

Town of Amherst Subdivision By-Law

As adopted by Town Council June 21, 2004

And Approved by Provincial Director of Planning July 30, 2004

THIS IS TO CERTIFY that the following is a true copy of the Town of Amherst's Sub-Division By-Law as adopted at a duly called meeting of the Town Council of the Town of Amherst duly held on the 21st day of June , 2004.

GIVEN under the hand of the Town Clerk and under the Corporate Seal of the Town this 6th day of July , 2004.

Ed Childs
Town Clerk
Town of Amherst

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LIST OF SCHEDULES

SCHEDULE “A” - Application For Subdivision Approval

SCHEDULE “B” - Notice of Approval

SCHEDULE “C” – Application for Approval of a Variance

SCHEDULE “D” - Application for Repeal of a Subdivision

SCHEDULE “E” - Repeal of a Subdivision

SCHEDULE “F” –Infrastructure Development Standards

SUBDIVISION BY-LAW FOR THE
TOWN OF AMHERST

SECTION 1: SHORT TITLE

1.1 This By-Law may be cited as the “Subdivision By-Law” for the Town of Amherst.

SECTION 2: INTERPRETATION

2.1 In this By-Law the word "shall" is mandatory and not permissive. Words used in the present tense shall include the future. Words used in the singular shall include the plural except where otherwise indicated and words used in the plural number shall include the singular. All other words shall carry their customary meaning except those defined hereinafter.

2.2 SCHEDULES "A", "B", "C", "D", “E” and "F" attached hereto are adopted by Resolution of Council and hereby declared to form part of this Bylaw.

2.3 This By-Law shall apply to the subdivision of all land within the Town of Amherst and shall be administered by the Development Officer.

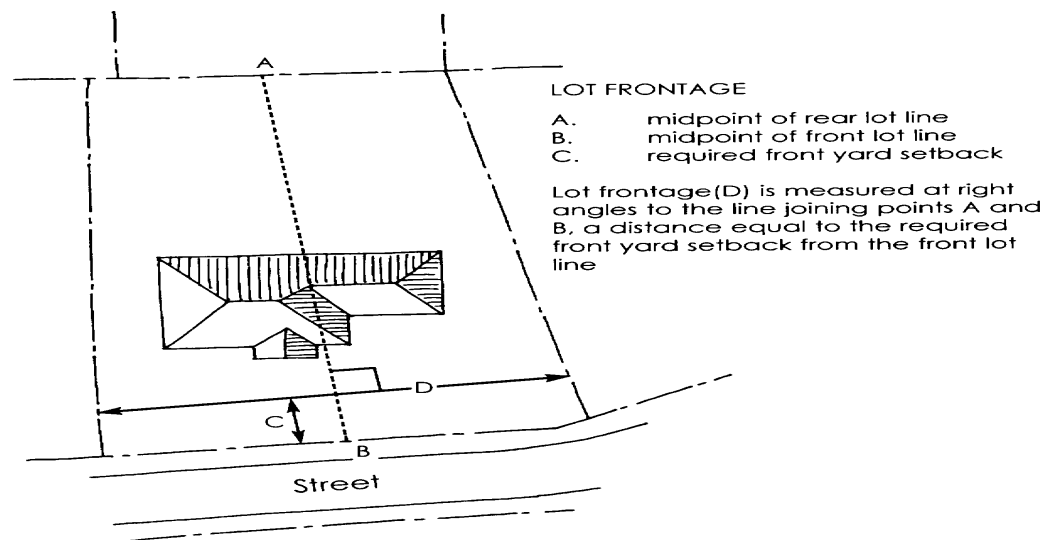
SECTION 3: DEFINITIONS

3.1 In these regulations,

- (a) “Act” means the Municipal Government Act (MGA), c. 18, Statutes of Nova Scotia, 1998, as amended.
- (b) “Area of land” means any lot or parcel as described by its boundaries.
- (c) “Council” means the Council of the Town of Amherst.
- (c) “Contour” means a line joining like elevations as determined by a surveyor, or the Nova Scotia Topographic Database.
- (d) “Cul-de-sac” means a local street, with only one connection to a thru street, and a permanent circular turn around at its end.
- (d) “Department of the Environment” means the Nova Scotia Department of the

Environment and Labour.

- (e) “Department of Transportation and Public Works” means the Nova Scotia Department of Transportation and Public Works.
- (f) “Development Officer” means the officer, or assistant, who is appointed by Council to administer the provisions of this Subdivision Bylaw.
- (g) “Director” means the Provincial Director of Planning.
- (h) “Engineer” means the engineer for the Town, and includes a person acting under the direction of the engineer.
- (i) “Lot” means a parcel of land described in a deed or as shown on a registered plan of subdivision.
- (j) “Lot Area” means the total horizontal area within the lot lines of a lot.
- (k) “Lot Frontage” means the length of a line joining the side lot lines and parallel to the front lot line. Calculation of Lot Frontage for irregularly shaped lots shall be the horizontal distance between the side lot lines as measured at a point, where a line drawn perpendicular to a line joining the midpoint of the rear lot line and the midpoint of the front lot line at a point equal to the required front yard. In determining yard measurements the minimum horizontal distance from the respective lot lines shall be used. Calculation of lot frontage for corner lots shall be the horizontal distance between the side lot line and the flanking lot line.



- (l) “Main Building” is the building in which the main use of the lot is carried out and is not accessory to another building on the said lot.
- (m) “Municipal Planning Strategy and Land Use By-Law” means the Municipal Planning Strategy and Land Use By-Law for the Town of Amherst.
- (n) “Public Sewer System” means any sanitary sewer system that is owned and maintained by the Town.
- (o) “Public Storm Sewer System” means any storm sewer system that is owned and maintained by the Town.
- (p) “Public Water System” means any water system that is owned and maintained by the Town.
- (q) "Public street or highway" means any street or highway owned and maintained by the Town of Amherst or the Department of Transportation and Public Works.
- (r) “Registry of Deeds” means the office of the registrar of deeds for the registration district of Cumberland.
- (s) “Subdivider” means the owner, or owners agent, of the area of land proposed to be subdivided.
- (t) “Subdivision” means the division of any area of land into two or more parcels, and includes a re-subdivision or a consolidation of two or more parcels.
- (u) “Town” means the Town of Amherst.
- (v) “Thru street” means a street which has at least two connections to other thru street(s).

SECTION 4: GENERAL PROVISIONS for SUBDIVISION

- 4.1** All lots approved on a final plan of subdivision shall abut a public street.
- 4.2** All lots shall meet the applicable requirements contained in the Land Use By-law.
- 4.3** (a) Notwithstanding the lot area and frontage requirements of Section 4.2, the Development Officer may approve a maximum of two lots, shown on a plan of subdivision, which are not less than 90% of the required minimums specified in the Land Use Bylaw, excluding flag lots. Any person requesting a variation shall submit to the Development Officer an application in the form specified in Schedule “C”.
- (b) Subsection (a) does not apply if the area requirements established by the Department of the Environment for the construction or installation of an on-site sewage disposal system are not met.
- 4.4** Notwithstanding Section 4.1 and the lot area and frontage requirements of Section 4.2, the Development Officer may approve a subdivision altering the boundaries of two or more areas of land for the purpose of improving an existing situation, where;
- (a) no additional lots are created;
- (b) the proposed subdivision will not result in any lot having either its lot area or lot frontage further reduced beyond the minimum requirements of the Land Use Bylaw.
- 4.5** Notwithstanding the lot area and frontage requirements of Section 4.2, where a development component of a permanent nature such as a structure, driveway, well, or on-site sewage disposal system is encroaching in or upon an immediately adjacent area of land, the Development Officer may approve a plan of subdivision to the extent necessary and practical to remove the encroachment.
- 4.6** Notwithstanding the lot area and frontage requirements of clause 4.2, where a parcel of land contains more than one main building, the Development Officer may approve a final plan of subdivision creating the same number of lots or fewer as there are main buildings provided that each proposed lot is serviced independently by both municipal water and municipal sanitary sewer and fronts on a public street.
- 4.7** Wherever possible, side lot lines shall be substantially at right angles to a public street, or radial to a curved public street.
- 4.8** Wherever possible, the rear lot lines of a series of adjoining lots shall be continuous, not stepped or jogged.

SECTION 5: MUNICIPAL SERVICES AND STREETS

- 5.1** Where a proposed subdivision involves the construction or extension of a public street or public water, sanitary sewer, or storm sewer system(s), the subdivider shall construct and provide such streets and services, free of encumbrances to the Town. Furthermore, the said streets and services shall comply with the specifications set forth in SCHEDULE "F Town of Amherst Development Standards" of this Bylaw.
- 5.2** (a) All proposed municipal public streets shall be approved by the Town Engineer.
- (b) Where a proposed municipal public street intersects a provincial public street, that intersection shall be approved by the Town Engineer and the Department of Transportation and Public Works.
- 5.3** All proposed accesses to a public street shall be approved by the Development Officer.
- 5.4** Where a plan of subdivision shows a proposed lot abutting an existing street, the engineer shall verify that the street is a public street.
- 5.5** The following are the minimum right-of-way widths for new public streets:
- | Type of Street | Width |
|----------------|---------------|
| Local | 15 m |
| Cul-de-sac | 18.6 m radius |
| Collector | 18 m |
| Arterial | 18 m |
- 5.6** A local public street, unbroken by an intersection shall not exceed 500 metres.
- 5.7** There shall be no more than four public street approaches in an intersection.
- 5.8** The minimum distance between public street intersections shall be 60 metres.
- 5.9** The length of a proposed cul-de-sac shall not exceed 200 meters from an intersection of a thru street to the base of the turning circle.
- 5.10** The Development Officer may approve a dead end street in excess of 200 metres in length, provided it has a temporary turning circle and a second connection to a thru street is shown on an approved Concept Plan of Subdivision.
- 5.11** All proposed intersecting streets must intersect at an angle of 70 to 110 degrees for a minimum distance of 30 meters from the intersection measured from the respective center lines.
- 5.12** Where a public street in an adjoining subdivision abuts the boundaries of a plan of subdivision submitted for approval, the public street in the latter shall, if reasonably

feasible, be laid out in prolongation of such existing public streets, unless it would be in violation of this Bylaw.

SECTION 6: PUBLIC OPEN SPACE

- 6.1** Prior to approval of the final plan of subdivision by the Development Officer, the subdivider shall reserve and convey to the Town free of encumbrances, for park, playground or similar public purposes an area of useable land, as defined below, equal to 5% of the area of land shown on the final plan of subdivision exclusive of public streets and the remainder lot.
- 6.2** The requirements of section 6.2 are waived when the applicant is requesting approval for:
- (a) the subdivision or consolidation of lots in any zone, other than a residential zone; or,
 - (b) the consolidation or re- subdivision of existing lots where no additional lots are created, or;
 - (c) the consolidation or subdivision of land for which the public land dedication requirement has already been paid.
- 6.3** USEABLE LAND for the purpose of this section, means that:
- (a) the land area has a minimum frontage of 6 metres on a public street and an area that can accommodate a circle with a minimum diameter of 10 metres, except in the case of a walking or bicycling trail, where the minimum width and street frontage shall be 3 metres; and,
 - (b) in the opinion of the Development Officer and the Director of Operational Services, can be utilized for passive purposes such as nature trails, picnic sites, leisure park area, the protection of environmentally significant or sensitive areas or other public purposes; or,

active purposes such as playing fields, playgrounds, etc., providing that such acquisition is not premature or inappropriate in terms of the capability of the Town to absorb any costs relating to the development of the said lands.
- 6.4** For the purposes of this section “Equivalent Value” shall mean: Payment, in the form of cash, based on the market value of the newly created lots as determined by an assessor.
- 6.5** Notwithstanding Section 6.5, where in the opinion of the Development Officer and the Director of Operational Services, land within the proposed subdivision does not satisfy the intent of the recreation land acquisition policies of the Municipal Planning Strategy, the subdivider shall:
- (a) be required to provide equivalent value in the form of cash; or,
 - (b) subject to Council approval, provide an equivalent amount of land, or a combination of equivalent value and land, outside the area being subdivided which satisfies the intent of the recreation land acquisition policy of the MPS.

**SECTION 7: REQUIREMENTS FOR PRELIMINARY PLANS OF SUBDIVISION
(Subdivider's Optional First Step)**

- 7.1** A subdivider submitting a preliminary plan of subdivision for approval shall submit to the Development Officer 3 copies of the preliminary plan.
- 7.2** Preliminary plans shall show the following information:
- (a) the words "Preliminary Plan" located in the title block;
 - (b) the "purpose" of the plan described below the title block;
 - (c) name of owners of the property being subdivided;
 - (d) the civic number of main building(s) on the area of land being subdivided;
 - (e) the shape, dimensions, and area of the lots being created or altered;
 - (f) each proposed lot identified by a unique number;
 - (g) the location of existing and proposed public streets;
 - (h) the location of existing buildings within 10 metres of a property line;
 - (i) the general location of watercourses and wetlands;
 - (j) the north point;
 - (k) the scale (in metric);
 - (l) any other information necessary to determine if the subdivision meets with municipal standards and accepted engineering practice as determined by the Development Officer.

**SECTION 5: PROCEDURE FOR APPROVAL OF PRELIMINARY PLANS OF
SUBDIVISION (Optional First Step)**

- 8.1** Application for an evaluation of a preliminary plan shall be made to the Development Officer in the form specified in Schedule "A" of these regulations.
- 8.2** The Development Officer shall contact any department of the Town necessary to determine if the proposed subdivision satisfies the various bylaws and regulations of the Town.
- 8.3** The Development Officer shall inform the applicant that he should forward a copy of the preliminary plan of subdivision to any agency of the Province that the Development

Officer deems necessary.

8.4 The Development Officer shall inform the subdivider in writing of the results of the evaluation of the preliminary plan of subdivision.

8.5 The following information shall be stamped or written and completed by the Development Officer on any preliminary plan which is approved:

- (a) "This preliminary plan is approved. Such approval lapses if the lots are not shown on a final plan of subdivision approved within one year of the date of the approval of the preliminary plan."
- (b) the date of the approval of the preliminary plan; and
- (c) "This preliminary plan shall not be filed in the registry of deeds as no subdivision takes effect until a final plan of subdivision is approved by the Development Officer and filed in the registry of deeds."

SECTION 9: REQUIREMENTS FOR CONCEPT PLANS OF SUBDIVISION

9.1 Where an area of land is being subdivided in phases and will contain new streets, a subdivider may submit to the Development Officer a Concept Plan of Subdivision. When a Concept Plan of Subdivision is submitted the subdivider shall submit ten copies of a concept plan of the entire area of land at one of the following metric scales – 1:500, 1:1,000 or 1:2,000.

9.2 Concept plans shall have a minimum font size of 2.187 mm and show the following information:

- (a) the words "Concept Plan" located in the title block;
- (b) the "purpose" of the plan described below the title block;
- (c) name of property owner(s) and name of all abutting landowners;
- (d) the proposed internal street system with connections to existing streets;
- (e) the proposed location of public open space;
- (f) the location of existing development, if any;
- (g) an approximate estimated lot yield figure, based on existing zoning requirements or requirements of the Department of the Environment and Labour;
- (h) the north point; and
- (i) contours at 2.5 metre intervals;

- (j) any other information necessary to determine if the subdivision meets with municipal standards and accepted engineering practice as determined by the Development Officer.

SECTION 10: PROCEDURE FOR APPROVAL OF CONCEPT PLANS OF SUBDIVISION

- 10.1** Application for approval of a concept plan shall be made to the Development Officer in the form specified in Schedule "A" of these regulations.
- 10.2** The Development Officer shall comply with the notification and approval provisions of the Act.
- 10.3** The Development Officer shall forward the concept plan and any supplementary information to appropriate agencies in order to evaluate the concept plan in terms of:
 - (a) the design's consideration of topography, natural features, and other site constraints and restrictions;
 - (b) street layout, pedestrian routes, and connections with existing and proposed transportation links on a local and regional scale;
 - (c) the feasibility of servicing with applicable services, and the effect of the layout on the provision of future services where applicable;
 - (d) public open space; and
 - (e) any proposed community and commercial uses.
- 10.4** Any agency that has been forwarded a copy of the concept plan pursuant to Section 10.3 shall forward a written report of their assessments or recommendations to the Development Officer within 7 days of receipt of the said concept plan.
- 10.5** Approval of a concept plan may not be refused or withheld as a result of the assessment or recommendations made by the Department of the Environment, the Department of Transportation and Public Works or of any other agency of the Province or the municipality unless the concept plan is clearly contrary to a law of the Province or regulation made pursuant to a law of the Province, including the Town's Municipal Planning Strategy.
- 10.6** Where the Development Officer either approves or refuses to approve a concept plan, the Development Officer shall give notice of the approval or refusal to all agencies that were forwarded a concept plan pursuant to Section 10.3.
- 10.7** Where the Development Officer refuses to approve a concept plan, the Development Officer shall inform the subdivider of the reasons for the refusal in writing and advise the subdivider of the appeal provisions of Section 284 of the Act.

- 10.8** The following information shall be stamped or written by the Development Officer on any concept plan which is approved:
- (a) “This concept plan is approved. Such approval lapses if the lots are not shown on a final plan of subdivision approved within five years of the date of the approval of the concept plan.”
 - (b) the date of the approval of the concept plan; and
 - (c) "This concept plan shall not be filed in the Registry of Deeds as no subdivision takes effect until a final plan of subdivision is approved by the Development Officer and filed in the Registry of Deeds."
- 10.9** The Development Officer shall forward an approved copy of the concept plan to the subdivider.

