The Town of
HOLYROOD

Engineering Design Guidelines for Subdivisions

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Forward:

These guidelines shall be used in conjunction with the latest edition of the following publications:

1. Government of Newfoundland & Labrador Municipal Water and Sewer and Roads Master Construction Specification

2. Transportation Association of Canada Road Design Manual (Metric Edition)

3. Transportation Association of Canada Uniform Traffic Control Devices for Canada (Metric Edition)

4. The National Building Code of Canada

5. The National Plumbing Code of Canada

6. The National Fire Code of Canada

7. The National Farming Code of Canada

In any case where standards in the above noted publication are below those stated in the Town's Subdivision Design Guidelines, the Town's Subdivision Design Guideline shall be used as the accepted standard.

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1.0 SURVEYING

1.1 Definitions

1.1.1 Survey means the determination of any point or the direction or length of any line required in measuring, laying off or dividing land for the purpose of establishing boundaries or title to land.

1.1.2 NL Provincial Co-Ordinate Survey System means a system established for referencing land surveys and is based on 3° (degree) transverse Mercator projection

1.1.3 Co-ordinate Monument means any marker established for the Provincial Co-Ordinate Survey System

1.2 Survey Plan

1.2.1 A Survey plan shall be drawn in accordance with Appendix 'A'- "Drafting" and shall include:

(a) the name of the owner of all abutting lands;
(b) the length and bearing of each line of any transverse which connects any point on the boundary of the subdivision with a Provincial Co-ordinate monument;
(c) each street, walkway and easement;
each lot and it's number;
(d) the length, bearing and internal angle of each line of the oundary of, and the area in square meters of:
  i. the land being subdivided;
  ii. each street, walkway and easement;
  iii. each lot;
  iv. the land, if any which is reserved for park, playground and public purposes;
(e) the geometry of connections between existing streets and streets of the subdivision;
(f) the location of any existing structure which is to remain;
(g) every water course and its direction of flow;
(h) all information necessary for the calculation and laying out of any curved line;
(i) the date of compilation;
(j) the date of revision, if any;

(l) all existing streets, roads, lanes, and intersections in the immediate area and their official names as designated by the Town;
(m) the location and extent of rock outcrops;
(n) the location and results of any test borings;
(o) at least two (2) center line points of known chainage related to the Provincial Coordinate Survey System;
(p) the location and elevation of the Town Bench Mark used;
(q) manhole numbers shall be assigned by using the last four whole numbers of the easting and the suffix "S" for sanitary sewer manholes and "R" for storm sewer manholes.

1.2.2 The survey plan shall be of a size within the following limits:

(a) MAXIMUM- Size designation, B1,which represents 707 mm wide x 1000 mm long;
(b) MINIMUM- Size designation, A1, which represents 597 mm wide x 841 mm long;
(c) LEGAL SIZE- Size designation, P4, which represents 21.5 cm wide x 35.5 cm long

Note: Refer to National Standards of Canada, CAN2-9.60 M and CAN 2-9.61M for paper size designation

1.2.3 A survey plan shall be to a scale as indicated in Appendix A (Drafting)

1.2.4 A survey plan shall know Key Plan to locate the subdivision as it relates to adjacent streets of the Town with the scale being as indicated in Appendix A (Drafting)

1.2.5 The radius, central angle, the length or arc, the point of curve and the point of tangency shall be given for each curved line and clearly indicated on the survey plan

1.2.6 A survey plan shall be certified by a Newfoundland Land Surveyor, registered for the current year.

1.3 Survey Details and Accuracy

1.3.1 All surveys are to be completed using total station technology

1.3.2 All boundry line dimensions to be shown to at least two (2) decimal places with all angles shown to the nearest 30 seconds or better

1.3.3 More or less distances shall only be accepted along a water boundary

1.3.4 Contours shall be shown to determine the proper elevations for all streets, roads, easements, and walkways in relation to the proposed lot layout

1.3.5 For proposed streets, the existing vertical alignment conditions (contours) shall be obtained from actual field surveys

1.3.6 All Vertical Control shall be related to the Province of Newfoundland Approved Datum

1.3.7 Information shown on a survey plan shall be sufficiently detailed to permit any point on any surveyed line to be accurately located in the field

1.3.8 The accuracy of closure shall be not less than 1 meter in 10,000 meters.

1.4 Street, Walkway and Lot Identification

1.4.1 When the roadway and street (street line to street line), have been constructed and the subdivision or area involved is ready for acceptance, each public lot, easement, walkway and street shall be identified by an iron or steel pipe driven into the ground at each corner, beginning of curve, and end of curve, unless these points fall upon solid rock. In such cases, an "X" shall be cut into the rock

1.5 Survey Information

1.5.1 Prior to Phase 1 work acceptance, a copy of all information, regarding permanent subdivision survey monuments, street lines, boundary lines, easements, and walkway locations will be presented to the Town;

1.5.2 Survey information shall be clear, concise, neat and accurate, properly labeled and signed by a Newfoundland Land Survey, registered for the current year.

1.6 Benchmarks

1.6.1 The Developer shall supply brass plugs and wedges or other markers to be used as Bench Marks

1.6.2 The Town shall assign numbers to the Bench Marks

1.6.3 The plugs with wedges shall be placed in the concrete curb flush with the concrete. Prior to setting, the plug hole will be filled with quick-set cement. Then,

with the use of a mallet and a wooden block, the plug and wedge will be driven into the hole

1.6.4 All bench marks shall be intervisible and coordinated using the 3 degree Modified Transverse Mercator Projection. The traverse closure shall be a Minimum of 1:10,000. Crown land reference monuments and their coordinates shall be listed when running the traverse

1.6.5 The maximum distance between bench marks shall be 300 meters

1.6.6 Bench marks must be established from other Town Bench Marks or Geodetic Bench Marks and end at the same or different Town Bench Marks that have acceptable elevation values. All lines beginning and ending in existing Bench marks with known elevations and all lines forming self-closing loops will be leveled one way. All Bench marks must be turning points and form part of the leveling loop.

1.6.7 Bench marks must be established by spirit levels done to third order standards with a minimum accuracy 24 mm/k where k=the distance in kilometers between bench marks measured along the leveling route. If the misclosure or discrepancy exceeds the allowable, the line shall be re-leveled.

1.6.8 The method used will be three wire method (mean of the reading for the three wires). The difference of elevation is the mean of the two running where:

$$\text{Mean} = \frac{(F) - (B)}{2}$$

1.6.9 The original field notes for the horizontal, vertical control and completed description sheets shall be submitted to the Town

1.6.10 All notes shall be on loose leaf paper (100 mm x 165 mm) with the cover sheet showing the name of the firm, date, name or observer, and recorder

1.6.11 The Town shall supply description sheets for the drafting of a reference plan for each Bench Mark

1.6.12 The description sheet shall be prepared in a fashion that will produce clear and legible copies. A minimum of three ties shall be shown to reference the Bench Mark. The reference plan does not have to be to scale, however, all lettering and numbering must be done using current AutoCAD software

1.6.13 All Bench Marks and Bench Mark information shall be shown on the subdivision plan according to the Town standards

1.6.14 If the work does not meet the above criteria, the contractor/surveyor's work shall be returned for corrections.

2.0 DRAFTING

2.1 Preparation of Drawings

2.1.1 CADD Drawings

Except as provided in Section 2.1.2, computer aided design and drafting (CADD) shall be used in the preparation of construction and as-built drawings for all developments

2.1.2 Manually Drafted Drawings

Manually drafted drawings are not acceptable

2.1.3 Size of Drawings

All drawings in any one development shall be the same size. The prime consultant shall coordinate the drawing size with any/all sub-consultants, i.e., surveyors, etc.

Maximum size: the maximum size designation shall be "B1" which represents a 707 mm wide by 1000 mm long sheet

Minimum size: the minimum size designation shall be "A1" which represents a 594 mm wide by 841 mm long sheet

2.1.4 Scales

All CADD drawings shall be drawn full size and plotted at a reduced scale

The Plotting Scale Of The:

(a) Engineering Plan or Site Services Plan shall be:

(i) Plan-1:500
(ii) Profile- 1:500 Horizontal
1:50 Vertical

(b) Survey Plan/Subdivision Plan shall be:

(i) 1:500 or
(ii) As approved by the Town

(c) Site drainage plan shall be:
(i) 1:500 or
(ii) 1:1000 or
(iii) As approved by the Town

(d) Location plan or key plan shall be 1:250

(e) Site grading plan shall be 1:500

(f) Detail plan and cross sections shall be at a scale that will fully illustrate the subject matter

2.1.5 Grid Reference

Drawings shall be prepared using NAD 83 (North American Datum 1983). Grid lines at 200 meters shall be shown and northings and eastings indicated

2.1.6 North Arrow

A north arrow shall be placed in the upper right corner of each drawing

2.1.7 Plan Orientation

Survey plans shall be drawn using the development's actual coordinates based upon NAD 83. Title blocks, borders and plots shall be rotated such that the top of the sheet is approximately north and text can be read left to right and/or bottom to top

2.1.8 Symbols and Line Types

Standard Town drafting symbols and line types, as shown on the sample drawing provided, shall be used on all drawings. Where symbols other than the standard ones are used, they shall be shown on the legend.

2.1.9 Lettering CADD

Except as noted below, all drawings notes and dimensions shall be roman simplex font and the minimum size lettering shall be Leroy 100, which represents a plotted height of 2.54 mm. For the purpose of annotating existing grades, test at a forty

five degree angle to the bottom of the drawing sheet should be used. This text shall be Leroy 60 size, which represents a plotted height of 1.524 mm. With the exception of text for existing grades, it is recommended that no more than three (3) lettering heights be used on any one drawing

2.1.10 Layering

Date on each drawing shall be layered according to standard engineering practice

2.1.11 Reserved Area

An area at least 21 cm high shall be reserved above the title block for the key plan, notes, legend, engineers stamp, revision date, etc.

2.1.12 Cover Sheet

A cover sheet shall be provided for each drawing set and shall contain the following information

(a) Project Name
(b) Key Plan
(c) Name of Consulting Engineer and Sub-Consultants
(d) Name of Developer
(e) List of Drawing Names and Numbers
(f) Date of Issue
(g) "As-Built" or "Record Drawing" when applicable

2.1.13 Submission of Drawings

(a) Design and construction CADD drawings shall be submitted as follows:

  (i) 3 each- White prints

(b) As-built CADD drawings shall be submitted as follows:

  (i) 1 only- Mylar Reproducible
  (ii) 2 only- White Prints
  (iii) 1 only- CD of AutoCAD 2006 or better, compatible files or DXF files suitable for same
  (iv) 1 only- Listing of screen color/pen designations

2.2 General Conditions

2.2.1 Street Names

All streets shall be identified and printed within street lines. All names to be submitted to the Town prior to incorporating. The Town will forward names to the Holyrood Fire Department for review. Upon approval by the Fire Department and Council, the developer will be advised of approved names

2.2.2 Intersection Identification

At intersection streets or where the continuations of the streets are on other plans, the following note shall be shown on the Plan:

"For Continuation see plan no. _____"

2.2.3 Traverse Plotting

All traverses shall be plotted by either:

(a) the "Tangent off-Set Method; or
(b) the calculated "Latitude (Lats) and Departure (Deps)" Method

2.2.4 Percent (%) Grade

Percent (%) grades (slopes) shall be shown for all appropriate services to two (2) decimal places

2.2.5 Accuracy of Measurements

All distances shall be measured to the nearest centimeter

2.2.6 Geodetic Datum

Elevations shown on any plan shall be referred to **the** Provincial Geodetic Datum and the reference Bench Mark (BM) along with its location and description shall be shown in the area above the Title Block

2.2.7 Irregular Boundary Line Measurements

More or less distances shall not be accepted except along a water boundary or other irregular boundaries in which case a "tie line" between the adjoining boundary end points shall show the bearing and the distance

2.2.8 Revisions To Plan

(a) If plans are revised, amended or altered, the date and Draftsman's initial shall be noted in the revision area of the Title Block; with a description of revision

(b) All corrections and changes shall be shown in permanent fashion, i.e. with ink

