City of Saint John

GENERAL SPECIFICATIONS

MAY 2022

Issue Date: May 17, 2022

City of Saint John

CITY OF SAINT JOHN
GENERAL SPECIFICATIONS – LIST OF 2022 REVISED SECTIONS

SECTION	TITLE
7.28	Excavation and Construction Near Natural Gas Pipelines
Division 10	Table of Contents
10.4.01	Pipes
10.4.10	Adaptors
10.4.14	Corrosion Protection
10.4.15	Couplings
10.4.17	Pipe Restraints for Mechanical Joint (MJ) Fittings
10.4.19	Service Saddles
10.5.18	Flushing and Disinfection of Watermains
Division 11	Table of Contents
11.4.13	Inlet Control Devices
11.6.01	Measurement for Payment
Division 17	Table of Contents
17.5.35	Existing Traffic Signs and Posts
23.5.01	Concrete Curb
23.6.01	Measurement for Payment
27.6.02	Basis of Payment

STANDARD DRAWINGS

	Table of Contents
S045-120	Grounding Plate Detail
S045-309A	Typical Section Concrete Curb and Sidewalk with Brick Median

City of Saint John

Contract Specifications

TENDER NO.

City of Saint John

CONTRACT SPECIFICATIONS

FOR

TENDER NO.

MONTH 2022

City of Saint John

GENERAL SPECIFICATIONS

TABLE OF CONTENTS

City of Saint John

GENERAL SPECIFICATIONS

TABLE OF CONTENTS

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 1

PROJECT DESCRIPTION

MONTH 2022

City of Saint John

TABLE OF CONTENTS

DIVISION 1 – PROJECT DESCRIPTION

PROJECT DESCRIPTION

1.1 GENERAL DESCRIPTION

The work consists generally of: *Contract Description*

1.2 CONTRACT DOCUMENTS

a) General Specifications, City of Saint John, New Brunswick, with all applicable Divisions as listed in the Table of Contents of the Contract Specifications.

b) Contract Specifications,
Tender No.:

Contract: *Title*
City of Saint John, New Brunswick

c) List of Drawings

1.3 PROJECT ENGINEER

All inquiries pertaining to the work specified in this Contract shall be referred to:
Engineer,
City of Saint John
175 Rothesay Avenue, Saint John, NB
(506) *Telephone No.*

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 2

INSTRUCTIONS TO TENDERERS AND TENDERING PROCEDURES

MONTH 2022

City of Saint John

TABLE OF CONTENTS

DIVISION 2 – INSTRUCTIONS TO TENDERERS AND TENDERING PROCEDURES

City of Saint John

TABLE OF CONTENTS

DIVISION 2 – INSTRUCTIONS TO TENDERERS AND TENDERING PROCEDURES

INSTRUCTIONS TO TENDERERS AND TENDERING PROCEDURES

2.1 TRADE TREATIES AND TENDERING POLICY

2.1.01 Internal Trade Agreements

Tenderers should note that the within procurement is subject to trade agreements including the Canadian Free Trade Agreement and the Atlantic Procurement Agreement and the Agreement on Opening Public Procurement for Quebec and NB.

2.1.02 Tendering Policy

Tenderers should note that the within Procurement shall conform with The City of Saint John "Tendering Policy for Construction Contracts" which is attached hereto as Appendix "A".

2.2 MATERIAL DISCLOSURES

2.2.01 General

The City makes the following material disclosures with respect to this Request for Tender. While the City has used considerable efforts to ensure the accurate representation of all information in this Request for Tender, including these material disclosures, such information is supplied solely as a guideline for Tenderers. The City does not warrant or guarantee the accuracy of such information, nor is such information necessarily comprehensive or exhaustive. Nothing in this Request for Tender is intended to relieve Tenderers of the obligation to form their own opinions and reach their own conclusions with respect to the matters addressed in this Request for Tender.

2.2.02 Permits Required for Project

Except as stated otherwise in the Tender Document, any and all permits and approvals required by the Authorities having jurisdiction, and arrangements for all inspections of the Work by these Authorities shall be obtained and paid for by the Contractor. The cost of such approvals, permits and inspection shall be included in the Tender Price.

2.2.03 Deemed Examination and Acceptance

Tenderers should note that by submission of a Tender they will be deemed to have examined and accepted the Specifications and Drawings, visited the site, and informed themselves as to existing conditions and limitations.

2.2.04 Availability of Services

The Tenderer shall ascertain from the relevant Authorities the availability of services, including, but not limited to, electricity, sewer, water, telephone, natural gas and transportation to the project and shall ascertain what prior notice each Authority will require for the installation of the service to the project.

2.2 MATERIAL DISCLOSURES (Cont'd)

2.2.05 Tax

a) Tenderers are advised to make special note of all applicable tax procedures.

b) The City is required to pay the Harmonized Sales Tax (HST).

c) The total tendered amount shall include the appropriate taxes on all labour, material and equipment to be incorporated into the Work.

d) Tenderers shall submit their Tenders on the basis that the total amount of the Tender shall include all taxes for which the City is liable.

e) Any increase or decrease in costs to the Tenderer due to the changes in such taxes and duties, after the date of the Tender Closing, shall increase or decrease the value of the Contract accordingly.

2.2.06 Performance Guarantees Required Prior to Contract Execution

Within five (5) Working Days following the City's notice of selection, the selected Tenderer shall provide the City with the required Performance Guarantees being a Performance Bond and a Labour and Material Payment Bond, each at fifty percent (50%) of the Tender Price covering the faithful performance of the full Contract. The bonds shall be in favour of *The City of Saint John* and show *The City of Saint John* as obligee; Unless specified elsewhere within the tender documents, the Performance Bond and the Labour and Material Payment Bond shall be in the form prescribed by regulation pursuant to the *Construction Remedies Act*. The Performance Bond and the Labour and Material Payment Bond shall be issued and be compliant with the requirements of the *Construction Remedies Act* whether the value of the Contract is less than the amount of prescribed pursuant to section 83(1) and 83(2) and 84(1) of the *Construction Remedies Act*.

2.2.07 Insurance

Tenders should refer to Division 6 (section 6.8) for details regarding insurance requirements.

2.2 MATERIAL DISCLOSURES (Cont'd)

2.2.08 WorkSafeNB Certificate and Business Corporations Act Certificate

a) New Brunswick Tenderers shall provide to the City a WorkSafeNB certificate which confirms proper registration and good standing with WorkSafeNB and a *Business Corporations Act* Certificate which confirms proper registration with the Province of New Brunswick - Corporate Affairs (of which the Contractor must be in good standing) within five (5) Working Days following the City's notice of selection.

b) Out-of-province Tenderers shall provide to the City a WorkSafeNB certificate which confirms proper registration and good standing with WorkSafeNB or a letter or certificate issued under the equivalent applicable legislation in the province of origin of the Tenderer confirming extension of coverage from said legislation to the Province of New Brunswick for the term of the Contract. Subject to paragraph c), out-of-province Tenderers shall also provide a *Business Corporations Act* Certificate which confirms proper registration with the Province of New Brunswick - Corporate Affairs (of which the Contractor must be in good standing) within five (5) Working Days following the City's notice of selection.

c) Tenderers from Nova Scotia may submit the appropriate *Business Corporations Act* Certificate from the Province of Nova Scotia.

2.2.09 New Brunswick Construction Safety Association

If the total Tender Price for the work, inclusive of HST, is two hundred and fifty thousand dollars ($250,000.00) or more, Tenderers shall supply a Letter of Good Standing under the Certificate of Recognition Program from the New Brunswick Construction Safety Association. Out-of-Province Tenderers shall supply an equivalent from the Tenderer's Province of origin acceptable to the Engineer.

2.2.10 Timetable for Completion of the Work

The Substantial Completion of the Work is _____.

2.3 SCHEDULE FOR THE TENDER PROCESS

Issue Date of Request for Tender	
Deadline for Enquiries	
Deadline for Issuing Addenda	
Tender Closing	

The Schedule for the Tender Process is tentative only and may be changed by the City in its sole discretion at any time prior to Tender Closing.

2.4 TENDER DOCUMENTS

2.4.01 Tender Documents to be Obtained in Prescribed Manner

Tender Documents shall be obtained from the City of Saint John, 175 Rothesay Avenue, 1st Floor, Saint John, New Brunswick. In order to obtain the Tender Documents the following requirements must be met:

a) deposit a non-refundable payment for each set of Tender Documents in an amount specified in the tender advertisement; and

b) the Tenderer must register on the City's official list of bidders for this project, as follows:

(i) registration of the full legal name, contact person, telephone number and email address of the Tenderer obtaining the Tender Documents; or, if applicable,

(ii) the registration of the full legal name, contact person, telephone number and email address of the Tenderer on whose behalf the Tender Documents are being obtained.

The names of the Tenderers having complied with the above criteria will be consolidated onto the City's official bidders list. Only Tenderers listed on the City's official bidders list shall be entitled to submit a Tender. Any Tender received from a Tenderer who has not obtained the Tender Documents from the City of Saint John and is not registered on the City's official list of bidders for this project in the manner set out above will not be evaluated.

The City will post the official list of bidders for all projects, updated on Tuesdays and Thursdays during the tendering period on the City of Saint John website www.saintjohn.ca under the Tenders & Proposals link.

2.5 COMMUNICATIONS AFTER ISSUANCE OF TENDER

2.5.01 Tenderers to Review Tender Documents

Tenderers shall promptly examine all Tender Documents and:

a) shall report any errors, omissions or ambiguities; and

b) may direct enquiries or seek additional information

in writing by email before the Deadline for Enquiries to the Authorized Enquiries Contact or the Designated Alternate Contact (in the event of absence) as set out below. No such communications are to be directed to anyone other than the Authorized Enquiries Contact or the Designated Alternate Contact.

Authorized Enquiries Contact	**Designated Alternate Contact**
_____, P.Eng. Municipal Engineer City of Saint John Email: _____@saintjohn.ca	_____, P.Eng. Municipal Engineer City of Saint John Email: _____@saintjohn.ca

It is the Tenderer's responsibility to seek clarification from the City on any matter it considers unclear. The City shall not be responsible for any misunderstanding on the part of the Tenderer concerning this Tender or its process.

The City intends to confirm receipt of a Tenderer's communication by way of an email in reply. If a Tenderer has not received a reply, the Tenderer may wish to resend its communication as the lack of reply may have resulted from a technical problem. The City is under no obligation to respond to enquiries or provide additional information but may do so at its sole discretion.

2.5 COMMUNICATIONS AFTER ISSUANCE OF TENDER (Cont'd)

2.5.02 Email Communication

The following provisions shall apply to any communications with the Authorized Enquiry Contact or the Designated Alternate Contact by email where such email communication or delivery is permitted by the terms of this Tender:

a) The City does not assume any risk or responsibility or liability whatsoever to any Tenderer:

(i) for ensuring that any email system being operated for the City is in good working order, able to receive transmissions, or is not engaged in receiving other transmissions such that a Tenderer's transmission cannot be received;

(ii) if a permitted email communication or delivery is not received by the City, or is received in less than its entirety, within any time limit specified by this Tender; and

(iii) for any error that may occur in the submission of communications or enquiries.

b) All permitted communications submitted by a Tenderer by email to the Authorized Enquiries Contact or the Designated Alternate Contact shall be deemed to have been received on the dates and times indicated on the Authorized Enquiry Contact's or the Designated Alternate Contact's email system

2.5.03 Addenda: Responses to Enquiries and Amendments or Clarifications to Tender Documents

The City may, in its sole and absolute discretion, through the Authorized Enquiry Contact or the Designated Alternate Contact, respond to enquiries and/or amend the Tender Documents before Tender Closing.