SECTION 11: REQUIREMENTS FOR TENTATIVE PLANS OF SUBDIVISION

- 11.1** A subdivider proposing to subdivide an area of land shall submit to the Development Officer ten copies of the tentative plan of the proposed subdivision meeting the requirements of this Section.
- 11.2** Notwithstanding Section 11.1, the Development Officer may waive the requirement for the application for tentative plan of subdivision to be submitted where:
- (a) the proposed lots abut an existing public street; and,
 - (b) the proposed lots will be serviced by existing municipal water and sewer services.
- 11.3** Tentative plans of subdivision submitted to the Development Officer shall be:
- (a) drawn to a scale of either 1:500 or 1:1,000;
 - (b) based on a description of the area of land to be subdivided, preferably but not necessarily as surveyed.
- 11.4** Tentative plans shall have a minimum font size of 2.187 mm and show the following information:
- (a) the words "TENTATIVE PLAN OF SUBDIVISION" located above the title block;
 - (b) the “purpose” of the plan described below the title block;
 - (c) a clear space for stamping being a minimum of 225 square centimetres with a minimum width of 8 centimetres;

- (d) the name of the subdivision, if any, and the name of the owner of the area of land;
- (e) if applicable, the book and page number of the deed to the area of land as recorded in the name of the owner in the registry of deeds;
- (f) the unique Parcel Identifier (PID) of all areas of land being subdivided;
- (g) the civic number of main buildings on the area of land being subdivided;
- (h) the names of all owners and the unique Parcel Identifier (PID) of all properties abutting the proposed subdivision;
- (i) a location map, drawn to a scale not smaller than 1:50,000 (such scale to be shown on the map), with the same orientation as the area of land proposed to be subdivided;
- (j) the shape, dimensions, and area of the lots being created;
- (k) each lot being approved identified by a unique number, beginning with the current calendar year;
- (l) no duplication of lot identifiers;
- (m) the boundaries of lots being created shown by solid lines, and the vanishing boundaries of existing areas of land being subdivided, consolidated or both, shown as broken lines;
- (n) the location of existing buildings within 10 metres of a new property boundary;
- (o) the location of existing and proposed public streets;
- (p) the name of existing and proposed public streets as issued pursuant to the Town's street naming policy;
- (q) the width and location of railroads and railway rights-of-way;
- (r) the general location of watercourses, wetlands, or prominent rock formations;
- (s) the width, location, and nature of any easements on or affecting the area of land proposed to be subdivided;
- (t) where applicable, a notation stating the lots are serviced by a central sewer and/or water system;
- (u) the north point;
- (v) the date on which the plan of subdivision was drawn and the date of any revisions;

- (w) the scale to which the plan of subdivision is drawn; and
- (x) any other information necessary to determine whether or not the plan of subdivision conforms to these regulations.

11.5 Where the tentative plan of subdivision is to be forwarded to the Department of the Environment the following additional information, if required by the Department of the Environment, shall be part of, or included with, the tentative plan:

- (a) the lot layout including buildings, proposed on-site sewage disposal system, proposed driveway and water wells;
- (b) the location of watercourses, wetlands and other features that may influence the design of the system, including ditches, roads and driveways;
- (c) the surface slopes and directions;
- (d) an explanation of the extent, volume and type of usage to which the system will be subjected;
- (e) an assessment report of the lot respecting its suitability to support an on-site sewage disposal system including the results of a soil evaluation test, except where the assessment report is to be prepared by the Department of the Environment; and
- (f) any other information necessary to determine whether the subdivision meets the *On-site Sewage Disposal Systems Regulations*.

SECTION 12: PROCEDURE FOR APPROVAL OF TENTATIVE PLANS OF SUBDIVISION

12.1 Application for approval of a tentative plan of subdivision shall be made to the Development Officer in the form specified in Schedule "A" of these regulations.

12.2 The Development Officer shall comply with the notification and approval provisions of the Act.

12.3 When applicable the Development Officer shall forward a copy of the tentative plan of subdivision to:

- (a) in areas not served by a central sewer, the Department of the Environment to determine compliance with the *On-site Sewage Disposal Systems Regulations*, except where the proposed lot:
 - (i) is more than 9000 square metres; and ,
 - (ii) has a width of 75 metres or more, and
 - (iii) is to be used for a purpose that does not require an on-site sewage disposal

system;

- (b) the Town Engineer;
 - (c) the Manager of Recreation Facilities;
 - (d) the authority having jurisdiction for public streets; and
 - (e) any other agency of the Province or the municipality that the Development Officer deems necessary.
- 12.4** Any agency that has been forwarded a copy of a tentative plan of subdivision pursuant to Section 12.3 shall forward a written report of their assessments or recommendations to the Development Officer within 7 days of receipt of the said concept plan.
- 12.5** Approval of a tentative plan of subdivision may not be refused or withheld as a result of the assessment or recommendations made by the Department of the Environment, the Department of Transportation and Public Works or of any other agency of the Province or the municipality unless the tentative plan of subdivision is clearly contrary to a law of the Province or regulation made pursuant to a law of the Province, including the Town's Municipal Planning Strategy.
- 12.6** Where the Development Officer either approves or refuses to approve a tentative plan of subdivision, the Development Officer shall give notice of the approval or refusal to all agencies that were forwarded a plan pursuant to Section 12.3.
- 12.7** Where the Development Officer refuses to approve a tentative plan of subdivision, the Development Officer shall inform the subdivider of the reasons for the refusal in writing and advise the subdivider of the appeal provisions of Section 284 of the Act.
- 12.8** The following information shall be stamped or written by the Development Officer on any tentative plan of subdivision which is approved together with any other information, including conditions, necessary for the tentative plan to proceed to the final plan stage.
- (a) "This tentative plan of subdivision is approved for Lots _____. Such approval lapses if the lots are not shown on a final plan of subdivision approved within two years of the date of the approval of the tentative plan.";
 - (b) the date of the approval of the tentative plan; and
 - (c) "This tentative plan of subdivision shall not be filed in the Registry of Deeds as no subdivision takes effect until a final plan of subdivision is approved by the Development Officer and filed in the Registry of Deeds."
- 12.9** The Development Officer shall forward a copy of the approved tentative plan of subdivision to the subdivider and the surveyor.

SECTION 13: REQUIREMENTS FOR FINAL PLANS OF SUBDIVISION

- 13.1** A subdivider proposing to subdivide an area of land shall submit ten copies of the final plan of subdivision meeting the requirements of Section 13.2 of these regulations to the Development Officer for approval. In addition, a digital copy of the plan shall also be submitted in one of the following formats: .dwg, .dxf or ESRI format.
- 13.2** Final plans of subdivision submitted to the Development Officer shall be:
- (a) drawn to a scale of either 1:500 or 1:1,000;
 - (b) certified and stamped by a Nova Scotia Land Surveyor that the lots for which approval is requested and any proposed street and road have been surveyed in the manner required by the *Land Surveyors Act* and its regulations; and
 - (c) folded to approximately 20x30 centimetres with the face of the folded print being the title block that is located in the lower right-hand corner of the final plan of subdivision.
- 13.3** Final plans shall have a minimum font size of 2.187 mm and show the following information::
- (a) the words "PLAN OF SUBDIVISION" located in the title block;
 - (b) a clear space for stamping being a minimum of 225 square centimetres with a minimum width of 8 centimetres;
 - (c) the “purpose” of the plan described below the title block;
 - (d) the name of the subdivision, if any, and the name of the owner of the area of land;
 - (e) if applicable, the book and page number of the deed to the area of land as recorded in the name of the owner in the registry of deeds;
 - (f) the unique Parcel Identifier (PID) of all areas of land being subdivided;
 - (g) the civic number of main buildings on the area of land being subdivided;
 - (h) the names of all owners or the identifiers of all properties abutting the proposed subdivision;
 - (i) a location map, drawn to a scale not smaller than 1:50,000 (such scale to be shown on the map), with the same orientation as the area of land proposed to be subdivided;

- (j) the shape, dimensions, and area of the lots being created;
- (k) each lot being approved identified by a unique number;
- (l) the boundaries of lots being created shown by solid lines, and the vanishing boundaries of existing areas of land being resubdivided, consolidated or both, shown as broken lines;
- (m) the location of all buildings within 10 metres of a proposed property boundary;
- (n) the location of all buildings within 3 metres of an existing boundary;
- (o) the width and location of existing and proposed public streets;
- (p) the name of existing and proposed public streets;
- (q) the width and location of railroads and railway rights-of-way;
- (r) the general location of watercourses, wetlands, or prominent rock formations;
- (s) the width, location, and nature of any easements on or affecting the area of land proposed to be subdivided;
- (t) the north point;
- (u) the date on which the plan of subdivision was drawn and the date of any revisions;
- (v) the scale to which the plan of subdivision is drawn;
- (w) the name, stamp and signature of the surveyor;
- (x) any other information necessary to determine whether or not the plan of subdivision conforms to this bylaw, and
- (y) where applicable, the Land Registration Act Number (LRA #).

13.4 Where the final plan of subdivision is to be forwarded to the Department of the Environment the following additional information, if required by the Department of the Environment, shall be part of, or included with, the final plan:

- (a) the lot layout including buildings, proposed on-site sewage disposal system, proposed driveway and water wells;
- (b) the location of watercourses, wetlands and other features that may influence the design of the system, including ditches, roads and driveways;
- (c) the surface slopes and directions;

- (i) an explanation of the extent, volume and type of usage to which the system will be subjected;
- (e) an assessment report of the lot respecting its suitability to support an on-site sewage disposal system including the results of a soil evaluation test, except where the assessment report is to be prepared by the Department of the Environment; and
- (f) any other information necessary to determine whether the subdivision meets the *On-site Sewage Disposal Systems Regulations*.

SECTION 14: PROCEDURE FOR APPROVAL OF FINAL PLANS OF SUBDIVISION

- 14.1** Application for approval of a final plan of subdivision shall be made to the Development Officer in the form specified in Schedule "A" of this bylaw.
- 14.2** The Development Officer shall comply with the notification and approval provisions of the Act.
- 14.3** When applicable the Development Officer shall forward a copy of the final plan of subdivision to:
- (a) in areas not served by a central sewer, the Department of the Environment to determine compliance with the *On-site Sewage Disposal Systems Regulations*;
 - (b) the Town Engineer;
 - (c) the Manager of Recreation Facilities;
 - (d) any other agency of the Province or the Municipality that the Development Officer deems necessary.
- 14.4** Any agency that has been forwarded a copy of the final plan of subdivision pursuant to Section 14.3 shall forward a written report of their assessments or recommendations to the Development Officer within 7 days of receipt of the said final plan.
- 14.5** Approval of a final plan of subdivision may not be refused or withheld as a result of the assessment or recommendations made by the Department of the Environment, the Department of Transportation and Public Works or of any other agency of the Province or the municipality unless the final plan of subdivision is clearly contrary to a law of the Province or regulation made pursuant to a law of the Province, including the Town's Municipal Planning Strategy.
- 14.6** At the time of application for approval of a final plan of subdivision, the subdivider shall submit to the Development Officer:
- (a) the fees for registering the final plan of subdivision, and;
 - (b) the fees for filing the notice of subdivision.

- 14.7** Before approving a final plan of subdivision that adds or consolidates parcels or areas of land in different ownerships, the Development Officer shall have received:
- (a) the executed deeds suitable for registering to effect the addition or consolidation;
 - (b) the fees for registering the deeds;
 - (c) the affidavit of value including particulars of any exemption, pursuant to Part V of the Act, including any fees payable
- 14.8** The Development Officer shall forward an approved copy of the final plan of subdivision to the subdivider and the surveyor.
- 14.9** Where the Development Officer either approves or refuses to approve a final plan of subdivision, the Development Officer shall give notice of the approval or refusal to all agencies that were forwarded a plan pursuant to Section 14.3.
- 14.10** Where the Development Officer refuses to approve a final plan of subdivision, the Development Officer shall inform the subdivider of the reasons for the refusal in writing and advise the subdivider of the appeal provisions of Section 284 of the Act.
- 14.11** A final plan of subdivision showing lots to be approved under circumstances described in subsection 287(3) of the Act, by special note on the plan shall:
- (a) identify such lots;
 - (b) state the names of the grantor and the grantee of such lots; and
 - (c) state the date, book and page number of the conveyance of such lots as recorded in the Registry of Deeds.
- 14.12** The following information shall be stamped or written and completed by the Development Officer on any final plan of subdivision which is approved:
- (a) "This final plan of subdivision is approved for Lots _____";
- 14.13** The Development Officer shall forward to the registry of deeds:
- (a) Six (6) approved copies of the final plan of subdivision and a notice of approval in the form specified in Schedule "B" of these regulations; and
 - (b) if applicable, the items required by Section 14.7 of this by-law.

SECTION 15: REPEAL OF A SUBDIVISION

- 15.1** Any person requesting a repeal shall submit to the Development Officer an application in the form specified in Schedule “D”.
- 15.2** The notification and approval provisions of the Act that apply to the approval of a plan shall also apply to a repeal.
- 15.3** When the Development Officer is satisfied that an application for repeal is complete, the Development Officer may forward a copy to any agency which provided an assessment or recommendations on the original plan of subdivision.
- 15.4** Where buildings have been erected on the subject lands after the date of the subdivision approval sought to be repealed, no repeal shall be granted which would cause these buildings to be in violation of any building code regulations, land-use by-law, or on-site sewage disposal regulations unless the violation can be rectified by the approval of a new plan of subdivision filed at the registry of deeds on the same day as the repeal is filed.
- 15.5** The Development Officer shall forward to the registry of deeds the repeal in the form specified in Schedule "E".
- 15.6** The Development Officer shall forward a copy of the repeal to:
- (a) the subdivider, and
 - (b) any agency that provided an assessment or recommendations on the original plan of subdivision.
- 15.7** At the time of application for the repeal of a subdivision the subdivider shall submit to the Development Officer:
- (a) the fees contained in the Costs and Fees Act, and its regulations, for registering a repeal of a plan of subdivision; and,
 - (b) Where the Development Officer refuses to repeal a subdivision, the Development Officer shall return the fees referred to in clause 15.7 (a) to the subdivider.
- 15.8** Where the Development Officer refuses to repeal a subdivision, the Development Officer shall give notice of the refusal to all agencies that were forwarded the application for repeal pursuant to Section 15.3.



TOWN OF AMHERST



APPLICATION FOR THE APPROVAL OF SUBDIVISION OF LAND

File Reference: _____ (office use only) Development Officer: _____

Type of approval requested: Tentative _____
Final _____

Submitter: Name: _____
Address: _____
Phone: _____
Fax: _____

Owner: Name: _____
Address: _____
Phone: _____
Fax: _____

Correspondence and approved plan should
be sent to: (please circle) Submitter Owner Other:

Name: _____
Address: _____
Phone: _____
Fax: _____

Approval is requested for the attached plan of subdivision.

The land in question is owned by the undersigned and it is the
intention to subdivide in the manner shown on said plan.

Plans Certified by _____
a Nova Scotia Land Surveyor, dated: _____

Signed: _____

Please Complete the Following

- 1. Name of Subdivision: _____
2. Location of Property: _____
3. Proposed Lot(s) Identification: (i.e. Lot-1) _____
4. PID(s) of Affected Parcels: _____
5. Number of Plans Submitted for approval: _____
6. Where Applicable, are you prepared to
construct roads to the specifications of the
Town of Amherst?(please circle) yes no n/a
7. Has Deed and affidavit of Value Been Submitted:
(required with two or more owners) yes no n/a

Office Use Only

- 1. Plan Review Complete: _____ 5. Fees Received: _____
2. Plan Sent to Reg. for LRA: _____ 6. Plan Approved: _____ Date: _____
3. Did Sub. Qualify for LRA? _____ 7. Correspondence Sent: _____ Date: _____
4. LRA info Received: _____ 8. Notes: _____

NOTICE OF APPROVAL OF A PLAN OF SUBDIVISION IN ACCORDANCE WITH SUBSECTIONS 285(3) AND 285(4) OF THE MUNICIPAL GOVERNMENT ACT

Name of Owner(s) _____

Name of Subdivision _____

Location _____

Date of Approval _____ For Lot(s) _____

Surveyor _____ Date of Plan _____

Dated this _____ day of _____
_____ Development Officer

_____, _____
(DATE) (YEAR)

Plan of Subdivision filed in the registry of deeds as Plan # _____

Dated this _____ day of _____, 2002.

This plan of subdivision may also contain information regarding the lots approved on this plan with respect to one or more of the following:

1. The lots' eligibility for on-site sewage disposal systems.
2. The availability of central sewer and water systems.
3. Information indicating whether or not the lots abut a public street.

APPLICATION FOR APPROVAL OF LOTS NOT MEETING REQUIREMENTS

This application form should be completed in full and forwarded to the Development Officer for the Town of Amherst. The applicant is applying under the provisions of Section 4.3 of this Subdivision Bylaw and Section 279 of the Municipal Government Act, R.S.N.S., 1998, C. 18, as amended for a variance on the minimum lot dimensions or lot area required by the Land-Use Bylaw and said variance is within the following guidelines:

- 1. The request involves a maximum of two (2) lots.
2. The lots are/or are not intended to be served by municipal sewer and water services.
3. The difficulty experienced is not general to the properties in the area or resulting from the intentional disregard of the requirements of this Subdivision Bylaw.
4. The proposed lot area and dimensions are no less than ninety percent of the required minimums for the lot area and dimension.

Name of Property Owner: _____

Address: _____

Phone: _____

Name of Applicant (if not owner): _____

Address: _____

Phone: _____

Location of lot/lots for which a variance is requested:

Table with 2 main columns: Lot #1 and Lot #2. Each column has sub-columns for Required and Proposed. Rows include Area, Lot lines (Front, R. Side, L. Side, Rear).

Why is it not possible to comply with the provisions of this Bylaw?

Has a relaxation ever been applied for on these lots? YES NO

If yes, describe briefly: _____

I certify that I am the owner or am acting with the owner's written consent.

Signature of Applicant _____ Date _____

APPLICATION FOR REPEAL OF A SUBDIVISION

Plan of Subdivision

File Number _____

APPLICANT RELATED INFORMATION

Name of Land Owner(s) _____

Phone _____

Address of Land Owner(s) _____

Postal Code _____

Documents To Be Returned To _____

Correspondence To Be Directed To _____

INFORMATION RELATED TO THE SUBDIVISION SOUGHT TO BE REPEALED

Name of applicant for subdivision approval _____

Location _____ Municipality _____

The subdivision was approved on the _____ day of _____, _____ (YEAR)

and is filed in the Registry of Deeds at _____ in the Municipality of _____ the County of _____ as # _____

Lot(s) # _____ was/were approved and repeal is sought for approval of Lot(s) # _____.

Registration fee submitted.

CERTIFICATION OF FACTS (Reasons For Repeal) (If more space required, attach additional sheet)

OWNER'S CERTIFICATE

I certify that the information in this application is true and complete, that I am applying for repeal of this subdivision with the full knowledge and consent of all persons with legal interest, including mortgagees, in the lands affected by the repeal and that these persons have co-signed this application.

Signature of owner/agent _____ Date _____

Co-Signer _____ Date _____

NOTICE OF REPEAL OF A SUBDIVISION

Plan of Subdivision

Name of Owner(s) _____

Name of Subdivision _____

Location _____

Date of Approval of the Subdivision _____

Being Registration # _____ at the registry of deeds.