2.2.9 Signing Of Plan

All plans shall be stamped and signed by a professional engineer licensed in the Province of Newfoundland and Labrador

2.2.10 Procedure Revision

This procedure is subject to change without notice, and the onus lies with the user to ensure that he is in possession of the latest revision

3.0 EASEMENTS

3.1 General

3.1.1 Easement means an incorporeal right, distinct from ownership or the soil, vested in the Town and consisting of a use of another's land for any Public service or utility

3.1.2 When sewers, surface drainage or water system pipes are to be installed other than in a street or walkway, an easement shall be provided over such installations

3.1.3 The owner of the easement land shall not construct any type of structure over such easement area

3.2 Design

3.2.1 The width of any easement shall be based upon the type and number of services proposed to be installed

3.2.2 The minimum width of an easement shall be six meters, ***unless otherwise approved by the Town***

3.2.3 The alignments for any easement shall be dependent upon the type of service to be installed

3.3 Acceptance

3.3.1 Acceptance of services within an easement shall be carried out as outline under the requirements in the Development Agreement

3.3.2 All easements shall be covered by legal agreement as approved by the Town's Solicitor

3.4 Restoration

3.4.1 When the Town carries out work within an easement, it shall be responsible for restoring the area as close as practical to its original condition or as otherwise stipulated in the Easement Agreement

3.4.2 This procedure is subject to change without notice, and the onus lies with the user to ensure that he is in possession of the latest revision

4.0 STORM DRAINAGE

4.1 Design Drainage Area

The drainage area may be determined from contour plans and shall include any fringe area not provided for in adjacent storm drainage areas, as well as other areas which may become tributary by reason of regarding

4.2 Drainage Plan

Plan of the drainage area shall be to a scale of 1:500, 1:1250, or 1:2500, depending on the size of the area and shall show generally:

(a) Streets
(b) Lots
(c) Water courses and direction of flow
(d) Proposed storm sewers with manhole, size of the area in hectares and the runoff coefficient clearly shown therein;
(f) Contour lines having an interval not exceeding one meter;
(g) Proposed surface drainage (including side ditches in areas without storm sewers)

4.3 Runoff

Computations shall be based on the Rational Method formula for areas less than 10 hectares. For areas greater than 10 hectares, an approved computer model will be used along with the appropriate intensity-duration frequency curves for the Regional area.

Q= R.A.I.N Where:
Q= maximum rate of runoff, in liters per second
R= Constant=2.78
A= area tributary to the point of design, in hectares

I= average rainfall intensity, having duration equal to the time of concentration of drainage area, in millimeters per hour
N= runoff coefficient

Standard design forms using Microsoft Excel shall be used for all calculations. Computations shall be submitted on the standard design forms and on CD.

4.4 Runoff Coefficient

The value of the coefficient shall be obtained by correlating the ratio of impervious to pervious surfaces. The minimum coefficients for fully developed areas shall be as follows:

(a)	Parks & Undeveloped Area	0.10 - 0.30
(b)	Single Family Residence	0.30 - 0.50
(c)	Semi-Detached	0.40 - 0.60
(d)	Row Housing	0.60 - 0.75
(e)	Apartments	0.50 - 0.70
(f)	Parking Lot Area (paved)	0.90 - 1.00
(g)	Light Industrial	0.50 - 0.80
(h)	Heavy Industrial	0.60 - 0.90
(i)	Hospitals	0.70
(j)	Light Commercial	0.50 - 0.70
(k)	Commercial Core	0.70 - 0.95
(l)	Heavily Developed Area	0.80 - 0.95

For Trunk Sewers, bridges and other critical structures, the runoff coefficient shall be chosen taking into account the effect of frozen ground on runoff rates.

4.5 Rainfall Intensity

The rainfall intensity shall be based on a 1 in 10 year return period and duration equal to the time of concentration for suburban residential areas. Trunk Sewers, bridges and other critical structures as determined by the town shall be on a 1 in 100 year return period with duration equal to the time of concentration. The design intensity must be obtained from the most up-to-date intensity-duration frequency curves available from Environment Canada for the Regional area.

4.6 Capacity of Pipe

This version of Manning's Formula $Q = \frac{7.8546 \times 10^{-6} \times D^2 \times R^{2/3} \times S^{1/2}}{n}$ shall be used

Where: D is the diameter of pipe
R is the dimensional ratio of pipe
S is the slope of pipe
Q is pipe discharge
n is roughness coefficient

to compute the capacity of storm sewers. The following roughness coefficient shall be used:

(a) concrete box culverts 0.013
(b) P.V.C. ribbed pipe 0.01
(c) C.S.P.- Aluminized or double galvanized Helical, Refer to C.S.P. Manual for roughness Coefficient based on particular pip size

4.7 Minimum Size

Street Sewers	300 mm
Catch Basin Leads	single 200 mm/double 300 mm
Building Sewer	100 mm

4.8 Velocity (for design flow)

Velocities shall be calculated using Manning's Formula:

$$V = \frac{R^{2/3} S^{1/2}}{n}$$

Where R is the dimensional Ratio of pipe
S is the slope of pipe
N is roughness coefficient of pipe

Minimum 1 m/s
Maximum 5 m/s for diameter up to and including 825 mm and 6m/s for diameters larger than 825 mm

4.9 Change of Size

No decrease of pipe size from a larger size upstream to a smaller pipe downstream shall be allowed regardless of the increase in grade

4.10 Clearance

(a) A minimum of 150 mm clearance is required between outside barrels at all sewer pipe crossings.

(b) A minimum of 450 mm in a vertical and horizontal direction is required between the sewer pipe and water pipe

4.11 Location

(a) Storm sewers shall be located such that manholes are placed in the center of driving lanes, wherever possible

(b) Manholes shall be located at every change of horizontal and vertical alignment, size and material of the sewer

4.12 Earth Load

Shall be calculated by using the Marston Formula, $W = cw\,(B)^2$

Where; W= Load/unit length of pipe
w = unit weight of soil c= coefficient
B = trench width

4.13 Superimposed Load

The effect of concentrated and distributed superimposed loads shall be evaluated by generally accepted formula, such as Boussinesq's Formula

$W_{sc} = C_s \times \frac{PF}{L}$ where W_{SC} = load on pipe L= effective length
P = concentrated load (Assume L=0.9m)
F = impact factor
C_s = load coefficient

4.14 Manholes

(a) Standard types of manholes and their details are shown on Standard Drawings

(b) All manhole chamber opening must be located on the upstream side of the manhole

(c) Special manholes shall be fully designed and detailed

(d) Maximum distances between manholes unless otherwise specified shall be 90 m for 700 mm pipe or smaller and 120 m for pipe greater than 700 mm

4.15 Special Structures

Inlet and outfall structures including Head walls, stilling chambers etc. shall be fully designed and submitted in detail. In each case, topography shall be shown as well as the protective works necessary to counteract erosion of the site at the structure. Trash racks shall be provided on all inlet structures and outlet structures greater than 600 mm in diameter and shall be fully designed, detailed and approved by the Town

4.16 Outfalls

All storm outfalls which empty into a ditch or water course must receive approval from Fisheries and Oceans Canada and the provincial Department of Environment

4.17 Catch Basins

(a) The lead shall have a minimum 2% grade and shall discharge directly to an existing or proposed manhole or open ditch located within 30 m of the catch basin

(b) Recess catch basin shall not be used

(c) Catch basins shall be located and spaced in accordance with conditions of design and shall provide for expected maximum flow

(d) Standard location for catch basins at street intersections shall be immediately upstream of sidewalk or pedestrian crosswalks and between intersections at all low points

(e) Spacing shall not exceed 95 m for road grades up to 3%. On steeper roads, this spacing shall be reduced as follows:

Grades between 3% - 6%	- 65 m
Grades between 6% - 10%	- 50 m

(f) Catch basins are to be depressed 30 mm with respect to the gutter grade

(g) Double catch basins are to be used at all low points

(h) All catch basins to be connected to storm manholes

4.18 Building Services

Separate and independent building services shall be provided for every single family house, each unit in a semi-detached and each apartment building, office building, factory or similar building. The location of the end cap will be clearly marked using a 50 x 100 timber marker extending 600 mm above finished curb grave (See House Service Detail). Storm sewer pipes must not be located within 3m of the side boundary of a building lot. Storm sewer service pipes must connect to the storm sewer main (or open ditch) and not to a storm sewer manhole.

4.19 Side Ditches

See Section 7.5

4.20 Head Walls

Head walls shall be designed for inlet control with

HW/D < or = 1.0 where HW - headwater depth
D - Diameter of pipe

Handrails shall be installed on all head walls as per the standard details

4.21 Revisions of Produce

This procedure is subject to change without notice and the onus lies with the Consulting Engineer to ensure that he is in possession of the latest revision

5.0 SANITARY SEWER

5.1 Design Drainage Area

The drainage area may be determined from contour plans and shall include all other areas which may become tributary by reason of regarding or pumping

5.2 Drainage Plan

Plan of the design area shall be to a scale as indicated in Appendix 'A' "Drafting" and shall show generally:

(a) streets
(b) lots
(c) the size and grade of the sanitary sewers with manholes numbered using the last four digits of the easting and the suffix "S" i.e 3145
(d) tributary areas to each manhole, size of the area in hectares and ultimate average population per hectare clearly shown therein

5.3 Evaluation of Design Flows

(a) Standard design forms using Microsoft Excel (Appendix C) shall be used for all calculations. A sample of same may be obtained from the Engineering Department- Bay New Plan Group Inc.

(b) The design of all sanitary sewers shall be based on the Peak Wet Weather Flow. A typical computation of Peak Wet Weather Flow is shown on attached Table 5.1 and some of its aspects explained in the following items

(c) The minimum rate of infiltration for which capacity shall be provided is 22 500 L/ha/d

(d) The design flows from developments of single family residence shall be based on an average population density of 80 people per hectare

(e) Flow computations shall be based on Table 5.1 and shall be submitted using the standard design forms on a CD

Average Sewer Flow: is predicted flow based on ninety (90%) percent of water consumption

Peaking Factor: is the ratio of the peak rate of flow on the average rate of flow. It is based on the Harmon Formula, $M = 1 + \frac{14}{4+p^{1/2}}$,

Where "p" is the tributary design population in thousands for residential areas. For other than residential, the design population "p" can be termed as an equivalent population and is computed by dividing the unit non-residential sewage flow by the average unit residential sewage flow of 275 L/c/d or by using the values given.

