ensure that the sand bed is not disturbed during construction.
   d. Using an approved mechanical flat plate vibrator, tamp the laid blocks to bring the paving surface to correct grade, eliminate lipping between adjoining units, and consolidate the sand bedding. Remove and replace any units structurally damaged during compaction.
   e. Where a structure is to carry heavy loads, use a pneumatic-tired roller, for compaction, as directed and approved by the Village.

f. Proceed with compaction as closely as possible following laying, up to one metre of the laying face. Leave all work to within one metre of the laying face fully compacted at the completion of each day's laying.

g. After compaction, prior to terminating work on each day and prior to allowing construction traffic, brush jointing sand across the pavement, and vibrate to completely fill the joints. Sweep off surplus material and leave the pavement surface clean.

4. Finished Pavement Tolerances

Maximum deviation from specified grade	= +10 mm
Maximum deviation under a 3 m straightedge	= 8 mm
Maximum differential level between 2 adjacent units	= 2 mm

5. Defects - Remove and replace defective and damaged materials and repair defective work at no additional cost to the Village.

G.12.0 ASPHALT PATHWAYS

The asphalt and base materials, mixing, spreading, and compaction shall conform to the Village of Thorsby's Standards and Specifications as outlined under this Section for all of the work required.

G.13.0. BOULEVARD AND MEDIAN GRASSING (REFER SECTION H FOR DETAILS)

G.14.0 TRAFFIC CONTROL DEVICES

1. A traffic control device is a sign, signal, marking, barrier or other device, placed upon, over or adjacent to a roadway which is intended to regulate, warn, or guide the road user. All such traffic control devices shall be installed in accordance with the latest revision of the "Uniform Traffic Control Devices for Canada" manual distributed by the Roads & Transportation Association of Canada and with the latest revision of the "Alberta Highway Signing Policy Manual".
2. All traffic control devices must be authorized and approved by the Village of Thorsby prior to placement. No traffic control device, nor its support, shall bear any commercial advertising.
3. It is the intent that these devices be kept serviceable for the safe movement of traffic in both daylight and darkness, year round. As such they must be designed and constructed to be operable and durable given expected environmental conditions.

14.1. TRAFFIC SIGNS

Signs inform road users of traffic regulations, warn of roadway characteristics and road hazards, and provide information necessary for route selection. Simplicity in design, care in placement, and a standard of maintenance are essential. Signs are to be used only when necessary and justified. All sign materials shall conform to the Canadian Standards Association (CSA) specifications.

1. Materials
   a. Signs

      Signs made of treated ferrous and non-ferrous metal and waterproof, resin-bonded plywood are suitable for use in permanent signs (certain other wood-fibre materials, when properly fabricated, are also acceptable). Wooden boards may be used for large signs and for temporary and seasonal signs.

   b. Sign Panels

      Information signs shall be constructed with high intensity reflective panels. Regulatory and Hazard signs shall be constructed with diamond grade reflective panels.

   c. Sign Posts

      Where applicable, it is encouraged that all signs be placed on existing supports used for other purposes such as traffic signals or streetlights. If signposts are required, they shall be made of galvanized metal (schedule 40), 60 mm in diameter and 3.65 m in length with a quick-fix breakaway coupling installed 50 mm from ground level. In grassed/residential areas, signs should be installed using schedule 40 pipe, 60 mm in diameter, 3.65 m in length, with 100 mm x100 mm tabs welded 300 mm above bottom of post.

   d. Fasteners

      Stainless steel fasteners shall be used to attach signs to their supports. Bottom of sign to be a minimum of 2.0 metres from ground surface.

2. Installation and Maintenance

   Signs are to be placed with the posts vertical and the signs level. The bottom of the sign should be a minimum of 2.0 meters above the level of the nearest travel lane or existing grades. Signs are to be positioned with best possible road visibility in mind. All signs shall be kept clean, in proper position, and legible - damaged signs are to be repaired or replaced as soon as possible. No vegetation, construction materials, snow, or other items or materials are to be allowed to obscure any sign.

14.2. TRAFFIC SIGNALS

Traffic control signals assign right-of-way between conflicting streams of traffic with the minimum delay and hazard reasonably obtainable. All traffic control devices are to conform to the "Uniform Traffic Control Devices for Canada" manual distributed by the Roads and Transportation Association of Canada, latest revision thereof.

14.3. PAVEMENT MARKINGS

1. Pavement markings are traffic control devices placed on driving surfaces to delineate and clarify traffic and pedestrian movement by regulating, warning, and conveying information to individuals without diverting attention from the roadway.

2. The most frequently used traffic marking materials are traffic marking paint and thermoplastic material.
3. Pavement markings shall conform to the following:
   a. Colour

      Yellow (solid) lines will be used to delineate the separation of opposing traffic flows. White lines will be used to delineate the separation of traffic flows in the same direction. All transverse pavement markings are to be white in colour.

   b. Pattern

      Broken longitudinal lines are to indicate that lane changing is permitted and solid longitudinal lines indicate that lane changing is not permitted. The line to gap ratio for separator lines is to be 3m:6m. Lateral pavement marking may be parallel or "zebra" lines and are to be used to indicate the limits of the drivers' right-of-way concerning stopping, pedestrian crosswalks, no parking areas and the like.

      Please see the "Uniform Traffic Control Devices for Canada" manual which details the requirements for pavement markings.

14.4. TEMPORARY SIGNAGE

Temporary signage and devices shall be located as to provide motorist and pedestrians with adequate warning of construction or unusual conditions. A plan showing signage location, spacing and types shall be submitted to the Village for approval a minimum of 72 hours prior to disruption. Refer to "Uniform Traffic Control Devices for Canada" manual Section D.

G.15.0 STREET LIGHTING

1. All street lighting layout and location of the buried and/or the overhead lines shall be approved by the Village. The location, type and frequency of street lights shall be such as to provide the minimum lighting levels as designated by the franchise utility company and in conformance with the Roads and Transportation Association of Canada guidelines.
2. Wherever possible, streetlight 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.
3. Only corrosive resistant street light poles complete with fixtures and concrete pedestals shall be used unless approved otherwise.
4. 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.
5. The Village may recommend the provision of electrical outlets on light posts.

G.16.0 COMMUNITY MAILBOXES (SUPER MAILBOXES)

Prior to the installation, erection, relocation, or removal of any Community Mailboxes within the Village of Thorsby, written approval shall be obtained from Canada Post. These boxes shall be placed in the most aesthetic manner possible while addressing concerns of safety and municipal and franchise utility operations. They shall conform to the following criteria for site selection:

16.1. DESIGN CRITERIA

Sighting considerations should address concerns regarding visual intrusion, traffic and pedestrian conflicts, traffic lines of sight, buried services, proximity to intersections, access to abutting, properties and site maintenance. Specific requirements for the Community Mailboxes are:

1. Where there is a sidewalk at a site, the box shall be installed directly behind the walk, facing the roadway. No boxes are to be located between the curb and sidewalk. Where no sidewalk exists, the box shall be installed facing the roadway.
2. A minimum setback of 2.0 m while still within the public right-of-way. Easement must be obtained if insufficient space exists.
3. No island or centre median site locations are permitted.
4. The curb is not to be lowered to accommodate wheelchair or other such access.
5. All locations are to be recorded on the appropriate as-built record drawing(s).
6. The access is to be a minimum of 2.0 m in width and constructed of poured-in-place unreinforced concrete, a reinforced concrete pad, or interlocking brick and shall be as long as required to reach the site. The pad is to be a minimum of 125 mm in depth with a maximum slope of 1:12.

16.2. MATERIALS

All materials are to conform to the standards and specifications contained in Section G of this Manual unless otherwise approved by the Village in writing.

16.3. INSTALLATION

1. All installations shall be accomplished as quickly and with the least amount of disruption as possible.
2. Subgrade Preparation - The subgrade shall be finished to conform to the required section, grade and density prior to the placement of the pad.
3. Forming - All forms shall be well staked and braced to the established line and grade.
4. Placing concrete - Concrete shall be placed only after the sub-base and forming have been inspected and approved by the Engineer.
5. Precast Pads - Such pads shall be constructed to the sizes and dimensions shown on the approved drawings and conform to CSA Std. A251. and contain reinforcing steel as noted on the attached "Pre-Cast Foundation - Type A" Figures G.2.16 and G.2.17.

6. Levelling - The boxes shall be installed to the requirements noted on Standard Drawings.
7. A toll free emergency telephone number for Canada Post shall be affixed to the box or otherwise made available on a 24-hour basis.

G.17.0 MISCELLANEOUS

17.1. CULVERTS

1. General
   a. Culverts shall be placed so that the minimum distance from the finished grade of the roadway to the top of the pipe shall be not less than one-half the diameter of the pipe or a minimum of 1 metre unless approved otherwise.
   b. A trench shall be excavated to the required depth and grade with the bottom shaped to conform to the bottom of the pipe to ensure 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 dug below the grade as ordered, and backfilled with approved granular material and thoroughly tamped, or otherwise compacted, to ensure an unyielding foundation.
   c. 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 grade established for the bottom of the pipe, and this additional excavation shall be backfilled with suitable material in such manner as to ensure a uniform bearing for the length of the culvert.
   d. Selected backfilling material, properly graded and free of frozen lumps, etc., shall be placed under and around the pipe and thoroughly tamped or otherwise compacted in place. The trench shall be completely filled and the pipe covered to a depth of at least 300 mm with hand placed and properly compacted material before the construction of the embankment over the culvert proceeds.
   e. If a trench is not required, the culvert pipe shall be laid true to line and grade, on a bed that is uniformly firm throughout its entire length, and the backfilling around and over the pipe shall be completed as specified in the preceding paragraph.
   f. When using corrugated pipe, the pipe shall be laid in the trench with the separate sections firmly joined together and with outside laps of circular joints pointing upstream and with longitudinal laps on the side. Corrugated pipe shall be so handled as to prevent damage to the pipe. In no case shall pipe culverts be dragged on the ground.
2. Removing Existing Culverts and Structures

   Where it is necessary to remove any existing culvert or structures from the grade or right-of-way, the Developer shall carefully remove and pile or place the materials as directed by the Engineer.

3. Rip-Rap

Embankments, the ends of culverts, and ditch bottoms may be protected by rip-rap as directed when required by the plans or as ordered by the Engineer.

a. Hand Laid Rip-Rap

Hand laid rip-rap 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, right, and reasonably plain surface, varying not more than 75 mm from the required contour.

b. Random Rip-Rap

Random rip-rap, graded so that the smaller stones are 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 rip-rap into that of hand laid rip-rap.

c. Sacked Concrete Rip-Rap

- Burlap Sacks

  Burlap sacks will be of approximately 40 litre capacity and supplied by the Developer.

- Fabric-formed Concrete

  Filter Point fabric (e.g. Fabricform) shall consist of a double layer of fabric woven together in such a manner to provide filter points on 200 mm centres for the relief of hydrostatic uplift pressure. The grout shall consist of a mixture of Portland cement, fine aggregate, and water, so proportioned and mixed as to provide a readily pumpable slurry and shall exhibit a minimum compressive strength of 30 MPa at 28 days. No simple butt joints are to be used; the material is to be field signed and the edges are to be embedded to a depth of at least 0.3 metres along the entire perimeter. No grouting is to occur when the ambient temperature is below 4º C (unless provisions for heating are made) and the fabricform is not to be laid on frozen ground. The fabricform installation shall be supervised directly by a qualified manufacturer's representative.

- Base Preparation

  The base shall be formed by excavating, filling, and shaping to the required depth below and parallel to the finished surface of the rip-

rap. The entire base shall be thoroughly compacted to provide a smooth and firm foundation of uniform density.

- Placement

  Each burlap sack shall be filled to two-thirds (2/3) of its capacity with concrete or soil cement, securely sewn or stapled to form a straight edge closure and immediately placed in its final position on the prepared base. The filled sack shall be kneaded, rammed, and packed into conformance with the prepared base and adjacent sacks already in position to form a closely molded smooth surface of uniform average depth of not less than 125 mm.

  All joints between rows shall be staggered and all dirt and debris removed from the top of sacks before succeeding courses are placed. Not more than five (5) courses of sacks shall be placed in any tier before such initial set has taken place in the first course of any such tier. Following placement, the sacked concrete or sacked soil cement shall be kept moist for a period of twenty-four (24) hours by sprinkling, moist earth covering, or other satisfactory means.