Written Addenda are the only means of responding to enquiries or amending the Tender Documents. Only the Authorized Enquiry Contact or the Designated Alternate Contact, and no other employee or agent of the City, is authorized to respond to enquiries and amend the Tender Documents by issuing an Addendum.

Responses to enquiries, changes, clarifications or corrections prepared and circulated by the City form part of the Tender Documents and will be issued as Addenda. Responses will be made in writing and distributed by email to all Tenderers who are registered on the City's official bidders list in accordance with the procedure outlined in section 2.4.01 b) above, as of the date the response is prepared by the City. Each Addendum will contain a signature page(s) which each Tenderer is required to sign and include with its Tender submission. While the City will make reasonable efforts to deliver each Addendum to all Tenderers, it makes no guarantee of timely delivery of any Addendum to any Tenderer.

2.5.03 Addenda: Responses to Enquiries and Amendments or Clarifications to Tender Documents (Cont'd)

The City will not identify the source of the question in the response. If a Tenderer requests that an enquiry be treated as confidential, the City, in its sole discretion, will either treat the enquiry or any reply as confidential or inform the Tenderer that it will not respond to the enquiry unless the Tenderer withdraws in writing its request that the enquiry be treated as confidential.

Orally communicated information shall not be binding upon the City. Information offered from sources other than the Authorized Enquiry Contact or the Designated Alternate Contact with regard to the content, intent or interpretation of this Tender is not official, may be inaccurate and should not be relied on in any way, by any Tenderer, for any purpose.

2.6 SUBMISSION OF TENDER

2.6.01 Location of Tender Box for the Submission of Tender

City of Saint John
175 Rothesay Avenue, 1st Floor
Saint John, New Brunswick

2.6.02 Tenders Must be Submitted Only in the Prescribed Manner

a) Tenders must be submitted in the prescribed *Form of Tender* together with the prescribed *Schedule of Quantities and Unit Prices*. The *Form of Tender* and the *Schedule of Quantities and Unit Prices* shall be filled out in ink or typewritten and bear the signature in longhand.

b) Tenderers must submit one completely filled out original *Form of Tender* signed by an authorized representative and should include the following information written on the outside of the sealed envelope:

(i) Tender No.:

(ii) Title of Work:

(iii) The full legal name and return address of the Tenderer; and

(iv) Tender Closing date and time.

c) Each Tender shall be accompanied by a Tender (Bid) Bond or certified cheque in the amount of $_____---($_____.00) or ten percent (10%) of the Tender Price.

d) Each Tender must be sealed and be addressed to the attention of the Purchasing Agent, City of Saint John, 1st Floor, 175 Rothesay Avenue, Saint John, New Brunswick E2J 2B4.

e) All Tenders shall include a surety consent letter or agreement to bond as per the requirements in the Form of Tender.

2.6 SUBMISSION OF TENDER (Cont'd)

2.6.03 Contingency Allowance

The Tender Price shall include the contingency allowance as specified in the *Schedule of Quantities and Unit Prices*, to cover additional costs that may occur during the execution of the Contract attributed to approved additional work not originally contemplated. No part of this allowance shall be expended without the written direction of the Engineer, and any part not so expended shall be deducted from the contingency allowance.

2.6.04 Tenders Must be Placed in the Tender Box Before Tender Closing

It is the responsibility of each Tenderer to ensure that its Tender is placed in the Tender Box before Tender Closing. Tenders submitted by fax or by any other electronic transmission will not be considered.

Tenders submitted after Tender Closing will be deemed late, Disqualified and returned to the Tenderer unopened. For the purpose of calculating time, the City clock at the location of the Tender Box shall govern.

The City is not responsible for any Tender that has not been placed in the Tender Box by the Tenderer. The City assumes no responsibility for improperly addressed or delivered Tenders, Tenders that are left outside of the Tender Box, or sent by electronic transmission.

2.6.05 Amending or Withdrawing Tender Prior to Tender Closing

At any time prior to Tender Closing, a Tenderer may amend or withdraw a submitted Tender by placing an amending letter signed by the person who signed the Tender in a sealed envelope in the Tender Box before the Tender Closing.

The amending letter should clearly specify that the Tenderer intends to withdraw its Tender or, in the case of an amendment, clearly indicate the part of the Tender that the amending letter is intending to replace. In the case of a unit price contract, the amending letter shall show the revision to the Tender Price. In the case of a lump sum contract, the amending letter shall state the amount to be added or subtracted from the Tender Price.

The sealed envelope should clearly state the full legal name of the Tenderer, as well as the Tender No., Title of Work, and Tender Closing date and time as stated in section 2.6.02 b).

Amending letters that are left outside of the Tender Box, or sent by mail, by facsimile, electronically, or by other means will not be considered.

2.6.06 Tenderers Shall Bear the Costs of Preparing and Submitting a Tender

Under no circumstances will the City be responsible for a Tenderer's costs of preparing or submitting a Tender.

2.6 SUBMISSION OF TENDER (Cont'd)

2.6.07 Tenders in English

All Tenders are to be in English only. Any Tenders that are not entirely in the English language may be disqualified.

2.6.08 Tender Acceptance Period

Tenders submitted before Tender Closing shall remain open to acceptance in the form submitted by the Tenderer for a period of sixty (60) calendar days after Tender Closing. Failure of the Tenderer to keep the Tender open for sixty (60) calendar days will result in the enforcement of the Tender (Bid) Bond or the cashing of the certified cheque submitted in lieu of the Tender (Bid) Bond pursuant to section 2.6.02 c).

2.6.09 Tender Documents Incorporated Into Tender

By submission of a Tender, a Tenderer is deemed to have accepted and incorporated all the instructions and terms and conditions contained in the Tender Documents into its Tender. Submission of a Tender shall also confirm that the Tenderer is satisfied as to the correctness and sufficiency of the Tender, the Tender Price and the prices entered in the *Schedule of Quantities and Unit Prices*.

2.7 AMENDMENT OR WITHDRAWAL OF TENDER POST TENDER CLOSING

2.7.01 No Amendment Post Tender Closing

No Tenderer is permitted to amend or withdraw its Tender after Tender Closing. A Tenderer who discovers an error in the Tender after Tender Closing may leave the Tender as is or request permission from Common Council to withdraw its Tender. A request to withdraw a Tender after Tender Closing must be delivered, along with the reasons for the request, to the City Clerk for consideration by Common Council within twenty-four (24) hours of Tender Closing.

2.7.02 Withdrawal Requests

Common Council, in its sole discretion, will decide whether or not to grant the withdrawal request based on the information supplied by the Tenderer and a recommendation from City staff. Where Common Council, in its sole discretion, decides to not allow the withdrawal, Common Council may require the Tenderer to perform the Contract or forfeit the Tender (Bid) Bond or the certified cheque submitted in lieu thereof pursuant to section 2.6.02 c).

2.8 TENDER EVALUATION PROCESS

2.8.01 Delivery of Tender Box to Tender Opening Room

Immediately following Tender Closing, the Purchasing Agent shall deliver the Tender Box to the tender opening room where it will be publicly opened by the Tender Opening Committee.

2.8.02 Tender Opening Process

All Tenders shall be removed from Tender Box, opened, evaluated pursuant to Section 2.8.03, then read and recorded by the Tender Opening Committee in public at the Tender Opening Location. The Tender Opening Committee shall open each Tender individually. Tenders submitted by Tenderers who are not registered on the City's official bidders list according to the procedure outlined in section 2.4.01 b) will not be evaluated. The Tender Opening Committee will conduct the evaluation of the Tenders in two stages.

2.8.03 Stage 1: Evaluation of Mandatory Requirements

Stage 1 will consist of a review to determine which Tenders comply with all of the mandatory requirements. Tenders which do not comply with all of the mandatory requirements set out below, shall be Disqualified and not evaluated further.

Tenders shall be deemed as not complying with the mandatory requirements where:

a) The Tender is not in a sealed envelope which bears on its face the full legal name and address of the Tenderer, the Tender number, Title of Work and Tender Closing date and time.

b) The Tender is illegible or its pricing terms or conditions cannot be understood by the Tendering Opening Committee.

c) Where it is a Tender for more than one item and where it is required that all items be bid, there is a failure to bid an item or it does not contain a unit price or extended total of all items to be bid.

d) The Tender contains a bid on an item not included in the *Schedule of Quantities and Unit Prices*.

e) The Tender does not contain the total tender price, the unit prices or the fixed price written in words or does not have the words "dollars" and, where applicable, "cents" set out in the written total tender price, unit prices or fixed price on the *Schedule of Quantities and Unit Prices*.

f) The Tender is not accompanied by the required Tender (Bid) Bond or certified cheque pursuant to section 2.6.02 c).

g) The Tender does not include a fully completed prescribed Form of Tender, signed by an authorized agent, which bears the Tenderer's corporate seal, pursuant to section 2.6.02 a) and Division 4.

2.8.03 Stage 1: Evaluation of Mandatory Requirements (Cont'd)

h) The Tender does not include all required documents specified in the Form of Tender, does not comply with the provisions of the Tender Documents, or does not include the signature page(s) of all addenda issued to the Tenderers signed by the Tenderer.

i) The Form of Tender contains a change in price that is not initialed by the person signing the Form of Tender.

j) The Tender contains an unsolicited alternative or a qualification to the terms of the Tender Documents.

k) Where a Tenderer submits more than one Tender in response to the Request for Tender, all such Tenders shall be Disqualified.

Tenders which are Disqualified by the Tender Opening Committee will be returned to the Tenderer at the address contained in the Tender or in person if the Tenderer is present at the Tender Opening. Tender Prices of Disqualified Tenders will not be announced at the Tender Opening.

2.8.04 Stage 2: Evaluation of Tender Price

Stage 2 will consist of a recording of the Tender Prices by the Tender Opening Committee.

2.8.05 Selection of the Successful Tenderer

At the conclusion of Stage 1 and Stage 2 of the evaluation process and, subject to the approval of selection by Common Council and the reserved rights of the City, the selected Tenderer will enter into the Contract, as set out in the Tender Documents.

2.9 NOTICE OF SELECTION AND EXECUTION OF CONTRACT

2.9.01 Selection of Tenderer

Notice of selection by the City to the selected Tenderer will be in writing. Within five (5) Working Days following the City's notice of selection, the Tenderer shall provide to the City:

a) those items listed at section 6.8.04 ("Insurance Policies and Certificates");

b) an executed Form of Agreement (Division 5); and

c) the required Performance Guarantees pursuant to section 2.2.06

This provision is solely to the benefit of the City and may be waived by the City at its sole discretion.

2.9 NOTICE OF SELECTION AND EXECUTION OF CONTRACT (Cont'd)

2.9.02 Over-Budget Bids

If the Tender Price of the lowest compliant Tender exceeds the City's project budget or the Engineer's estimate for the Project, the City may proceed with negotiations with the lowest compliant Tenderer. Said negotiations shall be conducted within a prescribed timeframe to identify changes in scope and/or quantities of work, in exchange for a corresponding bid price reduction. Where the City and lowest compliant Tenderer establish acceptable changes and a corresponding bid price reduction, those changes shall be documented as post-bid addendum.

Any such negotiations or resulting recommendations shall be conditional and subject to the approval of Common Council and, in accordance with the Limitation of Liability and Waiver set out in section 2.12 below, there shall be no liability resulting from any failure to award a contract.

Where acceptable changes and a corresponding bid price reduction cannot be successfully negotiated with the lowest compliant Tenderer, the City may proceed with a new tender call at a later date.

2.9.03 Failure to Enter Into the Contract

In addition to all of the City's other remedies, such as the enforcement of the Tender (Bid) Bond, if a selected Tenderer fails to execute the Contract, or satisfy any of the applicable conditions set out above at section 2.9.01 within five (5) Working Days of the notice of selection, the City may, in its sole and absolute discretion and without incurring any liability rescind the selection of the Tenderer and proceed with the selection of the next lowest compliant Tenderer.