TABLE 5.1		
Land Use	**Average Sewer Flows**	**Peaking Factor**
Residential	**275 L/c/d**	$1 + \frac{14}{4 + P^{1/2}}$
Commercial Core	**90 000 L/ha/d**	$0.8\left(1 + \frac{14}{4 + P^{1/2}}\right)$
Light Commerce	**28 000 L/ha/d**	$0.8\left(1 + \frac{14}{4 + P^{1/2}}\right)$
Heavy Industrial	**168 500 L/ha/d**	$0.8\left(1 + \frac{14}{4 + P^{1/2}}\right)$
Light Industrial	**39,000 L/ha/d**	$0.8\left(1 + \frac{14}{4 + P^{1/2}}\right)$

5.4 Capacity of Pipe

Manning's Formula $Q = \frac{7.8546 \times 10^{-6}}{n} D^2 R^{2/3} S^{1/2}$

Where D is the Diameter of pipe
R is the Dimensional Ratio of pipe
S is slope of pipe
Q is pipe discharge
n is roughness coefficient of pipe

shall be used to compute the capacity of sanitary sewers. The following roughness coefficient "n" shall be used:

(a) Concrete Pipe 0.013
(b) P.V.C 0.011

5.5 Minimum Size

Of Street sewer 200 mm
Of Building sewer 100 mm

5.6 Velocity (for design flow shall be calculated using Manning's Formula)

$V = \frac{R^{2/3} S^{1/2}}{n}$

Where R is the Dimensional Ratio of pipe
S is the Slope of pipe
n is roughness coefficient of pipe

Minimum - 1 m/s

Maximum - 5 m/s for diameter up to and including 825 mm and
6 m/s for diameters larger than 835 mm

5.7 Change of Size

No decrease in pipe size from a larger size upstream to a smaller size downstream shall be allowed regardless of the increase in grade

5.8 Clearance

(a) A minimum of 150 mm clearance is required between outside pipe barrels at all sewer pipe crossings

(b) A minimum of 450 mm clearance in vertical and horizontal direction is required between the sewer pipe and water pipe

5.9 Manhole Location

(a) Sanitary sewers shall be located such that manholes are placed in the center or driving lanes wherever possible

(b) Manholes shall be located at every change of grade, alignment, size or material of the sewers

(c) Manholes shall be spaced a maximum of 90 m apart for sewers smaller than 700 mm diameter and 120 m apart for sewers over 700 mm diameter

5.10 Earth Load

Earth loads on sewers shall be calculated by using the Marston Formula

$W = c_w(B)^2$ Where, W= load/unit length
^{w} = unit weight of soil
B = trench width
c = coefficient

5.11 Superimposed Load

The effect of concentrated and distributed superimposed loads shall be evaluated by generally accepted formula such as Boussinesq's Formula,

$$W_{sc} = C_s \times \frac{PF}{L}$$

Where, W_{sc} = load on pipe F=impact factor
P = concentrated load C_s = load Coefficient
L = effective length of pipe (assume 0.9 m)

5.12 Manhole Details

(a) Standard types of manholes and their details are shown in Standard Drawings

(b) All manhole chamber opening must be located on the upstream side of the manhole

(c) All pipes turning at a greater angle than 45° in a manhole require a 150 mm drop between pipe inlet and outlet

(d) Special manholes shall be fully designed and detailed

5.13 Building Services

Separate and independent building services shall be provided for every single family house, each unit in semi-detached, and each apartment building, office building, factory or similar building. The end cap for the sanitary service shall be painted red. The location of the end cap shall be captured using total station and will be clearly marked using a 50 x 100 timber marker extending 600 mm above finished curb grade.

5.14 Storm Water

Storm water drains, roof drains, foundation drains, shall not be connected to any part of the sanitary sewer

5.15 Force mains

Pipe for all sewage force mains shall be ductile iron, class 50. Flow velocity in the force main shall be between 1 and 3 m/sec

5.16 Sewage Lift Stations

All sewage lift station pumps and controls shall be new and CSA approved , and shall be enclosed in a concrete chamber designed by the Engineer. The pumps shall be designed to lift the required sewage flows the appropriate hydraulic gradient. The pump size chosen will be based on maximum efficiency and minimum friction losses.

5.17 Revisions of Procedure

This procedure is subject to change without notice and the onus lies with the Consulting Engineer to ensure that he is in possession of the latest revision

6.0 WATER SYSTEMS

6.1 General

6.1.1 Definitions

Water system:	means an assembly of pipes, fittings, control valves and appurtenances which convey water to water service pipes and hydrants.
Water service pipe:	means a pipe that conveys water from a water system to the inner side of the wall through which the pipe enters the building

6.2 Design Criteria and Location

6.2.1 Dead Ends

The water system shall be so designed to exclude any dead ended pipe, so far as is reasonable possible

6.2.2 Size of Water Pipe

(i) All pipe is to be designed, but in all cases a minimum pipe size of 150 mm diameter mains will be used on cul-de-sacs. Minimum 200 mm diameter mains shall be used for all other mains

(ii) The size of a main feeder pipe shall be a minimum of 300 mm

6.2.3 Depth of Cover

(i) All water pipe shall have a minimum cover of 2000 mm in relation to the final finished street grade

(ii) For streets not paved prior to December 1 of any year, a sufficient depth of fill shall be placed to give a minimum cover of 1500 mm.

6.2.4 Location of Water Pipes

(i) All water pipes shall normally be laid on the quarter point of the street right of way and in separate trench from the sanitary and storm sewers

(ii) Where a water pipe is to be laid in a trench, other than in a street, the sub-divider shall grant to the Town by deed and plan, at his cost, title to the Easement. Such Easement shall be not less than six (6) meters in width and its location shall be approved by the town

6.2.5 Location of Valves

(i) Valves at street intersections shall be located in the roadway at street line intersection. Measurements giving the location of all valves shall be shown on the "As Built" drawings. A minimum of two measurements shall be shown for each valve

(ii) Four (4) valves shall be required at each four-way intersection. If there are more or less than four (4) streets meeting at any intersection, the appropriate number of valves shall be installed to allow complete isolation of the system. The minimum number of valves at any intersection shall be three

(iii) On straight runs in a residential area, the maximum distance between valves shall be 180 m

(iv) On dead end streets zoned for future development a valve shall be installed at the end of the water main

6.2.6 Valve Chambers

(i) All valves 400 mm in diameter and larger shall be geared

(ii) All valves 400 mm and larger shall be installed in a chamber constructed of reinforced concrete or made from a 1500 mm diameter pre-fabricated concrete manhole

(iii) The values of 400 mm and larger shall be installed in a chamber constructed of reinforced concrete or made from a 1500 mm diameter pre-fabricated concrete manhole

6.2.7 Hydrants

(i) Hydrants shall be placed at the center of lots, at the rear of the sidewalk, and spaced not more than 140 m apart

(ii) Hydrants shall be installed so that the top of the standpipe flange will be from 100 mm - 150 mm above the finished curb grade

(iii) The branch pipe to the hydrant shall be 150 mm in diameter and shall include a 150 mm branch valve located 2.75 meters from the hydrant. Where the hydrant valve is less than 3.0 m from the water main the valve shall be restrained to the main with an approved mechanical restraint collar

(iv) Although dead-ended pipes are not desirable, if unusual conditions exist and warrant the installation of a dead ended pipe, a hydrant shall be installed in its proper location at the dead end. The 140 m maximum spacing requirement will still apply in these situations

6.2.8 Building Services

Separate and independent building services shall be provided for every single family house, each unit in a semi-detached and each apartment building, office building, factory or similar building. The minimum size pipe accepted shall be 20 mm in diameter, type k copper. The location of the end cap shall be captured using total station and will be clearly marked using a 50 x 100 timber marker extending 600 mm above finished curb grade. Refer to National Building Code for different size requirements.

6.3 Design of Water Main System

6.3.1 General

The design of water systems shall be based on the flow requirements needed to satisfy domestic, commercial, industrial and fire flow demands

6.3.2 Flow Requirements

Domestic, Commercial and Industrial flow requirements shall be based on the values give in Table 5.1 of Section 5.3. Fire flow demand shall be based on the following formula:

$$F = 3.7C\sqrt{A} \qquad \text{Where}$$

F= the required fire flow in liters per second
C= coefficient related to the type of construction
A= Total floor area of all stories (excluding basement) in square meters
C= 1.5 for wood frame construction (structure essentially all combustible)
C= 1.0 for ordinary construction (brick or masonry walls, combustible interior)
C= 0.8 for non-combustible construction (unprotected metal structural components
C= 0.6 for fire-resistive construction (fully protected frame, floors, roof)

NOTE

For types of construction that do not fall within the fire categories given use a coefficient reflecting the differences. Such coefficients shall not be greater than 1.5 nor less than 0.6 and may be determined by interpolation

A = total floor area (including all stories, but excluding basements) in the building being considered. For fire-resistive buildings consider the 6 largest successive floor areas if the vertical openings are unprotected; if the vertical openings are properly protected, consider only the 3 largest successive floor areas.

The values obtained from the preceding formula may be adjusted as a result of other factors such as proximity of buildings, presence of complete automatic sprinkler protection etc., for these the designer should consult the Insurer's Advisory Organization

In all cases the minimum accepted fire flow will be 40l/sec. At a residual pressure of 140 Kpa.

6.4 Connections to Existing Water Systems

6.4.1 Service Interruption:

A connection of the sub-dividers water system to any part of the existing water system must be carried out to cause the least interruption to existing service and each such connection must be approved by the Town. All costs associated with closure shall be borne by the Developer

6.4.2 Scheduling of Connection:
The Town will assist in the scheduling of any such connection. The Developer will install the tapping sleeve and valve at the Developer's expense. The work must be done under the supervision of the Town at the Developer's expense.

6.4.3 Other Connections:

Whenever the existing water system is within reasonable distance from a proposed subdivision, and an interconnection is practical, the subdivider shall be required, at his cost, to install the necessary pipe and interconnect the water system in his subdivision to the existing water system

6.4.4 Prohibited Cross-Connections:

No pipe or water service pipe, cross-connection will be made from the existing water system to a water system in a subdivision which is connected to some other source of supply

6.5 Tapping Sleeves and Mains

Unless otherwise approved by the Town, tapping sleeves and valves shall be used for all ductile iron connections to existing water mains and shall be as approved in Appendix "E". The Developer will be responsible for determining the outside diameter of the existing water main

7.0 STREETS

7.1 Street Classification

Streets shall be classified as shown in the following table:

Table 7.1

	ARTERIAL	COLLECTOR	LOCAL
Traffic Service	Traffic movement first consideration	Traffic movement and	Traffic movement second consideration
Land Service	Land access second consideration		Land access first consideration

Parking	Some parking	Parking	Parking
Design Volume (A.D.T)	12,000-30,000	12,000-30,000	Less than 1,000
Characteristics of traffic flow	Uninterrupted except at signals and crosswalsk	Interrupted flow	Interrupted flow
Vehicle type	All types but trucks may be omitted	All type with truck limitations	Passengers and service vehicles; large vehicles restricted
Connects to	Arterials, collectors, freeways and some locals	Arterials, collectors, locals	Collectors, locals

Characteristic of Street Classes Street Classification				
	ARTERIAL	**COLLECTOR**	**LOCAL**	**LOCAL UNSERVICE**
Street grade maximum	10 % (6% ***)	10 % (6% ***	10%	10%
Street grade minimum	0.5%	0.5%	0.5%	0.5%
Street right of way width	30m	20.5m	15m	20.5m**
Minimum Radius	90m	90m	50m	50m
Maximum super Elevation	0.06m/m	0.06m/m	0.06m/m	0.06m/m
Minimum stopping sight distance	65m	65m	45m	45m
Pavement widths	15m	15m	9m	8m
Minimum "K" valve vertical curve **Crest** **Sag**	 7 11	 7 11	 7 11	 7 11

Minimum length of vertical curve	L= length in meters should not be less than design speed in Kilometers per hour			
Vertical curve maximum (length for drainage)	Crest= K=60 Sag: K=30			
Minimum distance between intersections	400m	60m	60m	60m
Minimum curb radius at intersections	15m	9m	8.0m	8.0m
Sidewalks (sides)	Both	Both	One* (Two)	--
Street lighting (minimum requirements)	1.5 cd/m or 22 lx	1.0 cd/m or 15 lx	1.6 cd/m or 15 lx	1.6 cd/m or 15 lx
Shoulders minimum width	2.0m	2.0m	2.0m	2.0m

* Unless a pedestrian traffic generator is in the area of the local road in which case sidewalk shall be required on both sides (e.g. Walkway system, school, shopping center, church, etc.)