17.2. VEHICULAR BARRIERS

1. Vehicular barriers should be constructed at the following locations:
   a. across the end of a lane cul-de-sac which abuts a roadway;
   b. across the end of a walkway which terminates in a lane;
   c. along a lane which parallels an adjacent roadway;
   d. near permanent bodies of water;
   e. at areas showing a large difference in grade separation;
   f. bridge abutments;
   g. retaining walls; or
   h. as a longitudinal divider on narrow medians.
2. While vehicular barriers are designed to reduce the hazard of errant vehicles leaving the highway surface, they themselves must also be considered as hazards. Their purpose is to shield those hazards which cannot be eliminated. Installation is warranted only where the severity of an accident without the barrier is greater than that of a collision with the traffic barrier itself.
3. W-Beam Guardrail
   a. Materials
      - Posts and Blocks shall be in accordance with Alberta Transportation Standards and be of the following dimensions:

Posts	200 x 200 x 1,800 mm (minimum) 200 x 150 x 1,800 mm (minimum)

Blocks	200 x 200 x 350 mm 200 x 150 x 350 mm

- Guardrail and Anchor Block Hardware - Guardrail shall be Amo "Flex-Beam", 2.7 mm thick galvanized steel. Bolts, nuts and washers shall be hot-dipped galvanized medium steel of 50 mm diameter.
- Concrete shall be Type 50 and have a minimum compressive strength of 30 MPa at 28 days.

b. Installation

- Posts shall be set plumb to a height, line and grade adjusted to give the entire guardrail installation a uniform and pleasing appearance in line and grade. The top, bottom and centre of the W-Beam rail shall bear on each block and laps shall be in the direction of the traffic flow. Bolts shall be tightened with exposed threads buried and shall not extend beyond the nuts by more than 13 mm.

17.3. FENCING

Uniform wood fencing and gates shall be constructed in accordance with the Standard Drawings for fencing and shall be constructed adjacent to and at the following locations:

1. arterial roadways;
2. parks and playfields;
3. public walkways and utility lots;
4. school sites;
5. Village owned lands;
6. multiple family sites;
7. institutional sites; and
8. other areas as required by the Village.

17.4. BACKFILLING UTILITY TRENCHES ON VILLAGE RIGHTS-OF WAY

All ditches, trenches, and cuts on Village right-of-ways shall be done with a minimal amount of disturbance. The backfill must be an approved material placed in uniform lifts not exceeding 300 mm (loose depths) to a density of not less than 97% of the Standard Proctor Density. No excavation shall be closed until compaction has been approved by the Village.

STANDARD DRAWINGS - TRANSPORTATION

G.1 ROAD SECTIONS

G.1.1 18 m Right of Way - 9 m Local Residential
G.1.2 24 m Right of Way - 11.5 m Residential Collector - Minor
G.1.3 24 m Right of Way - 13.5 m Residential Collector - Major
G.1.4 33 m Right of Way - 15.8 m Undivided Arterial
G.1.5 33 m Right of Way - 16.8 m Divided Arterial
G.1.6 44 m Right of Way - 16.8 m Divided Arterial
G.1.7 21.5 m Right of Way - 10.5 m Local Industrial
G.1.8 23 m Right of Way - 12 m /13 m Collector Industrial
G.1.9 Typical Overlay Section
G.1.10 6 m Right of Way - 5.8 m Paved Residential Lane

G.2CONCRETE STRUCTURES

G.2.1 150 Curb with 500 Gutter
G.2.2 150 Curb with 250 Gutter
G.2.3 Roll Face Curb & Gutter
G.2.4 Concrete Gutters
G.2.5 Concrete Curb
G.2.6 1.5m Walkway
G.2.7 1.5m Monolithic Sidewalk
G.2.8 Roll Face Monolithic Walk and Gutter
G.2.9 Residential Crossing - Separate Walk
G.2.10 Residential Crossing - Monolithic Walk
G.2.11 Lane & Commercial Crossing - Separate Walk
G.2.12 Lane & Commercial Crossing - Monolithic Walk
G.2.13 Typical Curb Ramp
G.2.14 Precast Community Mailbox Association

G.3MISCELLANEOUS

G.3.1 Pavement Markings
G.3.2 Crosswalk & Stop Line Markings
G.3.3 Standard Crosswalk Markings
G.3.4 Parking Curb - Precast Concrete
G.3.5 Barrier Posts
G.3.6 Guard & Barrier Post Details
G.3.7 Culvert Details
G.3.8 Culvert Backfill Details
G.3.9 Parking Curb
G.3.10 Box Beam Guardrail
G.3.11 Box Beam Guardrail

Table G-1 - Summary of Recommended Design Standards for Urban Streets*

Classification	Traffic Volumes (v/d)	Design Speed (km/h)	Speed Limit (km/h)	Min. Radius of Curvature (m)	Max. Gradients (%)	Min. Gradients (%)	Max. Super Elevation (m/m)	Pavement Width (m)	Parking Lanes (m)	Travel Lanes (m)	Recommended ROW (m)	Intersection Spacing (m)	Lighting Columns and Other Obstructions	Parking	Access
Residential Cul-de-sacs	N/A	N/A	50	90	6	0.6	N/A	9.0	N/A	N/A	18.0	60	See Std. Drawings	Permitted	Driveway
Residential Locals	Up to 1000	N/A	50	90	6	0.6	N/A	9.0	N/A	N/A	18.0	60	See Std. Drawings	Permitted	Driveway
Industrial Local	N/A	N/A	50	90	6	0.6	N/A	10.5	Optional	N/A	21.5	60	See Std. Drawings	Optional	Driveway
Residential Collector	1000-5000	60	50	150	6	0.6	0.06	11.5/13.5	2.0-2.5	2.0-3.7	24.0	60	See Std. Drawings	Permitted	Driveway
Industrial Collector	N/A	60	50	150	6	0.6	0.06	12.0/13.0	Optional	N/A	23.0	60	See Std. Drawings	Optional	Driveway
Urban Arterials-Undivided	5000-12,000	70-80	50-60	225	5	0.6	0.06	15.8	None	3.7-4.0	33	250	See Std. Drawings	No	Restricted
Urban Arterials-Divided	12,000-30,000	80	50-70	225	5	0.6	0.06	16.8	None	3.7-4.0	33.0**	400	See Std. Drawings	No	Restricted

Notes:

* Intersection requirements are stricter than have been outlined for the roads.

** Land for noise attenuation will be in addition to the road right-of-way requirement,
6 lane divided should be 44 meters.
Minimum gradient 0.8% on curb radii of 23m or less
Minimum length of curves shall be 45m.

TABLE G-2 - TESTING FREQUENCY

ASTM or CSA Test	Test #	Embankments	Subgrade Preparation	Cement Stabilized Subgrade	Granular Sub-Base Course	Hot Mix Asphalt	Concrete	Granular Base Coarse	Subgrade Under Walks & Curb
Density	D2167 D1556 D2922	1 Per 2000 m^2 Per Lift	1 Per 1000 m^2	1 Per 1000 m^2 Per Lift	1 Per 1500 m^2 Per Lift	1 Per 1000 m^2 Per Lift		1 Per 1500 m^2 Per Lift	1 Per 150 lin m
Moisture Density Relationship	D558								
Moisture Density Relationship	D698	Method A1 Per Soil Type or 6000 m^2	Method A1 Per Soil Type or 6000 m^2	Method A1 Per Soil Type or 6000 m^2	Method A1 Per Soil Type or 6000 m^2			Method C1 2000 m^2 Per Lift	
Sieve Analysis	C 136 C117					1 Per Shift or 1000 Tonnes			
Full Marshall Analysis (D2726)	C117 C136 D1559 D2041 D2172					1 Per Shift or 1000 Tonnes			
One Mold + Marshall Density Only (Core)	D2726 D1559 D3203					1 Per 1000 m^2 Per Lift			
Compressive Strength	C39						1 Per 60 m^3		
Slump	C143						1 Per 60 m^3		
Entrained Air	C231						1 Per 60 m^3		
Plasticity Index	D424	As Required			As Required			As Required	
Thickness						1 Per 1000 m^2 Per Lift			

TABLE G-3 - MIN. RECOMMENDED TESTING REQUIREMENTS

Location	Depth	Density	Test Frequency	Max. Lift Thickness
Trench Backfill				
Plastic - Under Proposed Roadway	All	98% - Standard	1 Per 100 Lineal m for each 150 mm compacted thickness	300 mm - loose
Plastic - Under Existing Roadway	All	98% - Standard	1 Per 100 Lineal m for each 150 mm compacted thickness	150 mm - compacted
Plastic - Adjacent to Roadway	All	96% - Standard	1 Per 150 Lineal m for each 1.5m	300 mm - loose
Non-Plastic - All Areas	All	98% - Standard	1 Per 150 Lineal m for each 0.75m	300 mm - loose
Fill Compaction				
All	All	98% - Standard	1 Per 2000 m^2 Per Lift	300 mm - loose
Subgrade				
All	0 - 0.3 m	100% - Standard	1 Per 1000 m^2 Per Lift	150 mm - compacted
Granular Base Course				
All	0 - 0.3 m	100% - Standard	1 Per 1500 m^2 Per Lift	150 mm - compacted

Notes:

1. Alternative testing requirements regarding the type of test and frequency of testing will be considered.
2. Routine tests and sample locations shall be randomly selected as far as it is practical to do so. (Routine testing is that testing required as a check to adherence to the quality of a contract item for which a unit bid price exists, at a frequency as called for in Table G.2, “Test Frequency”.)
3. Unless stated otherwise , routine testing shall be performed at the contractor’s expense.
4. Re-tests (tests to verify a routine test that has failed to meet the minimum requirement of a specification) shall be performed at the contractor’s expense.

SECTION H – LANDSCAPING, FENCING AND MISCELLANEOUS

UNIFORM WOOD FENCING AND GATES

CHAIN LINK FENCING

SITE FURNISHINGS AND SITE SIGNS

LANDSCAPING

H.1.0. DESCRIPTION

This section specifies the requirements for placing topsoil, seeding, sodding, watering, fertilizing, cutting vegetation and maintenance procedures during warranty period on all Village's green belt and roadway rights-of-way areas.

H.2.0. MATERIALS

All materials used are subject to inspection, testing and approval by the Village.

2.1. TOPSOIL

1. Topsoil requirements
   a. It shall be of a natural, fertile agricultural soil of the "A" horizon layer capable of sustaining vigorous plant growth.
   b. It shall be free of subsoil, clay lumps, stones, live plants and other roots, sticks or other extraneous matter.
   c. It shall be the best of quality and screened.
2. Recommended soil composition
   a. 35% Sand; 30% Clay; 35% Silt;
   b. Organic matter 5 - 10 %
   c. Free of toxic materials
   d. Electrical conductivity of max. 1.5 ohms per cm^2
   e. pH of 6.0 - 7.5.
3. Contractor Submission

   The contractor shall submit a sample and an independent laboratory analysis of topsoil from each source to be used in the performance of this contract seven calendar days in advance of delivery to the site. The laboratory analysis shall include tests for N, P, K, minor element values, soluble salt content, electrical conductivity, pH and physical values (sand, clay and organic material). If necessary, correct additions, e.g. bonemeal, limestone, pesticides, phosphates, sulfates shall be added as approved by the Village.

2.2. SEED MIXTURE

1. Requirements:
   a. Grass seed shall be Canada #1 certified seed meeting the requirements of the "Canadian Seeds Act."
   b. The mixture shall comply with federal and provincial seed laws and have a minimum germination of 75% and a minimum purity of 97%.
   c. Bags containing the seed mixture shall be clearly tagged, showing the name of the supplier, the contents, the date bagged and location, and the year of seed production.
2. Seed varieties shall be mixed and application rate set to suit the planting conditions and location. Acceptable seed mixes and application rates are

outlined in Table H.1. Other mix designs may be used, subject to the approval of the Village.

2.3. SOD

1. Sod shall be certified No. 1 cultivated turf grass sod of the type as specified on the Plant List, grown and sold in accordance with the classification of the Nursery Sod Growers Association of Alberta and Western Turfgrass Association Standards. At time of sale it shall have a strong, fibrous root system and shall be free from stones and burned or bare spots.
2. Sod shall consist of a uniform mixture of the industry standard mix as per Sod Growers Association of Alberta latest manual, or approved equal.
3. Cutting Requirements
   a. Sod shall be cut by approved methods in accordance with the recommendations of the Sod Growers Association of Alberta and/or the Canadian Nursery Trade Association shall be:
   b. a minimum of eighteen months old
   c. of a quality that satisfies weed tolerance rates as outlined by the Growers Association
   d. 20 - 25 mm in uniform thickness
   e. cut in strips of uniform width
   f. sufficiently moist so that no burning of the edges has occurred
   g. harvested at 12 mm soil depth, cut uniform free of any holes and tears

2.4. FERTILIZERS

1. Fertilizer
   a. shall be packed in standard containers, clearly marked with the name of the manufacturer, mass and analysis. Use only standard commercial fertilizer with guaranteed chemical analysis
   b. All fertilizer shall be stored in a weatherproof storage place and in such a manner that it will stay dry and its effectiveness is not impaired.
2. Root Starter
   a. Slow release formulated 16-32-0 or 11-54-0
   b. Polymer coated slow release urea if available.