2.10 CONFIDENTIAL INFORMATION AND MEDIA COMMUNICATIONS

2.10.01 Tenderer's Confidential Commercial Information

The City is committed to an open and transparent Tendering Process while understanding the Tenderers' need for protection of confidential commercial information. To assist the City in meeting this commitment, Tenderers will cooperate and extend all reasonable accommodation to this endeavour.

2.10.02 Tenderer Not to Communicate With Media and Public

To ensure that all public information generated about the Work is fair and accurate, and will not inadvertently or otherwise influence the outcome of the Tendering Process, all public information generated in relation to the Work, including communications with the media and the public, must be coordinated with, and is subject to the prior approval of, the City.

2.10.02 Tenderer Not to Communicate With Media and Public (Cont'd)

Tenderers will notify the City of requests for information or interviews from the media.

Tenderers will ensure that all of the Tenderers' Subcontractors and others associated with the Tenderer comply with the foregoing requirements.

2.11 RESERVED RIGHTS

The City reserves the right to:

a) Reject an unbalanced Tender. For the purpose of this section, an unbalanced tender is a tender containing a unit price which deviates substantially from, or does not fairly represent reasonable and proper compensation for the unit of work bid or one that contains prices which appear to be so unbalanced as to adversely affect the interests of the City. The City reserves the right to use tenders submitted in response to this Request for Tender or for other like or similar work as a guideline in determining if a bid is unbalanced.

b) Amend or modify the scope of the Work, and/or cancel or suspend the Tender award, at any time for any reason;

c) Require Tenderers to provide additional information after the Tender Closing to support or clarify their Tender;

d) Not accept any or all Tenders;

e) Not accept a Tender from a Tenderer who is itself, or whose principals, owners or directors are also principals, owners or directors of another entity which is, involved in litigation, arbitration or any other similar proceeding against the City;

f) Reject any or all Tenders without any obligation, compensation or reimbursement to any Tenderer or any of its team members;

g) Withdraw this Request for Tender and cancel or suspend the Tendering Process;

h) Extend, from time to time, any date, any time period or deadline provided in this Tender (including, without limitation, the Tender Closing), upon written notice to all Tenderers;

i) Assess and reject a Tender on the basis of:

   (i) information provided by references;

   (ii) the Tenderer's past performance on previous contracts;

   (iii) the information provided by a Tenderer pursuant to the City exercising its clarification rights under this Tendering Process;

   (iv) the Tenderer's experience with performing the type and scope of work specified including the Tenderer's experience as a general contractor;

   (v) other relevant information that arises during this Tendering Process

2.11 RESERVED RIGHTS (Cont'd)

j) Waive formalities and accept Tenders which substantially comply with the requirements of this Request for Tender;

k) Verify with any Tenderer or with a third party any information set out in a Tender;

l) Disqualify any Tenderer whose Tender contains misrepresentations or any other inaccurate or misleading information;

m) Disqualify any Tenderer who has engaged in conduct prohibited by the Tender Documents;

n) Disqualify any Tenderer who is guilty of an offence listed in Schedule C of the New Brunswick Regulation 2014-93 under the Procurement Act;

o) Disqualify any Tenderer for documented significant or persistent deficiencies in fulfilling or performing a substantive requirement or obligation under a prior contract or contracts. The disqualification for past performance shall be conducted in accordance with sections 64 thru 81 of the New Brunswick Regulation 2014-93 under the Procurement Act;

p) Make changes, including substantial changes, to the Tender Documents provided that those changes are issued by way of addenda in the manner set out in these Instructions to Tenderers;

q) Select any Tenderer other than the Tenderer whose Tender reflects the lowest cost to the City;

r) Cancel this Tendering Process at any stage, for any reason;

s) Cancel this Tendering Process at any stage and issue a new Request for Tender for the same or similar deliverables;

t) Accept any Tender in whole or in part; or

u) Accept a Tender which contains the following errors:

(i) error in mathematics – whether this involves the extension of a unit price or an error in addition, the mistake will be corrected and the correct total will be used for evaluation purposes and will be binding on the Tenderer.

(ii) conflict between the written and numerical bid prices. In all cases, the total bid price will be corrected to reflect the written bid price, whether lump sum or unit price.

(iii) failure to include the contingency allowance in the total Tender Price. If the contingency allowance was not included in the addition, the Tender Price shall be corrected to reflect its inclusion.

and these reserved rights are in addition to any other express rights or any other rights which may be implied in the circumstances and the City shall not be liable for any expenses, costs, losses or any direct or indirect damages incurred or suffered by any Tenderer or any third party resulting from the City exercising any of its express or implied rights under this Request for Tender.

2.11 RESERVED RIGHTS (Cont'd)

By submitting a Tender, the Tenderer authorizes the collection by the City of the information set out at paragraph 2.11 i) in the manner contemplated in that subparagraph.

2.12 LIMITATION OF LIABILITY AND WAIVER

Each Tenderer, by submitting a Tender, agrees that:

a) Neither the City nor any of its employees, agents, advisors or representatives will be liable, under any circumstances, for any Claim arising out of this Tendering Process including but not limited to costs of preparation of the Tender, loss of profits, loss of opportunity or for any other Claim; and

b) The Tenderer waives any Claim for any compensation of any kind whatsoever, including Claims for cost of preparation of the Tender, loss of profit or loss of opportunity by reason of the City's decision to not accept the Tender submitted by the Tenderer, to award a Contract to any other Tenderer or to cancel this Tendering Process, and the Tenderer shall be deemed to have agreed to waive such right or Claim.

2.13 INVOICES

a) In light of the requirements of Section 169 of the *Excise Tax Act*, R.S.C. 1985,c. E-15, and amendments thereto, the selected Tenderer shall provide to the City properly documented invoices with all requests for payments. This includes a government issued business number and the amount of tax included on the invoice.

b) Failure to provide properly documented invoices may result in delays in processing payments or outright rejection of the payment request.

City of Saint John

APPENDIX 'A'

TENDERING POLICY FOR CONSTRUCTION CONTRACTS

City of Saint John

TENDERING POLICY FOR CONSTRUCTION CONTRACTS

PREAMBLE

Whereas the City of Saint John seeks to duly represent the public interest in the management of its public tendering process for construction contracts;

And whereas taxpayers/ratepayers have the right to expect the benefits of free and open competition, that is, the best goods and services at the lowest possible prices;

And whereas municipal tendering should duly respect the place of other stakeholders, including vendors and contractors, in the process;

And whereas the values of integrity, effectiveness, due process and efficiency must be inherent in the process;

Common Council establishes this tendering policy for construction contracts.

POLICY AND APPLICABLE STATUTES

Persons and/or companies that submit tenders for construction contracts are deemed to have understood and agreed to the requirements of this policy and all applicable tender documentation, as well as all applicable Municipal by-laws and Federal or Provincial statutes. Applicable federal and provincial statutes include, but are not limited to: the *Canada Competition Act*; the *New Brunswick Procurement Act*; *Construction Remedies Act*; *Local Governance Act* and the amendments thereto.

APPLICATION OF POLICY

The City of Saint John seeks to optimize fair, open and independent competition for municipal construction work and to afford interested and qualified contractors the opportunity to seek the business.

This policy has been established for construction contracts valued in excess of $100,000 (before HST). The procedures detailed herein shall apply to all publicly advertised tender calls issued on behalf of the City of Saint John for construction contracts, but do not apply to publicly advertised tenders for the supply of goods and/or services or to invited bids or calls for proposal.

The following divisions of tender specifications for construction contracts form part of this policy: *Instruction to Tenderers and Tendering Procedures* (Division 2); *Form of Tender* (Division 4); and *Form of Agreement* (Division 5).

PUBLIC NOTICE OF TENDER/TENDER ADVERTISEMENT

A public notice of tender shall be issued for all construction contracts valued in excess of one hundred thousand dollars ($100,000). The notice shall state the contract number, a brief description, the date and the time for the closing of tenders, the location of the locked box for receipt of tenders, and the date, time and location of the tender opening.

TENDER DOCUMENTATION

The following documentation shall be provided to those persons or companies who wish to submit a tender, at an appropriate cost as determined by the Chief City Engineer:

1. Division 1: *Project Description* – as determined by the Chief City Engineer or a designate;

2. Division 2: *Instruction to Tenderers and Tendering Procedures* – forming part of this policy;

3. Division 3: *Particular Specifications* - as determined by the Chief City Engineer or a designate;

4. Division 4: *Form of Tender* - forming part of this policy, and including a Certificate of Independent Tender Determination;

5. Division 5: *Form of Agreement* - forming part of this policy;

6. A notice that Division 6: *General Administration of Contract* and Division 7: *Construction of Municipal Services* of the General Specifications apply to all contracts, and that it is the responsibility of the tenderer to familiarize itself with the provisions in Divisions 6 and 7, as well as those of any other division in the General Specifications determined by the Chief City Engineer or a designate to be applicable to the contract; and

7. Applicable contract drawings, as determined by the Chief City Engineer or a designate.

TENDER PROCESSING

Tenders shall be received and processed in accordance with the provisions set out in Division 2: *Instruction to Tenderers and Tendering Procedures*.

TENDER OPENING COMMITTEE

A tender opening committee is hereby established, consisting of a chairman and two members, as follows:

Chair:	*Purchasing Agent or a designate*
Member:	*Chief City Engineer or a designate*
Member:	A member of staff designated by the City Manager

The committee shall proceed in accordance with the provisions set out in Division 2.

TENDER REJECTION AND AWARD OF CONTRACT

The City of Saint John reserves the right to reject any or all tenders, or to accept a tender other than the lowest tender and to accept the tender deemed to be in its best interests, based on evaluation of relevant criteria, including quality, service and price.

Common Council shall make the decision as to whether or not a contract shall be awarded and to whom it will be awarded.

GENERAL SPECIFICATIONS

The Chief City Engineer may, from time to time, revise the technical provisions of the General Specifications to reflect changes in technology, methods or construction industry practices.

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 3

PARTICULAR SPECIFICATIONS

MONTH 2022

City of Saint John

TABLE OF CONTENTS

DIVISION 3 – PARTICULAR SPECIFICATIONS

Appendices

PARTICULAR SPECIFICATIONS

This division shall be read in conjunction with and take precedence where they may prove at variance with the City of Saint John, General Specifications.

3.1 ADDITIONAL SPECIFICATIONS FOR THIS PROJECT

«Addition_Spec_1» ..... **«Addition_Spec_Text_1»**

«Addition_Spec_2» ..... **«Addition_Spec_Text_2»**

«Addition_Spec_3» ..... **«Addition_Spec_Text_3»**

«Addition_Spec_4» ..... **«Addition_Spec_Text_4»**

«Addition_Spec_5» ..... **«Addition_Spec_Text_5»**

«Addition_Spec_6» ..... **«Addition_Spec_Text_6»**

«Addition_Spec_7» ..... **«Addition_Spec_Text_7»**

«Addition_Spec_8» ..... **«Addition_Spec_Text_8»**

3.2 REVISIONS TO THE GENERAL SPECIFICATIONS

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 4

FORM OF TENDER

MONTH 2022

City of Saint John

TABLE OF CONTENTS

DIVISION 4 – FORM OF TENDER

4.1 TENDER IDENTIFICATION

Tender No: _____

Title of Work: _____

_____

4.2 TENDERER'S RESPONSIBILITIES AND AGREEMENT

TO THE CITY OF SAINT JOHN, NEW BRUNSWICK:

The undersigned hereby agrees that failure to complete all required parts of the Form of Tender shall be subject to the reserved rights of the City and shall be grounds for rejection of the Tender in accordance with Section 2.11.