** Right of way width may increase for ditching

*** Maximum road grade in industrial/commercial parks to be 6%

7.2 Design Criteria

7.2.1 Streets shall be designed to provide the safest and smoothest traffic flow possible. The criteria in table 7.2 consist of the minimum requirements for flat vertical alignments

7.2.2 For specific situation not covered by this section, the latest edition of Transportation Association Canada (TAC) should be used as a guide

7.3 Cul-de-Sacs

Cul-de-sacs should only be used where approved by the town's Engineering Department. They shall have the following additional minimum requirement:

(a) Face of curb line, turning circle, radius of 15.25 m

(b) Maximum exit grade of +2% for 20 m from the intersection

(c) Low back curb and gutter to extend around the turning circle

(d) Transitional street line radius of 15.25 m into street line turning circle

(e) Maximum length of 300 — measured from connecting street right of way or intersecting street to end of the turning circle. For unserviced subdivisions the maximum length shall be 300 m

(f) In cases where turning circles are temporary due to phasing of developments, all temporary turning circles shall be paved with 50 mm asphalt

7.4 Intersections

7.4.1 Intersections shall:

(i) Be of "T" type design,
(ii) Have a vertical alignment within the intersection approach of not more than 2% grade for a minimum distance of 20 m from the roadway intersection curb line,
(iii) Have an intersecting angle of 90° where possible. Angles less than 90° may be accepted only at Town's direction. (Minimum 75°),
(iv) have a minimum center line distance between adjacent and/or opposite intersections:
  (a) on Local streets to Collector street of 60 m
  (b) on Collector streets to Collector streets 60 m
  (c) on Arterial streets to Collector streets 400 m
  (d) on Arterial streets to Arterial streets 400 m

7.4.2 When two (2) streets (or more) intersect, only one (1) street may have a curved horizontal alignment; all other streets at this intersection shall have a minimum tangent section of 30.5 m as measured from the point of street line intersection to the first point of horizontal curvature on each approached street line

7.5 Side Ditches

7.5.1 Side ditches shall be constructed along both sides of streets that do not have piped storm drainage systems. In all cases the invert of the ditch shall be below sub grade of the street and shall conform to the following dimensions:

Minimum Bottom Width	= 1.0 m
Minimum Depth	= 1.0 m
Maximum Side Slope	= 2:1

7.6 Guide Rail Barriers

In fill areas greater than 1.5 m, traffic and/or pedestrian barriers shall be constructed along the affected areas, in accordance with the guidelines established by the Transportation Association of Canada, as designated by the Town Engineer

7.7 Other General Requirements

7.7.1 Tangent distances between horizontal reverse curves shall not be less than 50 m

7.7.2 Horizontal alignment of streets shall be such that the center line and curb lines shall be symmetrical with their street lines

7.7.3 Vertical alignments of streets shall be considered as symmetrical about the center line unless otherwise instructed by the Municipality

7.7.4 All streets shall have a minimum of 150 mm crowned roadway cross-section and in no case should be crowned roadway cross-section be less than 2%

7.7.5 No driveway (ramp) shall be permitted to enter onto a proposed designated limited access freeway, arterial or major street

7.7.6 Curb and gutter is required in all areas serviced with storm sewers. All services subdivisions shall have piped storm drainage systems or at the minimum. Storm discharge for catch basin and the house storm servicing must be piped to the open ditch one side.

7.7.7 All streets have a minimum of 150 mm Class "B" and 75 mm Class "A" granulars, 38 mm base course and 38 mm surface course asphalt. Additional granulars and asphalt may be specified as determined by the Town Engineer

7.7.8 Paraplegic Ramps shall be required at all intersections

7.8 Street Signs, Markings and Traffic Control Devices

All street signs, marking and traffic control devices shall conform to the latest version of the Transportation Association of Canada manual entitled "Uniform Traffic Control Devices for Canada" (metric edition).

7.9 Road Cut Policy

7.9.1 Street Excavation Permit

Any person wanting to perform excavation in the Town's road right-of-way will be

required to obtain a "Street Excavation Permit". The cost of this permit will be as per the Town's fee structure for current year.

In addition to the permit fee, the Town will require a security deposit to be supplied to the Town in accordance with the Town's fee structure for the current year.
This deposit will be held by the Town of a period of 24 month from the date of the deposit. This period will cover two full winter seasons. At the end of the 24 months, the security deposit will be refunded to the payee provided the road cut does not require any repairs. If repairs are required, the payee must perform the necessary work to complete such repairs to the satisfactory of the Town. The repairs will be inspected by the Town and if satisfactory, the security deposit will be returned to the payee. If the payee does not complete the necessary repairs in the time as stated by the Town, the payee will forfeit the security deposit and the Town will complete the necessary repairs.

7.9.2 Street Excavation Procedure

The permit holder shall ensure all required traffic control signage, personnel, and standards are in place as per the Occupational Health and Safety Regulations of the province of Newfoundland and Labrador.

Asphalt shall be saw-cut in clean straight lines a minimum of 1 meter beyond the top of the slope of the service trench.

A minimum of 300 mm of compacted granular material (38 mm diameter max.), shall be placed over the top of water and sewer pipes.

7.9.3 Backfilling Procedure

The following options shall be accepted by the Town of Holyrood:

(i) All remaining trench dept will be backfilled using unshrinkable fill (i.e. low strength concrete), having a maximum compressive strength of 0.4 Mps. Traffic shall be sept off the newly placed unshrinkable fill until the material has set. This may require the trench being backfilled ½ the road width at one time to permit a minimum of one lane traffic flow at all times. If traffic has to pass over the newly placed unshrinkable fill, steel plates shall be used to cover the area for a minimum of 24 hours.

(ii) All remaining trench shall be backfilled and compacted in layers with suitable fill material in accordance with the Department of Municipal Affairs Master Specification for trench excavation. A professional geotechnical company registered in the Province of Newfoundland shall be required to inspect and certify the backfilling and compaction of the trench

material. A report certifying the compaction and backfilling procedure shall be forwarded to the Town.

7.9.4 Asphalt Repair Procedure

Existing asphalt adjacent to the street cut shall be cold planed a minimum depth of 38 mm and a minimum of 1 meter in width for the entire length of the asphalt cut. This shall be done on both sides of the excavation. The cold planed area and cut edge of the asphalt shall be tack coated.

A minimum of 76 mm of asphalt (compacted thickness) will be placed in the excavated area and overlapped onto the cold planed area. The compacted asphalt shall blend into the existing asphalt such that no depression or hump exits. The new asphalt shall be compacted to a minimum 95% proctor.

7.9.5 Unshrinkable Fill Specification

Cement Type	Type 10 or 30 Portland
Maximum 28 day compressive strength	0.4 Mpa
Maximum size aggregate	37.5 mm
Slump at point of discharge	180 +/- 40 mm

8.0 "AS BUILT" INFORMATION

8.1 Drawings

2 sets white prints (properly stamped and signed by approved Engineering Firm)
1 CD- Auto CAD 2006 or newer

8.2 Reports

8.2.1 Sanitary and Storm Sewer Inspections

- Infiltration tests
- Exfiltration tests
- Deflection tests
- Video tape inspections
- House service lateral information

8.2.2 Water main

- Disinfection reports
- Pressure test reports
- Swabbing reports

8.2.3 Streets

- Asphalt Quality Control Tests
- Class 'A' and Class 'B' Sieve Analysis
- Compaction Tests
- Class "A'
- Class 'B'
- Asphalt
- Subgrade

8.2.4 Concrete Works

- Compressive Strength Tests
- Slump Tests
- Air Entrainment Test
-

8.2.5 Final Inspection

- Manhole/Catch Basin/Valve Box Cleaned
- Valves/Curb Stops Operational
- Streets Cleaned
- Signage and Traffic Marking in Place

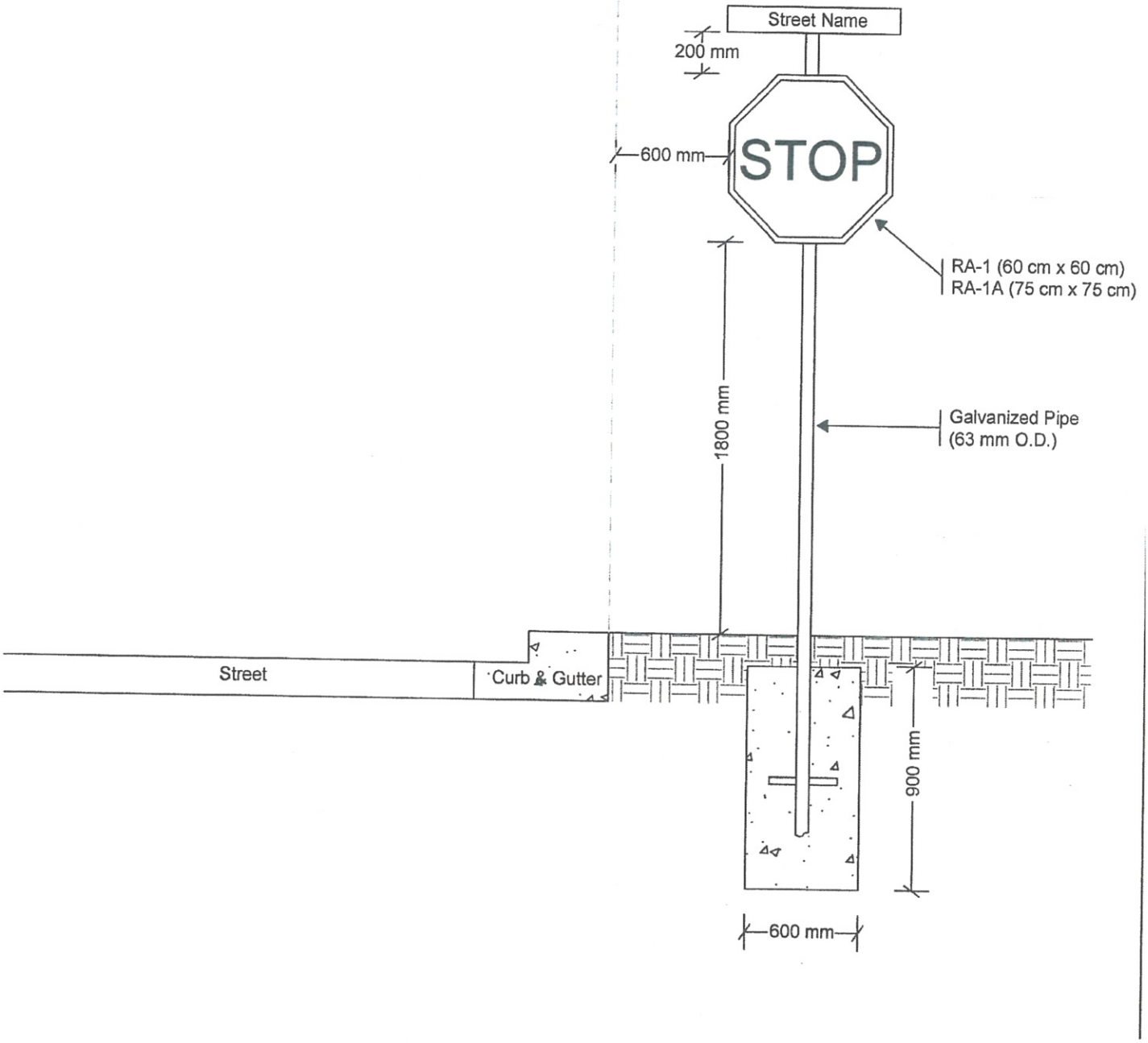
8.2.6 Financial Report

- Final Construction Costs (Detailed Breakdown)
- Engineering Costs
- Assessment Calculations