2.5. PEAT MOSS

1. If organic material is required to meet the organic material specifications for topsoil, peat moss shall be added in the field and thoroughly mixed with cultivation equipment. The peat moss shall meet the following specifications:
   a. free of toxic material, live plants, live roots, seeds or other deleterious material
   b. delivered in a pulverized condition
   c. approved prior to mixing with the topsoil

d. of a pH not less than 4.5 and not greater than 6.0

2.6. TREES, SHRUBS, AND VINES

All plant material shall conform to the horticultural standards of the "Canadian Nursery Trades Association" standards for Fort Saskatchewan area. Nomenclature (plant names) shall conform to the rules of the international code of nomenclature for cultivated plants. All plants shall be nursery grown, unless approved otherwise of sound stock, typical of their species or variety. Preference will be given to local growers.

1. Stock - They shall be healthy (free from damage, disease and pests, eggs or larvae), well-branched, densely foliated when in leaf with well developed root systems and of the specified caliper and height. All undersized or girdling root systems will be rejected. Stock shall be free of mechanical damage. Tags shall remain until inspection is complete.
2. When in excess of 40mm, caliper shall be the determining measurement
   a. Deciduous trees with a caliper up to 100mm shall be measured no less than 15cm above the ground
   b. Deciduous trees with a caliper 100mm and larger shall be measured no less than 30cm above the ground
3. Species of trees, shrubs, and vines shall be selected to suit the planting conditions and locations.
   a. For parks, open spaces, and naturalization areas, diversity of species, aethestetics, hardiness, disease resistance, natural occurance, rate of growth and growth habit, and ratio of trees, shrubs, and perennials shall be considered when selecting varieties. Acceptable trees, shrubs, and vines are outlined in Table H.2.
   b. Special consideration shall be given to the suitability of a species (including size, growth habit, hardiness, and maintainability) for boulevard and median plantings. Acceptable boulevard trees are outlined in Table H.3.
4. Substitutes will not be permitted unless approved in writing by the Village.
5. Bare Root Shrubs shall be planted with adequate fibrous roots retained. The minimum size of root balls for trees shall be as specified below:
6. Balled and Burlapped Plants

   Such plants shall be dug with firm natural balls of earth to sufficiently include most of the fibrous roots. Ball sizes shall meet the following specifications based on the tree sizes:

Deciduous Trees

Caliper (mm)	Root Ball Diameter (mm)	Machine Ball Diameter (mm)
25	600	-
50	750	860
75	900	1220
100	N/A	1520
125	N/A	1520
150	N/A	2280
200	N/A	2280
250	N/A	2280

Coniferous Trees

Height (m)	Root Ball Diameter (mm)	Machine Ball Diameter (mm)
1.50 – 2.40	900	1220
2.50 - 3.00	1220	1520
3.00 – 3.50	1220	2280

6. Container Grown Stock

   Such stock shall be grown in a container long enough for the root system to have developed sufficiently to hold its soil together - no plants shall be loose in the container. Soil shall have sufficient moisture.

7. Trees and Shrubs

   All plant material shall conform to the horticultural standards of the latest edition of the “Canadian Standards for Nursery Stock.” Nomenclature (naming system) shall conform to the rules of the international code of nomenclature for cultivated plants. All plants shall be nursery grown, unless otherwise approved, and of sound stock, typical of their species or variety.

8. Materials

   a. Fertilizers shall be 8-24-24 or approved equal delivered as specified in standard size, unopened containers, showing the weight, analysis and manufacturer's name, and will specify as either coniferous or deciduous.

   b. Tree Stakes shall be 2.0 - 2.5m in length and of the steel "T" bar type.

   c. Tree Ties shall be a number ten (#10) gauge galvanized wire inserted into a 200 mm length of 10 mm diameter polythane plastic tubing. Tree ties shall be marked with orange flagging type.

2.7. WATER

Water shall be free of any impurities that would inhibit germination or otherwise adversely affect growth.

2.8. LIME

Lime to be used where the pH of the soil is less than 6.0 shall be ground limestone containing not less than 80% of total carbonates combined. It shall be ground to such fineness that at least 50% will pass a 100-mesh sieve and at least 90% will pass a 20-mesh sieve. Where limestone is specified it shall be stored in such a manner as to stay dry and free flowing.

2.9. MULCHING MATERIAL

Mulching material shall be deciduous wood cellulose fiber or approved equal, clean, dry and free of weeds and other foreign matter.

H.3.0. CONSTRUCTION

3.1. WEED CONTROL

The Contractor shall be responsible for the control of existing weeds and all subsequent weed growth within the contract site(s) as shown on the plans or in the list of locations from the date the contract is awarded or the date that the location is made available until the completion certificate has been issued. The "Alberta Weed Control Act" shall govern.

3.2. SUBSOIL PREPARATION

All weeds, roots, stones larger than 50 mm in diameter and other foreign matter shall be removed from the surface of the subsoil. Immediately before placing topsoil the subsoil shall be loosened to a depth of not less than 50 mm by means of a disc, spike tooth harrow or other means satisfactory to the Village and leveled to a firm, even surface. The final grade shall be 150 mm (or as specified) below the adjacent top of curb and/or subgrade and sloped so that no ponding or runoff onto adjacent private property occurs.

3.3. EXISTING APPURTENANCES

All existing utilities shall be adjusted to finished grade elevations and all existing features (curbs, sidewalks, trees, monuments, valves, etc.) shall be protected against any damage.

3.4. TOPSOIL PLACEMENT AND CULTIVATION

1. Placing
    a. The topsoil shall be uniformly spread on the prepared subsoil to a minimum compacted depth of 150 mm (6 inches) (or as specified). Topsoil shall not be placed when either the topsoil or subsoil is frozen, excessively wet, extremely dry or otherwise in a condition detrimental to proper grading, compaction or cultivation. The upper 50 mm shall be of a fine texture and free of stones or lumps 6 mm or larger. Allowances for settlement shall be provided where necessary. Manually spread topsoil around trees, plantings or the structures to prevent damage.

b. If required, lime shall be well worked into the soil before the application of any fertilizers to obtain a minimum pH value of 6.0.

2. Cultivation

   After topsoil placement the area shall be thoroughly disced, harrowed and floated to a minimum depth of 75 mm. All hard lumps shall be broken down and all stones larger than 50 mm in diameter, roots, stumps and other foreign matter shall be removed and disposed of.

3. Fertilizer

   The application rate shall be 10 kg/100 m2 with an approved spreader and be well worked into the upper 75 mm of soil.

4. Compaction

   Topsoil shall be compacted to 80 - 85% standard Proctor density.

5. Finishing

   Float the surface until smooth and fine grade to eliminate rough or low areas. Final grade for seeded areas shall be flush with adjacent surfaces, for sod shall be 25 mm below finished grade of adjacent work.

3.5. PLANTING

The location of all trees and shrubs are to be marked and approved prior to installation at the correct grade and alignment, species, spacing, and sizing as noted in Table H.3. Three working notice to the Village prior to commencement of planting.

1. Planting Season
   a. Spring (April 15 – June 15), or
   b. Fall (August 15 – October 15)
   c. All coniferous material – planted in spring season only.
2. Planting Location

   Contractor stake the location of all plantings for approval by the Village.

3. Site Preparation

   Rough grading, excavation to required depth and the preparation of subgrade to receive topsoil and tree planting, and fine grading.

4. Tree Planting
   a. Trees larger than 75mm caliper shall be moved by machine.
   b. Tree pits shall be excavated 400mm (16 inches) greater in diameter than the ball of earth or spread of roots of the tree and deep enough to allow for a 150mm layer of the planting mixture beneath the ball or roots.
   c. Trees shall be set straight in the Centre of the pits, at such a level that after settlement, the crown of the plant will be 25 mm lower than the surrounding finished grade. Trees to be faced to give the best appearance or relationship to adjacent structures, walkways or park features. Top 1/3 of wire basket to be folded back or removed and top 1/3 of burlap to be cut back and removed.

d. All plants shall be pruned after planting to the minimum necessary to remove dead or injured branches and to compensate for the loss of roots. Pruning practice according to the I.S.A.

5. Tree Staking
   a. Deciduous Trees (bare root) shall be supported by a tree stake driven securely into the ground, plumb and on the windward side of the prevailing wind. The tree shall be fastened to the stake with a tree tie. (See Std. Dwg. H2.1)
   b. Evergreens and Deciduous Trees (Balled and Burlapped) shall be supported by two (2) steel bars driven securely into the ground and fastened with a tree tie. (See Std. Dwg.)
   c. All plants to be pruned according to industry practices
6. Protection of Tree Base

   All newly planted trees are to be protected at the base with a horticulturally approved arbor guard.

6. Shrubs Planting

   Shrub beds to be prepared to a depth of 450mm below finished grade. Installation to include 300 mm depth topsoil, optional weed liner and landscape edger where specified and 100 mm depth wood chip mulch of other specified decorative mulch, Install week liner and edger as per manufacturer's specifications.

7. Fertilizer

   Fertilizer shall be applied evenly over the pit at the following rate when approximately two thirds of the plant pit has been backfilled with soil:

Vines, Groundcover	0.03 Kg/plant
Herbacious Plants	0.03 Kg/plant
Small Shrubs	0.06 Kg/plant
Small Trees	0.25 Kg/25 mm of caliper
Shade Trees	0.50 Kg/25 mm of caliper
Evergreens	0.03 Kg/300 mm of height

3.6. SEEDING

1. Condition of Seedbed

   The Contractor shall obtain approval of the seedbed from the Village's Operation Departments before proceeding with any seeding. The seedbed shall be free of frost, snow or standing water. Seeding shall not occur if the soil temperature is below $13^{o}C$.

2. Wind

   Seeding shall not be carried out when wind velocities are above 8 km/h.

3. Slopes Three Horizontal to One Vertical or Less
   a. Grass seed shall be sown at a rate ($kg/100m^2$) as per supplier recommended in two passes of a mechanical spreader at 90^{o} to each other.

b. Seed shall be applied by means of an approved mechanical dry seeder "Brillion" or approved equal which can roll and cover the seed with 3 mm to 6 mm of soil. Where the above type of equipment cannot be used, seeding may be done by a cyclone seeder or equivalent dragged with flexible wire mat and rolled with a light turf roller weighing between 90 and 114 kg into the prepared seedbed in two directions in equal amounts.

4. Slopes Greater Than Three Horizontal to One Vertical

   A hydro-seeder of approved design capable of thoroughly mixing water, grass seed, fertilizer and pulverized wood fiber shall be used at the following rates:

   - Grass Seed 24 kg/1000 m^2
   - Water 468 L/1000 m^2
   - Mulch 170 kg/1000 m^2
   - Fertilizer 50 kg/1000 m^2

   OR

   In lieu of using a hydro-seeder, seeding may be done as described in Section (3) above, but the seeded slope shall be protected with approved erosion control blanket installed to manufacturers specifications to prevent erosion.

5. Watering

   If watering is required it shall be with a fine spray which will not create any erosion problems.

   NOTE: Any seed which fails to germinate for whatever reasons, shall be re-cultivated and re-seeded until germination has taken place at the developer's expense.

6. Supplementary Seeding & Fertilizing

   Approximately six weeks after germination the area shall receive a supplementary application of an organic fertilizer at rates determined by soils tests. If seed fails to germinate within four growing months recultivate and reseed until germination takes place.

3.7. SODDING

Sodding is required on slopes that are three horizontal to one vertical or steeper, or where specified by the Village.

1. Subsoil Preparation

   On slopes less than two horizontal to one vertical the subsoil shall be prepared as specified in Section 3.2 above.

2. Sod Laying

   a. The Contractor shall obtain approval from the Village's Operation Departments before proceeding with any sodding.

   b. Sod shall be laid evenly with staggered joints closely butted together and matched to the existing grades or surrounding areas.

c. All areas shall be rolled with a medium roller (90 to 114 kg) to provide close contact between sod and topsoil and to produce a smooth and even surface. Sod shall be laid at right angles to the slope along the contours of the slope. On slopes of three horizontal to one vertical or steeper pegs/staples shall be driven full depth on intervals of 1 m.