THIS SUBDIVISION IS REPEALED

Entire Plan or Only Lots # _____

Dated at _____

in the Province of Nova Scotia, this _____ day of _____, _____.
(DATE) (YEAR)

Development Officer

Please note: Any lot or parcel created by this repeal may not be eligible for development.

TOWN OF AMHERST; INFRASTRUCTURE DEVELOPMENT STANDARDS

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INTRODUCTION

The intent of this document is to establish the required servicing standards for development in the Town of Amherst. These standards shall be used in the design and construction of sanitary and storm sewers, waterworks, and roads, in new developments.

The Developer is responsible for all engineering and will retain the services of a Consulting Professional Engineer for all engineering which will involve preliminary and final design and drawings as well as sufficient resident inspection of the works to certify that prior to the Town taking over the works that the project has been completed to standard. The developer is responsible to retain and pay for the services of a registered land surveyor where needed.

DEFINITIONS

"Consulting Engineer" shall mean the Engineers appointed by the developer who are licensed to practice in the Province of Nova Scotia.

"Development" shall mean any change or alteration in the use made of land including extensions or other modifications to existing municipal infrastructure as regulated by these standards.

"Developer" shall mean the owner of an area of land, proposed to be developed, and, including anyone acting with the Owners written consent.

"Service Laterals" shall mean any service pipe connected to the municipal water, sanitary sewer or storm water street main.

"Standard Specifications" shall mean the Nova Scotia Standard Specification for Municipal Services latest edition for construction of the works required for development within the Town of Amherst.

"Substantial Performance" shall have been reached when the work is ready for use or is being used for the purpose intended and is so certified by the consulting engineer.

"Total Performance" is defined as the date of one year following the issuance of the certificate of Substantial Performance which will be the completion of the warranty period.

"Town" shall mean the Town of Amherst, NS.

"Town Engineer" is the Town Engineer or his designate.

"Works" shall mean all required aspects of the development infrastructure required to meet the Town's standards and any other requirements which may be deemed necessary by the Town upon review of this particular development

EXISTING INFRASTRUCTURE

It is a requirement of the Developer to assess the impact of the development on all existing infrastructure. This may involve traffic analysis, flow monitoring and pressure testing, or other investigations as may be described by the Town at the time of the development application. The Town will be the sole judge of the impact that the development may have on the Town's infrastructure.

Overloading, damaging or destroying existing infrastructure shall not be permitted. The developer may be required to upgrade existing infrastructure if it is demonstrated through an engineering design brief that adverse effects are predicted due to the development. Additions to existing infrastructure systems shall not cause any adverse effect to or overload of existing systems.

Where a phased development is being proposed, the developer shall provide a master plan and design and construct all infrastructure to accommodate full build out of the development. In addition, infrastructure shall be oversized where required to accommodate future development on adjacent parcels of land.

COST SHARING POLICY

Certain infrastructure is eligible for cost sharing by the Town when not required to support the proposed development, including:

- Sanitary sewer mains exceeding 200 mm in diameter.
- Water mains exceeding 200 mm in diameter.
- Storm sewers exceeding 600 mm in diameter.
- Looping of water mains in cul-de-sacs.

The Town will pay the difference in material costs between the pipe diameters noted above and the pipe diameters required for the development. If the construction is to be undertaken by the developer, cost-sharing is contingent upon the following:

- Formal approval of the Town's portion of the costs by either budget appropriation or funding authorization.
- Approval of the plans, specifications and cost-estimate of the work by the Town before the work commences.

DEVELOPER'S OBLIGATIONS

Pre-Construction Obligations:

The developer is responsible for obtaining all approvals for the development in accordance with all applicable Municipal, Provincial and Federal regulations and specifications including Town of Amherst and Nova Scotia Department of Environment and Labour.

Design, Construction and Post-Construction Obligations:

1. Provide construction services through a Professional Engineer with experience in site development, municipal infrastructure construction and roadway construction who has been contracted to provide the requirements outlined in this document.
2. Provide construction drawings and supplementary technical specifications.
3. Provide and warranty for one year all infrastructure constructed within the development.
4. Supply and install electric power and telephone infrastructure on all subdivision streets per utility and Town requirements.
5. Provide construction inspection and certification by a Consulting Engineer that all works have been completed to the relevant Town and Provincial standards. Certification by the Engineer to be submitted to the Town at the issuance of Substantial Performance.
6. Provide record drawings to Town in digital (.dxf) and hardcopy format.

The Contractor/Developer shall ensure that the completed works are protected pending the Total Performance of the Contract and shall be responsible for the correction of any defects in the works regardless of whether or not they were apparent when the Certificates of Provisional or Final Acceptance were issued.

The Consulting Engineer and Town of Amherst shall, upon receipt of an application from the Contractor/Developer for a Certificate of Substantial Performance, make an inspection and assessment of the work to verify the validity of the application. When the Engineer finds the Work to be Substantially Performed a certificate shall be issued. The date of this certificate shall be the date of Substantial Performance of the Contract.

Immediately following the issuance of the Certificate of Substantial Performance, the Engineer and the Town of Amherst, in consultation with the Contractor/Developer shall establish a reasonable date for the Total Performance of the Contract. This will normally be one year from the date of issuance of the Certificate of Substantial Performance, and will begin the one year warranty period leading to Total Performance.

The Consulting Engineer and Town of Amherst shall, upon receipt of an application from the Contractor/Developer for payment upon Total Performance of the Contract, make an inspection and assessment of the work to verify the validity of the application. The Engineer shall notify the Contractor of approval or disapproval of the application. When the Engineer finds the Work to be totally performed satisfactorily a Certificate of Total Performance shall be issued.

The issuance of the Certificate of Total performance shall constitute a waiver of all claims by the Town of Amherst against the Contractor/Developer except those previously made in writing and still unsettled,

if any, and those arising from the provisions of Warranty, or those arising from negligence on the part of the Contractor.

Design Brief

Documentation must be provided containing the design rationale and submission requirements noted in this document for each of the following elements of the subdivision.

- Domestic Water Supply and Fire Protection
- Storm Sewer
- Sanitary Sewer
- Road System

This documentation must be stamped by a Professional Engineer licensed in the Province of Nova Scotia and be bound into one complete document.

Engineering Design Drawings

All plan and profile drawings and detail drawings shall be presented as follows:

- Each submission to be accompanied by a cover sheet indicating the project title, name and address of the Developer and the Consulting Engineer.
- Plan and profile tracings shall be top half clear, bottom half ruled. Drawing and proposed dimensions shall be 600mm x 900mm. All dimensions are to be in metric units.
- Existing conditions must be shown.
- Plan and profile drawings shall have a horizontal scale of 1:500 and a vertical scale of 1:50.
- North shall point to the top or to the right on all drawings.
- All grading plans and profiles shall be to Geodetic Survey of Canada Datum.
- The zero meterage shall start at the projection of an intersecting street centerline.
- The profile must be a vertical projection of the plan. Intersecting street meterages and names must be shown on the profile.
- Calculated meterages of the beginning and ends of curves must be noted on the plan and profile.
- Existing and future services shall be shown on all drawings.
- Each plan shall have the Engineers stamp, signature and date including revision number.

The following design drawings shall be submitted for review:

- A Cover Sheet shall be provided indicating the following:
 - A list of the drawings included in the Contract Set.
 - A Key Plan (Scale of 1:50,000) showing the location of the proposed development.
 - The project title and the name and address of the owner and the Consulting Engineer. A general plan, to a scale of 1:500 showing all services to be constructed.
- Plan and profile drawings with a plan scale of 1:500 showing the existing and proposed

finished centerline profile, sanitary sewer system, storm sewer system and water distribution system.

- A lot grading plan to a scale of 1:1000 showing:
 - Estimated final ground elevations at lot corners
 - Proposed final centre line of road elevations at 25 metre stations.
 - **Contours extending a minimum of 25 metres beyond the limit of the plan at 2.5 meter intervals. N.S. Topographic Records Database acceptable.**
Location and direction of flow of swales by means of arrows with at least one arrow to be shown at the rear of each lot.
All proposed rear lot catch basins, leads and easements if required.

SANITARY SEWER SYSTEM

Developer's Obligations

This section establishes criteria relating to the design and installation of sanitary sewer systems for new development in the Town of Amherst. All subdivisions or developments requiring sanitary sewers shall be serviced by connecting sewer lines to the municipal sanitary sewer system. All plans of such works shall be approved by the Town. These Standards do not preclude the use of higher standards where required, in the design of infrastructure to service new development.

Regulatory Standards

Sanitary sewers shall be designed and constructed in accordance with the latest revision of the Nova Scotia Municipal Services Specification and the Nova Scotia Department of Environment & Labour for the Installation of Gravity Sewers, Sewage Force mains and Water Mains in Combined and Separate Trenches. In addition, a copy of the plans must be submitted to the Provincial Department of Environment & Labour for approval.

A copy of all Regulatory Agency approvals shall be forwarded/copied to the Town before any work commences.

Contractors/Developers shall make themselves familiar with the requirements of the Nova Scotia Municipal Services Specification before making application to the Town.

3.1 Scope

Sanitary sewage is defined as the wastewater from a community consisting of liquid conveying solids from residential, commercial, and industrial facilities excluding stormwater inflow and groundwater infiltration. A sanitary sewerage system is a system receiving, conveying, and controlling sanitary sewage. Such systems consist of mainline sewers, lateral sewers, service lateral lines, pumping facilities, and treatment facilities.

3.2 Gravity Systems

3.2.1 Design Requirements

3.2.1.1 General

The sanitary sewerage system shall be designed for peak flows generated from all lands within the serviceable area which are naturally tributary to the drainage area as determined from topographic plans. Any lands within the serviceable area which are tributary by pumping or regrading which are at present or anticipated to contribute to the design area are to be included in the calculated flows for the system being designed.

3.2.1.2 Materials

Sanitary sewer main material, fittings, and appurtenances are to be as per the latest version of the Nova Scotia Standard Specifications for Municipal Services.

Sanitary sewer mains shall be PVC DR-35 colour-coded green meeting ASTM D 3034 (Latest Edition)

3.2.1.3 Hydraulic Design

Sanitary sewer mains, fittings, and appurtenances shall be designed to convey the calculated peak design flow (PDF).

The consultant shall ensure that surcharging of the system does not occur during peak design flow conditions by taking into consideration the hydraulic gradeline accounting for factors including backwater effects and energy losses at manholes.

Peak design flow (PDF) may be calculated by the following equation:

where:

$$PDF = \frac{P \cdot q \cdot m}{86.4} + I \cdot A$$

PDF peak design flow including extraneous flows (L/s),
P design population in thousands,
q average daily domestic flow (L/cap·day),
M peaking factor,
I peak extraneous flow (L/s·ha)
A tributary area (ha).

The peaking factor (M) may be calculated by the Harman equation or the Babbit equation:

$$M = 1 + \frac{14}{4 + P^{0.5}} \quad [3.2]$$

$$M = \frac{5}{P^{0.2}} \quad [3.3]$$

The sanitary sewerage system shall be designed for a gross population density of 45 persons per hectare. Average daily domestic dry weather flows shall be calculated on the basis of an allowance of 320 litres per person per day.

Peak design flows shall be calculated based on an allowance of 1,430 litres per person per day, plus an infiltration allowance of 11,230 litres per hectare per day.

The capacity of the sanitary sewer mains is to be calculated using the Manning equation or an appropriate nomograph.

Table presents 3.1 presents a list of Manning roughness coefficients (n) for various materials.

Table 3.1 - Manning Roughness Coefficient (n) for Piped Flow

Material	Description	Manning Roughness Coefficient (n)
	Cast Iron Pipe (Cement Lined)	0.011 to 0.015
Concrete	Concrete (monolithic)	0.012 to 0.014
	Reinforced Concrete Pipe (RCP)	0.011 to 0.015
Corrugated Steel Pipe	Corrugated Metal Pipe (plain)	0.022 to 0.026
	Corrugated Metal Pipe (paved invert)	0.018 to 0.022
	Corrugated Metal Pipe (spun asphalt lined)	0.011 to 0.015
Plastic Pipe PVC/HDPE	Ribbed	
	Plain	0.011 to 0.015

3.2.1.4 Minimum Velocity

Under peak design flow (PDF) conditions from the tributary area, when fully developed, sanitary sewage flow velocities shall be a minimum of 0.6 m/s.

3.2.1.5 Maximum Velocity

Under peak design flow (PDF) conditions from the tributary area, when fully developed, sanitary sewage flow velocities shall be a maximum of 4.0 m/s.

3.2.1.6 Minimum Diameter

Sanitary sewer main diameter shall not be less than 200 mm in diameter.

3.2.1.7 Changes in Diameter

Sanitary sewer main diameter shall not decrease in the downstream direction. Manholes are to be provided where the sanitary sewer main diameter changes.

3.2.1.8 Minimum Slope

The minimum pipe slope for sanitary sewerage mains is 0.4%. The minimum slope for sanitary sewerage mains on a permanent dead-end is 0.6%. Under special conditions, if full and justifiable reasons are given, slopes less than 0.4% and 0.6% may be permitted provided that self-cleansing velocities under full flow conditions are maintained. Minimum pipe slopes required to produce a self-cleansing velocity for full flow conditions of 0.6 m/s are presented in Table 3.2. Such decreased slopes will only be considered where the depth of flow will be at least 30 percent of the diameter of the pipe for Peak Design Flow. The slope shall be selected to obtain the greatest practical velocities to minimize settling problems. In no case shall the slope be reduced to less than 0.10 percent.

Table 3.2 - Minimum Slope for Sanitary Sewers Possessing Self-Cleansing Velocities Under Full-Flow Conditions

Sanitary Sewer Main Diameter (mm)	Minimum Slope (m/m)
200	0.40
250	0.28
300	0.22
350	0.17
375	0.15
400	0.14
450	0.12
525	0.10
600	0.1
675	0.1
750	0.1
900	0.1

3.2.1.1.9 Minimum Depth

The design engineer shall take into consideration possible future extensions of the gravity sanitary sewer system when determining depth of cover and grade of sewer mains so that, wherever possible, those mains shall be installed at a sufficient depth to provide service to adjoining lands.

The depth of sanitary sewer mains as measured from the design grade at finished surface to the crown of the pipe shall be a minimum of 1.5 m. The depth of sanitary service laterals at the property line measured from finished surface to crown of pipe shall be a minimum of 1.5 m.

The sanitary sewer depth shall be sufficient to service the proposed basement elevations and to avoid conflicts with other underground utilities.

3.2.1.1.10 Location

Wherever possible, all sanitary sewer mains and appurtenances shall be located within the street right-of-way or a right-of-way owned by the Town of Amherst.

The minimum width of an easement shall be 6.0 m. However, the actual width shall depend upon the depth and size of any pipe contained therein such that safe access to the pipe is possible. Easements shall be of sufficient width to allow safe access to the pipe line in accordance with

the requirements of the Occupational Health and Safety Act for the Province of Nova Scotia. All sanitary sewer mains shall be located as close as possible to the centreline of the street or right-of-way.

Where a need is identified by the Town of Amherst to accommodate future upstream lands naturally tributary to the drainage area, an easement shall be provided from the edge of a street right-of-way to the upstream limit of the subdivision at a location to be approved by the Town Engineer.

3.2.1.11 Manholes

Sanitary sewer manholes are to be as per the latest version of the Nova Scotia Standard Specifications for Municipal Services.

A manhole is to be provided on a sanitary sewer main at any change in diameter, material, horizontal alignment, vertical alignment, at pipe main intersections, and at the upstream end of each line. Where a sanitary sewer main is less than 600mm in diameter, manhole spacing shall not exceed 100m.

The following criteria shall be used for pipe elevation and alignment in sanitary sewer manholes to account for hydraulic losses through the manhole:

- An invert drop equal to those presented in Table 3.3 shall be provided unless a different drop is determined by appropriate calculations.

Table 3.3 - Minimum Manhole Drops for Sanitary Sewers

Manhole Deflection	Minimum Manhole Drop (mm)
Straight Run	15
Deflection up to 45°	30
Deflection up to 90°	60

- The crown of a downstream pipe shall not be higher than the crown of an upstream pipe.
- At the connection of a lateral sewer to a mainline sewer, 300 mm in diameter or larger, the lateral sewer invert shall be no lower than the 0.75 D point of the mainline sewer, as measured from the invert of the mainline sewer.
- An internal/external drop manhole shall be constructed where the vertical drop between pipe inverts in the manhole exceeds 1.0 m.

The design engineer shall take into consideration energy losses at manholes during peak design flow (PDF) conditions to ensure that surcharging of the system does not occur.

The minimum internal diameter of a manhole shall be 1050 mm. The design engineer shall ensure that the internal diameter is adequate to accommodate all pipe and appurtenances in accordance with manufacturer's recommendations.

3.2.1.12 Service Laterals

All sanitary service laterals, fittings, and appurtenances are to be as per the latest version of the Nova Scotia Standard Specifications for Municipal Services.

All service laterals shall be installed according to the following provisions:

- Each property will be provided with sewer lateral connection of a minimum diameter of 100 mm, having a minimum slope of 1.5% from the main to the property line.

- A "tee connection" or saddle must be provided at the main for the sanitary sewer service lateral.
- Where existing isolated buildings become part of a subdivision, their sewers shall be connected to the new system.
- Storm service lateral locations will be subject to the approval of the Town Engineer. Where the lot slopes along the frontage, the service lateral must be installed at the down grade corner of the lot.
- Sanitary service laterals 200 mm or greater must connect to the sewer main at a manhole structure.
- All properties shall have a back water valve installed on the sanitary sewer service line located within the building limits or, at the Towns discretion, outside the building limits.
- For semi-detached buildings, one sanitary service lateral is required for each dwelling.
- The depth of sanitary service laterals shall not be less than 1.5 m within the street right-of-way.
- Sanitary service laterals with a total length greater than 25 m shall be installed complete with a wye-type cleanout or access manhole in a location as approved by the Town of Amherst.
- Sanitary Sewer Service laterals shall be PVC DR-35 color coded green meeting STM D 3034, latest edition.

3.2.1.13 Groundwater Migration

The design engineer shall assess the possibility of groundwater migration through mainline, lateral, and service lateral trenches resulting from the use of pervious bedding material. Corrective measures, including provision of impermeable collars or plugs, to reduce the potential for basement and street flooding resulting from groundwater migration should be employed.

3.2.1.14 Video Inspection

All sanitary sewer mains and lateral services between the main and property line shall be video inspected to ensure the integrity of the pipe installation. Video tape recording and inspection report including index of this inspection will be turned over to the Town Engineer before the final inspection of the municipal services.