APPENDIX A

DRAWINGS

The Town of Holyrood



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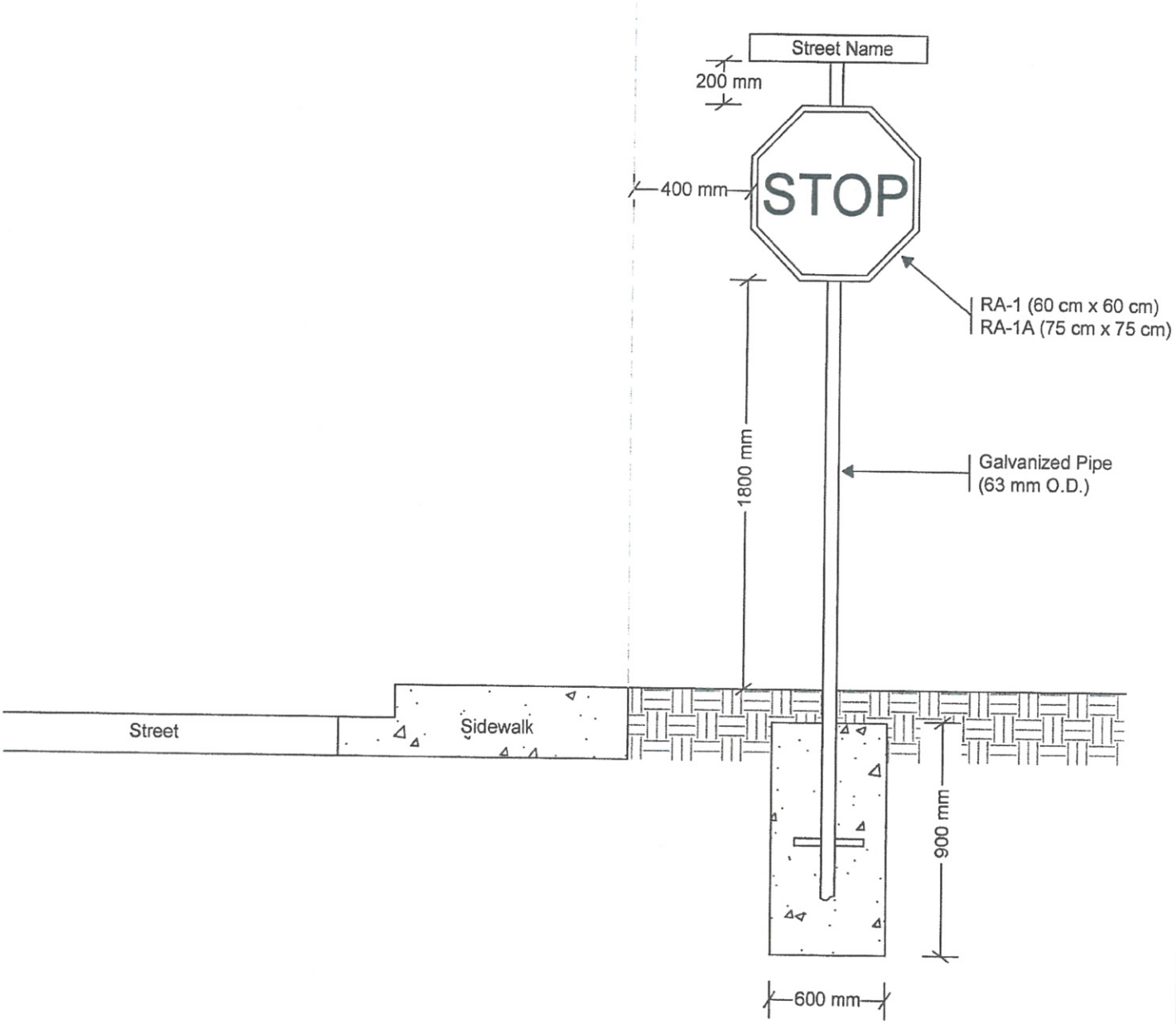

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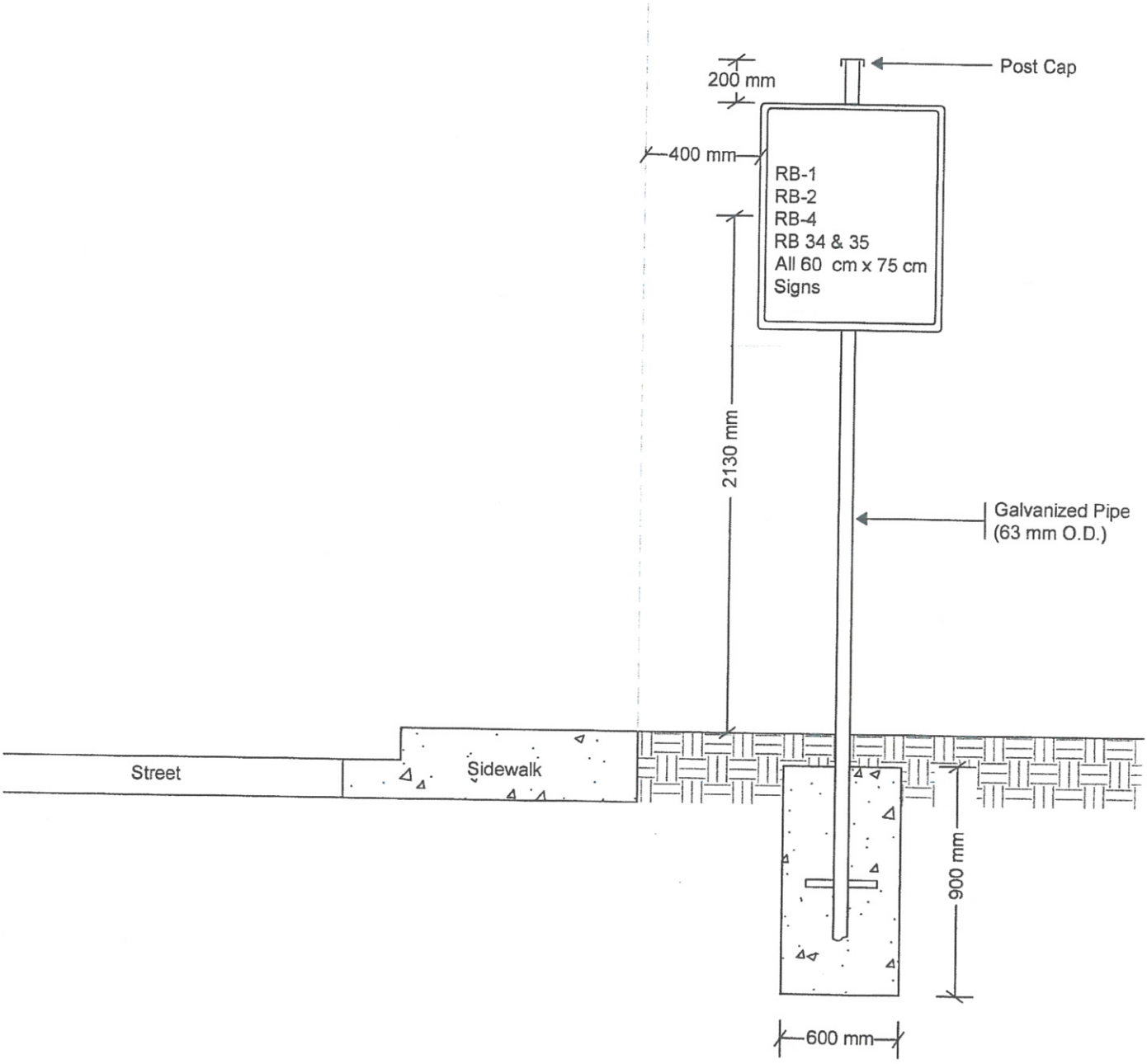

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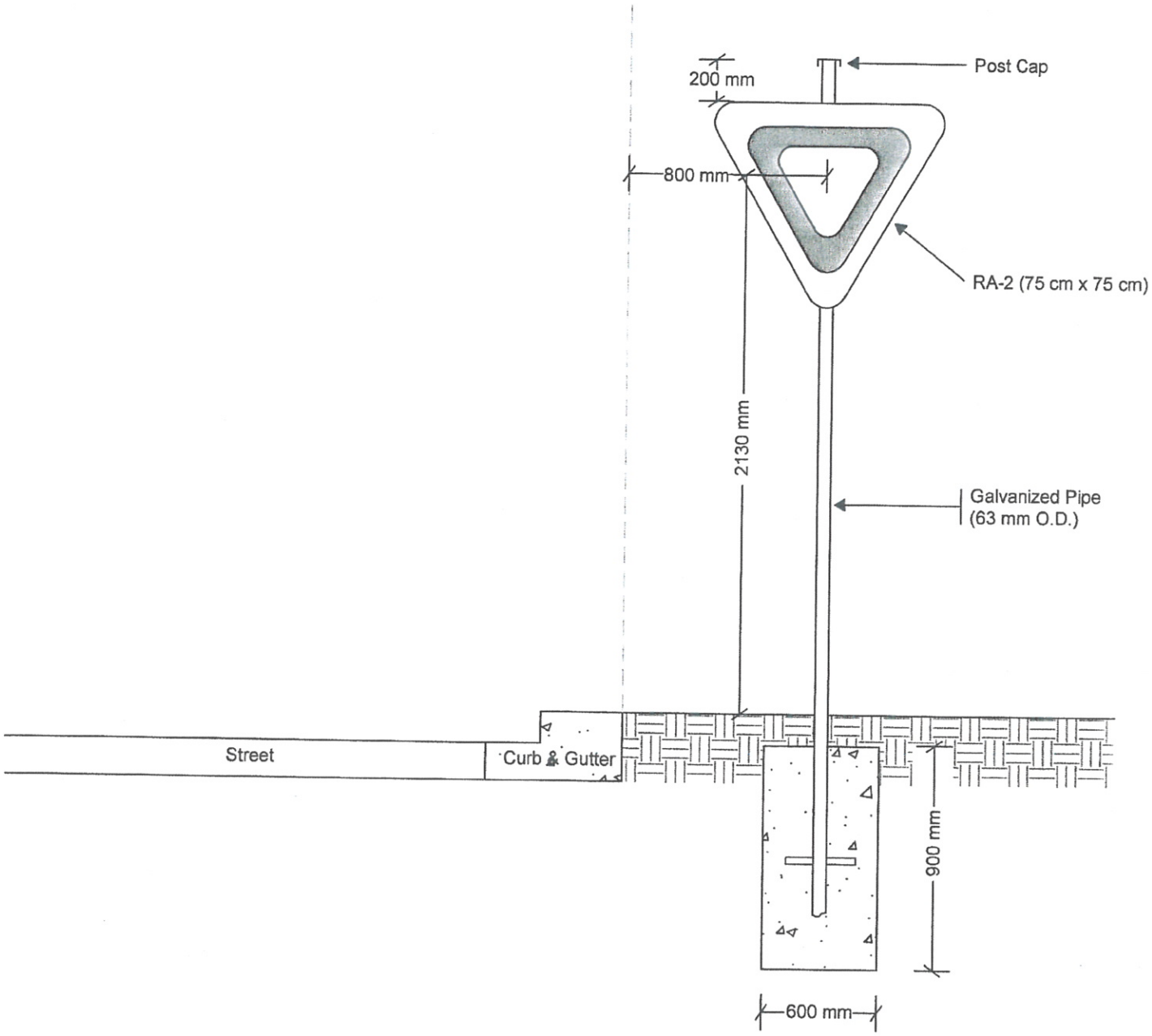

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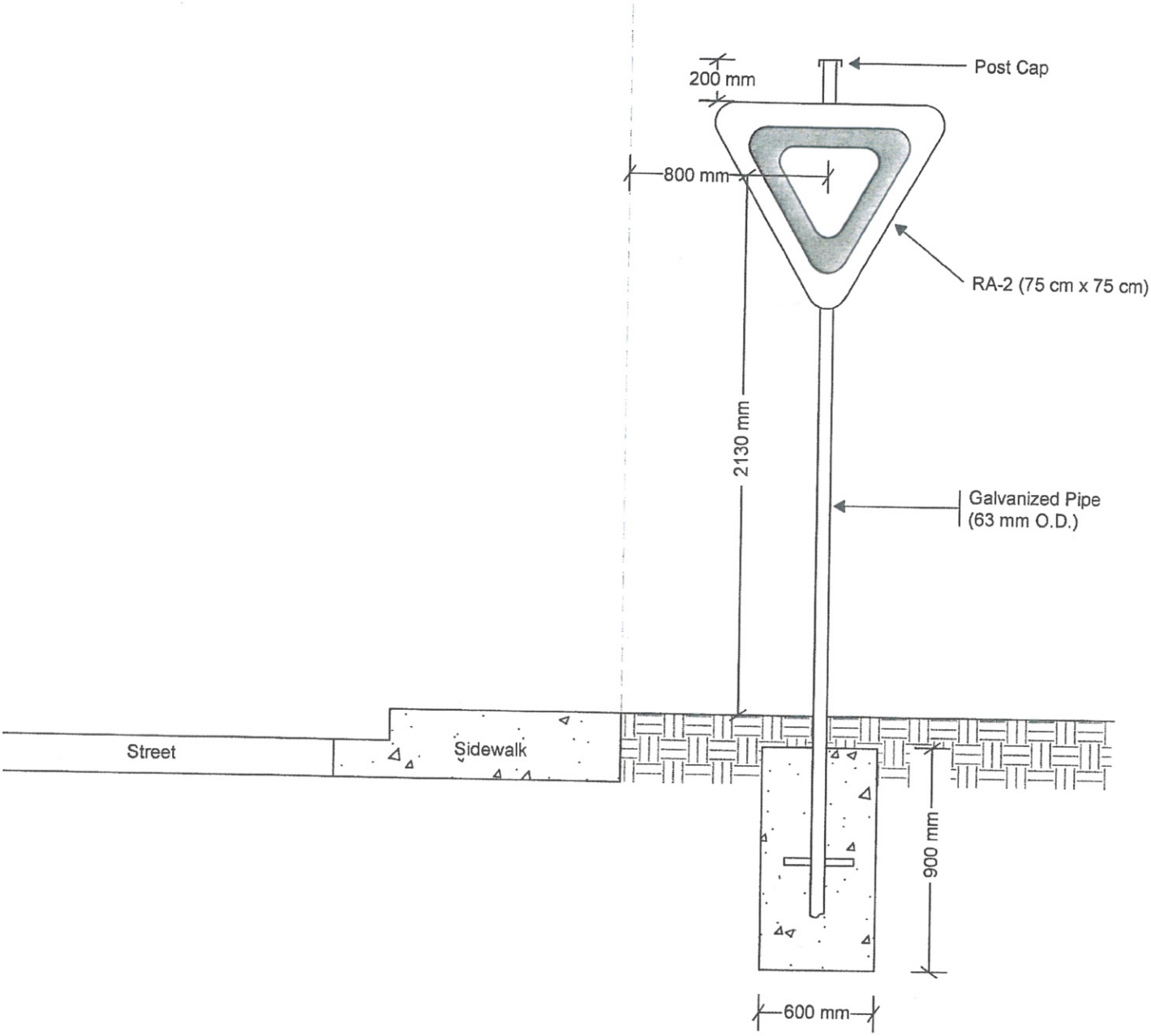