3. Watering
   a. The sod shall be watered sufficiently to saturate the upper 100 mm of soil immediately after installation. After sod and soil has dried sufficiently to prevent damage, the area shall be again rolled with a medium roller to ensure a good bond between sod and soil and to remove minor depressions and irregularities.
   b. Adequate watering shall again be applied immediately following rolling to saturate the upper 100 mm of soil. Watering shall be carried out when required to prevent grass and underlying soil from drying out for a minimum period of 15 days after placement or until the sod is well rooted and established.
4. Supplementary Fertilizer Application

   Approximately four weeks after sod laying, and after the initial cutting, the sodded area shall receive an application of organic fertilizer, rates determined by soils tests.
5. Workmanship

   The finished turf shall be smooth and even, and there shall be no sudden irregularities in the final grade.

3.8. GROWING SEASON

1. Grass Planting

   Grass seed shall not be planted before May 1 or after September 15.
2. Sod Laying

   Sod shall not be laid before May 1 or after September 30. Sod laying on slopes 3:1 or steeper shall not be done when temperature is above 23^{O}C.

TABLE H.1 SEED MIXTURE

GENERAL PARKS AREA MIX

Suitability: for general use in park areas
Mixture: 25% Argyle Kentucky Bluegrass
25% Bluechip Kentucky Bluegrass
25% Tomcat Tall Fixture
15% Creeping Red Fescue
10% Perennial Rye Mix
Application Rate: Seed Drill = 100kg/ha
Broadcaster = 125kg/ha

SPORTS FIELD MIX

Suitability: for use on dry land, non-irrigated sports fields
Mixture: 15% Argyle Kentucky Bluegrass
15% Able 1 Kentucky Bluegrass
15% Nu Destiny Kentucky Bluegrass
20% AC Parkland Crested Wheatgrass
25% Tomcat Tall Fescue
10% Citation Perennial Ryegrass
Application Rate: Seed Drill = 150 kg/ha
Over-seeding Rate: Verticut/Spike Overseeder = 100 kg/ha

Suitability: for use on irrigated sports fields.
Mixture: 20% Award Kentucky Bluegrass
20% Nu Destiny Kentucky Bluegrass
20% Tsunami Kentucky Bluegrass
25% Tomcal Tall Fescue
15% Citation Perennial Ryegrass
Application Rate: Seed Drill = 150 kg/ha
Over-seeding Rate: Verticut/Spike Overseeder = 100 kg/ha

STORM WATER POND MIX

Suitability: Wet Meadow Mix to withstand 2 – 3 weeks of flooding
Mixture: 25% Fowl Bluegrass (Nutracoat)
20% AEC Hillcrest Awned Wheatgrass
15% Nortran Tufted Hairgrass (Nutracoat)
15% ARC Sentinel Spiked Trisetum
15% Fults Distans Alkali Grass
10% Beckmann's Sloughgrass
Application Rate: Seed Drill = 30 kg/ha
Broadcaster = 60 kg/ha
Hydro seeder = 120 kg/ha

Suitability: Dry Meadow Mix to withstand 2 – 3 days of flooding
Mixture: 20% ARC Mountainview Junegrass
20% Adanac Slender Wheatgrass
15% Elbee Northern Wheatgrass
15% Green Needle Grass
10% Sodar Streambank Wheatgrass
10% Nakiska Sheep Fescue
10% Blue Grama (Nutracoat)
Application Rate: Seed Drill = 30 kg/ha
Broadcaster = 60 kg/ha
Hydro seeder = 120 kg/ha

HIGHWAY/ROADSIDE MIX

Suitability: highways and roadsides including ditch sides and bottoms.
Mixture: 25% Slender/Awed Wheatgrass
15% Green Needle Grass
15% Fringed Brome (Nutracoat)
10% Northern Wheatgrass
10% Indian Rice Grass
10% Canada Wildrye
10% Alkali Grass
05% Western Wheatgrass
Application Rate: Seed Drill = 30 kg/ha
Broadcaster = 60 kg/ha
Hydro seeder = 125 kg/ha

TEMPORARY COVER MIX – DISTURBED AREAS

Suitability: For disturbed soils where development will occur within 1 – 2 years.
Mixture: 25% Annual Ryegrass
75% Perennial Ryegrass
Application Rate: Seed Drill = 100 kg/ha
Broadcaster = 125 kg/ha
Hydro seeder = 200 kg/ha

Suitability: For disturbed soils where development will occur within 4 – 5 years.
Mixture: 25% Annual Ryegrass
25% Argyle Kentucky Bluegrass
25% Turf Type Tall Fescue
25% Perennial Ryegrass
Application Rate: Seed Drill = 100 kg/ha
Broadcaster = 125 kg/ha
Hydro seeder = 200 kg/ha

TABLE H.2 TREES, SHRUBS, AND VINES – GENERAL

A) SHRUBS/VINES SPECIES

SPECIES	COMMON NAME
Amelanchier, alnifolia	Saskatoon
Aronia, melanocarpa	Chokeberry
Caragana, arborescens ‘Sutherland’	Sutherland Caragana
Caragana, arborescens ‘Walker’	Walker Caragana
Caragana, arborescens ‘Pendula’	Weeping Caragana
Caragana, pygmaea	Pygmy Caragana
Caragana, frutex ‘Glosbosa’	Globe Caragana
Cornus, sericea/stolonifera	Red Osier Dogwood
Cornus, alba ‘Sibirica’	Siberian Coral Dogwood
Cornus, alba ‘Bud’s Yellow	Bud’s Yellow Dogwood
Cornus, alba ‘Aureo-marginata’	Silver Leaf Dogwood
Cotoneaster, integerrimus	European Cotoneaster
Cotoneaster, lucidus/acutifolia	Hedge/Peking Cotoneaster
Euonymus, nana ‘Turkestanica’	Turkestan Burning Bush
Euonymus, alata	Winged Burning Bush
Euonymus, alata	Dwarf Burning Bush
Hippophae, rhamnoides	Sea Buckthorn
Juniperus, squamata ‘Holger’	Holger Juniper
Juniperus, horizontalis ‘Prince of Wales’	Prince of Wales Juniper
Juniperus, horizontalis ‘Blue Rug’	Blue Rug Juniper
Juniperus, horizontalis, ‘Blue Prince’	Blue Prince Juniper
Juniperus, horizontalis, ‘Hughes’	Hughes Juniper
Juniperus, communis ‘Effusa’	Common Juniper
Juniperus, scopulorum ‘Wichita Blue’	Wichita Blue Juniper
Juniperus, scopulorum ‘Gray Gleam’	Gray Gleam Juniper
Juniperus, sabina ‘Blue Danube’	Blue Danube Juniper
Juniperus, sabina ‘Arcadia’	Arcadia Juniper
Juniperus, sabina ‘New Blue Tam’	New Blue Tam Juniper
Juniperus, sabina ‘Calgary Carpet’	Calgary Carpet Juniper

Lonicera, tartarica ‘Arnold Red’	Arnold Red Honeysuckle
Lonicera, tartaria ‘Sunstar’	Sunstar Tatarian Honeysuckle
Lonicera, x xylosteoides	Miniglobe Honeysuckle
Lonicera, x □rownie ‘Scarlet Trumpet’	Dropmore Honeysuckle (Climber)
Lonicera, x ‘Mandarin’	Mandarin Honeysuckle (Climber)
Parthenocissus, quinquefolia	Virginia Creeper (Climber)
Philadelphus, lewisii	Mock Orange
Philadelphus, lewisii ‘Waterton’	Waterton Mock Orange
Philadelphus, x virginalis ‘Minnesota Snowflake’	Minnesota Snowflake Mock Orange
Philadelphus, x virginalis ‘Snowbelle’	Snowbelle Mock Orange
Physocarpus, opulifolius ‘Diabolo’	Diabolo Ninebark
Physocarpus, opulifolius ‘Luteus’	Golden Ninebark
Picea, abies nidiformis	Bird’s-Nest Spruce
Picea, abies pumila	Dwarf Norway Spruce
Pinus, mugo mughus	Mugo Pine
Pinus, mugo pumilio	Dwarf Mugho Pine
Potentilla, fruticosa Various Cultivars	Potentilla (Shrubbery Cinquefoil)
Prunus, virginiana melanocarpa	Western Chokecherry
Prunus, x cistena	Purple Leaf Sandcherry
Prunus, tomentosa	Nanking Cherry
Prunus, triloba multiplex	Double Flowering Plum
Prunus, tenella	Russian Almond
Ribes, alpinum	Alpine Current
Ribes, aureum	Golden Current
Rosa, x rugosa	‘Various Cultivars’Rose (Explorer Series)
Rosa, x arkansana ‘Various Cultivars’	Rose (Parkland Series)
Rosa, species ‘Various Cultivars’	Hardy Shrub Rose
Rosa, acicularis	Prickly Rose
Rosa, rubrifolia	Red Leaf Rose
Salix, purpurea ‘Nana’	Artic Willow
Salix, brachycarpa ‘Blue Fox’	Blue Fox Willow
Salix, exigua	Coyote Willow

Sambucus, caradensis/nigra 'Aurea'	Golden Elder
Sambucus, racemosa 'Sutherland'	Sutherland Elder
Shepherdia, argentea	Silver Buffaloberry
Sorbaria, sorbifolia	False Spirea
Spiraea, x vanhouttei	Bridal Wreath Spirea
Spiraea, x bumalda 'Anthony Waterer'	Dwarf Pink Spirea
Spiraea, x bumalda 'Froebelii'	Dwarf Pink Spirea
Spiraea, x bumalda 'Goldflame'	Dwarf Pink Spirea
Spiraea, x arguta	Garland Spirea
Spiraea, japonica 'Goldmound'	Goldmound Spirea
Spiraea, japonica 'Little Princess'	Little Princess Spirea
Spiraea, japonica 'Magic Carpet'	Magic Carpet Spirea
Spiraea, japonica 'Shirobana'	Shirobana Spirea
Spiraea, trilobata	Three Lobed Spirea
Symphoricarpos, albus	Snowberry
Symphoricarpos, occidentalis/orbiculatus	Coralberry
Syringa, x prestoniae 'Coral'	Preston Lilac, Coral
Syringa, x prestoniae 'Donald Wyman'	Preston Lilac, Donald Wyman
Syringa, x prestoniae 'James McFarlane	Preston Lilac, James McFarlane
Syringa, x prestoniae 'Minuet'	Preston Lilac, Minuet
Syringa, x prestoniae 'Miss Canada'	Preston Lilac, Miss Canada
Syringa, x prestoniae 'Royalty'	Preston Lilac, Royalty
Syringa, patula	Miss Kim Lilac
Syringa, vulgaris 'Sensation'	Common Lilac, Sensation
Syringa, vulgaris 'Ludwig Spaethe'	Common Lilac, Ludwig Spaethe
Syringa, vulgaris 'Belle de Nancy'	Common Lilac, Belle de Nancy
Syringa, vulgaris 'Congo'	Common Lilac, Congo
Syringa, vulgaris 'Madame Lemoine'	Common Lilac, Madame Lemoine
Syringa, meyeri 'Palibin'	Little Leaf Lilac
Syringa, x hyacinthifora 'Pocahontas'	Hyacinth- Flowered Lilac
Thuja, occidentalis 'Brandon'	Brandon Cedar
Thuja, occidentalis 'Wareana'	Wareana (Siberian) Cedar
Thuja, occidentalis 'Techny'	Techny Cedar
Thuja, occidentalis 'Globe'	Globe (Woodwardii) Cedar
Thuja, occidentalis 'Holmstrup'	Holmstrup Cedar

Viburnum, trilobum	American Highbush Cranberry
Viburnum, trilobum 'Compactum'	Compact American Cranberry
Viburnum, opulus 'Nanum'	Dwarf European Cranberry

B) TREE SPECIES

SPECIES	COMMON NAME
Abies, balsamea	Balsam fir
Acer, tataricum, ssp. Ginnala	Amur maple
Aesculus, glabra	Ohio Buckeye
Betula, papyrifera	Paper birch
Betula, papyrifera 'Chikadee'	Chickadee birch
Betula, pendula (verrucosa)	European weeping birch
Betula, pendula 'Gracilis'	Cutleaf weeping birch
Betula, pendula 'Youngii'	Young's weeping birch
Crataegus, mordenensis 'Toba'	Toba Hawthorn
Crataegus, mordenensis 'Snowbird'	Snowbird Hawthorn
Crataegus, succulenta	Fleshy Hawthorn
Crataegus, cerronis	Chocolate Hawthorn
Elacagnus, angustifolia	Russian Olive
Fraxinus, mandshurica	Manchurian Ash
Fraxinus, pennsylvanica 'Patmore'	Patmore Ash
Fraxinus, pennsylvanica 'Rugby'	Prairie Spire Green Ash
Fraxinus, pennsylvanica lanceolata	Green Ash
Fraxinus, pennsylvanica 'Heuver'	Foothills Green Ash
Larix, sibirica (russica)	Siberian Larch
Larix, laricina	Tamarack
Larix, decidua	European Larch