3.3 Sewage Pumping Station

3.3.1 Design Requirements

3.3.1.1 General

Pumping stations shall be provided when, in the opinion of the Town of Amherst, a gravity system is either not possible or not economically feasible.

3.3.1.2 Flooding

Sewage pumping stations and appurtenances should be protected from flooding and flood related damage by the 1 in 100 year storm.

Sewage pumping stations and appurtenances should remain operational during the 1 in 25 year storm.

3.3.1.3 Surcharge

Pumping stations are to be designed such that the incoming sewers will not surcharge under peak flow conditions.

3.3.1.4 Access

Town approved access hatchways and doorways shall be provided. All locks shall be keyed alike to the Town of Amherst standard.

3.3.1.5 Equipment Removal

All pumping stations shall be equipped with Town approved devices for the removal and maintenance of pumps, motors, controls, and auxiliary power equipment.

3.3.1.6 Design Capacity

Unless otherwise approved by the Town of Amherst, all pumping stations, including wet wells, dry wells, pumps, forcemains and appurtenances shall be designed for the ultimate sanitary sewage flows from the tributary drainage area as described in Section 3.2.1. In the selection of pumps, both present and ultimate development conditions shall be considered, and pump overloading situations avoided.

Design parameters such as the Hazen Williams roughness coefficient (C_{hw}) of pipe and flow volumes can vary significantly over time, and therefore pumps must be designed for the maximum ultimate flow.

3.3.1.7 Phased Development

In situations of phased development, the effects of minimum flow conditions shall be investigated to ensure that the retention time in the wet well will not create an odour or septic problem, and that pumping equipment will not operate too infrequently based on manufacturer's recommendations. Pump operational floats and wet well levels should be adjusted to account for phased development.

3.3.1.8 Safety Precautions

The pumping station and appurtenances shall be designed in such a manner as to ensure the safety of operations, in accordance with all applicable Municipal, Provincial, and Federal regulations including the Occupational Health & Safety Act of the Province of Nova Scotia. All moving equipment shall be covered with suitable guards to prevent accidental contact.

Equipment that automatically starts and stops shall be suitably signed to ensure that operators are aware of this condition. Lock-outs on all equipment shall be provided to ensure that the equipment is completely out of service when maintenance or servicing is being conducted.

3.3.2 Pumping Requirements

3.3.2.1 Pump Selection

Pumps are to be selected to perform at maximum efficiency under normal operating conditions.

System head calculations and curves shall be provided for the range of operating conditions and roughness coefficients presented in Table 3.4.

Table 3.4 - Sanitary Sewage Pump Selection Criteria

Operating <i>Conditio</i> <i>n</i>	Roughness Coefficient (C_{hw})	Wet Well Sewage Level
A	110	Low sewage level in initial condition
B	120	Medium sewage level over normal operating range
C	130	High sewage level in overflow condition

Operative curves for condition 'b' shall be used to select the pump and motor since this most closely represents normal operating conditions. The extreme operating ranges will be given by the intersections of condition 'a' and condition 'c' with the selected pump curve. The pump and motor shall be capable of operating satisfactorily over the full range of operating conditions.

3.3.2.2 Duplicate Pumps

All pumping stations must have a minimum of two pumping assemblies. If only two pumps are provided, they shall each have the same capacity, with each pump capable of handling the expected Peak Design Flow. Where three or more units are provided, they shall be designed to fit actual flow conditions and must be of such capacity that, with any one unit out of service, the remaining units will have capacity to handle Peak Design Flow, taking into account head losses associated with parallel pump operation.

The pump control circuitry shall be designed to automatically alternate pumps for each pumping cycle. Run time meters shall be provided for each pump, and an additional meter shall be provided to record run time for two pumps operating simultaneously.

3.3.2.3 Pump Intake

Each pump should have an individual intake located in the wet well to minimize turbulent flow conditions.

3.3.2.4 Positive Suction Head

Pumping stations, wet wells, and dry wells, are to be designed such that all pumps will operate under a continuous positive suction head condition during the entire pump cycle.

3.3.2.5 Minimum Velocity/Maximum Velocity

Suction and header piping shall be sized to carry the Peak Design Flow of the maximum permissible discharge rate. Flow velocities shall be:

- Minimum self-cleansing velocity of 0.6 m/s
- Maximum velocity of 1.5 m/s

Regardless of the above conditions, piping less than 100 mm in diameter is not acceptable, unless otherwise approved by the Town of Amherst.

3.3.2.6 Mechanical Piping

All mechanical piping including suction and header piping shall be either ductile iron, Class 54 with coal tar epoxy lining or stainless steel, Type 316 or 316L, 11 Gauge. Regular steel pipe spool pieces are not permitted.

Threaded flanges shall be used for all ductile iron pipe joints, fittings, and connections within the station. Pressed or rolled vanstone neck flanges shall be used for all stainless steel pipe joints, fittings, and connections. All piping within the pumping station shall be properly supported and shall be designed with appropriate fittings to allow for expansion, contraction, and thrust restraint.

3.3.2.7 Valves

Hand operated isolation valves must be provided on discharge and/or suction piping to allow for proper maintenance. A check valve shall be provided on the discharge lines between the isolation valve and the pump. Check valves shall be accessible for maintenance.

All valves and other appurtenances must be located outside the wet well and installed so that they can be operated under normal conditions.

3.3.2.8 Pump Openings

All pump openings shall be capable of passing spheres a minimum of 75 mm in diameter. All pump inlet and discharge openings shall be a minimum of 100 mm in diameter.

3.3.2.9 Pump Removal

All pumps shall be removable for maintenance and repair. All submersible pumps shall be removable for maintenance and

repair without dewatering the wet well.
All submersible pumps shall be equipped with remote release mechanisms, guide tracks, lift rings, cables, hoisting equipment and appurtenances.

3.3.2.10 Submersible Pump Flush Valve

Submersible pumps are to be designed to minimize the deposition of solids in the wet well. One flush valve per wet well is to be provided on all submersible pump installations.

3.3.2.11 Hydraulic Analysis

A hydraulic transient analysis shall be undertaken to ensure that pressure surges resulting from pump start, stop, and full load rejection during power failure do not adversely affect the mechanical piping or valves in the system.

3.3.3 Power Supply

3.3.3.1 Electrical

All electrical equipment and appurtenances installed within partially enclosed, or fully enclosed spaces that may be subjected to the presence of flammable or explosive materials shall comply with Part 1 of the Canadian Electrical Code.

- Electric motors less than 10 h.p. shall be 208 v, 3-phase.
- Electric motors 10 h.p. and larger shall be 600 v, 3-phase, and VFD controlled.

In instances where only single-phase power is available, electric pump motors must be supplied to suit this condition.

3.3.3.2 Control Panel

All pumping station control equipment is to be mounted in either a CSA Type 3 stainless steel enclosure, or a Surfex Model 215, or an approved equal. Each panel is to be equipped with a Surfline Model 9015 pump controller complete with communications hardware, including all connections made to phone data lines and interface cables.

Communication software shall be provided and must be fully compatible with the Town of Amherst's SCADA central monitoring system.

Adequate grounding of all electrical equipment and appurtenances and lighting arrestors shall be provided.

The control panel is to be isolated from the wet well by a conduit seal meeting the requirements of Part 1 of the Canadian Electrical Code.

3.3.3.3 Power Cord

The pump motor power cord shall be designed for flexibility and serviceability for use in a wet and corrosive environment.

The pump motor power cord shall be equipped with ground fault protection and meet all requirements of Part 1 of the Canadian Electrical Code.

3.3.3.4 SCADA System

The SCADA unit must be compatible with the system presently in use in the Town of Amherst. The SCADA unit shall have two extra digital points and two extra analog points and shall be capable of transmitting the following signals and alarms to the central monitoring location:

Electrical service from the transmission main to the control panel and the data transmission wiring from the station SCADA output to the telephone system shall be placed through buried conduit.

Pumping station functions must be monitored using an integrated Supervisory Control and Data Acquisition (SCADA) system to ensure that the station is performing satisfactorily. All software is to be fully compatible with the Town of Amherst central SCADA system. The SCADA unit must have two extra digital points and two extra analog points and must be capable of transmitting the following signals and alarms to the central monitoring location:

A flow meter, approved by the Town Engineer, must be installed in the pumping station. Town approved pressure gauges, complete with isolation valves, must be installed on the suction side and on the discharge side of the pumps.

Pumping Stations shall be equipped with alarm systems that will activate and send a signal for the following conditions:

Alarm Conditions

- Hand-off automatic selector switch status
- Output control through SCADA system
- Power generating system (overload, battery status, fuel tank level, etc.)
- Low level alarm
- High level alarm
- Intrusion alarm
- Building fire alarm
- Power failure alarm
- Panic alarm
- Low and or High temperature alarm
- Pump information alarms (overload, underload, leakage, motor current, pump status and phase monitoring)
- Building flood alarm

Station Operating Data

- Station voltage
- Amperages
- Station metered discharge
- Pump status (On/Off)

Standby Power Unit Alarms (If applicable)

- Power failure alarm
- Generator status (On/Off)
- Hand-off automatic selector switch status (On/Off)
- Battery status (Charged/Charging)
- Fuel tank level (Diesel only)
- Fuel tank pressure (Propane only)
- Generator current overload alarm
- Generator temperature overload alarm

3.3.4 Wet Wells

3.3.4.1 Pump Cycle

The wet well should be sized in order to provide a minimum of a 10 min. cycle time for each pump. For a two pump sewage pumping station, the wet well should be sized in order to provide a volume (m^3) of 0.15 times the maximum pumping rate (l/s) of one pump for one pump cycle.

3.3.4.2 Float Controls

All pumping stations shall have either pressure transducer controls, mechanical float controls (Flygt ENM-10 or equivalent mechanical switches) or ultrasonic echo controls set to control pump starts and stops. Additional

controls shall be provided for high level alarm and low level alarm.

3.3.4.3 Pump Start Elevation

The wet well level required for pump start should be a minimum of 300 mm below the invert of the inlet pipe to the wet well. However, under special conditions, if full and justifiable reasons are given, the wet well level required for pump start may be permitted above the invert of the inlet pipe provided that surcharging of the gravity system, basement flooding, and solids deposition do not occur.

3.3.4.4 Pump Stop Elevation

The wet well level required for pump stop should be a minimum of 300 mm, or two times the pump inlet pipe diameter above the centreline of the pump inlet pipe.

3.3.4.5 Sump Elevation

The wet well sump should be a minimum of $D/3$ and a maximum of $D/2$ below the intake of bell-mouth and turned-down pump inlets where D is the diameter of the pump inlet.

3.3.4.6 Emergency Overflow

Although every sewage pumping station is designed to minimize or eliminate the occurrence of overflows by the provision of redundant pumping systems, underground storage, and auxiliary power, each pumping station shall be provided with an emergency overflow arrangement acceptable to both the Town of Amherst and Nova Scotia Department of Environment and Labour.

The invert of the emergency overflow pipe at the pumping station shall be lower than the invert of any sanitary sewer laterals at the property line. The invert of the emergency overflow pipe shall be at an elevation high enough to prevent backwater effects or surcharging of the sanitary sewerage system due to elevated hydraulic gradelines in the receiving system.

In addition, to prevent or minimize emergency overflows, each pumping station shall be designed with a detention

capacity calculated on the basis of Peak Design Flow for a duration related to frequency and length of power outages based on historical records for the area.

In the absence of reliable historical records regarding the frequency and length of power outages, a minimum detention capacity of 4.5 hours at Peak Design Flow shall be provided. An auxiliary power supply may be used as a substitute for detention capacity at the pumping station.

3.3.4.7 Auxiliary Power

The auxiliary power supply shall be designed with adequate capacity to start and operate the sewage pumps required to pump Peak Design Flows, control and monitoring systems, and heating and lighting systems within the pump house.

3.3.4.8 Auxiliary Power Building

A building shall be provided to house the auxiliary power supply unit, control panel, piping, valves, and any other appurtenances. These items shall be located in the building in such a way as to provide convenient access and safety of maintenance personnel.

The auxiliary power supply building construction shall meet the requirements of all applicable Municipal, Provincial, and Federal regulations, including the latest edition of the National Building Code of Canada, and the latest edition of the Canadian Electrical Code.

Exterior wall assembly shall be 200 mm (8 inch) split face concrete block with a minimum of R-10 insulation.

The building shall have a hip roof with a minimum slope of 12 horizontal to 6 vertical and a minimum of R-20 insulation.

There shall be no windows in any exterior wall. Adequate ventilation for all mechanical equipment shall be provided by vandal-resistant, heavy duty type steel intake and exhaust louvres. Engine emissions shall be directed away from the building so as not to create a ventilation "short circuit". Provision shall be made to support wall mounted equipment inside the building.

The building floor shall be a minimum 150 mm above the external ground surface. The sewage pumping station shall accommodate the flooding criteria of Section 3.3.1.2. Pump house floors shall be poured reinforced concrete and sloped toward the access door, or be designed with a floor drain system.

All interior wall surfaces, doors, and trim shall be painted to a colour scheme as approved by the Town of Amherst.

3.3.4.9 Floor Slope

The wet well floor slope to the hopper bottom shall be a minimum of 1:1 (H:V). The area of the hopper bottom shall be no greater than necessary to accommodate the installation and operation of the pump inlets.

3.3.4.10 Wet Well Ventilation

Adequate ventilation shall be provided for all sewage pumping stations. Mechanical ventilation is required for all buried installations, including wet wells, dry wells, pump pits, and valve chambers. Wet wells and dry wells shall have independent ventilation systems with no interconnection between the systems. For buried installations greater than 4.5 m in depth, multiple ventilation inlets and outlets are recommended.

For submersible pump installations, an adequate ventilation system capable of delivering fresh air to the wet well at a rate of 110 litres per second at 15 mm static pressure is to be provided (acceptable model - Joy 4076, 115, 1/12 HP, or equivalent). A separate circuit is to be provided for the fan with ground fault interrupter. The ventilation fan is to be controlled by a switch at the pumping station control panel set to operate when the control panel door is opened. The ventilation fan controls shall also provide for automatic operation of the fan at least 4 times during a 24 hour period. The ventilation fan is to be mounted on the pumping station control panel mounting structure adjacent to the control panel.

3.3.4.11 Inlet Arrangement

A manhole shall be provided outside of the pumping station to collect the flow from all contributing sanitary sewer mains. Only one inlet pipe shall be permitted from this collection manhole to the pumping station wet well. Discharge to the wet well must be controlled to prevent turbulence and flood interference.

3.4.12 Access

Vehicle access to the sewage pumping station shall be provided in order to accommodate the need for maintenance and service personnel and vehicles.

Driveway of 3.4m minimum width shall be provided. The driveway shall be constructed of 300 mm thick crushed stone.

Town approved access hatchways and doorways shall be provided. All locks shall be keyed alike to the Town of Amherst standard with keys provided to the Town.

3.3.5 Site Considerations

All pumping stations and control panels shall be located off the street right-of-way in an appropriate area specifically designated for that purpose. The ownership of this property shall be deeded to the Town. All pumping station land shall be graded such that ponding of water does not occur. The elevation of the top of the wet well shall be no less than 100 mm and no more than 150 mm above the finished grade of the pumping station lot. All exposed areas shall be sodded/hydroseeded.

3.3.6 Operation and Maintenance Manual

Three (3) copies of the pumping station operation and maintenance manual must be prepared in a form acceptable to the Town of Amherst, and provided to the Town of Amherst prior to acceptance of the pumping station. This manual must contain at least the following:

- System description
- Design parameters, system hydraulics, design calculations, and system curves
- Civil, mechanical, and electrical drawings, record drawings
- Pump literature, pump curves, and operating instructions
- Manufacturer's operation and maintenance instructions for all equipment
- Name, address, and telephone number of all equipment suppliers and installers
- Information on guarantees/warranties for all equipment

All special tools and standard spare parts for all pumping station equipment is to be provided by the contractor prior to acceptance of the system by the Town of Amherst.

3.4 Forcemain Standards

3.4.1 Sanitary Forcemain

The following types of pipe are approved for use for all sanitary sewer forcemains in the Town of Amherst. Also included in this listing are conditions or requirements which are to be met where each type of pipe is proposed for use.

- Ductile Iron Pipe, Class 52, cement lined is generally accepted for use in any buried forcemain application in the Town of Amherst. However, the design engineer shall carry out an investigation of soil conditions to determine requirements for an appropriate means of corrosion protection.
- Ductile Iron Pipe, Class 350, cement lined may be used in certain applications. This pipe is approved for use in sizes up to and including 250 mm diameter. All Class 350 ductile iron pipe is to be installed with polyethylene encasement and all fittings are to be wrapped with an approved anti-corrosion tape such as "Denso" or approved equal.
- PVC Pipe, DR18 may be used in certain applications. This pipe is approved for use in sizes up to and including 250 mm diameter. All fittings used with PVC pipe installations are to be wrapped with an approved anti-corrosion tape such as "Denso" or approved equal.

3.4.2 Design Friction Loss

The hydraulic losses in the forcemain shall be calculated using the Hazen-Williams formula or an appropriate nomograph. Hazen-Williams roughness coefficients (C_{hw}) are presented in Table 3.3.

3.4.3 Identification

Since forcemains are constructed of material which could cause that pipeline to be confused with a potable watermain, the forcemain shall be identified by placing an underground warning tape at the top of the primary backfill layer above the pipe. The warning tape shall be 150 mm wide polyethylene tape with green background and black lettering. The message on the warning tape shall be "Caution, Sewer Line Buried".

3.4.4 Minimum Velocity/Maximum Velocity

The forcemain shall be designed such that a minimum cleansing velocity of 0.6 m/s is maintained for Peak Design Flow conditions.

The maximum velocity in any forcemain shall not exceed 2.4 m/s with two or more pumps operating or 1.5 m/s with one pump operating. Piping less than 100 mm in diameter is not acceptable, unless otherwise approved by the Town of Amherst.

3.4.5 Minimum Depth/Maximum Depth

Forcemains shall have a minimum cover of 1.5 m

Forcemains shall have a maximum cover of 2.4 m. The depth of cover shall be that as measured from the design grade at finished surface to the crown of the pipe line.

3.4.6 Minimum Horizontal Separation/Maximum Vertical Separation

Forcemains shall not be located in common trench with a watermain. There shall be a 3.0 m horizontal separation between forcemains and watermains.

There shall be a 0.5 m vertical separation between forcemains and watermains.

At crossing locations, one full length of watermain will be laid so that the joints are located equidistant from the forcemain.