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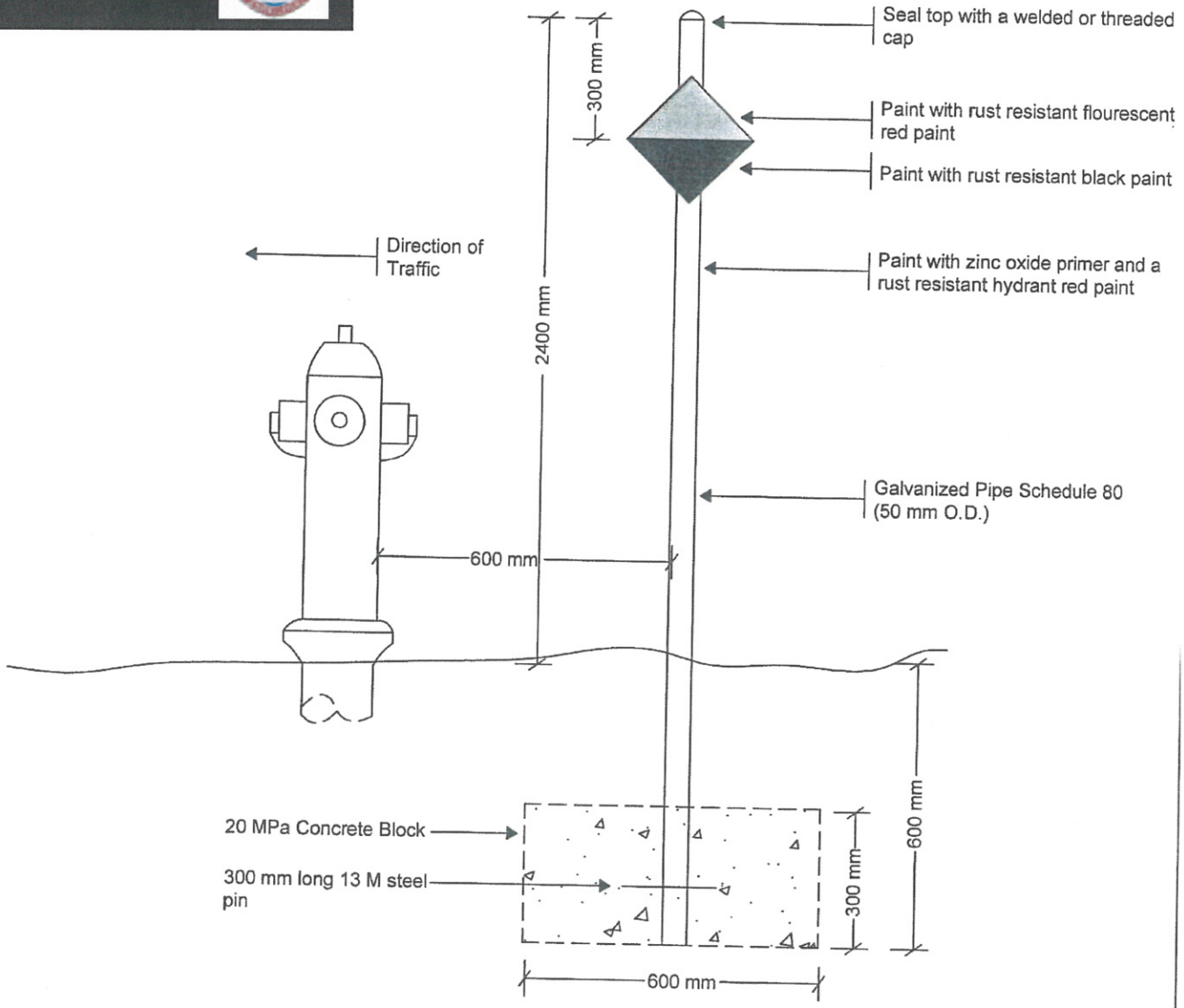
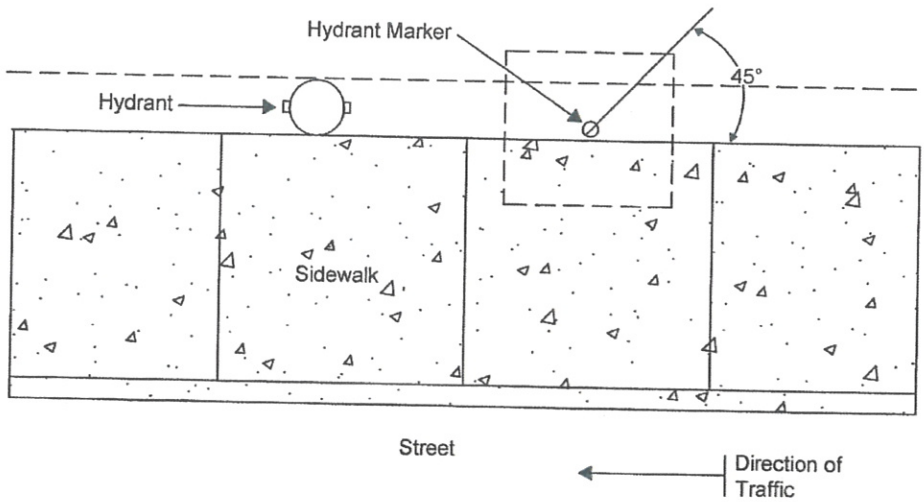
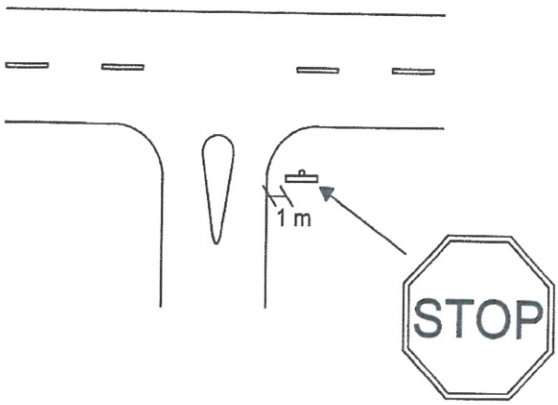
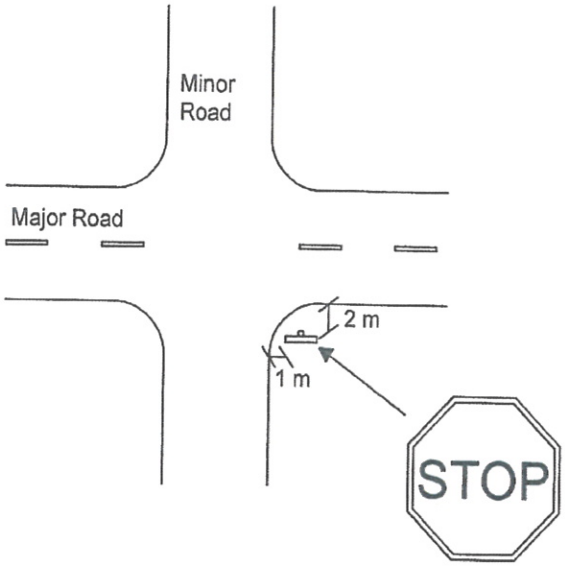


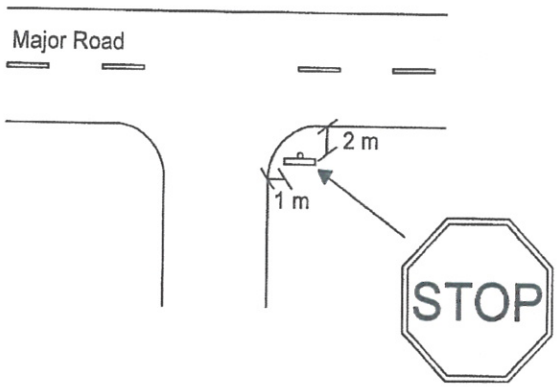


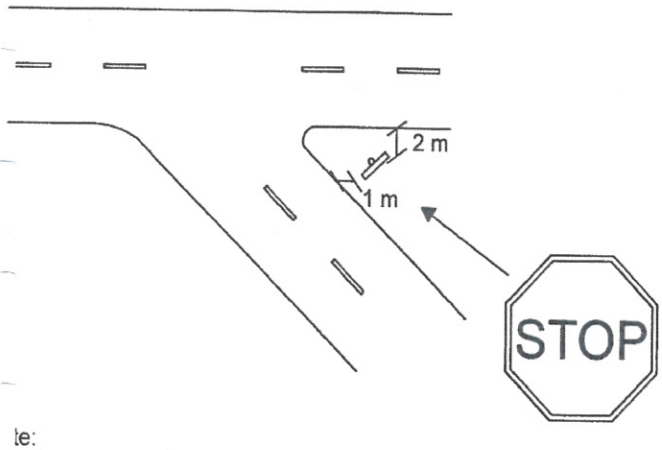
The Town of Holyrood

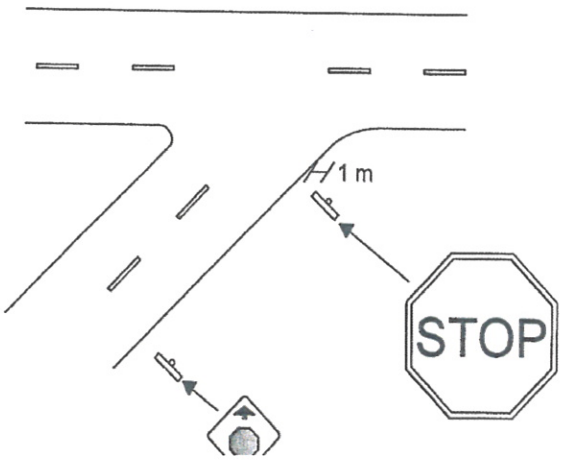
Typical Locations of Stop Signs at Various Intersections











te:

The Town of Holyrood

Frontt Elevation

Storm Sewer
(Left Hand Side)

Sanitary Sewer
(Right Hand Side)

Street

Within the Town of Holyrood, all House Service Laterals shall be installed with the Storm Sewer Line on the Left and the Sanitary Sewer Line on the Right as shown above. Contractors will be held responsible for services installed incorrectly.