Malus, x adstringens ‘Thunderchild’	Thunderchild Flowering Crab
Malus, x adstringens ‘Dolgo’	Dolgo Flowering Crab
Malus, x adstringens ‘Kelsey’	Kelsey Flowering Crab
Malus, x adstringens ‘Makamic’	Makamic Flowering Crab
Malus, x adstringens ‘ Strathmore’	Strathmore Flowering Crab
Malus, x adstringens ‘Royalty’	Royalty Flowering Crab
Malus, x adstringens ‘Selkirk’	Selkirk Flowering Crab
Picea, glauca	White Spruce
Picea, glauca ‘Densata’	Black Hills Spruce
Picea, pungens	Colorado Spruce
Picea, pungens cvs.	Colorado Spruce cvs.
Picea, mariana	Black Spruce
Picea, omorika	Serbian Spruce
Pinus, aristata	Bristlecone Pine
Pinus, contorta latifolia	Lodgepole Pine
Pinus, ponderosa	Ponderosa Pine
Pinus, sylvestris	Scots Pine
Pinus, strobiformis	Southwestern White Pine
Pinus, banksiana	Jack Pine
Pinus, cembra	Swiss Stone Pine
Populus, jackii	‘Northwest’Northwest Poplar
Populus, x canescens ‘Tower’	Tower Poplar
Populus, tremula ‘Erecta’	Swedish Columnar Aspen
Populus, tremuloides	Trembling Aspen
Populus, x ‘Byland Green’	Byland Green Poplar
Prunus, maakii	Amur Cherry
Prunus, mandshurica	Apricot
Prunus, nigra (americana)	Canada Plum
Prunus, x nigrella ‘Muckle’	Muckle Plum
Prunus, padus commutate	Mayday
Prunus, pensylvanica	Pincherry
Prunus, virginiana ‘Schubert’	Schubert Chokecherry
Prunus, virginiana melanocarpa	Western Chokecherry
Pyrus, ussuriensis	Ussurain Pear
Quercus, macrocarpa	Bur Oak
Quercus, alba	White Oak
Salix, acutifolia	Sharp Leaf Willow

Salix, pentandra	Laurel Leaf Willow
Sorbus, americana	American Mountain Ash
Sorbus, aucuparia	European Mountain Ash
Sorbus, aucuparia ‘Fastigiata’	Pyramidal Mountain Ash
Sorbus, aucuparia ‘Rossica’	Russian Mountain Ash
Sorbus, decora	Showy Mountain Ash
Syringa, reticulate/amurensis japonica	Japanese Tree Lilac
Tilia, americana	American Linden
Tilia, x flavescens	Dropmore Linden
Tilia, cordata	Little Leaf Linden
Tilia, cordata ‘Ronald’	Norlin Linden
Ulmus, americana	American Elm
Ulmus, americana ‘Brandon’	Brandon Elm
Ulmus, pumila	Siberian/Manchurian Elm

TABLE H.3 MEDIAN AND BOULEVARD TREE PLANTING

A) DISTANCE BETWEEN SPECIES

Species	Minimum Boulevard Width (m)	Minimum Spacing (m)	Maximum Spacing (m)
American Elm	2.0	15.0	20.0
Brandon Elm	2.0	10.0	15.0
Green Ash	2.0	9.0	14.0
Prairie Spire Green Ash	2.0	8.0	14.0
Foothills Green Ash	2.0	8.0	14.0
Patmore Green Ash	2.0	7.0	12.0
Swedish Columnar Aspen	2.0	3.0	5.0

B) SETBACK - ALL SPECIES

	Minimum Setback (m)
Street Corner	7.5
Light Poles	3.5
Stop & Yield Signs	4.0
Bus Stops	4.0
Other Signs	2.0
Driveways and Walkways	2.0
Fire Hydrants	2.0
Underground and Overhead Utilities, Pedestals, Transformers, and other Street Furniture	2.0

C) SIZE SPECIFICATIONS

	Size
Deciduous Trees	50mm caliper at 15cm above ground
Coniferous Trees	2.0m in height

H.4.0. MAINTENANCE & WARRANTY

4.1. GENERAL

1. Maintenance Period

   Continuously maintain and warranty landscape work as specified for a period of at least two (2) years from the issuance of a Complete Completion Certificate (C.C.C.) and until the issuance of a Final Acceptance Certificate (F.A.C.).

2. Hours of Work

   Perform maintenance work during regular working hours of 07:00 to 18:00, Monday to Friday. Obtain Village approval to do maintenance outside of regular working hours. Provide Village with at least two days advance notification of intent to spray for weed and insect control.

3. Maintenance Log

   Keep Daily Maintenance Log throughout contract and submit Log to Village monthly. Include in Log: detail activities and dates in which activities were carried out. Detail applications of chemicals in Log. Include target weed or insect, mode, type and rate of application of chemical, date, time, weather conditions and results of application.

4. Safety

   The contractor shall provide, erect and maintain barricades, signs and protection that may be necessary for the preservation of public health and safety.

5. Regulatory Approvals

   Provide Village with copies of permits and licenses required by regulatory authorities, including current pesticide applicator's license number.

6. Damage to Property

   The Contractor shall be responsible for all costs incurred related to the liability and damages caused by contractor's personnel and equipment during the term of the contract. Report damages immediately to Village. Obtain approval of Village for repairs and replacements. Return grass areas, plants, equipment and buildings to their original condition before damage. Scalping of turf and mechanical damage to trees including tearing bark shall be considered as damage and shall be repaired to the Village's satisfaction.

7. General Workmanship

   Schedule timing of operations to growth, weather conditions and use of site. Provide copy of schedule for approval by Village. Do each operation continuously and complete within a reasonable time period. Provide equipment and material necessary for maintenance to acceptable horticultural standards. Coordinate maintenance practices with Village. Maintenance schedules may have to be altered to accommodate Village's site activities. Collect and dispose of excess material and debris to municipal disposal site following each day's work. Cleanup shall be a

continuous operation and at no time shall topsoil or debris of any kind be allowed to remain on roadways overnight.

4.2. TURF MAINTENANCE

1. General

   Maintenance shall include all measures necessary to establish and maintain seeded and sodded areas in an acceptable, vigorous and healthy growing condition during the maintenance and warranty period. Proper grades established, should not have divots, low / high spots.

2. Mowing

   Maintain turf with sharp mowers at 60 mm during growing season. Cut as required to maintain specified height. Remove papers, rocks, and other foreign material before cutting. Change direction of cut with each mowing where practical. Do not remove grass clippings from turf areas unless volume is such as to be harmful to turf areas or unsightly. Remove clippings from sidewalks, roads, parking lots, windows or building during the same mowing and remove from site. If growth of turf has exceeded 60 mm, raise mower blades so that not more than 30% of grass blade will be cut at one time. Do not allow turf height to exceed 100 mm.

3. Fertilizing

   Adjust fertilizer requirements according to soil test analysis. Use only mechanical equipment. Check calibration of spreader to ensure that specified rat is used. Spread 50 % of fertilizer in one direction, then 50 % at right angles. Water, immediately after fertilizing, according to manufacture's recommendations; obtain moisture penetration of 50 mm minimum. Apply fertilizer at manufacture's specified rates. Fertilize three times per growing season: Spring – Apply 12-51-0 fertilizer (or approved equal) before May 31st, Summer- Apply 27-14-0 fertilizer (or approved equal) during the first two weeks of July, Fall – Apply 16-20-0 fertilizer (or approved equal) during the last two weeks of August.

4. Watering

   For sodded areas, supply labour, water truck, pumps, potable sprinkler systems and water necessary to provide adequate watering to maintain plant growth during warranty period. Fire hydrants shall not be used as a source of water supply unless written approval is provided by the Village.

5. Topdressing and Reseeding

   Mow grass to height of 40 mm. After mowing, rake thoroughly, removing loose and dead grass, stones and debris. Spread topsoil to maximum thickness of 15 mm, filling in low areas and bare spots. Overseed areas with seed mixture equivalent to existing grasses at manufacturer's specified rates. Rake seed into topsoil. Roll lightly. Water to ensure penetration of 80 mm and at frequent intervals to maintain vigorous growth.

6. Sod Replacement

Cut out areas of dead of unhealthy sod and replace with new sod. All repair areas to be square or rectangular. Rake topsoil before installing new sod. Butt new sod tightly to adjacent existing sod and grades. Roll lightly to reduce contact will soil. Water to ensure penetration of 80 mm and at frequent intervals to maintain healthy growth.

4.3. TREE AND SHRUB MAINTENANCE

1. General

   Tree and shrub maintenance shall include all measures necessary to establish and maintain all plants in an acceptable, vigorous and healthy growing condition during the maintenance and warranty period.

2. Watering

   Deep water trees and shrubs to maintain adequate moisture level within root systems to meet the plant's requirements. The contractor is responsible for supplying loading, hauling and distributing water.

3. Cultivation and Weeding of Plant Beds

   Cultivate upper 40 mm of soil monthly. Edge plant beds evenly to depth of 100 mm in lines of original layout. Remove weeds bi-weekly including their roots. Do not damage roots of plants. Collect and dispose of paper, refuse and dead plants.

4. Staking

   Keep stakes and guy wires taut and plants plumb for duration of maintenance period. Remove flagging/rope from plants at time of planting.

5. Pruning

   The amount of pruning shall be limited to the minimum necessary to remove dead or injured branches. Only clean, sharp pruning tools shall be used. All cuts shall be clean and cut to the branch collar, leaving no stubs. Pruning of trees and shrubs shall be performed by an experienced pruner knowledgeably on horticulture industry standards.

6. Plant Replacement

   All plant materials found dead or not in a healthy, satisfactory growing condition or which, in any other way, does not meet the requirements, shall be replaced immediately by the contractor at the contractor's own expense.

7. Fertilizing

   Apply a high phosphorous fertilizer, 10-52-10 (or approved equal) at manufacture's specified rates at the time of planting and each spring prior to June 1st. No fertilizer should be applied in July or August. Apply water after fertilizing to ensure penetration of fertilizer level.

4.4. WEED, INSECT AND DISEASE CONTROL

1. General Considerations

   Ensure proper, positive identification of infestations and consult with Village before taking corrective action. Before chemical applications, obtain written approval from Village and treatment area to be posted. Use equipment and containers free of harmful residues not related to specific control measures applicable to situation. Perform disease, weed and insect control, in accordance with Provincial chemical application regulation. Notify Village of intent at least three days before any chemical application. Prepare and apply chemical according to manufacturer's specification by licensed applicator. Minimize drift at all times. Carry out treatment with regard to climatic effect on surroundings and occupants of buildings.

2. Weed Control

   Apply chemical to eradicate weeds or perennial grass in turf areas, driveways, interlocking concrete paving stone areas, along fences, storage areas, parking lots, gravel and rip-rap stone areas with boundary of site. Repair and pay for damage caused by application of herbicides. Effectiveness of treatment program to be determined by inspection by Village. Repeat as required.

3. Insect and disease Control

   Make weekly inspection of lawns and plants for insect and disease infestations. Laboratory testing may be required for diagnosis of disease. Apply chemicals based on development stage of insects' life cycles. Repair and pay for damages caused by application of chemicals. Effectiveness of treatment program to be determined by inspection by the Village. Repeat as required.

4.5. SPRING AND FALL

1. Spring

   Complete spring clean-up as soon as working conditions are favourable and by May 15. Remove and dispose of sane, gravel, salt and debris, accumulated during winter months, to municipal disposal site. Remove from site: snow fence, stakes and sand containers. Clean plant beds and planters of debris and dead plant material. Loosen and lightly cultivate soil without disturbing roots of permanent plantings.

2. Fall

   Remove and dispose of annuals form plant beds and planters within one week after first killing frost. Deep cultivate plant beds and planters. Cut back foliage of perennials within one week after killing frost. Stake locations of perennials if required. Deep water trees and shrubs between October 1 to 15.

4.6. FINAL INSPECTION

1. Turf Areas

   Final inspection of seeded and sodded areas will be made prior to the end of the warranty period. At the time of inspection the turf should be mowed and shall be alive and in a healthy satisfactory growing condition, free of weeds. Replacing areas that show root growth failure, deterioration, bare or thin spots or which have been damaged by any means to the satisfactory of the Village.

2. Trees and Shrubs

   Final inspection of trees and shrubs will be made prior to the end of the warranty period. At the time of inspection all non-mulched beds and tree pits shall be freshly cultivated. Mulched beds and tree pits shall be refilled to original specified depths. All planting areas and tree pits shall be free of weeds and debris. Any plant that is dead, not true to name or specified, or not in satisfactory growth, shall be removed and replaced by the contractor.

3. Clean-up

   Clean roadway, walkway and surrounding areas of soil, seed clippings and other debris and restore all disturbed and damaged areas during execution of work to Village's standards.