3.4.7 Valves

To prevent air locks in the pipe, automatic air relief and vacuum valves shall be located in a manhole at all high points of the forcemain system or in such other locations as directed by the Engineer. Drain valves shall be located at low points as required by the Engineer.

3.4.8 Change in Direction

Any change in direction which is in excess of the pipe joint deflection tolerance shall require a suitable fitting as approved by the Town of Amherst. Thrust blocks and mechanical restraining glands shall be provided at any change of direction and shall be designed considering the operating pressure, surge pressure, peak flow velocity, and the bearing capacity of the trench floor and wall.

3.4.9 Termination

Forcemains shall terminate in a well-benched manhole such that the flow is directed down the barrel of the receiving gravity pipe. The downstream pipe receiving flow from a forcemain must be of sufficient size and grade to prevent surcharging at the maximum flow from the forcemain.

SUBDIVISION DESIGN GUIDELINES – Easements

4.1 General

- 4.1.1 Easement means an incorporeal right, distinct from ownership of the soil, vested in the Town and consisting of a use of another's land for any Public service or utility.
- 4.1.2 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.
- 4.1.3 The owner of the easement land shall not construct any type of structure over such easement area.

4.2 Design

- 4.2.1 The width of any easement shall be based upon the type, depth and number of services proposed to be installed.
- 4.2.2 The minimum width of an easement shall be six meters.
- 4.2.3 The alignments for any easement shall be dependent upon the type of service to be installed.

WATER DISTRIBUTION SYSTEM

DEVELOPER'S OBLIGATIONS

This section establishes criteria relating to the design and installation of water distribution systems for new development served by the Town of Amherst Water Utility. These Guidelines do not preclude the use of higher standards, where required in the design of infrastructure to service new development. No water will be supplied to any development unless servicing was installed in accordance with these Town Standards and the Amherst Water Utility Regulations.

REGULATORY AGENCY'S AND STANDARDS

AWWA and CSA Standards
Fire Underwriters Guidelines
Canadian Plumbing Code
Nova Scotia Standard Municipal Services Specification
Nova Scotia Department of Environment and Labor

A copy of all Regulatory Agency approvals shall be forwarded/copied to the Town before any work commences.

Contractors/Developers shall make themselves familiar with the requirements of the Nova Scotia Municipal Services Specification before making application to the Town.

DESIGN CRITERIA AND STANDARDS

5.1 Scope

A water distribution system is a system, conveying, and controlling potable water. Such systems consist of mainlines, lateral lines, fittings and appurtenances, pumping facilities, treatment facilities, pressure control facilities, and storage facilities. Water supply and water quality is monitored and maintained by the Town of Amherst Operational Services Department and water distribution systems must be designed such that the water quality is maintained while being distributed at adequate flows and pressures.

In addition to these design criteria, all water distributions systems must conform to the latest edition of the Standard Specification for Municipal Services for Nova Scotia, and the following:

- Water Supply for Public Fire Protection – A Guide to Recommended Practice as prepared by the Fire Underwriter's Survey (FUS) in conjunction with the Insurers' Advisory Organisation (IAO)
- National Fire Protection Association (NFPA)
- American Water Works Association (AWWA)
- Hydraulic Institute Standards (HIS)
- Canadian Standards Association (CSA)
- National Building Code (NBC)
- National Plumbing Code (NPC)
- Underwriters Laboratories of Canada (ULC)

Additionally, water distribution systems must conform to any requirements established by the Nova Scotia Department of Environment and Labour (NSDEL). No system shall be constructed until the design has been approved by the Town Engineer and NSDEL.

5.2 System Design

5.2.1 Design Water Demands

Water distribution systems must be designed to accommodate the greater of either of the following demands:

- Maximum Daily Demand plus Fire Flow (where Fire Flow is to be provided);
- Maximum Hourly Demand;
unless otherwise approved by the Town Engineer.

Fire Flow demand must be established by the Town Engineer in accordance with the latest requirements contained in the publication *Water Supply for Public Fire Protection - A Guide to Recommended Practice*, as prepared by the Fire Underwriter's Survey (FUS) in conjunction with the Insurers' Advisory Organisation (IAO).

Domestic flow demands must be established in accordance with the following:

- Average Daily Demand: 300 litres per capita per day;
- Maximum Daily Demand: 600 litres per capita per day;
- Maximum Hourly Demand: 1,000 litres per capita per day.

Domestic flow demands must be based upon a gross population density of 45 persons per hectare. In developments where the anticipated population exceeds, or is anticipated to exceed, the population density of 45 persons per hectare, or in areas of commercial, industrial, or institutional development, the domestic demand shall be adjusted accordingly. Typical water demands for commercial, industrial, and institutional development are presented in Table 5.1.

**Table 5.1
Typical Water Demands for Commercial, Industrial, and Institutional Development**

Development	Water Demand	Unit
Shopping Centre	2,500 – 5,000	L / 1,000m ² / day

Hospital	900 – 1,800	L / bed / day
School	70 – 140	L / student / day
Recreational Vehicle Park – without hook-ups	340	L / site / day
Recreational Vehicle Park – with hook-ups	800	L / site / day
Campground	225 – 570	L / site / day
Manufactured Home Park	1,000	L / site / day
Motel	150 – 200	L / bed space / day
Hotel	225	L / bed space / day

5.2.2 Minimum Pressures

Water distribution systems must be designed and sized in order to provide and maintain a minimum residual pressure of 200 kPa, measured at the main, at all points along the distribution system during Maximum Hourly Demand conditions. Water distribution systems must be designed and sized in order to provide and maintain a minimum residual pressure of 150 kPa at all points along the distribution system during Maximum Daily Demand plus Fire Flow conditions.

Design calculations and analysis are to be submitted by the Consultant in the form of a Design Brief at the time that the Application for Final Approval for the extension of, or connection to, an existing water distribution system is made.

As a result of differences in ground elevations, or distance from the source of supply, isolated areas may require increasing the pressure of the water system to adequately meet minimum pressure requirements. In order to accomplish this, a water booster station may be required to adequately service a specific area. Such areas, or Pressure Zones, are generally isolated from the remainder of the water distribution system.

In the event that the number of dwellings or structures affected by inadequate domestic flow and pressure within a Pressure Zone is minimal, or does not warrant a water booster station, the Town Engineer may permit alternative measures to be employed. Alternative measures shall be consistent with the National Plumbing Code, and must increase the available pressure as close as possible to the 200 kPa requirement. Alternative measures may include, but are not limited to, the following:

- provision of increased diameter service laterals and increased diameter residential plumbing to provide a system hydraulically equivalent to a 200 kPa static pressure system serviced through standard diameter service laterals, and minimum diameter residential plumbing;
- provision of individual residential booster pumps within each serviced dwelling or structure to increase the available pressure as close as possible to the 200 kPa requirement.

5.2.3 Maximum Pressures

Water distribution systems must be designed and sized in order to operate under a normal range of pressures from 200 kPa to 600 kPa under Maximum Daily Demand conditions.

The maximum pressure in the water distribution system should not exceed 700 kPa in order to avoid damage to residential plumbing systems, fixtures, and appurtenances.

5.2.4 Maximum Velocities

Water distribution systems must be designed and sized such that the maximum velocity in the pipe must not exceed the following:

- 1.5 m/s during Maximum Hourly Demand;
- 2.4 m/s during Fire Flow.

5.2.5 Hazen-Williams Roughness Coefficient (C_{HW})

Water distribution systems must be designed and sized assuming an ultimate pipe friction will be attained over long term operation. Table 5.2 presents Hazen-Williams roughness coefficients (C_{HW}) that shall be applied regardless of the pipe material.

Table 5.2
Hazen-Williams Roughness Coefficients (C_{HW})

Pipe Diameter	C_{HW}
NPS-6	100
NPS-8 to NPS-10	110
NPS-12 to NPS-24	120
NPS-24 and greater	130

5.2.6 Materials

All water distribution system materials not specified herein are to be as per the Standard Specification for Municipal Services for Nova Scotia.

5.2.7 Minimum Diameter

Water distribution systems must be designed and sized to meet all of the criteria outlined above, but under no circumstances shall be less than 150 mm in diameter.

5.2.8 Minimum Cover

All watermains must be designed with a minimum cover of 1.7 m as measured from the finished grade to the top of the pipe.

2.9 Maximum Cover

The cover as measured from the finished grade to the top of the pipe may be increased to a suitable depth to prevent freezing of either the watermain or the services, but under no circumstances shall the cover exceed 2.4m unless approved by the Town Engineer.

5.2.10 Location

In the case of common trench installations, the watermain must be laid adjacent to the sanitary sewer with a minimum 0.9 m horizontal separation, and a minimum 0.30m vertical separation, with the watermain being located above the sanitary sewer.

All watermain and appurtenances must be located within the street right-of-way owned by the Town of Amherst or the Nova Scotia Department of Transportation and Public Works. In the case of off-street servicing, all watermain and appurtenances must be located within a 6.0 m wide municipal service easement granted to the Town of Amherst.

Contingent upon the length and location of the municipal service easement, the Town Engineer may require a suitable travelled way to be provided within the easement for operations and maintenance purposes.

In the case of curb and gutter street design, all watermain and appurtenances must be located within the travelled way and no closer than 1.8 m of the curb line.

In the case of open ditch street design, all watermain and appurtenances may be located in the gravel shoulder.

In the case of municipal service easement installations, all watermain and appurtenances must be located as close as possible to

the centreline of the easement.

Where a need is identified to accommodate future development on adjacent lands, municipal service easements must be provided from the edge of a street right-of-way to the property boundary of the subdivision subject to approval of the Town Engineer.

5.2.11 Grid Design and Looping

The layout of water distribution systems must be based on a grid design of closed loops wherever possible. Municipal service easements must be provided in order to provide closed loops where the street right-of-way does not. The occurrence of dead-end watermains should be minimized, or eliminated. Where dead-end watermains cannot be avoided, they shall be provided with a fire hydrant, or acceptable blow-off to provide the opportunity for disinfection and flushing. Additional looping may be required to increase the reliability of the system at the discretion of the Town Engineer.

5.2.12 Water Mains

Ductile iron pipe shall be supplied in minimum pressure class 350 for 100 mm through 350 mm, pressure class 250 for 350 mm through 500 mm cement mortar lined. Materials, fittings and appurtenances shall be in accordance with American Water Works Association (A.W.W.A) specifications.

PVC pipe shall be to CSA B137.3 M90, series 160 unless otherwise agreed to by the Town, or to AWWA C900-89 for pipe sizes 100 mm to 300 mm, DR 18 (pressure class 1034 kPa) unless otherwise agreed to by the Town or AWWA C905-88 for pipe sizes 350 mm to 900 mm, DR 18 (pressure class 1620 kPa) unless otherwise agreed to by the Town. All pipe shall be certified to CSA B 173.3 M90, shall be U.L. and F.M. approved, and shall have 1 Mpa gasket bell end, cast iron outside diameter.

Water mains shall be installed in accordance with AWWA Specifications C600-54T and the Nova Scotia Municipal Service Specification.

5.2.13 Isolation Valves

All connections to an existing water distribution system must provide an isolation valve so that the connection can be isolated from the existing water distribution system. The Town can not guarantee leak-proof operation of existing valves, therefore, it is recommended that a new valve be installed when connecting to existing mains.

The connection to an existing water distribution system must be coordinated by the Consultant with the Town Engineer. Any such connection is to be witnessed by the Consultant and the Town Engineer. All tapping of existing water distribution systems for such connections must be conducted and inspected with the existing water distribution system operating under working pressure.

All valves must be gate valves and shall be provided on water distribution systems to satisfy the following conditions:

- Isolation valves must be provided on each leg of intersections to permit isolation of any section by operating not more than three valves;
- A sufficient number of isolation valves must be provided to allow for shut-down of any section without putting more than 40 customers out of service at any time;
- A sufficient number of isolation valves must be provided so that a break or other failure will not affect more than 150 m of water distribution system in commercial districts, or 250 m of water distribution system in residential districts.;
- Where water distribution systems serve customers located on large rural lots, and where future development is not expected, isolation valve spacing must not exceed 425 m.
- Gate valves shall be McAvity, Bibby, Mueller, AVK or approved equal and each shall be accommodated in a valve box.

5.2.14 Automatic Combination Air Relief and Vacuum Valves

Automatic combination air relief and vacuum valves must be installed in an appropriate insulated manhole structure at all significant high points in the distribution system, and at other locations as required by sound engineering judgement, or at the discretion of the Town Engineer.

5.2.15 Drain Valves

Water distribution systems exceeding 300 mm in diameter must be equipped with drain valves located at low points to permit drainage during maintenance and repairs to the system.

Water distribution systems less than 300 mm in diameter must be equipped with hydrants located at low points to permit draining through pumping or compressed air during maintenance and repair to the system.

2.16

Fire Hydrants

Fire hydrants must be provided at a recommended spacing in accordance with the latest requirements contained in the publication Water Supply for Public Fire Protection - A Guide to Recommended Practice, as prepared by the Fire Underwriter's Survey (FUS) in conjunction with the Insurers' Advisory Organisation (IAO). Under no circumstances shall the maximum fire hydrant spacing exceed 300 m.

The following are desirable fire hydrant locations:

- Fire hydrants should be located at localized high points in the water distribution system, unless an automatic combination air release and vacuum valve is required at that location;
- Fire hydrants should be located at localized low points in the water distribution system, unless a drain valve is required at that location;
- Fire hydrants should be located at intersections of roads;
- Fire hydrants should be located at the end of dead-end streets or cul-de-sacs.

5.2.17 Fire Hydrants Materials

- Gate valves must be provided for all hydrants.
- Laterals between the water main and fire hydrant must be a minimum of 150 mm in diameter.
- Hydrants shall be of the break-away type.
- Hydrants shall be McAvity M67-Brigadier, internally plugged, and be equipped with 2-65 mm diameter hose connections. A 114 mm Storz connection must be provided. All threads to be to the Town of Amherst Standard. Color to be yellow.

5.2.18 Fittings

Any horizontal or vertical change in direction exceeding the manufacturer's recommended maximum deflection tolerance at a pipe joint requires an approved bend.

5.2.19 Joint Restraint

Calculation of thrust forces on pipe joints and fittings should account for normal operating pressure plus pressure transients induced at peak flow velocity plus dynamic thrust if the peak flow velocity is excessive.

Joint restraint must be provided for the following fittings and appurtenances:

- caps and plugs;
- tees and wyes;
- reducers and enlargers;
- horizontal and vertical bends;
- valves;
- hydrants.

Thrust blocks must be provided at fittings and appurtenances requiring joint restraint and shall consider the soil bearing capacity of the in-situ material that the thrust block bears against. The Consultant should exercise sound engineering judgement in order to account for reduced

bearing capacity associated with shallow trench installations.

Mechanical joint restraint systems may be used in lieu of thrust blocks at the discretion of the Town Engineer. The Consultant should exercise sound engineering judgement in the design of mechanical joint restraint systems recognizing that not only the fittings and appurtenances require restraint, but adjacent pipe sections require restraint in order to develop adequate skin friction equal to the restraint offered by the thrust block. The number of restrained joints and number of restrained pipe runs should be clearly identified on plan and profile drawings.

5.2.20 Trench Drainage Relief System

The Consultant shall assess the possibility of groundwater migration, caused by an elevated water table, through pervious bedding and backfill material, and shall be responsible for the design of corrective measures to prevent flooding as a result of this groundwater migration.

Water distribution systems installed in a separate trench, or installed in areas where sanitary sewer mains and/or storm sewer mains are not installed must require a trench drainage relief system to lower the elevated water table in the trench below the invert of the watermain.

5.2.21 Service Laterals

All water service laterals must be designed with a minimum cover of 1.6 m as measured from the finished grade to the top of the lateral including the goose neck.

All water service laterals from the watermain to the property line must be provided by the Developer. A single water service lateral is to be supplied to each existing lot or potential future lot that could potentially be created under the land use bylaw in effect at the time of installation of the water distribution system. Whenever possible, water service laterals should not be installed in private driveways or other travelled ways.

In order to avoid high friction losses in water service laterals, the maximum length of any 19 mm diameter water service lateral must be limited to 55 m from the curb stop to the dwelling or structure. Water services laterals longer than 55 m must be a minimum of 25 mm in diameter.

5.2.22 Water Service Laterals Materials

Each single unit detached residential property will be provided with a water service of 19 mm (minimum) type “K” soft copper to the curb stop meeting A.S.T.M Standard B88. Service connections for other occupancies will depend on fire regulations and the National Plumbing Code and are to be approved by the Town Engineer.

Service laterals shall consist of the connection to the main and a curb stop with stainless steel rods, located on the property line.

5.2.23 Backflow Prevention Devices

Backflow prevention devices are required on new services if there is a risk of contamination of the potable water supply. Premises which require backflow prevention devices include, but are not limited to, the following:

- industrial, commercial, and institutional buildings;
- apartment buildings larger than four units;
- sprinkler service lines.

5.2.24 Testing

Prior to final testing and disinfection the mains shall be flushed. Appropriately sized water main swabs shall be inserted into the newly constructed water main to ensure that each newly installed section of water main is swept by a swab when the system is flushed. After the main has been swabbed, hydrant leads will be thoroughly flushed by opening and closing hydrants and valves several times with an adequate flow velocity to remove foreign material and debris.

Only Town staff are authorized to operate valves and hydrants during filling and flushing.

The consultant must test for chlorine residual at chlorination and after 24 hours and forward results to Town Engineer.

Disinfection to be carried out in accordance with Nova Scotia Standard Specification for Municipal Services.

De-chlorination must be performed prior to disposal of water on site in situations where chlorinated water cannot be discharged to the sanitary sewer. Under no circumstances shall chlorinated water be allowed to be discharged to the surface or a watercourse.

5.3 Domestic Water Pumping Station

5.3.1 General Requirements

As a result of differences in ground elevations, or distance from the source of supply, isolated areas may require increasing the pressure of the water system to adequately meet minimum pressure and fire flow requirements as outlined elsewhere in this standard.

In order to accomplish this, a water booster station may be required to adequately service a specific area within the Water Service District. Such areas, or Pressure Zones, are generally isolated from the remainder of the water distribution system.

Water booster stations may incorporate either ground storage reservoirs or elevated storage reservoirs into their design and

operation. The incorporation of such storage is normally done in order to supply extreme demand requirements such as Maximum Hourly Demand or Fire Flow.

5.3.2 Floating Storage

Water booster stations, without floating storage, must be designed and sized in order to supply the extreme water demand conditions outlined in Section 5.2.2.