APPENDIX B

STORM SEWER CALCULATIONS

Calculation of Storm Sewer Flows

Design Assumptions

Design Storm: 1:10 year for Subdivisions

Design Storm: 1:100 year for bridge structures, culver diameters > 1500 mm, for highway crossings and retention facilities

Q = Rain (for area less than 10 hectares)

Tc = overland flow time + (length of flow/average channel velocity)

(If area > 10 Ha, use an approved computer model)

(Use the most recent I.D.F. curves from Environment Canada for intensities and durations)

MANNINGS Formula for Velocity in Storm sewer pipes

D = [(3.21 x Q x n) / (S^0.5]^0.375

V = [0.397 x (D^0.667) x (S^0.5)] /n

Pipe Material

Concrete n = 0.013

CSP (helical) n = 0.018 (for Dia <900)

CSP (ultraflo) n = 0.013

PVC (ultra Rib) n = 0.01

Table 1

Storm Sewer Calculations

Manhole Section	(A) Design Area (ha)	(N) Runoff Coeff	(I) Rainfall Intensity (mm/hr)	(R) Constant	Section Design Flow (I/s)	Incremental Design Flow (c.m/s)	Design Slope (%)	Mannings Coeff N	Design Diameter (mm)	Nominal Diameter (mm)	Nominal Diameter Velocity (m/s)	Nominal Diameter Flow (c.m/s)	Extra Capacity (c.m/s)	Percent Extra Capacity (%)
1 to 2														
2 to 3														
3 to 4														

APPENDIX C

SANITARY SEWER CALCULATIONS

Calculation of Sanitary Sewer Flows

MANNINGS Formula for Velocity in Sanitary sewer pipes

D = [(3.21 x Q x n) / (S^0.5]^0.375

V = [0.397 x (D^0.667) x (S^0.5)] /n

Pipe Material

PVC, n = 0.01

Concrete

CSP (ultraflo) n = 0.013

PVC (ultra Rib) n = 0.01

Table 1

Sanitary Sewer Calculations

Q= Area x Population Density x Peaking Factor x Flow/Person + Infiltration

Manhole Section	Area	Pop Density	Design	Peaking Factor	Flow/ Person	Infiltra	Incremental Design Flow	Design Slope	Manning's Coefficient	Design Diameter	Nominal Diameter	1-5 m/s Design Velocity	Nominal Diameter Design Flow	Extra Capacity	Extra Capacity
		(c/ha)	(c)	(2.5 – 4.5)	(l/c/d)	(l/s)	(l/s)	(%)	N	(mm)	(mm)	(mm)	(l/s)	(l/s)	(%)
1 to 2															
2 to 3															
3 to 4															

APPENDIX D SUPPLEMENT TO:
Government of Newfoundland and Labrador Municipal Water and Sewer and Roads Master Construction Specifications

Division #1

Index

Section 01001

Definitions

Engineer: Shall mean Consulting Engineer registered in the Province of Newfoundland and Labrador, for the current year retained by the Developer to be responsible for design and supervision of the work.

Owner: Owner, where used in the Master Specifications, refers to the Developer, a person or company who has applied for and has been granted approval to subdivide or service and existing parcel of land.

Section 01005

General Instructions

1.2.1 Where a Contractor is required to install storm or sanitary sewer mains beginning at an existing manhole or section of existing main, the Contractor shall install a temporary 6 mm mesh screen over the outlet pope of the first downstream existing manhole to prevent debris and gravel from entering the existing system from the new work. If this location is not appropriate, the Engineer may choose a more suitable location, to be approved by the Town Engineer.

Section 01570

Traffic Regulations

1.3.1 Traffic detours shall not be implemented unless the owner receives the prior written approval of the Town. The owner shall request approval at least seven (7) days in advance of the proposed implementation of the detour.

Traffic detours shall be applicable to through traffic movements only. The owner shall provide adequate means whereby access is maintained to properties fronting on closed sections of streets.

Division #2

Index

Section 02702

Pipe Sewer Construction

1. All sewer service pipe to be SDR 28. All PVS storm mains to be perforated with two rows of 13 mm diameter holes, 400 mm on centre, 45° and 315° from the pipe invert.

2. Place Type 1 granular bedding materials on all storm and sanitary service. Minimum 150 mm below invert and 300 mm above top of pipe.

3. Delete the items as shown and substitute as follows:

   a. Scope of Work:

      The work covered by this specification consists of furnishing all materials, labour, supervision, equipment and plant, to perform all work necessary for the television inspection of the gravity sewer lines as specified.

   b. When Television inspection will be required:

      A Television Inspection will be required:

      i) For all new sewers (sanitary and storm), sewers are to be inspected prior to acceptance of Phase I works and ten months from the date of acceptance or before placing of surface course asphalt, whichever occurs first.

      ii) When any proposed construction project may conceivably damage, disrupt or otherwise disturb any portion (or an appurtenance) of the municipality's sewerage system, a preconstruction and post-construction inspection of the system will be required.

   c. Arrangement for Inspections:

      The Contractor will arrange all pre-construction and post-construction television inspections.

   d. Pre-Construction Inspection of Sewers:

      In the area of the proposed construction, all building services connected to the sewer main shall be assumed to be in reasonable structural condition if they have been functioning properly in the past. If a malfunction of a building service is caused, the contractor will be held responsible for any repairs. As an alternate to the previously outlined preconstruction inspection requirements, the Contractor may accept the sewer line conditions noted in a previous T.V inspection report for the affected area, which may be presently on file, however, to permit utilization of a past report the following criteria must be met;

(i) The T.V. inspection report shall be less than 3 years old

(ii) No major construction works shall have been undertaken in the immediate area since this inspection

e. Post-Construction Inspection of Sewer:

The post-construction inspection must be completed thirty days of completion of the works, and in any case before the work is accepted. The T.V. inspection contractors shall record both the pre-construction and post-construction inspections on video tape, as outlined. Upon completion of the post-construction, the tapes will be submitted to the Engineer.

f. Evaluation of Inspection Results:

The results of the t.v. inspection will be evaluated by the Engineer for determination of any damage as a result of the construction project. The sewer system and its appurtenances will be assumed to be damaged by a construction project under the following conditions:

(i) The excavation is of sufficient proximity and depth;

(ii) In bedrock, to cause damage to sewers by blasting tremors or rock movement.

g. Repair of Damaged Sewers:

All damage incurred by the sewer system due to the construction project shall be repaired by the contractor in accordance with the Town standards. Upon completion of these repairs, a subsequent verification inspection shall be undertaken to assess the quality of the repairs.

h. Definitions:

i) "Clean" shall mean the removal of all sand, grease and all other solid or semi-solid material from the length of pipe connecting two manholes.

ii) "Building service" shall mean the sewer line (lateral) extending from the building to the sewer main.

i. Television Equipment:

Television equipment shall consist of self-contained camera and a monitoring unit connected by a 3 wire coaxial cable. The camera shall be small enough to ensure passage through a 150 mm sewer, shall be water proof, and shall have a self-contained remotely controlled lighting system capable of varying the illumination of the interior of the sewer line for inspection and photographic purposes.

Picture quality shall be such as to produce a continuous 600 line resolution picture showing the entire periphery of the pipe. All videos submitted must be DVD or VD (.avi format). An audio description of the inspection must also be provided, as well as a written report.

j. Television Inspection:

The television inspection shall be performed on one sewer line section at a time. Each sewer line section being inspected shall be isolated where necessary from the remainder of the line by the use of a line plug to ensure total viewing of the periphery of the pipe. The inspection shall be performed in the direction of the flow, where possible. An inspection record prepared by the Engineer shall be kept, showing the exact location of each point of infiltration, fault and building service observed by the camera. The Town Engineer reserves the right to take pictures of the television monitor, as long as such photographing does not interfere with the Contractor's operations and work. Sewer lines 1050 mm in diameter or greater may be inspected by walking through the pipe. Video pictures shall be recorded with a hand held television inspection camera. In addition, still pictures may be taken with a 35 mm camera. Sections found to have deficiencies are to be retaped after deficiencies have been rectified, therefore, taping of new work will show no deficiencies.

k. Accommodation for Viewing:

The Contractor shall provide the accommodation for no less than two people, for the purpose of viewing the monitor, while the inspection is in progress.

l. Records:

An Inspection Record, in log form, shall be maintained during the television inspection by the Engineer. This log shall show the exact location of each leak, fault and building service. The location shall include the distance away from the referenced manhole and also the position as referenced to the axis of the pipe.

Further, a detailed technical description shall be accompanied with photographs as supporting data for each leak or fault noted in the Inspection Report. The term leak or fault is hereinafter defined as:

1) Any sewer pipe joint which displays a gap or spread, offset, or signs or infiltration.
2) Any building service which has water entering around the junction of the lateral to the sewer line section or a steady flow entering the line section through the sewer lateral.
3) Any building service exhibiting a pronounced protrusion into the sewer line section.
4) Any section of the sewer which is crushed, broken or displays cracks which are parallel or perpendicular to the axis of the pipe (longitudinal cracks or shears).
5) Any variance in the grade of the sewer line section. The final t.v. inspection report for each section will be submitted by the Engineer in the format as noted in item 201.16- Standards for Television Inspection Records. In addition to the normal inspection report format, the Contractor shall record all the television on DVD. These DVDs shall be submitted to the Municipality. The written inspection report will be prepared by the Engineer. All photos and video pictures shall be of excellent quality and resolution. They should present a clear picture of the condition of the pipe with a precise and distinct definition of all observations, ie: leaks, faults, cracks, obstructions, etc.

m. Threading of Sewers

A 6 mm nylon rope or equivalent may be installed in the sewer not more than one day in advance of the inspection, in order that the camera cable may be drawn through the sewer. The rope shall be tightly secured to the manhole ladders, making sure the line is taut, leaving no slack in the sewer line. The line will be removed once inspection is completed.

n. Site Safety:

Manhole barricades are required around all open manholes, in addition to Traffic Control, as per Division 7. Manhole barricades shall be as per Form 741. Prior to entering manholes and sewer lines, the contractor shall ensure that dangerous gases or oxygen deficiencies are not present. The contractor shall keep a gas detector and air blower at the site to ensure the safety of the workman when they are working inside the manholes and sewer lines and ensure safety harnesses and related equipment are used with individuals entering confined spaces.

o. Flow Control

When sewer line flows are above the minimum requirements (1/4 of the pipe diameter) to effectively conduct the inspection, one or more of the following methods of flow control shall be used:

Plugging or Blocking

A sewer line plug shall be inserted into the line at a manhole upstream from the section to be inspected. The plug shall be designed so that all or any portion of the sewage flows can be released. During the inspection portion of the operation, flows shall be shut off or substantially reduced in order to properly inspect the pipe at the invert. After the inspection is complete, flows shall be restored to normal.

Pumping or By-passing

When adequate flow control cannot be obtained by the plugging method, pumps or siphons shall be used to divert all or a portion of the flows as may be necessary to perform the inspection, as approved by the Engineer. Excess sewage flows shall be transported through a pipe or by tank trucks to the nearest or most economical disposal area.

p. Standards for Television Inspection Reports:

Within ten working days following completion of a t.v. inspection on a section of sewer, a final television inspection video on this section shall be submitted by the Contractor to the Engineer. The Engineer shall prepare and submit a final television inspection report to the Municipality. The 10" x 11 ½" enclosure for the final report will meet the following specifications:

- The report shall be suitable bound;
- Only letter-sized paper (81/2 x 11) will be used;
- The title page of the final report will be as follows with the appropriate substitution where required;

(See following page)

Television Inspection Report

Subdivision _____ Street Name: _____

Manhole No. _____ To Manhole No. _____

Distance: _____ Gradient: _____

Pipe Length: _____ Pipe Size: _____ Pipe Material: _____

Date: _____ Ref. Dwg. No. _____ Sheet No. _____

TAPE NUMBER	LINE FOOTAGE	PHOTO NO.	COUNTER REF. NO	OBSERVATIONS

T.V Inspection
Of
Sanitary/Storm Sewer
Department of Engineering

Location: _____

Video Taped by: _____

Report Prepared by: _____

Date: _____

- An Index Page is to be included with each report and will state:
  "Street names from manhole # ___ to manhole # ___"

- Whether inspected at the same time or not, the complete sewer inspection report will be presented together, from upstream to downstream manhole.

- All pages will be numbered in the upper right hand corner of the right hand page. Thus, only every second page will be numbered with the same number referring to botht the left and right hand page.