UNIFORM WOOD FENCING & GATES

H.5.0. DESCRIPTION

1. All uniform wood and metal fencing and gates shall be constructed and installed in accordance with standard detailed drawings H1.1 to H1.10. Uniform wood fencing shall be constructed adjacent to the following:
   a. Expressways and Arterial Roadways
   b. Parks and Playfields
   c. Public Walkways and Utility Lots
   d. Village Owned Lands
   e. School Sites
   f. Multiple Family Sites
   g. Neighborhood Commercial Sites
   h. Institutional Sites
   i. Other areas as required by the Village
2. All wooden fence material shall be pressure treated cedar or approved alternative and stained or painted (2 coats). The applicant shall be responsible for, and at his own expense, correcting any defect, deficiency or fault in the completed work prior to the end of the specified maintenance period. The work is to comply with the applicable requirements of the Alberta Building Code, latest revision thereof.

H.6.0. MATERIALS

All materials used are subject to inspection and approval by the Village. Materials are to be protected from weather at all times.

6.1. LUMBER

1. All lumber is to be graded by an agency certified by the Canadian Lumber Standards Administrative Board and marked with a recognized, visible grade stamp.
2. Dimension Board Lumber

   Graded in accordance with National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber and to CSA 0141-1970 and meeting the following criteria:
   a. maximum 19% moisture content at time of installation;
   b. lumber to be rough sawn to sizes noted on the drawings.

6.2. FASTENING DEVICES AND HARDWARE

1. Nails and Spikes in accordance with Alberta Building Code 1981 and as follows:
   - Use common spiral nails except where indicated otherwise.
   - Use hot tip galvanized finished steel for exposed exterior work.
2. Bolt, nut, washer, screw and pin type fasteners:

- hot dip galvanized sheet steel finish to CSA G164-1955 (R1972)

3. Rail Bracket
   - minimum 1.6 mm sheet, galvanized
   - configuration to suit detail
   - to be approved by the Owner prior to installation
4. Fence Post U-Bracket
   - 800 x 152 x 100 mm wide x 6.25 mm thick galvanized sheet steel.
5. Man Gate Hinges
   - No. 311 x 165 mm, quantity - 1 pair, manufactured by Richards-Wilcox Manufacturing company or approved equal.
6. Bow Handles
   - no. 81-#2, (200 mm long) quantity - 2, No. 81-#1 quantity - 1, manufactured by Richards - Wilcox Manufacturing Company Limited or approved equal.
7. Cane Bottom bolt
   - No. 524-#2 (19 x 600 mm long) quantity 7 - 2, with keepers, manufactured by Richards - Wilcox Manufacturing Company or approved equal
8. Man Gate Latch
   - No. 128-#2 (12 x 200 mm long), quantity - 1, manufactured by Richards - Wilcox Manufacturing Company, or approved equal. Furnish with padlock eye
9. Chain
   - to be 38.1 x 22.2 x 6.35 mm diameter galvanized steel, electro-weld type chain, 600 mm long to be looped through vehicle gate bow handles and secured with padlock. Padlock to be supplied by Owner.

6.3. SURFACE APPLIED WOOD PRESERVATIVE

1. Surface apply Cuprinol clear stain or approved equal wood preservative to all wood components. Treat surface of components with wood preservative before installation. Wherever possible apply preservative after components have been cut and fitted to size. Apply preservative by dipping, or by brush or spray to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber.
2. Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of surface applied wood preservative before installation.

6.4. EXECUTION (SEE STANDARD DRAWINGS H1.7-H1.10)

6.5. WOOD FENCE AND GATE COMPONENTS

1. All work to be fabricated and finished as shown on drawings. Members shall fit close and accurately together. Verify all dimensions on site prior to proceeding with fabrication.

2. Whenever possible, members shall be precut prior to treatment. Site cuts are to be treated with two coats preservative brushed in.
3. Allow preservative to cure prior to erecting members.
4. Ensure all ardox nails are installed flush to fence slats.
5. Fence post brackets to be cast in concrete footings as detailed so that final post alignment is plumb. Supply all components required for anchoring fence posts to concrete footings.
6. The wood fence shall provide a firm continuous structure. Finished unit should not utilize any cracked or damaged timber panels or posts. Height of fence panels to remain constant above grade. Difference in height of fence panel in relation to next panel due to grade change to be taken up at fence post between panels.

6.6. CONCRETE

Use Type 50 Sulfate Resistant with compressive strength of 25 MPa at 28 days.

CHAIN LINK FENCING

H.7.0. MATERIAL

1. Pipe material used for fencing shall be hot-dipped, zinc-coated, butt-welded, Schedule 40 seamless steel pipe fabricated in conformance with ASTM A120. Zinc coating shall be not less than 0.61 kg per square metre of total surface area.
2. The use of tubing, conduit, or open seam material will not be permitted.
3. Pipe material shall have the following minimum dimensions:

1.8m Fencing

Type of Post	Outside Dia. (mm)	Min. Weight Per Metre	Min. Wall Thickness
Line Post	60	5.43	3.91
Terminal Post	90	11.30	5.49
Top Rail	42	3.40	3.56
Brace	42	3.40	3.56
Gate Post	100	13.60	5.74

1.2m Fencing

Type of Post	Outside Dia. (mm)	Min. Weight Per Metre	Min. Wall Thickness
Line Post	47	5.43	3.91
Terminal Post	73	11.30	5.49
Top Rail	42	3.40	3.56
Brace	42	3.40	3.56
Gate Post	100	13.60	5.74

7.1. LINE POSTS

Line posts support fencing at points where fabric is continuous. In wet areas they are to be a minimum 3600 mm length. (See Std. Dwg.). All posts are to be capped.

7.2. TERMINAL POSTS

Terminal posts are end posts, corner posts, straining posts, and gate posts, positioned where fencing or fabric is discontinuous and attached to posts by means of tension bars. Posts for barb wire overhang are to be 1050 mm longer than fabric height.

7.3. TOP RAILS

Top rails are horizontal pipes supporting the top selvage of fabric. Top rails shall be continuous at line posts and pass through holes in line post tops.

7.4. BRACES, FITTINGS

Braces are horizontal galvanized 45 mm CD pipes positioned at mid-height of fabric and shall extend from terminal posts to the nearest line post along each

fabric attached to the terminal post. All fittings shall be galvanized steel or aluminum.

7.5. TENSION BARS

Tension bars shall be 5 x 19 mm and shall have a length equal to the height of the fabric.

7.6. TENSION BANDS

Tension bands shall be not less than 9 mm in width and shall be not less than 3.5 mm in thickness.

7.7. COUPLINGS

Couplings shall be an outside type, not less than 175 mm in length, and shall have a material thickness of not less than 3.5 mm.

7.8. EXTENSION ARMS

1. Extension arms shall be malleable iron or cast iron and shall have provision to accommodate 3 strands of barbed wire at 45^{o} angle overhand.
2. The top strand of barbed wire shall be approximately 300 mm above the fabric. Extension arms shall have holes for top rails.

7.9. POST TOPS

Post tops shall be of galvanized steel or aluminum. Line post tops shall have holes for top rails.

7.10. ZINC COATING

1. Zinc coating shall be applied to tension bars, tension bands, fittings, and post tops which are not fabricated from corrosion-resistant material.
2. Zinc coating shall be not less than 0.61 kg/m2 of surface area and shall be applied by hot-dip in conformance with ASTM A123.

7.11. WIRE

1. Tension wire shall be not less than 4.8 mm diameter, single strand, electro-galvanized wire that will withstand at least 6 dips in conformance with ASTM A239. Fabric shall be double galvanized 150 x 150 mm, 3.7 - 180 mm high (See Std. Dwg.).
2. Tension wire shall have an ultimate tensile strength at least equal to that specified for wire for chain link fabric, and shall have a corrosion protection system equal to that specified for fabric.
3. Barbed wire galvanized 2 mm thickness with 4 point barbs at 150 mm centers wire to ASTM A121-77. Fastening clips galvanized to wire.

7.12. GATES (SEE STD. DWGS. H1.2 & H1.3)

1. Gates to be framed with steel pipe ASTM A120-77 standard galvanized. Use 45 mm O.D. pipe for outside frame and 40 mm O.D. pipe for bracing. Galvanize after welding.
2. Gate posts to conform to the following:

Opening	**Gate Post O.D.**
Single to 3.0 m and double to 6.0 m	90 mm 2 hinges per leaf
Single from 3.0 m to 4.3 m and double to 6.0 m	114 mm 3 hinges per leaf provide brace
Single from 4.3 m to 7.6 m and double from 8.5 m to 12.2 m	170 mm 3 hinges per leaf provide brace

   a. Gate fabric to be 3.7 mm galvanized Chain link with 50 x 50 mm mesh.
   b. Gates shall be fabricated with electrically-welded joints, complete with galvanized, malleable iron hinges, lockable latch & latch catch.
   c. Gate latches shall be suitable for padlock which can be attached and operated from either side of the gate.
   d. Gate hinges shall permit a 90^{O} swing both in and out.
   e. Double gates to have Centre rest with drop bolt for closed position and chain hold open for open position.

7.13. CONCRETE

1. Compressive strength 25 MPa at 28 days.
2. Use type 50 Sulfate Resistant Cement.
3. Shop drawings of gates and related appurtenances shall be approved by the Contractor and submitted to the Village for review prior to fabrication of assembly.

H.8.0. WORKMANSHIP

8.1. GRADING

Remove debris and grade between posts to provide ground clearance between 40 mm and 70 mm.

8.2. CONCRETE FOOTINGS

1. All posts shall be set in concrete and the concrete extended above ground (approximately 25 mm) for drainage.
2. Concrete foundations shall be of such size and shape as required to withstand any strain or shocks ordinarily brought to bear on the fence, but not less than indicated below:

Post Type	Diameter of Concrete	Depth of Concrete

	(mm)	(mm)
Line Post	300	1100
Terminal Post	300	1100
Gate Post 100 mm OD	300	1100

a. Concrete for footings shall be compacted by interval vibrator or by rodding, and shall be allowed to set sufficiently before cutting fence - minimum 5 days.
b. If forms are used, compact backfill to density of adjacent in-situ soil.

8.3. POST INSTALLTION (SEE STD. DWG. H1.4)

1. Posts shall be set in concrete footings plumb and true to line. Spaces between line posts shall be uniform and shall not exceed 3.0 meters.
2. Install straining posts where required.

8.4. FENCING (SEE STD. DWG. H1.1)

1. Top rails shall be secured to terminal posts using receptacle fittings, shall be run through holes in line post tops and joined with couplings.
2. Chain link fabric shall be suitably tensioned. Fabric shall be attached to terminal posts using tension bars and bands. Tension bars shall be threaded through fabric mesh and shall be connected to terminal posts by means of tension bands spaced not more than 375 mm apart. Fabric shall be fastened with tie wire to line posts at approximately 300 mm o/c, and to top rails, braces, and tension wire at approximately 450 mm o/c. The bottom selvage of fabric shall be approximately 50 mm, but no more than 125 mm, above finished grade.
3. Bottom tension wire shall be strung along the bottom selvage of the fabric, pulled taut, and firmly attached to terminal posts with suitable fittings.

8.5. GATE INSTALLATION (SEE STD. DWGS. H1.2 & H1.3)

Gates shall be installed at locations shown on the drawings or as directed by the Engineer. Gates shall be hung to be level and 50 mm above finished grade. Gates shall swing into the site 90 degrees. A gate "Spot Post" or other means shall be provided to hold the gate open. Gates shall be so constructed that they can be opened and closed smoothly with minimum effort.

8.6. CLEAN UP

Touch up damaged galvanizing by cleaning with a wire brush and applying two (2) coats of Gal.

SITE FURNISHINGS AND SITE SIGNS

H.9.0 GENERAL

9.1. DESIGN GUIDELINES

1. Select and locate furniture elements to provide service and comfort to the park user.
2. Locate signs and furnishings on the basis of:
   a. safety to park user and maintenance crews, consider pedestrians, cyclists, skiers, individuals with roller blades, etc., and maintenance vehicles,
   b. facilitate routine operational and maintenance programs,
   c. minimize clutter in the landscape, select and locate signs of necessity considering safety of park user and key information.

9.2. INTENT

1. Supply all labor, equipment, materials, products and incidentals necessary to complete signs and furnishings ready for public use.
2. Assemble and finish items ready for installation. Check to ensure all surfaces are smooth to touch, all splinters and burrs removed and marred finishes repaired or refinished.
3. Damaged components shall be repaired or replaced at the direction of the Village.
4. When requested, supply extra materials to Village's storage facility.