The undersigned Tenderer has carefully examined the site of the Work described herein, has become familiar with local conditions and the character and extent of the Work, has carefully examined every part of the proposed Contract, and thoroughly understands its stipulations, requirements and provisions and has carefully examined all of the following documents which together comprise the Tender Documents:

1. Project Description (Division 1)
2. Instructions to Tenderers and Tendering Procedures (Division 2)
3. The Particular Specifications (Division 3)
4. The Form of Tender (Division 4)
5. The Form of Agreement (Division 5)
6. The General Specifications (Divisions 6 through 31)
7. The Plans and Drawings
8. Addenda Issued

together, the "Tender Documents".

The undersigned Tenderer has determined the quality and quantity of materials required, has investigated the location and determined the source of supply of materials required, has investigated labour conditions, and has arranged for the continuous execution of the Work herein described.

The undersigned Tenderer hereby agrees to be bound by the award of the contract, and if awarded the Contract, to sign the Form of Agreement (Division 5) within five (5) working days following the City's Notice of Selection.

In the event the City accepts its Tender, the undersigned Tenderer hereby agrees to Substantially Complete the Work no later than _____.

The undersigned Tenderer agrees that they have received all Addenda and the Tender Price includes the provisions set out in the Addenda.

4.2 TENDERER'S RESPONSIBILITIES AND AGREEMENT (Cont'd)

The undersigned Tenderer further agrees to provide all necessary permits, approvals, labour, material, plant, equipment, tools, incidentals, products, water, light, heat, power, transportation, facilities, services and other means of the specified requirements which are necessary to complete the work in accordance with the contract and agrees to accept, therefore, in payment in full, the unit prices stated herein in the *Schedule of Quantities and Unit Prices*, plus applicable taxes, for the actual quantities performed in accordance with the drawings and specifications, for the total sum of

_____
_____
_____

in Canadian Funds, which price includes HST (the "Tender Price").

By submitting a Tender, the Tenderer absolutely waives any right, cause of action or claim for any compensation of any kind whatsoever as a result of participating in this Request for Tender Call or by reason of the City's failure to accept the Tender submitted by the Tenderer, and the Tenderer shall be deemed to have agreed to waive such right, cause of action or claim.

Place of Signing: Signed, sealed and delivered at _____

Date of Signing: This _____ day of _____, in the year _____

Name and Title: By_____

Legal Name of Tenderer: _____ *PLACE*

Signature of Tenderer or Authorized Agent: _____ *SEAL*

Signature of Witness: _____ *HERE*

Address of Tenderer: _____
_____

4.3 BONDING AND INSURANCE COMMITMENTS

Failure of the Tenderer to complete Sections 4.3.01, 4.3.02 and 4.3.03 may be grounds for rejection of the Tender.

4.3.01 Tender (Bid) Bond or Certified Cheque

A certified cheque or Tender (Bid) Bond accompanies this Tender, as indicated below:

(a) Certified Cheque

Provided is a certified cheque payable to The City of Saint John in the amount of

_____

***Signature of Tenderer or Authorized Agent**:* _____

(b) Tender (Bid) Bond

Provided is a Tender (Bid) Bond payable to The City of Saint John in the amount of

_____

The Tender (Bid) Bond has been negotiated for, procured from and the premium paid to a New Brunswick agent of an insurance company licensed to do business in New Brunswick.

***Signature of Tenderer or Authorized Agent**:* _____

4.3.02 Performance Guarantees

One of the following acceptable forms of Performance Guarantees will accompany the Contract, as indicated below:

Performance Bond and the Labour and Material Payment Bond

The Performance Bond and the Labour and Material Payment Bond, each at fifty percent (50%) of the Tender Price covering the faithful performance of the full Contract, will be issued by an insurer licensed under the *Insurance Act* to transact guarantee insurance or surety insurance.

The Performance Bond and the Labour and Material Payment Bond shall be in the form prescribed by the regulations under the *Construction Remedies Act*. Where permitted pursuant to the *Construction Remedies Act* and where specifically allowed and called for in the Tender Documents as being permitted, the City may allow alternate forms of security.

A surety consent letter or Agreement to Bond must accompany the Tender submission.

***Signature of Tenderer or Authorized Agent**:* _____

4.3.03 Insurance

The undersigned Tenderer has reviewed the insurance requirements in the Contract. The following provision for contract insurances will be utilized, as indicated below:

The insurance required in the contract will be negotiated for, procured from and the premium paid to an insurance company licensed to do business in the Province of New Brunswick.

***Signature of Tenderer or Authorized Agent**:* _____

4.4 STATEMENTS

A Tender which does not include completed statements at Sections 4.4.01 to 4.4.07 hereunder and the duly completed Schedule of Quantities and Unit Prices at Appendix 4A may be Disqualified.

4.4.01 Reference Regarding Tenderer's Financial Status

Name of Reference: _____

Address of Reference: _____

_____

4.4.02 Particulars of Tenderer's Recent Contracts

The Tenderer shall provide hereunder particulars of at least three (3), and if possible, five (5) contracts which the Tenderer has successfully carried to completion within the last three (3) years, or is now carrying to completion.

Tenderers shall be actually engaged in performing the type and standard of work specified, and the projects referenced below shall be work of a similar character to the Work now being tendered and shall be of comparable or greater size.

Tenderers who have not performed work for The City of Saint John within the last three (3) years shall submit additional information with the Form of Tender that would demonstrate the Tenderer's ability to perform the type and standard of work specified and the Tenderer's financial, technical and project management reliability.

4.4.02 Particulars of Tenderer's Recent Contracts (Cont'd)

Contract 1: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 2: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 3: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

4.4.02 Particulars of Tenderer's Recent Contracts (Cont'd)

Contract 4: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 5: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 6: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

4.4.03 Particulars of Current Construction Work by Tenderer

If none of the projects described in 4.4.02 were in progress in Canada during the twelve (12) months immediately preceding this Tender, the Tenderer shall provide below particulars of a contract which the Tenderer satisfactorily carried out in Canada during that period.

Brief description of contract: _____

_____

_____

Owner, contact name
and telephone number: _____

_____

Date of commencement: _____

Date of (anticipated) completion: _____

Contract value: _____

Contractor's supervisor: _____

4.4.04 Tenderer's Senior Supervisory Staff

The Tenderer shall identify their senior supervisory staff in the spaces below.

Tenderers who have not performed work for the City within the last three (3) years shall submit with their Form of Tender a completed resume for each staff member listed hereunder outlining their experience, education, designations/certificates and continued training/education.)

Name	Position	Qualifications	# Years Experience

4.4.05 Tenderer's Plant

The Tenderer shall list below the construction plant (type of machinery, equipment, trucks, etc.) the Tenderer proposes to use, other plant under the Tenderers control, and the plant the Tenderer proposes to hire, to complete the work within the time allowed.

Type	Make	Model # & Year	Gas/ Diesel	Net Engine Horsepower	Bucket Size Excavator GVW

4.4.06 Tenderer's Other Resources

The Tenderer shall list below the batch plant, gravel pits or quarries, and the like that the Tenderer proposes to use to complete the work within the time allowed.

4.4.07 Sub-Contractors and Suppliers

Tenderers shall state the name and address of each proposed sub-contractor or supplier.

The listing of more than one sub-contractor or supplier for any one sub-trade or failure to submit a complete list of sub-contractors and suppliers may be grounds for rejection of the Tender. After the City has provided the selected Tenderer with written notification of the City's acceptance of its Tender, the selected Tenderer shall not substitute other sub-contractors or suppliers in place of those named below without the written approval of the Engineer.

Sub-Trade or Supplier	Name of Sub-Contractor/Supplier	Address

4.5 SCHEDULE OF QUANTITIES AND UNIT PRICES

The tenderer shall complete and attach as Appendix 4A the required *Schedule of Quantities and Unit Prices* for the Work tendered, in the format specified by the Engineer.

4.6 CERTIFICATE OF INDEPENDENT TENDER DETERMINATION

I, the undersigned, in submitting the accompanying Tender to The City of Saint John for:

Tender No.: _____

Title of Work: _____

_____

do hereby make the following statements that I certify to be true and complete in every respect:

I certify, on behalf of _____ that:

(Corporate Name of Tenderer)

4.6 CERTIFICATE OF INDEPENDENT TENDER DETERMINATION (Cont'd)

1. I have read and I understand the contents of this Certificate;

2. I understand that the accompanying Tender will be disqualified if this Certificate is found not to be true and complete in every respect;

3. I am authorized by the Tenderer to sign this Certificate, and to submit the accompanying Tender, on behalf of the Tenderer;

4. Each person whose signature appears on the accompanying Tender has been authorized by the Tenderer to determine the terms of, and to sign, the Tender, on behalf of the Tenderer;

5. For the purposes of this Certificate and the accompanying Tender, I understand that the word "competitor" shall include any individual or organization, other than the Tenderer, whether or not affiliated with the Tenderer, who:

(a) may submit a Tender in response to this Request for Tender;

(b) could potentially submit a Tender in response to this Request for Tender, based on their qualifications, abilities or experience;

6. The Tenderer discloses that (check one of the following only, as applicable):

☐ the Tenderer has arrived at the accompanying Tender independently from, and without consultation, communication, agreement or arrangement with, any competitor; or

☐ the Tenderer has entered into consultations, communications, agreements or arrangements with one or more competitors regarding this Request for Tender, and the Tenderer discloses, in the attached document(s), complete details thereof, including the names of the competitors and the nature of, and reasons for, such consultations, communications, agreements or arrangements.

7. In particular, without limiting the generality of paragraphs (6)(a) or (6)(b) above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:

(a) prices;

(b) methods, factors or formulas used to calculate prices;

(c) the intention or decision to submit, or not to submit, a Tender; or

(d) the submission of a Tender which does not meet the specifications of the Request for Tender;

except as specifically disclosed pursuant to paragraph (6)(b) above;

4.6 CERTIFICATE OF INDEPENDENT TENDER DETERMINATION (Cont'd)

8. In addition, there has been no consultation, communication, agreement or arrangement with any competitor regarding the quality, quantity, specifications or delivery particulars of the products or services to which this Request for Tender relates, except as specifically authorized by The City of Saint John or as specifically disclosed pursuant to paragraph (6)(b) above;

9. The terms of the accompanying Tender have not been, and will not be, knowingly disclosed by the Tenderer, directly or indirectly, to any competitor, prior to the date and time of the official Tender Opening, or of the awarding of the Contract, whichever comes first, unless otherwise required by law or as specifically disclosed pursuant to paragraph (6)(b) above.

Name of Tenderer or Authorized Agent: _____

Signature of Tenderer or Authorized Agent: _____

Position Title: _____

Date: _____

Address of Tenderer: _____

_____

ATTACHMENT: TENDERER'S CHECKLIST

(The onus is entirely on the Tenderer to understand all the requirements of the tendering process and the Tender Documents. This checklist is provided for information only and is not required to be submitted with the Form of Tender.)

BEFORE SUBMITTING YOUR TENDER, CHECK THE FOLLOWING POINTS:

- ☐ Has your Tender been signed and witnessed?
- ☐ Have you sealed the *Form of Tender* with your corporate seal?
- ☐ Have you enclosed your Tender (Bid) Bond or certified cheque?
- ☐ Have you enclosed the surety consent letter?
- ☐ Have you completed all sections of the *Form of Tender*?
- ☐ Have you completed all schedules and prices in the *Form of Tender*?
- ☐ Have you written each unit price or lump sum price out in words, including the words "dollars" and "cents"?
- ☐ Have you included signed copies of all addenda signature pages?
- ☐ Have you listed your Subcontractors and suppliers?
- ☐ Have you listed your experience in similar work?
- ☐ Have you listed your senior staff?
- ☐ Have you listed the Tenderer's plant?
- ☐ Have you attached required appendices and required supplemental information?
- ☐ Are the documents complete?
- ☐ Is everything legible?