- A standard form for documenting the television and manhole inspection findings is provided in Item 202. The form must show:
  (a) For t.v. inspection results the heading will state:
    (i) The street names
    (ii) The manhole number applicable to this section
    (iii) The reference drawing number
    (iv) The date of the inspection

  (b) The key plan will consist of a small drawing (not to scale) showing the appropriate locations of the two manholes in relation to any nearby reference points such as houses (with corresponding civic numbers), telephone poles (with corresponding pole numbers) etc. This drawing will denote:
    (i) The manhole numbers
    (ii) The horizontal distance between the two manholes
    (iii) The direction of sewer flows

All photographs will appear on the left page only, opposite the corresponding description for the photo which appears on the right hand page. When there are more pictures in any run than can be placed on the first left page, these will be placed on subsequent pages with corresponding descriptions appearing opposite. All photographs will be numbered in order. This number will appear beside them and will consist of an area sewer plan to scale, showing the street inspected for the report and applicable manhole numbers.

Deflection test for PVC Sanitary Sewers

A deflection test shall be carried out on all sections of the sewer. The maximum allowable deflection under fully backfilled and compacted trench conditions shall not exceed 5% before 30 days and 7.5% after 30 days.

Locations with excessive deflection shall be repaired and/or pipe shall be replaced. The equipment used for the deflection test shall be that as recommended by the manufacturer, and may include an Electronic Deflectometer or a Rigid "Go-No-Go" Device. For the purpose of deflection measurement, the base inside diameters and the deflection mandrel dimensions are provided in Table 2. To ensure accurate testing, the liens shall be thoroughly cleared.

Table 2

Base Inside Diameters and Deflection Mandrel

Dimensions, PVD SDR-35 (ASTM D3034)

NOMINAL SIZE	BASE INSIDE DIAMETER (mm)	5% DEFLECTION MANDREL (mm)	7.5% DEFLECTION MANDREL (mm)
200	194.69	185.0	180.0
250	242.90	230.8	224.6
300	288.57	274.0	266.9
375	353.01	335.4	326.6

2.2 SECTION 02713 WATER MAINS

1.1.1 (1) Curb stops shall be located behind the sidewalk within the street right of way

(2) 2.1.1 – All water mains shall be ductile iron, class 52.
Delete 2.1.2, 2.1.3 and 2.1.4

(3) Item 2.4- All water service pipe to be copper tubing, type K.
Delete all references to other pipe materials.

(4) 2.6.1- Granular bedding materials to be Type 3

2.3 SECTION 02724 SEWAGE FORCE MAINS

(1) Item 2.2.1- Change as follows: Granular bedding materials to be Type 3 for ductile iron pipe

Division # 3

Index

Section 03300

3.1 Surface Finishing

All concrete surfaces, unless specified otherwise, that will be visible on completion of the work shall confirm to surface finish Class 2. The surface shall be uniform in colour and texture when viewed from a distance of 15 m and shall be attained as follows:

Class 2- Rubbed Finish

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other effects shall be cut back to sound concrete and thoroughly cleaned. No feather edging is permissible. If reinforced steel is exposed, concrete shall be cut back for at least 50 mm around the reinforcement. After having been kept saturated with water for a period of not less than three hours, the cavities shall be carefully pointed and trued with a 30 MPa non shrink grout. The patches shall be placed and cured as specified by the manufacturer.

All construction and expansion joints in the completed work shall be left carefully tooled and free of all grout and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The resulting surfaces shall be started as soon as its condition will permit, however, before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of three hours, but sufficient time shall have elapsed before the wetting down to allow the grout used in the pointing of rod holes and defects to thoroughly set.

Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of extra cement and fine sand mixed in proportions such as to match existing concrete verified by a patch test. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time. After all concrete above the surface being treated has been cast; the final finish shall be obtained by rubbing with a fine carborundum stone and water.

This rubbing shall be continued until the entire surface is of a smooth texture and uniform colour. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

3.2 HAND RAIL

(1) Scope of Work:

Fabricate and erect pedestrian hand railing constructed of steel pipe posts. Locations shall be as shown on the drawings.

(2) Form and Dimensions:

The form and dimensions of the handrails shall conform to those given in the drawings, and the length shall be as required to suit the particular site conditions where necessary. The Contractor shall vary the spacing of the posts such that the spacing is uniform throughout the length of the rail.

(3) Materials and Fabrication:

Steel posts and rails shall consist of 50 mm inside diameter galvanized schedule 40 pipe conforming to ASTM Standard A53. The railing shall be pre-fabricated before erection, and joints between rails and posts shall be made by proper cutting and fitting to insure complete contact. The joints shall then be welded and the welds and surrounding heat-damaged areas shall be galvanized after fabrication or otherwise suitably protected from corrosion by the use of a zinc based coating. The railing shall be delivered to the site complete and ready for erection.

(4) Installation and Finish:

Posts shall be bedded in cement, non shrink grout, in accordance with the bedding detail in the drawings. Holes shall be either drilled or formed in the concrete walls, walks, steps or sidewalks as required.

After installation, the posts and rails shall be prepared and painted as follows:

i. Clean galvanized with a Matchless brand #802 metal conditioner or approved equal.
ii. Prime (one coat) with Matchless brand #590 Zinc Dust Zinc Oxide primer or approved equal.
iii. Paint (two coats) with Matchless brand #119 enamel in colour selected by the Engineer.

Town of Holyrood

Sanitary Sewer Test Results

Project:

Date:

Table 1

Sanitary Sewer Test Results

Date	Section MH to MH	Location (street)	Pipe Size (mm)	Length of Pipe (m)	Allowable Loss (L)	Number of Building Services	Length of Service Pipe	Exfiltration Test			Infiltration Test			Comments
								Test Time (min)	Measured Loss (L)	Pass/Fail	Test Time (min)	Measured Loss (L)	Pass/Fail	
Allowable Exfiltration: 0.000023 L/min/mm, DIA/m														
Allowable Infiltration: 0.00000767 L/min/mm, DIA/m														

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Site Representative: _____

Consulting Engineer: _____

Town of Holyrood

Project:

MANHOLE TEST RESULTS

Date:

MH #	Location	Allowable Leakage	Test Time	Actual Leakage	Pass/ Fail	Dept of Test Water of Inv.			Comments:

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

Town of Holyrood

Project:

PIPE DEFLECTION TEST RESULTS

Date:

Section MH to MH	Location Street	Pipe Size	Allowable Deflection	Actual Deflection	Pass/ Fail	Manufacturer			Comments:

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

Town of Holyrood

WATER MAIN DISINFECTION TEST RESULTS

Project:

Date:

Water Main Disinfection Test Results

Date	Section Sta. to Sta.	Location (street)	Pipe Size (mm)	Section Length	Disinfection Concentration Injected (mg/l)	Test Time (hrs)	Residual Disinfection Concentration Measured	Type of Pipe	Pass/Fail	Test Water Discharge Location	Comments

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

Town of Holyrood

WATER MAIN HYDROSTATIC PRESSURE TEST RESULTS

Project:	
Date:	

Allowable leakage shall be calculated as follows:

L= [ND(P)^0.5]/128 where:

L=allowable leakage in liters/hour

N-= number of pipe joints in test section

D= nominal diameter of pipe in meters

P= average test pressure in kPa

Water Main Hydrostatic Pressure Test Results

Date	Section Sta. to Sta.	Location (street)	Pipe Size (mm)	Section Length	Working Pressure (kPa)	Test Pressure (kPa)	Allowable Leakage (L)	Test Leakage (L)	Comments

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

Town of Holyrood

WATER MAIN SWABBING PRESSURE TEST RESULTS

Project:

Date:

Water Main Swabbing Pressure Test Results

Date	Section Sta. to Sta.	Location (street)	Pipe Size (mm)	Section Length	Type of Pig/Swab used	Post Test Pig/Swab Condition	Pass/Fail		Comments

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

Town of Holyrood

ASPHALTIC CONCRETE PAVEMENT TEST RESULTS

Project:	Street:
Date:	Sample Location (Station):

Asphaltic Concrete Pavement Test Results

Date	Section Size (mm)	Base Course Required % Passing (by wt)	Base Course Actual % Passing (by wt)	Surface Course Required % Passing (by wt)	Surface Course Actual % Passing (by wt)	Comments
	19.0	100		100		
	12.5	80-100		97-100		
	4.76	35-75		55-75		
	2.0	20-60		35-55		
	0.425	10-35		18-30		
	0.075	0-8		0-8		

Other Parameters	Required Content Base Course	Actual Content Base Course	Required Content Surface Course	Actual Content Surface Course	
Asphalt Content	5.0%-7.0%		5.5%-7.5%		
% Air Voids	3%-5%		3%-5%		

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

Town of Holyrood

GRANULAR MATERIAL TEST RESULTS

Project:		Street:	
Date:		Sample Location (Station):	

Granular Material Test Results

Date	Sieve Size (mm)	Class "A" Required % Passing	Class "A" Actual % Passing	Class "B" Required % Passing	Class "B" Actual % Passing	Comments
	50.8	-		75-100		
	19.0	100				
	15.9			45-80		
	9.51	55-80				
	4.76	35-60		25-55		
	1.20	17-35		12-35		
	0.30	7-20		7-20		
	0.075	3-6		3-6		

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

Town of Holyrood

COMPACTION TEST RESULTS

Project:

Date:

Compaction Test Results

Street	Station	Sub-grade Compaction	Class "B" Thickness	Class "B" Compaction	Class "A" Thickness	Class "A" Compaction	Base Asphalt Thickness	Base Asphalt Compaction	Surface Asphalt Thickness	Surface Asphalt Compaction	Comments

I hereby certify that all tests have been performed according to the contract specifications and this/these sections of pipe have passed the required test.

Contractor Representative: _____

Consulting Engineer: _____

Site Representative: _____

APPENDIX E

APPROVED PRODUCTS

Approved Products & Manufacturers		
	Water Systems	
Water main pipe & fittings	Ductile Iron (Class 52)	Canada Pipe U.S. Pipe
Water main fittings (M.J.)	Ductile Iron (Class 52)	Canada Pipe U.S. Pipe MUELLER
Tapping Sleeves & Valves	Ductile Iron (M.J.)	MUELLER
Hydrants	M67	McAvity
Valves	Double Gate Valve Resilient Seat Gate Valve	DARLING McAVITY MUELLER MUELLER BIBBY McAVITY
Valve Boxes	Buffalo Bibby	MUELLER BIBBY
Water Service Pipe	Copper Type K	WOLVERINE CERRO
Cooperation Stops	Flared	MUELLER CANADA BRASS CAMBRIDGE BRASS FORD
Curb Stops	Flared	MUELLER CANADA BRASS CAMBRIDGE BRASS FORD
Couplings	Flared	MUELLER CANADA BRASS FORD DRESSER
Curb Stop Boxes	Slider	MUELLER
Curb Stop Box Extensions	A12	MUELLER
Curb Stop Box Covers	800 or 808	MUELLER
Water Main Repair Clamps	Split/Solid Stainless Steel Ductile Iron M.J.	MUELLER SMIT-BLAIR CONCORDE-CLOW CANADA PIPE U.S. PIPE SMITH-BLAIR MUELLER
Mechanical Joint Restrainers	Mecha-Holder Mega-LUG	CANADA PIPE EBAA IRON

Approved Products and Manufacturers			
Sewer Systems			
Item	Product	Manufacturer	Approval Date
Sewer Main Pipe	PVC SDR 35 PVC Ribbed Concrete (reinforced) CSP (aluminized helical) CSP (double galvanized)	IPEX REHAU IPEX REHAU L.E. SHAW ARMTEC A.I.L	
Force Main Pipe	Ductile Iron (class 50)	CANADA PIPE U.S. PIPE	
Sewer Service Pipe	PVC SDR 28	IPEX REHAU	
Sewer Main Fittings	PVC	IPEX REHAU	
Repair Couplings	Appropriate Series	PREPER FERNCO	
Manholes & Catch basins	Pre-cast (CSA approved)	L.E. SHAW WHITES CAPITAL READY MIX	
Manhole Frames & Covers	Round	NAFCO IMP	
Catch Basin Frames & Covers	Herring Bone	NAFCO IMP	
Structural Plate Arches	CSP (aluminized) CSP (double galvanized)		