9.3. HANDLING AND DELIVERY

Make no deliveries until site conditions are adequate to receive this work. Protect materials from weather while in transit to site. Adequately protect finished surfaces during handling and shipping.

9.4. INSTALLATION

1. Do not install furnishings and signs which encourage public use until the site is ready to sustain such use safely and without damage to surrounding areas.
2. Mark proposed location of signs and furniture items in the field. Prior to continuing with construction, the Owner shall review proposed locations and the Contractor shall have underground utilities marked.
3. Supply and install bollard posts, T-bollards and other barriers as soon as possible.
4. Supply and install safety signs as soon as possible.

9.5. WARRANTY

All materials and workmanship shall be guaranteed for two (2) years from date of sign and/or furnishing installation. Warranties shall be as specified.

H.10.0 MATERIALS AND FINISHES

10.1. GRAVEL

1. 20 mm Crushed Gravel: locally available sound, hard durable particles free from elongated particles, soft shale, organic or other materials.
2. See Section G - Transportation 5.1.a.

10.2. CONCRETE PILES

Supply "Controlled Concrete" with 28 day strengths as defined by CAN3-A23.1-M90 in accordance with following table:

Concrete Strength (Minimum)	25 MPa
Cement Type	50
Exposure Class	S-3
Air Content	5-7%
Aggregate Size (Maximum)	20 mm
Slump	80 ± 20 mm

10.3. CONCRETE SLABS

1. Characteristic Requirements

Concrete Strength (Minimum)	30 MPa
Cement Type	10
Exposure Class	C-2
Air Content	5-7%
Aggregate Size (Maximum)	20 mm
Slump	60 ± 20 mm

Strength	28 day compressive strength per CSA.A23.2.
Type	Cement type as defined in CSA.A23.1 clause 3.
Exposure	Class of exposure per CSA.A23.1 clause 15 for determination of water cement ratio.
Air	Air content % by volume; N = natural air - no air entraining agent.
Slump	As determined in accordance with CSA.A23.2-5C.

2. Add air entraining agent to CAN-A23.1-M90, Section 6.
3. Curing Compound: Liquid membrane conforming to CAN3-A23.1-M90.
4. Preformed Joint Filler: Asphalt impregnated type to ASTM D1751-73.
5. Poured Joint Filler: Asphalt elastic compound to ASTM D1190-74 (1980).
6. Welded Wire Fabric: 150 x 150 - MW 11.1 x M2 11.1 welded wire mesh to CSA G30.5M, flat sheets.
7. Reinforcing Steel: 10 M bars to CSA G30.12-M77.

8. Forms: pre-manufactured and profiled steel forms, wooden or steel forms for curved sections.
9. Form oil: non-staining mineral type.

10.4. TIMBERS

1. Wood bollard posts and posts for title sign, 250 x 250 square, spruce, pressure preserved CCA-PEG or ACZA, green. CAN/CSA O 80.0-M89, M1-89, M3-89 and CAN/CSA - O 80.1-M89, Preservative Treatment of All Timber Products by Pressure Processes, and CAN/CSA - O 80.5-M89, Preservative Treatment of Posts by Pressure Processes.
2. Wood shall be incised.
3. Wood members round or sawn greater than 114 mm shall be treated by full cell process.
4. All lumber shall be stamped ACA or CCA.
5. All lumber shall be dried to a moisture content not exceeding 25%.
6. Cut ends of timbers shall be carefully painted with two (2) coats green CCA or ACA preservative to match preservative used on timbers. Apply to manufacturer's specification.

10.5. LUMBER

1. Trails Signs
   - Lumber for trail signs shall be green CCA or ACA pressure preserved spruce, incised wood to Section 4 above.
2. Benches and Picnic Tables
   - Lumber for benches and picnic tables shall be green CCA or ACA pressure preserved, S4S, non-incised pine, to Section 4 above. Knots shall be firm, without gaps and not exceed 1/4 of the lumber face. All lumber surfaces shall be sanded smooth to touch.
3. Preservative
   - Brush on preservative for cut ends to match lumber preservative and to manufacturer's specifications.

10.6. FASTENERS

1. All fasteners shall be weatherproof cadmium coated, stainless steel, galvanized, ardox, etc.
2. Fasteners shall be supplied as specified. If changes are required due to supply conditions, discuss and receive approval of Owner prior to substitutions.

10.7. MANUFACTURED FURNISHINGS

1. Waste Containers
   a. Waste containers shall be Haul-All Equipment Systems - HID-A-BAG I, HID-A-BAG II and HID-A-BAG MINI as required by the site and program or approved equal.

b. Waste containers shall be supplied in custom color in polyester powder coat finish to match item H - 8.2 below.

c. Waste container(s) shall be mounted on a concrete slab, sized so to extend a minimum of 300 mm beyond all edges of the container and to finish level and flush with adjacent walk, trail or other pedestrian surface. Front face of container shall be located a minimum of 900 mm clear to edge of adjacent trail. Clearance to any obstruction at the back of the unit minimum 1200 mm.

2. Fire Ring

a. Fire ring shall be Blue Imp Playground Equipment campfire ring model 109 modified to provide a minimum side wall dimension above finished grade to 450 mm or approved equal.

b. Fire ring shall be located away from combustible materials including vegetation. Position for clear, level, unobstructed access to all sides. Apron surrounding fire box minimum 1800 mm measured from fire box wall. Apron adjacent to grill and back of fire box minimum 900 mm measured from fire box wall. Fire ring apron shall be at a minimum a compacted granular pad. Where site development and design warrants, a hard surface (concrete slab, unit pavers, etc.) may be installed.

c. Excavate all organic soils to their full depth from the fire box area and for 500 mm beyond exterior of fire box wall.

d. Backfill with 20 mm crushed gravel and compact in layers to 90% SPD ready for apron.

3. Barbecues

a. Barbecues shall be Blue Imp Playground Equipment charcoal grill Model 105 mounted on fixed galvanized Schedule 40 metal posts with adjustable grates and capable of full rotation or approved equal.

b. Barbecues shall be mounted level and plumb with Centre rack of grill at 760 mm from finished grade.

c. Posts for barbecues shall be set in a concrete pile footing 300 mm ø x 1200 mm depth. Post shall extend into pile a minimum of 750 mm. Concrete pile shall be finished with slope to shed water, perimeter of pile shall finish flush with surrounding grade. Barbecue apron shall be as a minimum, compacted granular pad extending a minimum of 1500 mm measured from post. Where site development and design warrants, a hard surface (concrete slab, asphalt, unit pavers, etc.) may be installed.

d. Barbecue aprons to finish flush and continuous with surrounding grade.

4. Flag Poles

a. Flag Poles shall be Blue Imp Playground Equipment model 130 G, tilt base, fixed flag mounting height, with no halyard assembly, polyester powder coat finish to item H - 8.2 below, or approved equal.

b. Manufacturer shall supply anchoring cage and details. Flagpoles shall be installed with a concrete pile minimum 300 mm diameter and

1500 mm depth. Pile to finish flush with surrounding grade and top sloped to shed water.

c. Locate poles taking into account length of pole and direction of tilt for maintenance.

10.8 FINISHES

1. Galvanized Finishes
   a. All fabricated metal frames and fasteners shall be hot dipped galvanized to 550 g/m^2 coating.
   b. Hot dip galvanizing shall occur after complete assembly and manufacture of each full component. In the fabrication of each metal component for galvanizing, drain holes shall be provided in hollow tube frames as needed to properly drain galvanic bath.
   c. Fasteners which are otherwise weatherproof, i.e., cadmium coated, stainless steel, aluminum etc., shall not be galvanized.
2. Polyester/Powder Coat

   (Optional finish in addition to galvanizing to be used in urban applications of furnishings)
   a. Thermoset polyester powder for hot rolled and galvanized steel surfaces, for electrostatic application:
      - Polyester Resin
      - Color RAL 5002 or equal
        Smooth Finish
        Finish 1.8 - 2.2 mils
      - Impact Resistance: ASTM B2794-69 160 in/lb. direct and reverse.
      - Humidity resistance: ASTM D2247-68 excellent at 1,000 hours.
      - Salt Spray Resistance: ASTM B117-73, 1,000 hours less than 1/32" creep at scribe.
      - Abrasion: Taber Abraser, CS-10 1,000g. load, 1,000 cycles, 60 - 70 mgs.
      - Water immersion: ASTM D870-54, excellent at 500 hours.
      - UV resistance: Westinghouse UV lamp 300 hours, 1-2 Macadam Units.
      - Specific Gravity: ASTM D792 1.2 - 1.8.
        Gloss (60°): ASTM D523 10-100%.
        Flexibility: ASTM D1737 180°, 1/4" mandrel.
   b. Surface Preparation:

      Pre-treat all metal surfaces in 5 stages:
      - Wash with alkaline detergent.
      - Rinse with clean potable water.
      - Wash with aqueous solution of iron phosphate.
      - Rinse with clean potable water.
      - Rinse with diluted chromic acid.

Ensure surface is completely dry before applying powder.

c. Applying Powder and Baking:
   - Apply powders with an electrostatic gun.
   - Hang or rack parts from hooks with good ground.
   - Regulate the electrostatic voltage of gun to obtain deposit thickness specified.
   - Bake immediately. Minimum 6 minutes at 200°C (actual metal temperature), or equivalent. Modify to meet finish specifications.

d. Handling and Shipping
   - Wrap finished product to separate parts to limit abrasion and chipping.
   - Label outside of package as to quantity and components.
   - Package frames and hardware in complete packages to assemble 1 unit.

e. Do not ship until Owner or site ready to use or properly store materials.

10.9. TRAIL SIGN PANELS

1. Sign panels shall be 200 x 200 mm, 0.2 cm aluminum panel, with message in reflective plastic sheeting to CGSB 62--GP-3a high intensity "Scotchlite" by 3M. Message element shall be white with dark blue background.
2. Sign panels shall be fastened with a minimum of two (2) stainless steel security screws 20 mm length.
3. A maximum of three sign panels shall be installed on any single face of the trail signage.

10.10. TITLE SIGN

1. Title signs shall be considered only for major parks that provide sports and/or recreation facilities of interest to the entire community and visiting teams.
2. Signs shall be located so to be clearly visible from arterial and collector streets, but not to interfere with safe transportation sight lines.
3. Proposed location of sign shall be staked on site. The Village shall review the proposed location. Thereafter, underground utilities shall be marked and location adjusted if necessary.
4. Village logo shall be provided as a self-adhesive decal. Sign panels for key park facilities shall be to the same specification as trail sign panels. Park facility panels shall be 300 mm x 300 mm and fastened with four (4) stainless steel security screws.
5. The sign manufacturer shall select and warranty materials, finishes and fabrication methods against deterioration, other than normal surface weathering, for a period of five (5) years.

10.11. INTERPRETIVE SIGNS

1. Permanent interpretive signs shall be considered only in areas where continuously new audiences occur. Interpretive signs shall be custom designed to suit the setting and program to which they provide information. Mounting height and angle (if any) shall be determined on the basis of the audience to be served. When preparing sign panels minimize text and maximize graphic information.
2. Original art work shall be prepared for the Village and supplied to the sign manufacturer. Sign size, story line, panel(s) layout, proposed graphics, text and type styles shall be progressively reviewed by the Village and any special interest group(s) or individuals as sign design progresses.
3. All graphic materials shall be accurately annotated and credited.
4. All spelling and grammar shall be proofed by an independent editor.
5. Original art work shall remain the property of the Village.
6. The message panels can be of the following systems:
   a. Photo Aluminum Sign Panels
      - Photo aluminum sign panels to CGSB 62-GP-10 0.81 mm thick complete with chromate conversion coating subsurfacely sealed below anodic layer, 'Sunfast Gold' in color.
      - Sign or message elements are to be read as dark images on a light background. Photo panels shall be backed with 6 mm thick marine grade aluminum (6061-T4).
      - Adhesive shall be 'Isotac", No. Y-968-5 mil adhesive transfer tape, or approved equal.
      - Photo plate shall be protected by Lexan plastic sheet, gloss surface 11-1123 clear transparent, 6 mm thick, hermetically sealed or mounted to allow free air flow between photo plate and protective sheet.
   b. Porcelain Enamel Panels
      - Porcelain enamel panels shall be plain vitreous enameling steel. All edges of panels shall have 20 mm deep flanges except connecting edges where multiple panels are utilized to create one sign image.
      - Surface finish shall be semi-matte. Panels shall be colored, background color and a maximum of two additional colors.
      - Porcelain enamel shall provide a continuous finish over all sign panel surfaces and edges. Porcelain enamel sign panels shall be fastened to 20 mm plywood backing panel cut to fit within panel flanges. Plywood shall be marine grade, GIS, with good surface to back of enameled panel. Plywood shall be sanded smooth all edges and faces, knots and edges sealed and finished with two (2) coats of exterior semi-gloss enamel, color to suit application. Panel(s) shall be mounted with vandal resistant fastening system.