PLEASE MAKE SURE THAT YOU:

(a) Place the Tender in an envelope;
(b) Seal the envelope;
(c) Put the Tender number, title of Work and closing date and time on the sealed envelope;
(d) Put the full legal name and return address of the Tenderer on the envelope; and
(e) Deposit the envelope in the Tender Box located at 175 Rothesay Avenue, 1st Floor, Saint John, N.B.

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 5

FORM OF AGREEMENT

MONTH 2022

City of Saint John

TABLE OF CONTENTS

DIVISION 5 – FORM OF AGREEMENT

5.1 AGREEMENT BETWEEN OWNER AND CONTRACTOR

THIS AGREEMENT made in triplicate between **THE CITY OF SAINT JOHN** herein (and in the Specifications) called the "Owner" or the “City”

AND

_____

herein (and in the Specifications) called the "Contractor".

WITNESSETH: That the Owner and the Contractor agree as follows:

(a) The Contractor shall provide all the materials and perform all the work shown on the drawings and described in the Contract Specifications titled:

Contract No: _____

Title: _____

(b) The Contractor shall do and fulfill everything indicated by this Agreement; and

(c) The Contractor shall Substantially Complete the Work no later than _____ .

5.2 CONTRACT DOCUMENTS

5.2.01 General Specifications

General Specifications, City of Saint John, New Brunswick,
with all applicable divisions, as updated and as listed in the Table of Contents of the Contract Specifications.

5.2.02 Contract Specifications

Contract specifications for

Contract No: _____

Title: _____

City of Saint John, New Brunswick,

5.2.03 Drawings

5.3 ADDENDA

The Contractor agrees that he has received addenda ___ to ___ inclusive, and that the tender price includes the provisions set out in the addenda.

5.4 CONTRACT PRICE

The Owner shall pay to the Contractor, in lawful money of Canada for the performance of the Contract, the amounts determined for each of the items of work completed at the unit prices as listed in the Schedule of Quantities and Unit Prices, plus applicable taxes, submitted with the tender, which is to be attached with this Agreement, for the total tender price of:

_____

_____

_____

If the Engineer orders in writing the performance of any work not covered by the drawings or included in the specifications that cannot be classified as coming under any of the contract units and for which a unit price can be agreed upon, then such additional work shall be paid for as described under the General Administration of Contract, Division 6.

5.5 PAYMENT

The Owner shall pay on account of thereof upon the Engineer's Certificate, as invoiced by the Contractor and approved by the Engineer, in the manner described in the Specifications.

5.6 AGREEMENT DOCUMENTS

The General Administration of Contract, Division 6 and the aforesaid Specifications and Drawings are all to be read into and form part of this Agreement and the whole shall constitute the Contract between the parties and it shall inure to the benefit of and be binding upon them and their successors, executors, administrators, and subject to the General Administration of Contract, their assigns.

5.7 EXECUTION OF AGREEMENT

In Witness Whereof the parties hereto have executed this Agreement.

	) SIGNED, SEALED AND DELIVERED
	)
	) this _____ day of _____, _____
	)
	) by _____
	) (Contractor)
	)
_____	) _____
(Witness)	) (Signature)
	)
_____	) _____
(Name and Title)	) (Name and Title)
	)
	) _____
	) (Signature)
	)
	) _____
	) (Name and Title)
	)
	)
	) *PLACE SEAL HERE*
	)
	)
	) SIGNED, SEALED AND DELIVERED
	)
	) this _____ day of _____, _____
	)
	) by THE CITY OF SAINT JOHN.
	)
	)
	) _____
	) MAYOR
	)
	) _____
	) COMMON CLERK
	)
	)
	)
	) *PLACE SEAL HERE*

5.8 AFFIDAVIT OF CORPORATE EXECUTION

CANADA

PROVINCE OF NEW BRUNSWICK

CITY OF SAINT JOHN

I, _____, of the _____

in the County of _____, and Province of New Brunswick

MAKE OATH AND SAY:

(1) THAT I am the _____ of _____, and _____ is the _____ of the said Company, as such I am/we are duly authorized officer(s) of the said Company to execute the foregoing instrument.

(2) THAT the signature _____ subscribed to the within instrument is my signature and in my own proper handwriting and that the signature _____ so subscribed is his signature made thereto by him in my presence.

(3) THAT the Seal affixed to the said instrument purporting to be the Corporate Seal of the said _____ is the Corporate Seal of the said Company and was affixed to the said instrument by me and by order of the Board of Directors of the Company.

SWORN TO BEFORE ME at the_____)
)
of _____)
)
in the Province of _____)
)
this _____ day of _____ A.D., _____.)
)
_____) _____
COMMISSIONER OF OATHS) CONTRACTOR
)

Note: The blank spaces are to be filled in with the name or names of the signing officer(s).

5.9 CHECKLIST FOR INSURANCE REQUIREMENTS

The insurance coverage required by the City is set out in General Administration of Contract, Division 6, of the General Specifications. An Insurance Certificate is to be deposited with the City.

The certificate of insurance should contain at least the following information:

- ❑ Be addressed to the City of Saint John.
- ❑ Be signed by an authorized representative on behalf of the insurance company.
- ❑ Contain a Wrap-up (Project Specific) Liability policy with inclusive limits of at least five million dollars ($5,000,000.00).
- ❑ Show that the City of Saint John, the Contractor and Sub-Contractors, the Engineer and the Architect, are added as Additional Insured with respect to the operations of the Contractor.
- ❑ Confirm coverage for bodily injury and property damage and set forth the amount.
- ❑ Confirm that there is coverage for Contractual Liability with respect to this Contract.
- ❑ Confirm that the policy contains a cross liability clause.
- ❑ Confirm that there is Contingent Employer's Liability Coverage.
- ❑ Confirm that there is coverage for Broad Form Property Damage.
- ❑ Confirm that there is Completed Operations coverage with respect to this contract and that such coverage shall continue to be in force for the duration of the guarantee period (maintenance period) which is a period of twelve (12) months from the date of issuance of the Certificate of Final Completion.
- ❑ Confirm that there is coverage for Non-Owned Automobiles or licensed vehicles.
- ❑ Confirm that there is coverage for Owned Automobiles or licensed vehicles.
- ❑ Confirm that the indicated policies will not be cancelled, substantially amended, or allowed to lapse without the City first being given a thirty (30) day written notice.

GENERAL SPECIFICATIONS

DIVISION 6

GENERAL ADMINISTRATION OF CONTRACT

City of Saint John

TABLE OF CONTENTS

DIVISION 6 – GENERAL ADMINISTRATION OF CONTRACT

City of Saint John

TABLE OF CONTENTS

DIVISION 6 – GENERAL ADMINISTRATION OF CONTRACT

City of Saint John

TABLE OF CONTENTS

DIVISION 6 – GENERAL ADMINISTRATION OF CONTRACT

6.1 DEFINITIONS AND INTERPRETATIONS

In this Contract the following capitalized words and expressions shall have the following meanings:

"ADDENDA" or **"ADDENDUM"** means each and every written document issued by the Authorized Enquiry Contact or the Designated Alternate Contact for the purpose of responding to an enquiry, amending or clarifying the Tender Documents and Tendering Process.

"**APPROVED**" or "**APPROVAL**" refer to approval by the Engineer unless otherwise stated.

"AUTHORIZED ENQUIRY CONTACT" means the person(s) identified in section 2.5.01.

"AUTHORITY" means any government authority, agency, body or department, whether federal, provincial or municipal, having or claiming jurisdiction over this Agreement; and **Authorities** means all such authorities, agencies, bodies and departments.

"**CITY**" and "**OWNER**" means The City of Saint John, a municipality in the Province of New Brunswick.

"CLAIM" means any claim, demand, liability, damage, loss, suit, action, or cause of action or other proceedings by whomsoever claimed and all costs and expenses relating thereto and **Claims** shall have a corresponding meaning.

"COMMISSIONING" means verification that all materials, equipment, and systems installed in the Work may be put into continuous operation and shall perform as required under the Contract.

"COMMON COUNCIL" means the elected municipal council of the City.

"COMPLETION RETENTION" has the meaning as set forth in section 6.20.04.

"CONSULTANT" means a consulting engineer or engineering firm or an architect or architectural firm who or which is currently licensed to practice within the Province of New Brunswick and has been designated or approved by the Chief City Engineer to carry out engineering or architectural services required to complete the project.

"**CONTRACT"** means a written contract to be entered into between the Contractor and the City and includes the Contract Specifications (Project Description (Division 1), the Instructions To Tenderers and Tendering Procedures (Division 2), the Particular Specifications (Division 3), the duly completed Form of Tender (Division 4), the Form of Agreement (Division 5), the General Specifications (Divisions 6 through 31), the Plans and Drawings, and all addenda.

"CONTRACTOR" means the selected Tenderer who entered into the Contract with the City, and includes a person who, the Contractor has advised the City in writing, is authorized to act as the representative of the Contractor.

6.1 DEFINITIONS AND INTERPRETATIONS (Cont'd)

"**CONTRACT PRICE**" means the sum that has been approved by Common Council and is set out in the Contract for the construction, erection, completion, testing and maintenance of the Work subject to such additions thereto or deductions therefrom as may be made pursuant to the Contract.

"**CONSTRUCTION EQUIPMENT**" means all fixed or mobile machines, tools or other things, whether owned or rented by the Contractor, which are required in the execution of the Work but does not include equipment, materials, or other things forming or intended to form part of the permanent Work.

"DEFICIENCY RETENTION" has the meaning as set forth in section 6.20.02.

"DESIGNATED ALTERNATE CONTACT" means the person(s) as identified in section 2.5.01.

"DISQUALIFIED" means exclusion of a Tenderer's Tender by the City from the Tendering Process and **Disqualification** shall have a corresponding meaning and **Disqualify** shall have a corresponding meaning.

"**DRAWINGS**" **or "PLANS"** means the drawings or plans referred to in the Contract and any modification thereto approved in writing by the Engineer, for the purpose of the Contract.

"ENGINEER" includes the Chief City Engineer, or any Engineer who is employed by the City and has been designated by the Chief City Engineer to act on their behalf, or a Consultant which has been retained in writing by the Chief City Engineer or the Engineer acting on behalf of the Chief City Engineer.

"**ENGINEER'S REPRESENTATIVE"** means any person who is employed by the City and had been designated by the Engineer to act on their behalf.

"**EQUIPMENT DOWNTIME**" means time during which Construction Equipment used in the carrying out the Work must remain idle because of decisions made by the City, or investigations, clarifications or changes in the Work required by the City.

"**INCIDENTAL SERVICES OR ITEMS**" refer to any items of work, material, labour or equipment necessary to complete the Work in accordance with the Contract, or otherwise required by a manufacturer or in accordance with recognized standards and procedures for which there is no particularly or specified item under the Contract, and for which no payment will be made.

"LABOUR AND MATERIAL PAYMENT BOND" has the meaning as set forth in section 2.2.06 and 6.7.02;

"**MACHINERY CONTRACTOR"** means a person with whom the City has or will enter into a Machinery Contract or has placed or will place an order for item(s) of electrical and/or mechanical plant and/or equipment for incorporation in the Work.

"PERFORMANCE BOND" has the meaning as set forth in sections 2.2.06 and 6.7.01.

"PERFORMANCE GUARANTEES" means both the Labour and Material Payment Bond and the Performance Bond.

6.1 DEFINITIONS AND INTERPRETATIONS (Cont'd)

"**PLANT**" includes all implements, machinery, vehicles, buildings, structures, equipment, articles, etc. required for the execution of the Work.

"**SCHEDULE OF QUANTITIES AND UNIT PRICES**" means the various rates and prices entered by the Contractor in the *Schedule of Quantities and Unit Prices* attached as Appendix 4A to Division 4 – Form of Tender at the time of tendering.