In the case of small pressure zones that do not have ground storage or elevated storage available, the necessity to meet Fire Flow Demand is the most critical.

In the case of large pressure zones that do not have ground storage or elevated storage available, the necessity to meet the extreme water demands directly from the water booster station may become cost prohibitive. Floating storage facilities become economically viable for large pressure zones and shall be incorporated into the system at the discretion of the Town Engineer.

Water booster stations, with floating storage, must be designed and sized in order to supply the Maximum Hourly Demand as outlined in Section 5.2.2. Floating storage must be available for water balancing and Fire Flow Demand conditions.

3.3 Pump System Capacity

Water booster stations, without floating storage, must be designed and sized with a minimum of one lead and two lag domestic pumps. Domestic pumps must be designed and sized such that the capacity of the pumping station with the two largest pumps out of service must provide a minimum of 80% of the peak demand of the serviced area when completely developed.

Water booster stations, with floating storage, must be designed and sized with a minimum of one lead and two lag domestic pumps. The domestic pumps must be designed and sized such that the capacity of the pumping station with the largest pump out of service must provide a minimum of 80% of the peak demand of the serviced area when completely developed.

The lead pump must provide a maximum of 25% of the peak demand and provide an adequate supply during normal periods of domestic demand.

The lag pumps must provide a maximum of 55% of the peak demand and

provide an adequate supply during maximum periods of domestic demand.

The fire pump must have adequate capacity to supply the necessary fire flow demand.

The use of variable speed pumps is preferred to compensate for the demand variations.

5.3.4 Domestic Pumps and Fire Pumps

Domestic pumps, fire pumps, and all fittings and appurtenances including system capacity, system sizing, system layout, control facilities, installation, and testing, must meet all applicable and relevant standards and codes.

5.3.5 System Head Curves

A single system head curve can not be developed due to fluctuations in water demands within the system. Therefore, projected points of operating head and flow for at least the following conditions shall be developed:

- Average Daily Demand;
- Maximum Daily Demand;
- Maximum Hourly Demand (A.M.);
- Maximum Hourly Demand (P.M.);
- Minimum Hourly Demand (Night).

Pumps that adequately operate over the anticipated range of demands at the station from a minimum total dynamic head to a maximum total dynamic head shall be selected. Generally, the pumps must be capable of meeting the following criteria:

- the rated point corresponding to the Maximum Daily Demand condition;
- the rated point corresponding to the maximum efficiency;
- the rated point corresponding to the minimum total dynamic head and the maximum total dynamic head;
- the minimum submergence level for a vertical turbine unit;
- the available NPSH for a horizontal centrifugal unit;

In general, pumps operate at a total dynamic head considerably less than the manufacturer's ultimate rated point. Therefore, the maximum efficiency point shall be specified as that point at which the pump will normally run. The rated point shall be selected as the point at which the pump will overcome the greatest amount of head for a specified flow rate.

Pumps shall be selected in order to avoid the following conditions:

- pumps subjected to low total dynamic head may be prone to destructive cavitation under high flow conditions;
- pumps subjected to high total dynamic head may be prone to high power consumption under low flow conditions;
- noise and vibration levels that are audible beyond the immediate station vicinity.

5.3.6 Site Considerations

5.3.6.1 Site Access

Vehicle access to the water booster station must be provided in order to accommodate the need for maintenance and service personnel and vehicles.

The driveway shall be constructed of 300 mm thick crushed stone.

Town approved access hatchways and doorways must be provided. All locks must be keyed alike to the Town of Amherst standard with keys provided to the Town.

3.6.2 Site Ownership

All structures, fittings, and appurtenances associated with the water booster station must be located on property outside of the street right-of-way in an appropriate area. The ownership of this property must be deeded to the Town of Amherst.

5.3.6.3 Flooding

Water booster stations and appurtenances should be protected from flooding and flood related damage due to the 1 in 100 year storm.

Water booster stations and appurtenances should remain operational in the 1 in 100 year storm.

Water booster station land must be graded such that ponding of water does not occur. All exposed areas must be sodded/hydroseeded.

5.3.6.4 Site Location

All structures and appurtenances associated with the booster station must be located off the street right-of-way in an appropriate area specifically designated for that purpose. The ownership of this property must be deeded to the Town of Amherst.

5.3.6.5 Equipment Removal

All water booster stations must be equipped with acceptable devices for the removal and maintenance of pumps, motors, controls, and auxiliary power equipment.

5.3.7 Civil

The pump house building must be of adequate size to accommodate the pumps, pump motors, control panel, auxiliary power supply, oil tank, and other accessories. These items must be located in the building taking into consideration safety for operators and convenient access for maintenance.

The pump house building design and construction must meet the requirements of the latest edition of the National Building Code. Exterior wall assembly shall be 200 mm split face concrete block with a minimum of R-10 insulation. There shall be no windows in any exterior wall.

Ventilation for all mechanical equipment must be vandal-resistant, heavy duty type steel intake and exhaust louvres. Engine emissions must be directed away from the building so as not to create a ventilation "short circuit". Provisions must be made to support wall-mounted equipment inside the building. The building shall have a hip roof with a minimum slope of 12 horizontal to 6 vertical and have a minimum of R-20 insulation.

The building floor must be a minimum 150 mm above the external ground surface and any potential flood level. Pump-house floors must be poured reinforced concrete and sloped towards the access door. All interior wall surfaces, doors, and trims should be painted to a colour scheme as approved by the Town Engineer. A non-metallic coloured hardener shall be added to the concrete floors during the finishing process to a colour scheme as approved by the Town Engineer.

Lifting devices of a type approved by the Town Engineer should be incorporated into the design of the structure so that pumps and/or motors can easily be transferred from their location within the station to an access door.

All locks must be keyed alike to the Town of Amherst standard system.

5.3.8 Electrical & Miscellaneous

The pumping station must be provided with a three phase power supply. Design and installation of the power supply system must meet all applicable and relevant standards and codes.

Full standby power supply must be provided utilizing a standby diesel generator set. The power generating system must be capable of providing continuous electric power during any interruption of the normal power supply. The standby power unit must be designed with adequate capacity to operate fire and domestic pumps, control and monitoring systems, and heating and lighting systems within the pump house.

The generating system must include the following items:

- diesel engine;
- alternator;
- control panel;
- automatic change-over equipment;
- automatic ventilation system;
- battery charger and battery;
- fuel supply unit.

Pumping station equipment must be equipped with control systems, compatible with the pumping station monitoring system. The control system must be capable of providing:

- uninterrupted fully automatic operation of the pumping station to meet the various demand requirements of the area being serviced;
- protection against equipment damage or failure during extreme hydraulic or electrical conditions.

Each pump shall be operated by an energy efficient electric motor capable of operating the pump over the full range of load conditions. Motors should be located such that they cannot be flooded should a pipe failure occur.

All electrical apparatus shall be located in an accessible location above grade with a clear access of 1.0 m around all pumps and motors. All panels and controls must be moisture-resistant.

Pump house must contain at least the following:

- electric unit heaters with individual built-in thermostats;
- adequate vapour proof lighting;
- a single photo-cell activated outside vandal proof security light adjacent to or over the access door;
- a weather-proof switch and electrical outlet inside the pump-house immediately adjacent to the access door;
- adequate lightning arrestors;
- a fire extinguisher;
- sufficient ventilation to ensure that heat generated from the electrical equipment is sufficiently dissipated.

5.3.9 Mechanical

Suction and discharge piping must be designed and arranged to provide easy access for maintenance. All piping and tubing, 100 mm diameter and smaller, must be stainless steel, Type 316 or 316L, Schedule 40, unless otherwise approved by the Town Engineer. All ductile iron piping within the station must be Class 54, cement lined. Threaded flanges must be used for all joints, fittings and connections within the station.

All piping within the pumping station must be properly supported and must be designed with appropriate fittings to allow for expansion and contraction, thrust restraint, etc. All exposed surfaces and pipes, other than stainless steel, must be finished, treated, and painted to prevent rusting. Colour scheme and paint types shall be approved by the Town Engineer.

A self-closing check valve must be incorporated in the discharge of each unit in the pumping station. It must be designed in such a way that if pump flow is lost, the valve will close automatically. The type and arrangement of check valves and discharge valves is dependent on the potential hydraulic transients that might be experienced in the pumping station.

An adequate number of isolation valves must be provided to allow maintenance of pumps and/or control valves.

In an in-line booster pumping station, the pressure on the suction side

of the pump must not be allowed to drop below 150 kPa when there are service connections on the suction side watermain.

5.3.10 Pressure Transients

Water distribution systems must be designed and sized in order to withstand maximum operating pressures plus pressure transients. Pressure transients, or surges, result from sudden changes in flow velocity within the water distribution system. These sudden changes in velocity are most often the result of rapid valve operation, pump start-up and shut-down, sudden demand fluctuations, and power failures.

Pipe and pipe joints must be able to minimally withstand the pressure transient created by the instantaneous stoppage of a water column travelling at 0.6 m/s. The magnitude of the pressure transient will vary as a function of pipe diameter, pipe wall thickness, and pipe wall material.

Celerity values expressed in many texts and manufacturer's catalogues for flexible pipe are for the unrestrained condition. Flexible pipe, when buried, often exhibits an effective celerity much higher than published values. The Consultant should exercise sound engineering judgement to account for this increased effective celerity. A rule of thumb approach is to assume an effective celerity twice that of the published value for flexible pipe.

Typical methods of surge protection that can be used to protect the booster station and equipment include the following:

- surge anticipator systems that dissipate over-pressure from the discharge lines;
- slow closing and opening control valves on pump discharges;
- hydro-pneumatic surge tanks on discharge headers;
- variable speed pumping units.

5.3.11 Safety Precautions

The pumping station and appurtenances must be designed in such a manner as to ensure the safety of operators, in accordance with all applicable Municipal, Provincial, and Federal regulations including the Occupational Health & Safety Act of the Province of Nova Scotia.

- All moving equipment must be covered with suitable guards and shields to prevent accidental contact by operations and maintenance personnel;
- All self-starting equipment must be labelled with suitable warning signage to ensure that operations and maintenance personnel are aware of this situation;

- All equipment must be equipped with lock-outs to ensure that the equipment is completely out of service when operations and maintenance personnel are working on the system.

5.3.12 Pumping Station Monitoring

Pumping station functions must be monitored using an integrated Supervisory Control and Data Acquisition (SCADA) system to ensure that the station is performing satisfactorily. All software is to be fully compatible with the Town of Amherst central SCADA system. The SCADA unit must have two extra digital points and two extra analog points and must be capable of transmitting the following signals and alarms to the central monitoring location:

Signals

- station flow;
- station suction pressure;
- station discharge pressure;
- station voltage;
- amperage.

Domestic Booster Pump Alarms

- pump status (On/Off);
- low discharge pressure alarm;
- high discharge pressure alarm;
- motor current overload alarm;
- motor temperature overload;
- surge valve alarm.

Fire Booster Pump Alarms

- pump status (On/Off);
- low discharge pressure alarm;
- high discharge pressure alarm;
- motor current overload alarm;
- motor temperature overload alarm.

Standby Power Unit Alarms

- power failure alarm;
- generator status (On/Off);
- hand-off automatic selector switch status (On/Off);
- battery status (charged/charging);
- fuel tank level (diesel only);
- fuel tank pressure (propane only);
- generator current overload alarm;
- generator temperature overload alarm.

Building Alarms

- panic alarm;
- building fire alarm;

- illegal entry alarm;
- building temperature alarm – lo & hi;
- building flood alarm.

5.3.13 Operation and Maintenance Manual

Three copies of the pumping station operation and maintenance manual must be prepared in a form acceptable to the Town Engineer, and provided to the Town Engineer prior to acceptance of the pumping station. This manual must contain at least the following:

- system description;
- design parameters, system hydraulics and design calculation;
- as constructed civil, mechanical, and electrical drawings;
- pump literature, pump curves, and operating instructions;
- manufacturers' operation and maintenance instructions for all equipment;
- name, address, and telephone number of all equipment suppliers and installers;
- information on guarantees/warranties for all equipment.

All special tools and standard spare parts for all pumping station equipment is to be provided by the contractor prior to acceptance of the system by the Town of Amherst.

6.1 Scope

A storm drainage system is a system receiving, conveying, and controlling discharges in response to precipitation and snow melt. Such systems consist of ditches, culverts, swales, subsurface interceptor drains, roadways, curb and gutters, catchbasins, manholes, pipes, retention ponds, and service lateral lines. The design criteria contained in this section is included to illustrate the more common aspects encountered in the design of storm drainage systems.

All storm drainage systems within the Town of Amherst shall be designed to achieve the following objectives:

- to prevent loss of life and to protect structures and property from damage due to storm events;
- to provide safe and convenient use of streets, property, and other improvements during and following precipitation and snow melt events;
- to adequately convey stormwater runoff from upstream sources;
- to mitigate the adverse effects of stormwater runoff, such as flooding and erosion, onto downstream properties;
- to preserve natural watercourses and wetland environment;
- to minimize the long-term effects of development on the receiving surface water and groundwater regimes from both a quantity and quality perspective.

In the Town of Amherst, storm drainage systems are owned, operated, and maintained by either the Town of Amherst, private landowners, or a combination of both.

The management and control of stormwater is a mixture of art and science, and like all other municipal services, storm drainage systems must be carefully designed, reviewed, and approved before construction proceeds.

All storm drainage systems shall conform to the latest revision of the Storm Drainage Works Approval Policy by the Nova Scotia Department of Environment and Labour (NSDEL) on December 10, 2002.

Proposed storm drainage works must be based on sound engineering design. For stormwater design work, this often requires good quality hydrologic and hydraulic modeling. Stormwater modeling can be divided into two basic fields:

Hydrology, which is the study of runoff produced from rainfall and/or snowmelt, and the factors which influence it, and

Hydraulics, which is the study of water flow in the channels, pipes, streams, ponds, and rivers which convey it to the sea. In each field, there are many techniques available for performing the required analysis, which requires a qualified professional engineer to choose the best methods for each situation.

6.2 Design Approach

6.2.1 Storm Drainage System Types

New developments shall be serviced by a dual drainage system consisting of both a minor storm drainage system (piped system) and a major storm drainage system (overland system).

6.2.2 Dual Storm Drainage System Design

Design of storm drainage systems shall include consideration of both a minor storm drainage system and major storm drainage systems. The design of the dual storm drainage system, including the minor system and the major system, shall be carried out to ensure that no proposed or existing structure shall be damaged by the runoff generated by any storm up to the 1 in 100 year return period storm. This requires proper care in the design of streets, curb and gutters, catchbasins, pipes, open channels, grading of lots and road profiles, setting of elevations or openings into buildings, foundation drains, roof drains, or other “off-street” connections.

6.2.2.1 Minor Storm Drainage System

The minor storm drainage system shall be designed to convey stormwater runoff from the 1 in 5 year return period storm, thereby providing safe and convenient use of streets and other areas. The minor storm drainage system shall consist of the following components:

- swales, subsurface interceptor drains, curb and gutters, catchbasins, manholes, pipes or conduits and service lateral lines in those areas where a piped storm drainage system is required.

6.2.2.2 Major Storm Drainage System

The major storm drainage system shall be designed to convey stormwater runoff from the 1 in 100 year return period storm, thereby preventing loss of life and protecting structures and property from damage. The capacity of the major storm drainage system shall be adequate to carry the discharge from a major storm event when the capacity of the minor storm drainage system is exceeded. The major storm drainage system shall consist of the following components:

- ditches, open drainage channels, swales, roadways, detention ponds, watercourses, floodplains, gullies, and creeks in those areas where a piped storm drainage system is required for the minor drainage system;
- ditches, open drainage channels, swales, roadways, watercourses, floodplains, gullies, and creeks in those areas where an open channel drainage system is required for the minor drainage system.

6.2.3 Storm Drainage System Outfall

The dual storm drainage system consisting of the minor storm drainage system and the major drainage system shall be extended to discharge to an existing downstream storm drainage system, or natural watercourse.

6.2.4 Existing Storm Drainage System Outfall

The downstream storm drainage system shall have adequate capacity to capture and convey discharge from the proposed storm drainage system in addition to its own base flow rate of discharge. Any potential adverse impact, such as flooding or erosion, as a result of the combined rate of discharge, on the downstream storm drainage system shall be investigated. Such investigation shall be carried out from the outfall location of the proposed storm drainage system to a location in the downstream watercourse where the peak rate of discharge from the proposed storm drainage system is 10% of the combined peak rate of discharge in the watercourse at that location.

The extent of any adverse impacts will be assessed by the Town Engineer based on this investigation. Depending upon the nature of any adverse impacts, the Town Engineer may require mitigative measures to be provided to the storm drainage system to prevent or alleviate such adverse impacts.

6.2.5 Design Parameters

6.2.5.1 Basis of Design

Design of the dual storm drainage system shall be based on the state of development anticipated to exist for both the subwatershed under design and upstream subwatershed when both areas are completely developed in accordance with the land-use zoning in place at the time of design.

6.2.5.2 Design Flow

6.2.5.2.1 Developed Areas

Except as indicated below, design flows for residential, commercial, or industrial land uses shall be based on summer rainfall data and corresponding runoff coefficients for summer conditions.

6.2.5.2.2 Undeveloped Areas

When the area under design includes greater than 50% designated for future development, peak design flows shall be the largest of flows estimated for both winter and summer conditions.

6.2.5.2.3 Long Duration

When the area under design requires calculation of flows for durations greater than 6 hours, design flows shall be the largest of the flows estimated for both winter and summer conditions.