10.12. PRE MANUFACTURED BUILDINGS

1. Pre manufactured buildings shall include picnic shelters, washroom buildings, change houses, and others as needs arise within the community. Buildings will be located and custom designed to suit the needs of each park area. Buildings shall be of precast concrete construction utilizing Conforce Structures Ltd. precast wall system or approved equal.
2. All buildings will have a concrete floor slab, the slab will extend 300 mm minimum beyond the roof eave line where eaves are greater than 300 mm beyond the wall face. Floor slabs shall finish flush with surrounding grade. Finished floor elevation shall be established to ensure positive surface drainage away from the building and to allow handicapped access to all entry points.
3. All wood framing and finishing for doors, and roof structures shall be pressure preserved lumber, sanded smooth to touch, to Sections H – 10.4 and H - 10.5.
4. All exterior door and roof materials shall be of pre-finished low corrugation steel panel construction. Soffits and fascias shall be pre-finished aluminum. Soffits shall be vented.

H.11.0 EXECUTION

11.1. FIELD STAKING

All signs, furniture items and buildings shall be staked in the field to illustrate proposed location and finished elevation of slabs. Prior to continuing construction, staking shall be reviewed and approved by the Village and their Consultant, and underground utilities shall be located and marked.

11.2 ACCESS AND CONSTRUCTION COORDINATION

Prior to commencing construction coordinate access point(s) and route(s) materials storage on-site and site preparation (clearing, grubbing, pruning, topsoil stripping, pavement demolition, cutting and patching) necessary to complete supply and installation.

11.3. SITE RESTORATION

1. If not included in a comprehensive construction package, specify site restoration and construction clean-up requirements of supply and installation contract.
2. As a minimum, site will be restored to the condition in which it was received. The Contractor shall be responsible for repairing and/or replacing at no cost to the Village, all work of others and site development damaged by his activities.

11.4. MATERIALS AND WORKMANSHIP

1. New materials, best of their kind only, shall be utilized in the work. The Contractor shall inspect and pre-select materials, removing any substandard and unacceptable materials and/or component assemblies.
2. The Contractor shall employ subcontractors, workmen and suppliers who are experienced and knowledgeable in the work for which they are engaged.

11.5. CONTRACTOR'S RESPONSIBILITY

1. The Contractor shall be responsible for the actions and safety of his subcontractors, employees and suppliers.
2. The work site(s) shall be signed, barricaded and controlled to ensure public safety. The Village shall not be responsible for theft, fire or damage to the Contractors work until following final acceptance of the work.

11.6. CONCRETE SLAB BASES FOR FURNITURE

1. All picnic tables, benches and waste containers shall be installed on concrete, or other hard surfaces.
2. Hard surfaces shall extend for a minimum of 600 mm beyond the extremities of picnic tables and benches and to Section H - 10.7.a. for waste containers.
3. Hard surfaces shall finish flush with surrounding grade.

11.7. LEVELS

1. All signs shall be installed plumb and vertical.
2. All furnishings shall be installed to fall with surrounding grade. Where slope exceeds 4% (1in 25) the furniture pad and/or activity area shall be leveled to produce a slope, not less than 1.5% (1 in 66), or greater than 4% (1 in 25).

STANDARD DRAWINGS – LANDSCAPING, FENCING AND MISCELLANEOUS

H.1 FENCING

H.1.1 Chain Link Fence
H.1.2 Chain Link Single Gate
H.1.3 Chain Link Double Gate
H.1.4 Post Details
H.1.5 Barbed Wire Fence Detail
H.1.6 Barbed Wire Gate Detail
H.1.7 Wooden Fence Detail
H.1.8 Uniform Wood Fencing
H.1.9 Uniform Wood Gate Detail
H.1.10 Garbage Enclosure

H.2 LANDSCAPING

H.2.1 Tree Staking (bare root)
H.2.2 Tree Staking (balled & developed)

H.3 POWER & TELEPHONE

H.3.1 Street Light Anchor Base (Type B)
H.3.2 Underground Distribution Road Crossings
H.3.3 Trench Details
H.3.4 Power & Telephone Road Crossing Detail

H.4 MISCELLANEOUS

H.4.1 Splash Pad

H.5 SITE FURNISHINGS

H.5.1 Bench With Back - Front Elevation
H.5.2 Bench With Back - Side View & Support Detail
H.5.3 Bench Without Back
H.5.4 Picnic Table - Details
H.5.5 Picnic Table - Details
H.5.6 Bike Rack

CONCRETE AND REINFORCED CONCRETE

1.0 DESCRIPTION

This specification covers the manufacture and placing of concrete, reinforced concrete and related work for the construction of One Course Concrete pavements, pavement base, curbs, gutters, sidewalks, catch basins, duct lines, sewers, and other ancillary structures associated with roadway construction; but not including bridges.

2.0 MATERIALS

1. Portland Cement
   Portland Cement shall conform to the Standard Specifications for Portland Cement (ASTM Designation C150), and shall be of the following types:
   - Normal Type 10
   - High Early Strength Type 30
   - Sulfate Resistant Type 50
2. Concrete Aggregates
   - Concrete aggregates shall conform to the Standard Specifications for Concrete Aggregates (ASTM Designation C33).
3. Air Entraining Agent
   - Air entraining agents shall conform to ASTM Standard Specification C260.
4. Calcium Chloride
   - Calcium Chloride shall conform to ASTM Standard Specification D.098.
5. Water
   - Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials and other deleterious substances.
6. Metal Reinforcement
   - Reinforcing bars shall be deformed bars in accordance with ASTM Standard Specification A615.
7. Cold Drawn Wire
   - Cold drawn wire or welded wire fabric for concrete reinforcement shall conform to the requirements ASTM Standard Specification A82.
8. Curing Compound
   - Resin base impervious curing compound shall conform to ASTM Standard Specification C309 Type ID - Type B. The curing compound shall contain white fugitive dye.
9. Sealing Solution
   - Sealing compound shall be a mixture of fifty percent (50%) Kerosene or Varsol and fifty percent (50%) boiled Linseed Oil or approved alternate.
10. Retarding Admixtures
    - Retarding admixtures shall conform to ASTM Standard Specification C494.

3.0 COMPOSITION AND STORAGE

The design of the structure is based on the assumption that concrete shall develop the specified compressive or flexural strength at twenty-eight (28) days (a seven (7) day test should give approximately seventy percent (70%) of the 28-day strength).

1. Storage

   Cement and aggregate shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

2. Batching Materials

   a) Cement - Cement shall be measured by weight and shall be weighed on a scale separate from those used for other materials.

   b) Aggregate - Aggregate shall be measured by weight. Batch weights shall be based on 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 - Water shall be measured by volume or by weight. The device for the measurement of the water shall be readily adjustable and, under all operation conditions, shall have an accuracy within one percent (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) Admixtures - Powdered admixtures shall be measured by weight and paste or liquid admixtures by weight or volume within a limit of accuracy of three percent (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.

4.0 CONCRETE CLASSES

1. Unless otherwise specified, all concrete used in roadway construction shall be one of the following classes:

Class	Aggregate	Min. 28 Day Compressive Strength (Mpa)	Slump (mm)	Entrained Air Limits (%)	Max. Size (mm)
A	Exposed pavement	30	60+/-10	5.5-8	28
B	Pavement base or unexposed use	30	60+/-20	5.5-8	28
C	Exposed road associated works	30	60+/-20	5.5-Up	28
D	General unexposed use	25	60+/-20	5.5-8	28
E	Filler	10	60+/-20	5.5-7	28

2. No subscript shall be used when Normal Portland Cement is required.
3. A subscript **30** attached to any of the above classes shall indicate that High Early Cement is specified.
4. A subscript **50** attached to any of the above classes shall indicate that Sulfate Resistant cement is specified.
5. Any concrete placed after September 30 will not be accepted unless its specified 28-day minimum compressive strength is attained in 7 days.

5.0 EQUIPMENT

All equipment used for batching, mixing and hauling concrete shall conform to ASTM Standard Specification C 94.

1. Hauling
   a) Delivery Time - When hauling equipment in Section 7 is used, concrete shall be delivered to the site and discharged into the work within one and one-half (1 1/2) hours after introduction of the mixing water to the cement and aggregate.
   b) Rotating Drum Type Haulers - 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. Haulers shall not be overloaded.
2. Use of Non-Agitating Equipment

   Non-agitating equipment may be used provided the Contractor receives written authorization from the Engineer and the following requirements are met:
   a) The distance from mixing plant to the work does not exceed 1.5 km.
   b) Bodies of hauler are smooth, watertight metal containers equipped with gates that can control discharge of the concrete.

c) Covers shall be used at all times.

d) If slump in various parts of the load does not vary more than 25 mm at the work site.

e) Concrete uniformity shall conform to requirements of Table XI of ASTM C 94.

6.0 FORMS

Forms, either of steel or wood, shall conform to the shape, lines and dimensions of the concrete as called for on the Plans. Lumber used in forms for exposed surfaces shall be dressed to a uniform thickness and shall be free from loose knots or other defects. Joints in forms shall be 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.

1. Design

   Forms shall be substantial and sufficiently tight to prevent leakage of mortar; 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.

2. Workmanship

   Bolts and rods shall preferably 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 be used through surfaces where discoloration would be objectionable. Forms shall be set to line and grade and constructed and fastened as to produce true lines. Special care shall be used to prevent bulging.

3. Oiling

   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.

4. Removal

   Forms shall not be disturbed until the concrete has adequately hardened. Shoring shall not be removed until the member has acquired sufficient strength to safely support its weight and the load upon it.

7.0 PLACING CONCRETE

1. Handling
   a. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation to loss of the ingredients. It shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling.
   b. The sequence of concrete placement shall be arranged so that concrete which has partially hardened shall not be subjected to injurious vibration.
2. Free Fall

   The vertical height of free fall of concrete shall not exceed 1 m. For falls greater than 1 m, chutes or tremies shall be used.
3. Compaction

   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.

   a) Vibrators and Screeds - 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.

   b) Initial Set - 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.

8.0 FINISHING

Working of the surface in the finishing operations shall be the minimum necessary to produce the specified finish. The finished surface shall have a fine granular or sandy texture without exposed aggregate or entrapped air holes.

1. Surface Water

   If there is evidence of excess water on the concrete surface, finishing shall be delayed until the excess water has evaporated to the satisfaction of the engineer.
2. Brush Finish

   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.

3. Burlap Finish

   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 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.

4. Mortar Finish

   Where approved by the Engineer, 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.

9.0 CURING

Exposed concrete surfaces shall be protected by using a resin base impervious membrane, unless otherwise specified.

1. Resin Base Impervious Membrane Curing

   The curing compound shall be applied under pressure with a spray nozzle in such a manner as to cover the entire surface thoroughly and completely with a uniform film at a rate which shall depend on the roughness of the surface of the concrete but in no case shall be less than 0.25 L/m^2 of concrete surface.

2. Moist Curing
   a. If specified in Special Conditions, moist curing shall be carried out according to the following requirements:
   b. 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.

10.0 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. The first application shall be made within seven (7) days after placing the concrete. The second shall be made immediately after the first has been absorbed and regains its dry appearance. The first application shall give a coverage of not more than 9 m^2/L. The second application shall give a coverage of not more than 12 m^2/L.

11.0 JOINTS

Contraction, construction and longitudinal joints shall be constructed where required as shown on the Plans or as specified.

1. Stress Relieving Joints

   Where specified, stress relieving joints shall be constructed either by sawing or by installation of polyethylene separators.

   a) Sawn Joints - Sawn joints shall be cut as late as possible following concrete finishing without permitting cracking to develop in the concrete slab. 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.

   b) Polyethylene Formed Joints - As an alternative to sawing, 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.

2. Contraction Joints

   a) Sawn Contraction Joints - Where specified, sawn joints shall be cut in such a manner that the edges are smooth and no aggregate is removed from the surface of the concrete.

   b) Formed Contraction Joints - Formed contraction joints shall be constructed with plates penetrating the concrete to a specified depth. The joint edges shall be finished with a 6 mm radius in both edges when the plates are removed.

   c) Tooled Joints - 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 engineer. The construction method used shall not affect the line and grade of the extruded section.

   c) Surface Joints - A surface or dummy joint shall be constructed to the depth specified and finished to a 6 mm radius on both edges.

   d) Construction Joints - Construction joints shall be constructed with a formed Keyway or "Vee" as shown on the drawings. Edges shall be finished to a 6 mm radius.

   e) Expansion Joints **-** When required, expansion joints shall be shown on the Plans or detailed in Special Conditions.