"**SITE**" means the lands and other places, on, under, in or through which the Work, in whole or in part, is to be executed or carried out and any other lands owned by the City for the purpose of the Contract.

"**SPECIFICATIONS**" means the Project Description (Division 1), the Instructions to Tenderers and Tendering Procedures (Division 2), the Particular Specifications (Division 3), the Form of Tender (Division 4), the Form of Agreement (Division 5) and the General Specifications (Division 6-31).

"SUBSTANTIAL COMPLETION" has the meaning set forth at section 6.20.01.

"SUBSTANTIALLY COMPLETE" shall have the same meaning as "Substantial Completion".

"SUBSTANTIAL PERFORMANCE" as defined in *Construction Remedies Act* shall for the purpose of the within Contract corresponds to "**Substantial Completion**" as defined above.

"TENDER" means a tender submitted by a Tenderer in response to this Tendering Process, and **Tender Submission(s)** shall have a corresponding meaning.

"TENDER (BID) BOND" has the meaning set forth in section 2.6.02(c).

"TENDER BOX" means the locked box for receipt of Tenders, located at 175 Rothesay Avenue, 1st Floor, Saint John, New Brunswick.

"TENDER CLOSING" means the time and date for submission of Tenders as set forth in section 2.3.

"TENDER DOCUMENTS" has the meaning set forth at section 4.2.

"TENDER OPENING COMMITTEE" consists of a chairman (Purchasing Agent or a designate), and two members (Chief City Engineer or a designate and a member of staff designated by the City Manager) designated to evaluate each Tender.

"TENDER OPENING LOCATION" means 175 Rothesay Avenue, 1st Floor Boardroom, Saint John, New Brunswick.

"TENDER PRICE" has the meaning set forth at section 4.2.

"TENDERER" means any entity, including a company, firm, consortium, joint venture or partnership, which responds to Tendering Process, who is registered with the City as having taken or received Tender Documents relating to the project.

6.1 DEFINITIONS AND INTERPRETATIONS (Cont'd)

"TENDERING PROCESS" means the overall process for the selection of a Tenderer to provide the type and standard of Work in conformance with the Specifications and Drawings as contemplated in this process.

"WORK" means the Work that is described in the Contract and is to be carried out in accordance with the Contract.

"WORKING DAY" means a day other than a Saturday, Sunday or statutory holiday in New Brunswick.

6.2 EXTENT OF CONTRACT AND ADHERENCE TO DRAWINGS AND SPECIFICATIONS

The Work consists of the construction, completion, testing and maintenance of the Work that is described in the Contract, and the provision of everything required to complete the Work, including labour, materials, equipment, and temporary work.

The Contractor shall carry out the Work strictly in accordance with the Drawings and Specifications, and with any supplementary directions, details or Change Orders issued or approved by the Engineer as being required for the proper completion of the Work.

6.3 AUTHORITY OF THE ENGINEER

6.3.01 General

The Engineer has full authority to define the meanings of the Drawings and other Contract Documents. The Engineer, either personally or through the Engineer's Representative, shall be the sole judge of the workmanship and materials in respect of both quality and quantity and has full powers to examine, inspect and approve or reject materials, methods of procedure and workmanship provided or used in the execution of the Contract and to determine whether or not materials and workmanship are of the character required by the intent and meaning of the Drawings and other Contract Documents.

Subject to section 6.34 (Disputes – Arbitration), the Engineer's decision shall be final and binding upon the Contractor.

6.3.02 Orders of the Engineer

a) The Contractor shall promptly and efficiently comply with all orders, directions and instructions given at any time by the Engineer with respect to the Work or the conduct thereof;

b) If the Contractor disagrees with any order, direction or instruction given at any time by the Engineer, they shall perform the Work as instructed and shall serve notice in accordance with the terms set out at section 6.34.02.

6.3.03 Construction Methods and Equipment

a) Equipment and methods used shall be appropriate to perform the Work outlined in the Contract Documents.

b) The Engineer reserves the right to order the discontinuance or use of any Construction Equipment or method which fails to consistently produce satisfactory results.

6.3.04 Unauthorized Work

a) Any work done or material supplied by the Contractor which is beyond the lines, grades, or descriptions detailed in the Contract Documents, or established by the Engineer by written notification, shall be considered as unauthorized and may not be measured for payment.

b) Upon order of the Engineer, unauthorized Work or materials shall be remedied, removed or replaced by the Contractor, at their own expense.

c) If the Contractor fails to comply promptly with any order made under this section, the Engineer may cause unauthorized Work or material to be remedied, removed or replaced in accordance with the terms of this Division 6.

6.3.05 Work to the Satisfaction of the Engineer

The Contractor shall construct, complete, test and maintain the Work in strict accordance with the Contract to the satisfaction of the Engineer and shall comply with, and adhere strictly to, the Engineer's instructions and directions on any matter that the Engineer deems relevant and in the best interest of the City, whether mentioned in the Contract or not. The Contractor shall take instructions and directions only from the Engineer, or where applicable, from the Engineer's Representative.

6.3.06 Alterations, Additions and Deletions

The Engineer may order variations or changes to the form, quality or quantity of the Work. The Contractor shall, upon receipt of a written Change Order from the Engineer to this effect, do any of the following as may be necessary in order to comply with said order:

a) Increase or decrease the quantity of any work included in the Contract;

b) Delete any such work;

c) Change the character or quality or kind of any such work;

d) Change the levels, lines, position, and dimensions of any part of the work; and

e) Execute additional work of any kind necessary for the completion of the Work.

No such variation or change will be made by the Contractor without first obtaining a written Change Order from the Engineer, which shall set out the general authority

6.3.06 Alterations, Additions and Deletions (Cont'd)

to perform the same, the details of the work to be performed and the amount or basis upon which the Contractor will be paid for same.

All the provisions of this Contract shall apply to any change ordered by the Engineer to the same extent as to the Work described in the Contract. The valuation of such variations or changes shall be made pursuant to Section 6.17, "Changes in the Work".

6.4 CONTRACT DOCUMENTS

6.4.01 Interpretation of Contract Documents

a) in the event of discrepancies or conflicts between the Drawings, the Contract Specifications and the "General Specifications Division 6 - General Administration of Contract", the "General Specifications Division 6 - General Administration of Contract" shall govern; and

b) in the event of discrepancies or conflicts between the General Specifications – Divisions 7 through 30 - and the "Contract Specifications Division 3 - Particular Specifications", the "Contract Specifications Division 3 - Particular Specifications" shall govern.

6.4.02 Interpretation of Plans and Contract Specifications

a) In the event of discrepancies or conflicts between the Drawings and the Contract Specifications, the Contract Specifications shall govern;

b) in the event of discrepancies or conflicts between Drawings, the Drawings drawn with the largest scale shall govern; and

c) in the event discrepancies between figured dimensions and scaled dimensions, the figured dimensions shall govern.

6.4.03 Verification of Measurements and Dimensions

The Contractor shall verify all measurements and dimensions and report any discrepancies to the Engineer.

6.4.04 Distribution of Contract Documents

The Drawings, Contract Specifications, and associated documents shall remain the sole property of the City, but two (2) copies thereof shall be provided to the Contractor at no charge. The Contractor shall promptly give notice in writing to the Engineer of any further drawings or plans or Contract Specifications required for the proper execution of the Work pursuant to the Contract and these will be provided to the Contractor at cost price. The Engineer may supply to the Contractor from time to time during the progress of the Work such further additional or substitute drawings or plans and instructions as the Engineer considers to be necessary or desirable for the purpose of the proper and adequate execution and maintenance of the Work.

6.5 SUFFICIENCY OF TENDER

Tenderers shall inspect and examine the site and its surroundings before submitting a tender. A Tenderer who submits a tender is deemed to be satisfied as to the nature of the ground and subsoil, the form and nature of the Site, the quantities and nature of the Work, the materials necessary for the completion of the Work, the means of access to the Site, any accommodation which may be required, and in general to have obtained all necessary information as to the proposed Work and as to any risks, contingencies, and other circumstances affecting the Work.

The Tenderer shall be deemed to have satisfied itself before submitting a Tender as to the correctness and sufficiency of the Tender and the prices entered in the Schedules of Quantities and Unit Prices, Division 4 of the Contract Specifications, and such prices shall be deemed to cover and include all obligations under the Contract.

6.6 ASSIGNMENT

The Contractor shall not assign any of the rights, benefits or obligations under the Contract without the written consent of the City. The consent of the City does not relieve the Contractor from liability under the Contract.

Notwithstanding the foregoing, the Contractor shall, where required under the Contract, employ specialized subcontractors for execution of those parts of the Work requiring special skills. The Contractor is responsible to the City for all work done by its subcontractors and all work performed by subcontractors shall comply with the Contract.

The Contractor shall comply, or bring about compliance, with all orders, notices, etc. given to it by the Engineer with respect to the execution of the Work by the Contractor or its subcontractors.

6.7 BONDS

The Contractor shall deliver the following bonds or certified cheques to the City within five (5) Working Days following the City's notice of selection:

6.7.01 Performance Bond

The Contractor shall provide to the City a Performance Bond covering the faithful performance of the Contract, including the period of maintenance, satisfactory to the City as to form and issuer. The Performance Bond shall comply with the *Construction Remedies Act* and the Regulations thereunder.

The bond shall be for fifty percent (50%) of the contract price and shall be with a Guarantee Surety company that is satisfactory to the City and is authorized to carry on business in the Province of New Brunswick. The City shall, upon receiving and approving the Performance Bond, return the Tender (Bid) Bond or certified cheque in lieu thereof.

Where permitted by the *Construction Remedies Act*, the City may allow alternate forms of security. Alternate forms of security, if any, shall be specified through the Particular Specifications.

6.7.02 Labour and Material Payment Bond

The Contractor shall provide to the City a Labour and Material Payment Bond satisfactory to the City as to form and issuer. The Labour and Material Payment Bond shall comply with the *Construction Remedies Act* and the Regulations thereunder.

The bond shall be for fifty percent (50%) of the contract price and shall be with a Guarantee Surety company that is satisfactory to the City and is authorized to carry on business in the Province of New Brunswick.

Where permitted by the *Construction Remedies Act*, the City may allow alternate forms of security. Alternate forms of security, if any, shall be specified through the Particular Specifications.

6.7.03 Duration of Bonds

The Performance Bond and the Labour and Material Payment Bond shall remain in effect until the Engineer issues the Certificate of Final Acceptance pursuant to section 6.20.06.

6.8 INSURANCE AND WORKSAFENB

6.8.01 Liability Insurance

The Contractor shall supply and keep in force for the full term of this Contract, a Wrap up Liability policy against liability for bodily and property damage that may arise with respect to the Work being performed under the Contract. This policy shall include the following:

a) Coverage shall be on an occurrence basis with inclusive limits of at least five million dollars ($5,000,000);

b) The City of Saint John, the Sub-Contractors, the Engineer and the Architect, shall be named as Additional Insured with respect to the operations of the Contractor;

c) Contractual Liability with respect to this Contract;

d) Coverage for bodily injury and property with the amount set forth;

e) A Cross Liability Clause;

f) Contingent Employers Liability coverage;

g) Non-Owned Automobile or licensed vehicle Liability coverage;

h) Completed Operations coverage, with respect to this Contract, that shall remain in force for the duration of the guarantee period (maintenance period) which is a period of twelve (12) months from the date of issuance of the Certificate of Final Completion;

6.8.01 Liability Insurance (Cont'd)

i) Thirty (30) days' written notice shall be given to the City of Saint John in the event of the cancellation, substantial amendment, or lapse, of this policy.

j) Coverage for Broad Form property damage; and

A separate policy endorsement shall be provided if any blasting is to be carried out under the Contract.