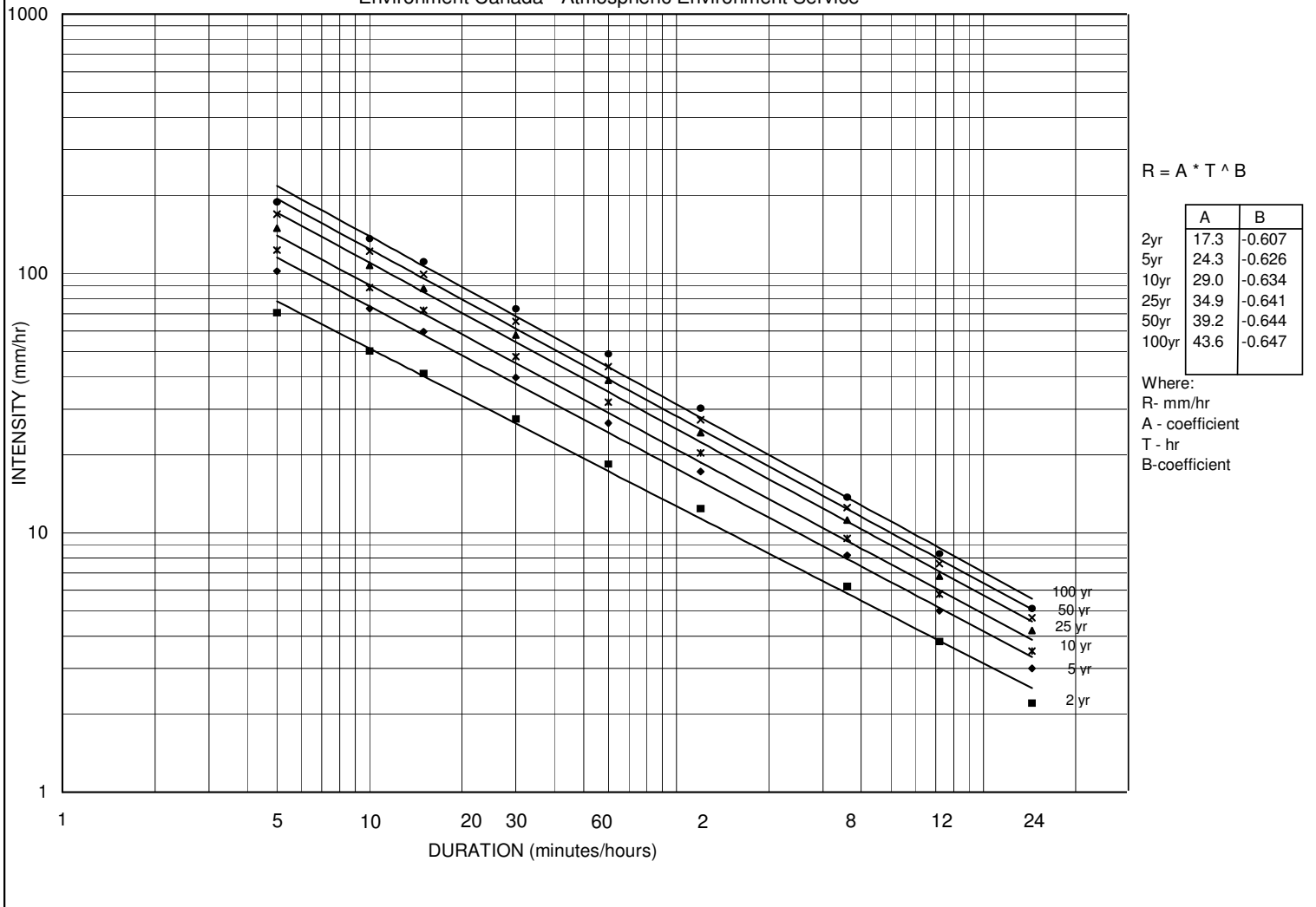
6.3 Meteorological Data

Rainfall data is used in a variety of forms including intensity-duration-frequency curves, synthetic design storms, historical design storms, and historical long-term rainfall records. Selection of the proper form depends upon the type of computational procedure to be used, contingent upon the type of problem to be solved and the level of analysis required.

6.3.1 Rainfall Intensity – Duration – Frequency Curve

Figure 6.1 contains rainfall intensity – duration – frequency curves which are based on annual rainfall at the Moncton International Airport (MIA) weather station. Additional detailed historical rainfall information is available through the Atmospheric Environment Service (AES) of Environment Canada.

FIGURE 6.1
ANNUAL RAINFALL INTENSITY-DURATION FREQUENCY CURVES FOR MONCTON (1946 - 1997)
 Environment Canada - Atmospheric Environment Service



6.3.2 Synthetic Design Storm

Advanced procedures for the design of storm drainage systems requires the input of rainfall hyetographs, which specify rainfall intensities for successive time increments during a storm event. For this purpose, it is standard to use both synthetic and historical design storms hyetographs. Synthetic design storm hyetographs are intended to represent some of the long term statistical properties of recorded rainfall.

6.3.3 Historical Design Storm

In some instances the design of storm drainage systems requires the input of historical design storms. Historical design storm hyetographs are intended to represent a specific recorded rainfall. Additional detailed historical rainfall information is available through the Atmospheric Environment Service (AES) of Environment Canada.

6.4 Runoff Methodology

There are numerous techniques and models available to the Consultant for use in the determination of stormwater runoff. Selection of an appropriate method must be based on an understanding of the principles and assumptions underlying the method and of the problem under consideration. It is, therefore, essential that appropriate techniques and models be selected and used by experienced engineers.

The following list of computational methods is not to be considered complete and comprehensive. Its intention is to provide general comments on several of the methods accepted by the Town of Amherst Operational Services.

6.4.1 The Rational Method

The Rational method is the most widely used empirical equation for predicting instantaneous peak discharge from a small subwatershed. The peak discharge is assumed to occur at a rainfall duration equal to the time of concentration. The Rational method may be used for the determination of instantaneous peak runoff, in the design of storm drainage systems up to 20 hectares in area, for preliminary design of systems serving larger areas, and as a check on flows determined by other methods. This method cannot be used to determine the size or hydraulic performance of storage facilities.

6.4.2 HEC

The United States Army Corps of Engineers (USACE) HEC model may be used for modeling overland storm drainage systems, natural watercourses and determining the extent of floodplains.

Methods other than those listed above may be used if their use is justified by the Consultant and approved by the Town Engineer. Results may need to be verified by checking with a second method, or calibration based on flow measurement.

6.5 Hydrologic Design Criteria

6.5.1 Rational Method

6.5.1.1 Runoff Coefficients

Table 6.1 and Table 6.2 present Rational method runoff coefficients appropriate for various land uses and surface types. Selection of values from Table 6.1 and Table 6.2 shall be based on a percent of impervious area, lot size, soil conditions, and other relevant considerations. For residential, commercial or industrial land uses, rainfall intensities from Figure 6.1 shall be used with coefficients for summer ground conditions. Where runoff from an area that includes a significant proportion of undeveloped land is to be determined, a comparison shall be made between summer and winter ground conditions using winter runoff coefficients from Table 6.3 and rainfall intensities from Figure 6.1 accounting for snowmelt contributions. For winter or year-round runoff calculations, the coefficients from Tables 6.1, 6.2, and 6.3 shall be increased

according to Table 6.4 for the 1 in 100 year return period.

Table 6.1
Rational Method Runoff Coefficients for Various Areas for the Summer Condition

Character of Area	Description of Area	Runoff Coefficient
Industrial	Light	0.50 to 0.80
	Heavy	0.60 to 0.90
Commercial	Downtown	0.70 to 0.95
	Neighbourhood	0.50 to 0.70
Residential	Single-Family	0.30 to 0.50
	Attached Multi-Unit	0.60 to 0.75
	Suburban	0.25 to 0.40
	Apartment	0.50 to 0.70
	Park, Cemetery	0.10 to 0.25
Other	Playground	0.20 to 0.40
	Railroad Yard	0.20 to 0.40
	Unimproved/Vacant Lands	0.10 to 0.30

Table 6.2
Rational Method Runoff Coefficients for Various Surfaces for the Summer Condition

Character of Surface	Description of Surface	Runoff Coefficient
Impervious	Asphalt	0.70 to 0.95
	Concrete	0.80 to 0.95
	Brick	0.70 to 0.85
	Rooftop	0.75 to 0.95
Pervious	Lawn, Sandy Soil, < 2%	0.05 to 0.10
	Lawn, Sandy Soil, 2%-7%	0.10 to 0.15
	Lawn, Sandy Soil, > 7%	0.15 to 0.20
	Lawn, Clayey Soil, <2%	0.13 to 0.17
	Lawn, Clayey Soil, 2%-7%	0.18 to 0.22
	Lawn, Clayey Soil, >7%	0.25 to 0.35

Note: Higher values than those presented in Table 6.2 are required to account for steeply sloped areas, longer duration events, and longer return periods to account for decreased infiltration and other losses.

Table 6.3
Rational Method Runoff Coefficients for the Winter Condition

Character of Area/Surface	Return Period	Runoff Coefficient
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All areas/surfaces with Summer coefficient < 0.80	5 year	0.80
All areas/surfaces with Summer coefficient < 0.80	100 year	1.00

Table 6.4

Rational Method Runoff Coefficients for the 100 Year Return Period

Runoff Coefficient for 5 to 10 Year Return Period	Corresponding Runoff Coefficient for 100 Year Return Period
0.10	0.20
0.20	0.35
0.30	0.50
0.40	0.65
0.50	0.80
0.60	0.90
0.70 to 1.00	1.00

6.5.1.2 Winter Runoff

Where calculation of winter runoff is required, frozen ground shall be simulated by assuming the area to be 80% paved in a 1 in 5 year design storm and 100% paved in a 1 in 100 year design storm, and the time of concentration (T_c) shall be adjusted to reflect flow over frozen ground.

6.5.1.3 Snowmelt

Estimation of snowmelt contribution is a complex process dependent on a number of variables, often not published for a given region. In lieu of available data, estimated snowmelt of 1.5 mm per hour shall be added to winter rainfall intensity as determined above.

6.5.1.4 Time of Concentration

For most piped systems in medium density urban areas, it is expected that a minimum five minute inlet time (T_i) will be used. Travel times (T_t) in piped systems should be based on velocities at peak design flow.

6.6 Storm Drainage Report

A storm drainage report shall be prepared and included as part of the submission for any subdivision to examine the effect of the development on the receiving watercourses and downstream drainage systems.

The storm drainage report shall include a Storm Servicing Schematic consistent

with the submission requirements outlined as follows:

6.6.1 Schematic Servicing Plans

Stormwater Schematic Servicing Plans must include the following in either graphic and/or tabular form:

- the location of the subdivision within the total topographic drainage area;
- site layout including proposed streets, lots and approximate location of proposed structures;
- pre-development contours at an interval not exceeding 2.5m;
- hydraulic grade line, or pressure zone;
- any additional information deemed necessary by the Town Engineer.

Wherever possible, Schematic Servicing Plans are to be drafted in one of the following standard metric ratios:

- 1 : 500
- 1 : 1,000
- 1 : 2,000

6.7 Design Requirements

6.7.1 Minor Storm Drainage System

6.7.1.1 Hydraulic Design

Minor storm drainage systems shall be designed to convey, without surcharge, the 1 in 5 year return period storm.

The capacity of a proposed storm sewer system or an existing storm sewer system shall be checked by accounting for the headloss through the pipe system and through any junctions including manholes and bends. As a preliminary check on the capacity of a piped storm system, the Manning's equation can be used. This will be particularly useful for sizing the pipes in the first instance; however, a more detailed analysis of the system as a whole will be required. This analysis will determine the hydraulic gradeline (HGL) when the storm system is conveying the 1 in 5 year flows, and will take into account losses at manholes and other junctions, the headloss through the pipes, and any backwater conditions at the outlet of the storm sewer system.

To ensure that the minor storm drainage system is not subjected to flows greater than its design capacity, it is required that the Consultant check the total inlet capacity for the entire system. It is likely that this analysis will determine that during a major storm, flows greater than that of a 1 in 5 year return period storm will enter the storm sewer system, and the Consultant will likely need to specify inlet control devices (ICDs) to limit the quantity of stormwater runoff that gets into the minor storm drainage system. To streamline the design process, it may be advisable to calculate the 1 in 5 year flows to each catchbasin using the appropriate hydrologic methods, specifying an inlet control device for each catchbasin which limits the flow to approximately that design flow for the 1 in 5 year storm, and apply the flow that the ICD will allow into the system at each catchbasin, and then calculate the hydraulic gradeline. Contingent upon the results of hydraulic gradeline analysis, it may be necessary to revise some of the junctions, or revise some of the storm sewer main diameters to ensure that the hydraulic gradeline is below the top of the pipe.

6.7.1.2 Minimum Pipe Sizes

Storm sewer main diameter shall not be less than 300 mm.

Catchbasin lead diameters shall not be less than 250 mm.

6.7.1.3 Changes in Storm Sewer Main Diameter

Storm sewer main diameter must not decrease in the downstream direction. Manholes are to be provided where the storm sewer main diameter changes.

6.7.1.4 Minimum Depth

The depth of storm sewer mains, measured from the design grade of the finished surface to the top of the pipe must be a minimum of 1.5 m.

6.7.1.5 Maximum Depth

The depth of storm sewer mains, measured from the design grade of the finished surface to the top of the pipe may be a maximum of 6.0 m. However, under special conditions, if justifiable reasons are given, the maximum depth of storm sewer mains may be increased so that the depth to the crown of the pipe at any manhole location shall not exceed 8.0 m.

6.7.1.6 Location

All storm sewer mains and appurtenances shall be located within the street right-of-way or a municipal service easement owned by the Town of Amherst. All storm drainage outfalls shall be located within a municipal service easement owned by the Town of Amherst.

Where future upstream lands naturally tributary to the drainage area exist, a municipal service easement shall be provided from the edge of the street right-of-way to the upstream limit of the subdivision.

The minimum width of a municipal service easement shall be 6.0 m. However, the actual width shall depend upon the depth and size of any pipe contained therein such that safe access to the pipe is possible. A travel way shall be provided within the municipal service easement for access and maintenance purposes.

6.7.1.7 Manholes

A manhole must be provided on a storm sewer main at any change in diameter, material, horizontal alignment, vertical alignments, pipe main intersections, and at the upstream end of a pipe.

Where a storm sewer main diameter is less than 1,500 mm, manhole spacing

shall not exceed 120 m. Where a storm sewer main diameter is equal to or greater than 1,500 mm, manhole spacing will be determined in consultation with the Town Engineer.

The following criteria shall be used for pipe elevation and alignment in storm drainage manholes to account for energy losses through the manhole:

- An invert drop equal to the difference in pipe diameter shall be provided unless a different drop is determined by appropriate calculations;
- The crown of a downstream pipe shall not be higher than the crown of an upstream pipe;
- An internal drop manhole shall be constructed where the vertical drop between pipe inverts in the manhole exceeds 1.0 m;
- The Consultant shall take into consideration energy losses at manholes during peak flow conditions to ensure that surcharging of the system does not occur;
- The minimum internal diameter of a manhole shall be 1,050 mm. The consultant shall ensure that the internal diameter is adequate to accommodate all pipe and appurtenances in accordance with manufacturer's recommendations. Manhole ladders are not required.

6.7.1.8 Service Laterals

All service laterals shall be installed according to the following provisions:

- For single-family lots, one storm drainage service lateral is to be supplied to each existing lot or potential future lot which could be created under the zoning in effect at the time of approval by the Town of Amherst;
- A minimum 100mm storm drainage lateral shall be laid at a minimum grade of 1.5% to the limit of the street right-of-way.

6.7.1.9 Catchbasins

Catchbasins shall be installed at the curb of the street and shall be adequately spaced to prevent excessive water from flowing in the travelled lanes during storm events corresponding to the design of the minor system. In no case shall the spacing of catchbasins exceed 90 m.

At intersections, catchbasin locations shall be dependent upon the slopes of intersecting streets and the alignment of the intersection as required by the Town Engineer.

All storm catchbasins will have a 300mm sump.

6.7.1.10 Inlet Control Devices

Inlet control devices (ICD's) must be provided where there is a risk of surcharging the minor storm drainage system by storm events that exceed the 1 in 5 year return period. Typical ICD sizing requirements for medium density residential development are provided in Table 6.5

Table 6.5
Typical Inlet Control Device (ICD) Sizes

Catchbasin Tributary Area (ha)	ICD Limiting Flow (L/s)	ICD Diameter (mm)
0.1	16	85
0.2	32	120
0.3	48	150
0.4	64	170

Table 6.5 is based on:

1. a Rational Method runoff coefficient ($C = 0.50$) for medium density residential development;
2. an inlet time ($T_i = 5$ min) for medium density residential development; and
3. a head of 1.13m.

6.7.1.11 Inlets

Inlets to piped storm drainage systems shall, for pipes 300 mm in diameter or larger, require grates to prevent entry. The orientation of the bars on the grate shall be vertical. The design of the inlet shall take into consideration the effect of the grating on restriction of flow into the pipe.

6.7.1.12 Outfalls

Design of outfalls from piped storm drainage systems into any receiving body of water shall take into consideration such factors as public safety, erosion control and aesthetics.

Outfalls from piped storm drainage systems of 300 mm in diameter and larger shall require grates to prevent entry. The orientation of the bars on the grate shall be horizontal. Inverts of outfall pipes should be installed above the normal winter ice level in the receiving stream wherever possible.

6.7.1.13 Required Pipe Strength

Pipe, when installed within the street right-of-way, or a municipal service easement, shall be either reinforced concrete pipe (RCP) manufactured to conform to CAN/CSA A257.2, Polyvinyl Chloride Pipe (PVC) pipe to conform to CAN/CSA B192.1, or as per the Standard Specification for Municipal Services for Nova Scotia. DVC pipe to be color white.

Required pipe strength shall be determined using the Marston and Spangler equations, or by nomograph method as published by the American Concrete Pipe Association for reinforced concrete pipe or the Uni-Bell PVC Pipe Association for PVC pipe.

Imposed loads should consider the effects of earth load (W_e), live load (W_l), surcharge load (W_s), bedding factor (B_f), and pipe diameter (D). A factor of safety (FS) of 1.5 should be applied when determining required pipe strength.

$$D_{load} = \frac{(W_e + W_l + W_s)}{B_f \cdot D} \quad [6.1]$$

where:

D_{load}	required pipe strength
W_e	earth load
W_l	live load
W_s	surcharge load
B_f	bedding factor
D	pipe diameter

6.7.2 Roads and Intersections

6.7.2.1 Minor Storms

In storms corresponding to the basis of design of the minor drainage system, it is expected that roadways will remain free of water other than that accumulated between inlets.

6.7.2.2 Major Storms

For barrier-type curb applications, storm drainage design shall provide that the depth and spread of flow in a 1 in 100 year return period storm shall be contained within the right-of-way.

For mountable-type curb applications, the area located directly behind the curb

must be graded in order that there be no overflow discharged from the right-of-way except at municipal service easements designed to convey the overland flow.

All low points in the roadway profile must be designed to collect and convey stormwater runoff off the roadway via a drainage easement designed to convey the overland flow.

Provision shall be made to remove runoff into drainage channels, watercourses, and pipe systems at low points and at intervals that will assure that this criteria is observed.

6.7.3 Ditches/Open Channels

6.7.3.1 Design

Roadway ditches, where curb and gutter systems are not required, shall be designed to conform to the typical cross section for rural roads in accordance with the Nova Scotia Department Transportation and Public Works Standard Specification. Ditches shall be designed with adequate capacity to carry the flow expected from the 1 in 100 year return period storm.