6.8.02 Automobile Insurance

The Contractor shall insure and maintain insurance against liability for bodily injury and property damage caused by motor vehicles owned by the Contractor and used with respect to the Work. Such insurance shall have an inclusive limit of at least five million dollars ($5,000,000). For the purposes of this Contract, the definition of a "motor vehicle" shall be the same as the definition of a "motor vehicle" in the *Motor Vehicle Act,* RSNB 1973, c. M-17, and amendments thereto.

6.8.03 WorkSafeNB

The Contractor shall pay such assessments as will protect the Contractor and the City from claims under the New Brunswick *Workplace Health, Safety and Compensation Commission Act*, 1994, S.N.B., c. W-14, and amendments thereto. The Contractor shall provide to the City a letter from WorkSafeNB stating that the Contractor is in good standing and is fully covered under said Act, pursuant to section 6.8.04.

6.8.04 Insurance Policies and Certificates

The Contractor shall, within five (5) Working Days following the City's notice of selection deliver the following:

a) Insurance Certificates, acceptable to the City, indicating compliance with the Liability and Automobile Insurance requirements set out in the Contract;

b) A certificate from WorkSafeNB which confirms that the Contractor is in good standing under the *Workplace Health, Safety and Compensation Commission Act*, 1994, S.N.B. c. W-14, and amendments thereto;

The WorkSafeNB certificate shall also be delivered:

(i) At intervals of six (6) months during the course of the Contract;

(ii) Sixty (60) days after the Certificate of Substantial Completion has been issued, and

(iii) At the time of Final Payment.

6.8.04 Insurance Policies and Certificates (Cont'd)

c) A Business Corporations Act Certificate which confirms proper registration with the Province of New Brunswick - Corporate Affairs of which the Contractor must be in good standing;

d) For Contracts with a Tender Price exceeding $250,000.00 (inclusive of HST), the Contractor shall provide a current Letter of Good Standing or a Letter of Good Standing "In Process" under the Certificate of Recognition Program issued by the New Brunswick Construction Safety Association. Out-of-province Tenderers shall supply an equivalent from the Tenderer's province of origin, acceptable to the Engineer.

6.9 INDEMNITY

6.9.01 Agreement to Indemnify and Hold Harmless

The Contractor hereby indemnifies, defends and saves harmless the City, its employees, officers, agents, successors and assigns, from and against any and all losses, costs, claims, demands, expenses, proceedings and actions of every nature and kind for injury or damages, including indirect, consequential and incidental damages, to persons or property which are or may be in any way related to, or connected or associated with the Work done or purported to be done in any manner under the Contract.

6.9.02 Loss or Damage

The Contractor hereby releases and forever discharges the City from and against any and all losses, costs, claims, demands, expenses, proceedings and actions of every nature and kind for injury or damages, including direct, consequential and incidental damages to the Work or to any material, equipment or similar item to be used or incorporated in the Work, which are or may be in any way related to or caused by fire or any like circumstances. The Contractor shall properly guard the Work and make good all loss or damage of whatever nature or origin that may arise, until the Work is completed and the Certificate of Substantial Completion has been issued. After Substantial Completion and during the Maintenance Period the Contractor shall remain responsible to make good on all loss or damage to the Work except where such loss or damage is a result of negligence by the City.

6.10 LABOUR, MATERIALS, WORKMANSHIP AND TESTING

The Contractor shall employ qualified personnel and pay wages in accordance with all applicable Federal and Provincial rules, requirements and legislation.

All equipment, materials and workmanship described in the Contract shall be of the highest quality and in accordance with the Engineer's instructions and shall be subjected from time to time to such standard tests as the Engineer may direct at the place of manufacture or fabrication or on the Site. The Engineer may forbid the use of any materials if, upon delivery, they are found to be defective or if the Engineer considers them unsuitable for use or incorporation in the Work.

The Contractor shall keep the Engineer fully advised of the order and delivery dates of materials.

The Contractor shall, at no cost to the City, provide such assistance, instruments, machines, labour, and materials as are normally required for examining, measuring and testing the Work and the

6.10 LABOUR, MATERIALS, WORKMANSHIP AND TESTING (Cont'd)

quality, weight or quantity of any material used for the Work. The Contractor shall also supply samples of materials before use or incorporation in the Work for testing, as may be required by the Engineer. The cost of doing so shall be deemed to have been distributed among and included in the Schedule of Quantities and Unit Prices.

The Contractor hereby releases and forever discharges the City from and against any costs, claims, expenses, proceedings and actions of every nature and kind for injury or damages, including indirect, consequential and incidental damages to persons or property which are, or may be in any way related to, or connected or associated with the rejection by the Engineer of such materials, and the removing of such materials from the Work and / or the Site.

The Contractor is not required to provide for testing the material of any equipment obtained from Machinery Contractors, unless, in the opinion of the Engineer, such equipment has suffered, or may reasonably be assumed to have suffered, damage while in the care of the Contractor.

6.11 ENGINEER'S REPRESENTATIVE

The duties of the Engineer's Representative are to watch over and supervise the Work and also to supervise the testing and examination of all materials to be used, or workmanship employed, in connection with the Work. Except as expressly provided in the Contract, the Engineer's Representative does not have any authority to relieve the Contractor of any of the Contractor's duties or obligations under the Contract, to order any work involving delay or extra cost to the City or to make variations in the Work.

The Engineer may from time to time in writing delegate to the Engineer's Representative any of the powers and authorities vested in the Engineer, and shall provide to the Contractor a copy of all such written delegations of powers and authorities. Only those written instructions or written approval given by the Engineer's Representative to the Contractor within the terms of such delegation shall bind the Contractor and the City as though it had been given by the Engineer.

Failure of the Engineer's Representative to disapprove any work or materials shall not prevent the Engineer from disapproving such work or materials and ordering the pulling down, removal or breaking up thereof.

The Contractor may, if the Contractor is not satisfied with a decision of the Engineer's Representative, refer the matter to the Engineer who may confirm, rescind or vary such decision.

6.12 CONTRACTOR'S REPRESENTATIVE

The Contractor shall, at all times during the continuation of the Contract, keep in full-time employment on the Site a competent Superintendent, Foreman or Agent who shall act as the Contractor's Representative and be fully empowered to act for and on behalf of and bind the Contractor in all matters pertaining to the Contract. Any explanation, order, instruction, direction or request given to the said representative shall be deemed to have been given to the Contractor. The appointment of any Superintendent Foreman or Agent as the Contractor's Representative shall be subject to the approval of the Engineer, and such approval may be withdrawn at any time. The Contractor's Representative shall, if the Engineer so requires, be solely employed for work directly connected with the Contract.

6.12 CONTRACTOR'S REPRESENTATIVE (Cont'd)

The Contractor shall upon request of the Engineer remove from the Work any Superintendent, Foreman, Agent or any other person employed by the Contractor to do work on the Contract who, in the opinion of the Engineer, is incompetent or has been conducting themselves improperly. The Contractor shall not allow a person so removed by the Engineer to remain on the Site of the Work.

The Contractor's representative shall be available to be contacted at any time on weekends, holidays or after working hours. This representative shall carry a pager or mobile telephone at all times and shall answer all calls made by the Engineer or the Engineer's Representative. The Contractor's Representative will be expected to receive and handle calls regarding conditions of the construction Site, safety, traffic, etc. The pager, telephone or mobile telephone number of the Contractor's Representative shall be given to the Engineer prior to commencement of the Work.

Should the City be unable to contact the Contractor's representative, the City may, in its sole discretion, correct any deficient conditions on the Work Site as are deemed necessary by the Engineer, and recover the cost of doing so from the Contractor. The City may set off such costs against any monies owed to the Contractor under the Contract.

6.13 SCHEDULE OF WORK

The Contractor shall as soon as is practicable, and in any case not later than ten (10) Working Days after the City has issued its Notice of Selection, submit to the Engineer for approval a schedule showing the order in or procedure and method according to which the Contractor proposes to carry out the Work. The Contractor shall, whenever required by the Engineer, provide particulars in writing of the Contractor's arrangements for the carrying out of the Work of the construction plant and temporary works which the Contractor intends to supply, use or construct as the case may be. The submission to and approval by the Engineer of such information shall not relieve the Contractor of its obligations under the Contract, nor shall it preclude the Engineer from ordering and directing at any time in what order or where the Work shall proceed.

6.14 COMMENCEMENT OF WORK, POSSESSION OF SITE, EASEMENTS, PERMITS AND LICENCES

The Contractor shall commence the Work within ten (10) Working Days after receipt of an order in writing to this effect from the Engineer and shall proceed with the same diligently, in accordance with the Engineer's directions and the schedule approved by the Engineer.

The Contractor shall take possession of the Site as soon as practicable after receipt of the Engineer's orders to commence the Work.

The City shall acquire all easements necessary for the Contractor to complete the Work.

Subject to section 7.12 "Environmental Compliance", the Contractor, at the Contractor's own expense, shall obtain all permits, permissions, licences, and approvals in connection with the Contract and shall deliver these to the Engineer.

When the Contractor is constructing an above ground structure, or an underground structure with electrical works, the Contractor shall obtain and pay for building permits and electrical permits.

All permits and approvals shall be applied for so they are obtained well in advance of the time they will be required. This includes but is not limited to electrical permits, building permits, demolition permits, and excavation permits.

6.14 COMMENCEMENT OF WORK, POSSESSION OF SITE, EASEMENTS, PERMITS AND LICENCES (Cont'd)

If the Contractor deems it advisable to acquire the right or rights to use, enjoy or occupy any additional or adjacent land or lands in order to facilitate the execution of the Work, the Contractor shall obtain such right or rights at the Contractor's expense, and the Contractor shall at all times indemnify and save harmless the City from any and all claims arising from the acquisition of such right or rights, or the use, enjoyment or occupancy of such land or lands. The Contractor shall supply to the City a signed statement of such rights obtained from the parties involved.

The Contractor shall supply to the Engineer all forms, permits, certificates, licenses or other documentation as required to complete the Work, including those referred to in the General Specifications.

6.15 TIME FOR COMPLETION

The Work shall be completed within the time stated in the Contract calculated from the date of the Engineer's written order to commence the Work or the date at which the Contractor received the Form of Agreement duly executed by both parties.

If the Contractor wishes to extend the prescribed time for completion of the Work because of delays occasioned by extra work, epidemic, pandemic, strikes, lockouts, fires, insurrection, acts of God, or delay in delivery of equipment, the Contractor shall give notice in writing to the Engineer within ten (10) Working Days after any such delay or other event listed above has first arisen stating the reason for the request and, in such an event, the Engineer may, in their absolute discretion, determine what extension of time, if any, will be allowed.

The Contractor hereby releases and forever discharges the City from any claim, demand, action, suit, or petition whatsoever for any damage suffered by the Contractor which are or may in any way be related to or connected or associated with delays from whatever cause arising in the progress of the Work, whether or not the Engineer exercised their discretion to allow an extension of time for completion.

6.16 MEASUREMENT OF THE QUANTITIES OF WORK

The quantities set out in the *Schedule of Quantities and Unit Prices*, are the estimated quantities of the Work only, and they are not to be taken as the actual and final quantities of the Work to be executed by the Contractor in fulfillment of the Contractor's obligations under the Contract. The City reserves the right, through the Engineer, to increase, decrease or eliminate entirely the quantities of all or any of the items in the *Schedule of Quantities and Unit Prices*.

Monthly measurements of the work being carried out under the Contract shall be made jointly by the Engineer's Representative and the Contractor's Representative at the end of each calendar month. The Contractor's Representative shall attend upon, and assist the Engineer's Representative in taking such measurements and shall provide all particulars required by the Engineer's Representative. The Engineer's Representative will notify the Contractor when such measurements are to be made.