*Table 6.9
Manning Roughness Coefficient (n) for Open Channel Flow*

Material	Description	Manning Roughness Coefficient (n)
Lined Channels	Asphalt	0.013 to 0.017
	Brick	0.012 to 0.018
	Concrete	0.011 to 0.020
	Rubble or Rip Rap	0.020 to 0.035
	Vegetal	0.030 to 0.400
Excavated Channels	Earth, straight and uniform	0.020 to 0.030
	Earth, curved and uniform	0.025 to 0.040
	Rock	0.030 to 0.045
	Unmaintained	0.050 to 0.140
Natural Channels	Regular section	0.03 to 0.07
	Irregular section with pools	0.04 to 0.10

6.7.3.2 Maximum Velocity

To prevent erosion, maximum velocities in a 1 in 100 year return period storm in ditches or open channels that convey stormwater runoff shall not exceed values set forth in Table 6.6 unless the channel is lined or acceptable energy dissipation facilities are provided.

Table 6.6
Maximum Permissible Mean Channel Velocity

Channel Material	Maximum Permissible Mean Channel Velocity (m/s)
Fine Sand	0.45
Coarse Sand	0.75
Fine Gravel	1.85
Earth – Sandy Silt	0.60
Earth – Silty Clay	1.05
Earth – Clay	1.20
Bermuda Grass Lined – Earth – Sandy Silt	1.85
Bermuda Grass Lined – Earth – Silty Clay	2.45
Kentucky Blue Grass Lined – Earth – Sandy Silt	1.50
Kentucky Blue Grass Lined – Earth – Silty Clay	2.15
Sedimentary Bedrock – Poor	3.05
Sedimentary Bedrock – Sandstone	2.45
Sedimentary Bedrock – Shale	1.05
Igneous Bedrock	6.10
Metamorphic Bedrock	6.10

6.7.4 Culverts

6.7.4.1 Minimum Size

Minimum culvert diameter is 450 mm for circular culverts. Minimum culvert width by height is 450 mm x 450 mm for rectangular culverts. No downstream decrease in culvert sizing is permitted.

6.7.4.2 Minimum Cover

Minimum cover for culverts under roadways is 500 mm.

6.7.4.3 Maximum Cover

The Consultant may be required to submit pipe strength calculations including earth loading, line loading, and induced loading, accounting for site conditions and construction practices.

6.7.4.4 Hydraulic Capacity

Culverts are to be sized to convey instantaneous peak flows with a headwater depth (*HW*) to culvert diameter (*D*) ratio of 1.0 accounting for both inlet control and outlet control.

Culverts located under driveways and roadways are to be designed to accommodate the 1 in 5 year return period storm, unless otherwise directed by the Town Engineer.

Culverts located in drainage courses or natural watercourses are to be designed to accommodate the 1 in 100 year return period storm, unless otherwise directed by the Town Engineer.

6.7.4.5 Maximum Headwater Depth

Maximum headwater elevation (*HW*) for both inlet control and outlet control should be checked relative to adjacent ground surface and adjacent structures for compatibility. The Consultant may reduce maximum headwater elevations (*HW*) for culverts under inlet control by improving inlet hydraulics. Table 6.8 presents entrance loss coefficients (k_e) for corrugated steel pipe (CSP).

Table 6.7
Entrance Loss Coefficients (k_e) for Reinforced Concrete Pipe (RCP)
Culverts Under Inlet Control

Inlet Geometry	Inlet Type	Entrance Loss Coefficient (k_e)
Projecting from fill (bell end)	1a	0.2
Projecting from fill (square cut end)	1b	0.5
Mitered to conform to slope	2	0.7
Headwall or headwall and wingwalls (bell end)	3a	0.2
Headwall or headwall and wingwalls (square cut end)	3b	0.5
Flared inlet conforming to slope	4	0.5
Headwall or headwall and wingwalls (rounded edge)	5	0.1
Bevelled ring	6	0.25

Table 6.8
Entrance Loss Coefficients (k_e) for Corrugated Steel Pipe (CSP) Culverts Under Inlet Control

Inlet Geometry	Inlet Type	Entrance Loss Coefficient (k_e)
Projecting from fill	1	0.9
Mitered to conform to slope	2	0.7

Headwall or headwall and wingwalls (square edge)	3	0.5
Flared inlet conforming to slope	4	0.5
Headwall or headwall and wingwalls (rounded edge)	5	0.2
Bevelled ring	6	0.25

6.7.4.6 Headwalls

All culverts under roadways are to be equipped with an inlet and outlet headwall, or some other form of embankment stabilization and erosion control.

6.7.4.7 Outlet Velocity

The maximum culvert outlet velocity is 4.0 m/s. A rip rap splash pad and apron must be designed to transition the culvert outlet velocity to the mean downstream channel velocity. Rip rap should be sized in accordance with Equation 6.2.

$$D_{mean} = 0.019 \cdot V^2 \quad [6.2]$$

where:

D_{mean} equivalent spherical diameter of rip rap (m)
 V culvert outlet velocity (m/s)

Culvert outlet velocities must not exceed the maximum permissible mean channel velocities for a given channel material as presented in Table 6.6.

6.7.4.9 Inlet and Outlet Grates

Culverts under driveways and roadways less than 25 m in length shall not normally require inlet and outlet grates.

Culverts longer than 25 m shall be equipped with inlet and outlet grates.

Inlet grates shall be constructed of vertically oriented bars. Outlet grates shall be constructed of horizontally oriented bars. Design and sizing of inlet and outlet grates must account for the restriction in flow created by the grate and blockage.

Under no circumstances shall a culvert be equipped with an outlet grate and no inlet grate. Generally, the cross sectional area of the inlet grate should be 5 to 10 times the cross sectional area of the pipe. Placement of the grate should be at least one pipe diameter from the end of the pipe.

6.7.4.10 Culvert Materials

Culverts under driveways shall be as per the Standard Specification for Municipal Services for Nova Scotia.

Culverts under roadways must be reinforced concrete pipe (RCP).

6.7.4.11 Other Considerations

Explicit consideration shall be given to public safety, NSDEL regulations, NSTPW regulations, nuisance, and maintenance implications of ditches, open channels, and drainage courses.

6.7.5 Stormwater Control Facilities

Investigation of requirements to mitigate the downstream effects of a proposed development shall be carried out to determine the requirements for and feasibility of the utilization of a storage facility for stormwater runoff control. If a determination is made that a storage facility is required, its design shall be carried out using appropriate methods and sound engineering principles. The design shall take into consideration various factors including, but not limited to, watercourse protection, erosion and sediment control, impact on adjacent property, maintenance requirements, public safety, access, liability, and nuisance.

Such storage facilities shall be designed to control the peak runoff conditions for multi-storm events up to the 100 year return period storm.

6.7.6 Municipal Service Easement

No storm drainage is to be carried onto, through, or over private property, within a subdivision, other than by a natural watercourse, excavated ditch, or minor storm drainage system. To ensure access to storm drainage systems, a municipal service easement in accordance with Section 4 of these Guidelines– Easements, shall be granted to the Town of Amherst in the following cases:

- Excavated ditches or storm sewers within the boundary of the subdivision;
- Where a need is identified by the Town of Amherst Engineer to accommodate future upstream drainage, a municipal service easement shall be provided from the roadway to the upstream limits of the subdivision;
- A municipal service easement may be required for excavated ditches or minor storm drainage systems that are adjacent to and immediately downstream of the subdivision that are required to ensure proper functioning of the municipal storm drainage system. A municipal service easement will not normally be required for a natural watercourse;
- Where stormwater runoff flows from the subdivision onto adjacent properties other than in a natural watercourse, a municipal service easement in favour of the Town of Amherst must be provided by the owners affected;

6.8 Minor Storm Drainage System Connections

6.8.1 Foundation Drains

Foundation drains will normally be connected by gravity to the minor storm drainage system unless the Consultant determines that surcharging of the system in a 1 in 100 year design storm will result in basement flooding or

foundation damage. The elevation of the lateral at the property line should be established at least 300 mm above the elevation of the top of the storm sewer main at the point of connection.

Where a minor storm drainage system does not exist, other options are permitted as specified in the National Building Code. In using other alternatives, the National Building Code shall be applicable.

Foundation drains shall not be permitted to discharge to ground surface in such a way as to direct stormwater runoff to the street surface, walkway, or adjacent private property.

6.8.2 Roof Drains

Roof drains shall not be connected to storm drains, but shall discharge onto splash pads at the ground surface a minimum of 600 mm from the foundation wall in a manner that will carry water away from the foundation wall. Where the roof area to be drained exceeds 250 square meters, it shall be directly connected to a storm drainage system.

6.9 Discharge to Adjacent Properties

All storm drainage is to be self-contained within the subdivision limits, except for natural drainage associated with runoff from undeveloped areas. However, runoff from within the subdivision must be directed to a natural stream, watercourse, or storm drainage system owned by the Town of Amherst.

In all cases, concentration and conveyance of stormwater to adjacent properties outside the subdivision limits is prohibited unless the developer obtains permission from the adjacent property owners, and private drainage or service easements are provided.

The grading along the limits of the subdivision shall be carefully controlled to avoid disturbance of adjacent properties or an increase in the discharge of stormwater to those properties.

The lot grading design shall provide for drainage from adjacent properties where no other alternative exists.

The lot grading design shall provide for temporary drainage of all blocks of land within the subdivision that are intended for future development.

During the design of storm drainage systems, provision must be made for accommodating natural drainage from adjacent properties by means of an interceptor swale or other system component.

6.10 Analysis of Existing Storm Drainage Systems

It may be necessary to analyze the capacity of existing storm drainage systems, including storm sewer systems within the Town of Amherst. This may be required due to the fact that a proposed development is going to increase stormwater runoff to an existing system, and the existing system needs to be analyzed to ensure that it will convey the additional flows without any problems. Where consultants are required to analyze an existing storm drainage system within the Town of Amherst, the following procedure shall be followed in doing so.

6.10.1 Hydrologic Analysis

Where existing systems are being analysed, it is crucial to determine the peak stormwater runoff to a given point in a system caused by severe rainfall events and snowmelt events. Where storage facilities are included in the study, it may be necessary to determine the hydrograph of the stormwater runoff to a particular point; that is, the simple instantaneous peak flow will not be adequate to analyse storage facilities. In determining the stormwater runoff or hydrographs, the methods as described in Subsection 6.4 shall be used.

In preparing the hydrologic and hydraulic model, it may be necessary to determine the drainage area to each individual storm manhole and each individual storm catchbasin. This information should be compiled on a master drawing of the area being studied with appropriate labels for the areas, manholes, and catchbasins such that calculations can be easily compared to the plan. For minor storm drainage systems, ie. storm sewers and catchbasins, the 1 in 5 year return period storm shall be checked for the points of interest. For open channels, watercourses, and major drains on streets, the 1 in 100 year return period storm shall be checked for the points of interest.

6.10.2 Hydraulic Analysis

For each component of the existing storm drainage system such as a storm sewer main, open channel, watercourse, or culvert, the hydraulic capacity of that portion of the system needs to be determined and compared to the flow determined from the hydrologic calculations. The following procedures are accepted by the Town of Amherst Department of Engineering and Public Works for determining the hydraulic capacity of storm drainage structures.

6.10.2.1 Open Ditches, Channels, and Watercourses

To determine the capacity of open channels, ditches, and watercourses, the Manning equation may be used where grades are relatively steep, greater than 1%. Where grades are less than 1%, it may be necessary to account for backwater effects using the energy equation and the direct-step or standard-step methodologies. This may be accomplished with a water surface profile model as per Subsection 6.4. Also to be considered in these calculations is the water surface elevation at the outlet of the ditch, watercourse, or channel.

6.10.2.2 Culverts

To calculate the hydraulic capacity of a culvert, the inlet capacity of the culvert and the outlet capacity should be checked taking into consideration maximum tailwater elevation at the outlet of the culvert. Also to be checked is the barrel capacity of the culverts using the Manning equation. In general, the inlet capacity of the culvert will be the limiting factor in determining the capacity.

6.10.2.3 Minor Storm Sewer System

Minor storm sewer systems consist of storm sewer mains, manholes, catchbasins, and various inlets and outlets. The capacity of a storm sewer system shall be checked as follows:

- Preliminary sizing of pipe diameter assuming full flow conditions for each pipe in the minor storm drainage system using the Manning equation for the 1 in 5 year return period storm. Manning's roughness coefficients (n) have been tabulated in Table 6.9. The ratio of the 1 in 5 year design flow (Q_5) to full flow pipe capacity (Q_{cap}) should not exceed 80%.

$$\frac{Q_5}{Q_{cap}} \leq 0.80 \quad [6.3]$$

where:

Q_5 1 in 5 year design flow (L/s)
 Q_{cap} full flow pipe capacity (L/s)

- Where deemed necessary by the Town Engineer, a determination of the hydraulic gradeline (HGL) for the 1 in 5 year return period storm should be conducted assuming the actual captured flow (Q_c) is 100% of the 1 in 5 year design flow (Q_5). Analysis should account for pipe friction losses, junction and bend losses, outlet tailwater elevation, and capacity constraints of the downstream system. HGL profiles may be determined by the standard-step method, the direct-step method, or acceptable energy equation principles. The HGL profile should be plotted on the plan and profile drawing to ensure that the water surface profile is contained the pipe. An elevated HGL may require a pipe diameter larger that as determined by the Manning equation in order to avoid surcharging of the minor storm sewer system.
- Where deemed necessary by the Town Engineer, a determination of the hydraulic gradeline (HGL) for the 1 in 100 year return period should be conducted assuming the actual captured flow (Q_c) is some percentage of the 1 in 100 year design flow (Q_{100}). The actual captured flow should be the lesser of the maximum catchbasin inlet capacity, the maximum catchbasin lead capacity, or the 1 in 100 year design flow (Q_{100}). Analysis should account for pipe friction losses, junction and bend losses, outlet tailwater elevation, and capacity constraints of the downstream system. HGL profiles

may be determined by the standard-step method, the direct-step method, or acceptable energy equation principles. The HGL profile should be plotted on the plan and profile drawing to ensure that the water surface profile is at an acceptable level. The elevated HGL profile should not threaten back-up into service laterals, or basements.

- Provision of inlet control devices (ICDs), is an acceptable means of limiting the actual captured flow (Q_c) by the minor system in storm events that exceed the design capacity of the minor storm sewer system. Design capacity (Q_{des}) of the major storm drainage system must account for any additional flow restricted from entering the minor storm drainage system.

6.10.2.4 Stormwater Detention Structures

Components of a storm drainage system may include man-made storm drainage detention facilities to reduce the peak flow downstream. The following procedures shall be used to check the performance of a storm drainage retention facility:

- Where deemed necessary by the Town Engineer, a 1 in 100 year return period, 24-hour duration, storm shall be applied to the watershed, using one of the applicable models in Section 6.4, and a hydrograph should be generated to assess the stormwater runoff detention facility performance.
- Where deemed necessary by the Town Engineer, the storage indication method shall be used to calculate the outflow from this pond, taking into consideration the outlet condition (that is, the hydraulic outlet structure of the pond). The maximum flood elevation of this facility shall be calculated as part of this work. Where the watershed is mostly urban or developed land, it is likely that a summer storm will be adequate to check this facility; however, if a large portion of the watershed is forested or open fields, it may be necessary to check the facility using a winter storm with snowmelt included in the runoff.

STREET SYSTEM

DEVELOPER'S OBLIGATIONS

This section establishes the minimum criteria relating to the design and construction of roads and streets serving new development in the Town of Amherst. All plans of such works shall be approved by the Town. These Guidelines do not preclude the use of higher standards, where required in the design of infrastructure to service new development. **The Developer shall supply and install sub-base and base materials and install a 6m wide x 50mm thick asphalt driving surface. The Town will install concrete curbing and complete the asphalt paving when occupancy levels dictate.**

REGULATORY STANDARDS

Roads and streets shall be designed and constructed in accordance with the latest revision of the Nova Scotia Standard Specification for Municipal Services, the Transportation Association of Canada's Geometric Design Guide for Canadian Roads and the Nova Scotia Department of Transportation and Public Works Standard Specification for Highway Construction and Maintenance.

A copy of all Regulatory Agency approvals shall be forwarded/copied to the Town before any work commences.

Contractors/Developers shall make themselves familiar with the requirements of the Nova Scotia Standard Specification for Municipal Services before making application to the Town.

DESIGN CRITERIA AND STANDARDS

Street Classification

Roadway classification groups roadways based on the type of service that they provide to the public. When a roadway is properly classified, the characteristics and "feel" of each roadway are easily understood. The classification of roadways is based on factors including: land use, service function, traffic volume, flow characteristics, running speed, vehicle type and connections **as designated in the Municipal Planning Strategy**. The classification also establishes the geometric design criteria for each group of roads, consistent with operational needs.

Table 3.0 – Street Classification System			
	Locals	Collectors	Arterials
Design speed (km/h)	50	70	70
min. intersection spacing (m)	60	60	200
Right-of-way width (m)	15	18	20
Min pavement width**	8m	9.2	10.4

**The minimum paved radius of a cul-de-sac shall be 13.8 meters.

Design Requirements

General Principles

- Residential streets shall conform to the overall community design intent of the development.
- Through traffic on local streets shall be minimized.
- Street patterns in the new development shall recognize patterns in existing adjacent developments and shall not detract from the efficiency of these existing streets.

Pavement Design

The pavement structure of the roadway must reflect the traffic volume on that particular roadway. Based on the existing silty-sand subgrade material commonly found in the Amherst area, the minimum thickness of sub-base, base and asphaltic concrete are provided in Exhibit 4.0.

Exhibit 4.0 – Minimum Required Material Thicknesses for Flexible Pavements			
Roadway Classification	Sub-Base Depth	Base Depth	Asphalt Concrete Depth

Local	250 mm	150 mm	75 mm
Collector	300 mm	150 mm	75 mm
Arterial	450 mm	150 mm	100 mm

Note: All Materials and existing subgrade to be compacted to 98% Standard Proctor Density.

Design Criteria

- Street intersections shall be constructed at between 70 degrees and 110 degrees.
- Where a proposed public street intersects an existing public street, the minimum sight distance along the existing public street shall be 65 meters.
- Maximum longitudinal roadway grades shall be as follows:
 - Arterial 4%
 - Collector 6%
 - Local 8%
- Minimum longitudinal grade 0.5%