The said monthly measurements shall not bind the Engineer in any manner in the preparation of the Final Measurement of the Works constructed by the Contractor under this Contract.

6.16 MEASUREMENT OF THE QUANTITIES OF WORK (Cont'd)

The Final Measurement (see section 6.20.05, "Certificate of Final Completion") shall similarly be made in detail as soon as is practicable after the Certificate of Substantial Completion has been issued pursuant to section 6.20.03, or as soon as the whole of the Work has been completed, and this Final Measurement shall be approved and accepted in writing by the Engineer and the Contractor before the Final Payment Certificate (see section 6.21.02, "Holdback Release") is processed.

6.17 CHANGES IN THE WORK

The Engineer shall determine the amount, if any, to be added to, or deducted from, the Tender Price, in respect of any additional work done, or work deleted pursuant to the Engineer's order. The Engineer shall, in their absolute discretion, determine whether all such work shall be valued using the *Schedule of Quantities and Unit Prices*.

If the Contract does not contain an item in the *Schedule of Quantities and Unit Prices*, applicable to the additional work, then reasonable prices shall be fixed by the Engineer. These prices shall be based on the sum of the following six (6) items:

a) The necessary cost to the Contractor of the material required for the work, as provided by the Contractor and delivered by the Contractor to the Site. All invoices are to be supplied by the Contractor as directed by the Engineer.

b) Basic wages or salaries paid for labour plus a mark-up of twenty-five percent (25%) (or more if submitted documents substantiate that additional payroll levies were paid by the Contractor), which shall be compensation for all payroll levies and burdens, small tools and other related items. No charge shall be made for personnel beyond the class of Foreman.

c) Cost of consumable tools, other than tools customarily provided by tradesmen (small tools), necessary for and used in the execution of the Work.

d) Fifteen percent (15%) of the sum of items (a), (b), and (c) which shall be considered as covering all other expenses and profit.

e) Use of Construction Equipment other than small tools, at the rate set out in Regulation 82-113 under the New Brunswick *Crown Construction Contracts Act* (*Machine Rental Regulation*). The rates set out in the *Machine Rental Regulation* shall apply to the Contractor's Construction Equipment whether said equipment is owned or rented.

f) All applicable taxes.

The Engineer may at the Engineer's sole discretion approve payment of additional work based on a quotation which has been received in writing from the Contractor.

No compensation for additional work or material shall be allowed unless such work or material is ordered, in writing, by the Engineer.

When the additional work, which was not valued in the *Schedule of Quantities and Unit Prices*, is carried out by the Contractor's approved subcontractor, the price for this work shall be based on the subcontractor's approved invoice plus ten percent (10%) of the amount of this invoice, which additional ten percent (10%) shall be considered as covering all the Contractor's expenses and profit.

6.17 CHANGES IN THE WORK (Cont'd)

Whenever any extra work is in progress, the Contractor shall, each Working Day agree with the Engineer, in writing, in full detail as to the amount of the labour, equipment and materials used in carrying out each order for extra work on the preceding Working Day, and the City shall not pay for such extra work or materials unless such agreement has been made.

Equipment Downtime will be paid at fifty percent (50%) of the rate set out in the *Machine Rental Regulation.* This rate shall apply to all the Contractor's equipment whether the equipment is owned or rented.

6.18 MAINTENANCE PERIOD

The maintenance period commences on the date on which the Certificate of Final Completion is issued and ends exactly twelve (12) months later.

6.19 RESPONSE TO DEFECT, FAULT OR DEFICIENCY IDENTIFIED PRIOR TO OR DURING MAINTENANCE PERIOD

The Contractor is responsible for and shall, at the Contractor's own expense and upon the Engineer's request, execute to the Engineer's satisfaction all work, repair, alterations, reconstruction or replacement required to remedy any defect, fault or deficiency (collectively referred to as "Deficiency") which develop or are detected in the Work at any time between the date when the Work begins and the date when the Certificate of Final Acceptance is issued.

The Contractor shall remedy or caused to be remedied deficiencies of a non-emergency nature within five (5) Working Days after receiving the Engineer's written notice to remedy. The Contractor shall remedy or cause to be remedied those deficiencies which are deemed by the Engineer to be of an urgent nature immediately upon receipt of the Engineer's Notice to Remedy. In the event the Contractor does not remedy the deficiencies within the timeframes above noted, the City may cause the deficiencies to be remedied and recover the cost of doing so against the Contractor. The City may set off said costs against any monies owed to the Contractor under the Contract.

At the request of the Engineer, the Contractor shall search for the cause of any defect or fault and carry out remedial work directed by the Engineer, including reinstatement work. The cost associated with finding the reason for and the cost of remedying a defect or fault shall be borne by the Contractor if the Engineer determines that the Contractor is responsible for the defect or fault.

Those same costs shall be borne by the City if the Engineer determines that the City was responsible for the defect or fault.

6.20 COMPLETION

6.20.01 Definition of Substantial Completion

"SUBSTANTIAL COMPLETION" of the Work shall have been reached when;

a) the Work is ready for use or is being used for the purpose intended and is so certified by the Engineer;

b) the Work has passed any final tests required under the Contract;

6.20.01 Definition of Substantial Completion (Cont'd)

c) the Contractor has given a written undertaking to complete any outstanding work expeditiously;

d) the Operations and Maintenance (O&M) manuals have been received and accepted by the Engineer and all necessary Commissioning has successfully been completed; and,

e) if there is a known defect, of correction, at a cost of not more than

(i) 3% of the first $250,000 of the Contract Price,

(ii) 2% of the next $250,000 of the Contract Price, and

(iii) 1% of the balance of the Contract Price.

6.20.02 Deficiency Retention

The amount deducted from the Contract Price for the purpose of ensuring the completion of a Deficiency in the Work shall be referred to as the "Deficiency Retention".

If a Deficiency is identified in the Work, the City may retain as a Deficiency Retention sufficient funds to allow the proper completion of the Work by others, including the use of the City's own forces or another contractor. The amount retained shall be no less than an amount equal to twice the Engineer's estimate of the cost of remedying the Deficiency. The amount shall be retained until the Deficiency is remedied to the satisfaction of the Engineer.

6.20.03 Certificate of Substantial Completion

The Engineer shall issue a Certificate of Substantial Completion once the Engineer is satisfied that the Work has been substantially completed, and the Work has passed any final tests required under the Contract, and the Contractor has given a written undertaking to complete any outstanding portion of the Work expeditiously. The Engineer may, in their sole discretion, issue a Certificate of Substantial Completion with respect to portions of the Work.

In addition to the Certificate of Substantial Completion, the Engineer shall issue a Form 7 pursuant to the *Construction Remedies Act, Regulation 2021-81.*

The Contractor shall post and deliver the Form 7 within the time specified and as required by the *Construction Remedies Act.*

6.20.04 Completion Retention and Holdback

When the Work, in the opinion of the Engineer, is ready for use or is being used for the purposes intended, but the Contractor is unable to complete the Work within the agreed schedule, the Engineer may, in its sole discretion, allow the Contractor to revise the schedule to complete a portion of the Work expeditiously and within the revised schedule.

6.20.04 Completion Retention and Holdback (Cont'd)

The value of the portion of incomplete Work may be deducted from the Contract Price in determining Substantial Completion but this does not relieve the Contractor from completing the Work. The amount deducted from the Contract Price for the purpose of the determination of Substantial Completion shall be referred to as the "Completion Retention".

The Completion Retention shall be subject to a Holdback under the *Construction Remedies Act*.

6.20.05 Certificate of Final Completion

The Engineer shall issue a Certificate of Final Completion once the agreement of final measurement has been approved and accepted in writing by both the Engineer and the Contractor, and the Contractor has, in writing, released the City from any further claims with respect to the Contract.

A Certificate of Final Completion will not be issued if the Work has a known defect unless the value of the defect in the opinion of the Engineer is less than one percent (1%) of the Contract Price and can be remedied expeditiously by the Contractor.

6.20.06 Certificate of Final Acceptance

The Engineer shall issue a Certificate of Final Acceptance after the Maintenance Period has expired and the Engineer is satisfied that the Contractor has fulfilled all the requirements under the Contract.

6.21 PAYMENT CERTIFICATES

6.21.01 Interim Payments

At the end of each calendar month, the Contractor shall submit to the Engineer, for verification of the measurement, a fully itemized statement showing the estimated value of the work executed up to the end of the month. The itemized statement shall be broken down into the same sections as the *Schedule of Quantities and Unit Prices*. A fully itemized statement of the values of the major items of materials on the Site which are intended for incorporation into the Work may be submitted at the end of each calendar month, accompanied with receipts for all items submitted. Payment for major items of materials on site but not yet incorporated into the Work shall be at the Engineer's sole discretion.

The statements shall be submitted on forms approved by the City and shall include:

a. The amount of HST component included in the payment certificate;

b. The Contractor's HST registration number; and

c. The signature of an authorized representative of the Contractor.

With each statement, the Contractor shall provide a Statutory Declaration (in a form satisfactory to the City) to the effect that all expenses incurred by the

6.21.01 Interim Payments (Cont'd)

Contractor in carrying out the Contract as at a date not greater than forty-five (45) days prior to the date of the statement have been paid.

From each monthly statement, except the final statement, the Engineer will prepare and submit to the City an Interim Payment Certificate and will include therein an amount which the Engineer considers firm and reasonable in respect of the value of the Work executed and of the major items of materials on Site.

The City shall retain money in the amount of ten percent (10%) as a Holdback in accordance with the New Brunswick *Construction Remedies Act*, and amendments thereto.

A certificate issued under this clause is not to be considered as either an approval by the City of the Work or materials or as a waiver by the City of any rights it has arising under the Contract against the Contractor.

The Interim Payment Certificate will show the Engineer's gross valuation of the Work and materials and the deduction of the appropriate amount of the Holdback and of the previous payments to the Contractor.

No Interim Payment Certificate shall be held to bind the Engineer in valuation of the Work for the purposes of the Final Payment Certificate, and the Engineer, may by any Payment Certificate, make correction or modification to any previous Interim Payment Certificate which the Engineer may have issued.

The City reserves the right to refuse to process any Interim Payment Certificates, or the payment of a Final Payment Certificate, if, in the opinion of the Engineer, the progress of the Work or the conduct of the Contractor is not satisfactory or the Contractor has done or neglected to do something which may prevent the Contractor from completing the Work in accordance with the Contract.

The City may retain from the Contract Price the amounts required as a Completion Retention and a Deficiency Retention. The City may retain additional amounts, under the contract, for any known claims, unpaid amounts due to subcontractors, labourers or suppliers, defective workmanship, equipment, materials, penalties and liquidated damages.

6.21.02 Holdback Release

a) Subject to paragraphs b) and c), the City shall, upon receipt of the following documents, release the *Construction Remedies Act* Holdback (10% of monies due to the Contractor) sixty-one (61) days after the Certificate of Substantial Completion has been issued:

   (i) A Statutory Declaration (in a form satisfactory to the City) to the effect that;

      1) all expenses incurred by the Contractor in carrying out the Contract have been paid except for statutory holdbacks properly retained;

      2) The Construction Remedies Act, Regulation 2021-81, Form 7 was posted in the manner and within the time required by the *Construction Remedies Act*; and,

6.21.02 Holdback Release (Cont'd)

3) The Contractor is not aware of any Claim for Lien made with respect to the public owner's holdback as contemplated by the *Construction Remedies Act*.

(ii) A certificate issued to the City of Saint John by a lawyer who is in good standing with the Law Society of New Brunswick wherein the lawyer certifies that no liens have been filed in the Registry Office with respect to the Work and/or the Site which remain outstanding sixty-one (61) days after the Certificate of Substantial Completion has been issued; and

(iii) A Clearance Certificate from WorkSafeNB.

b) The City may retain such further amounts from the Contractor under the *Construction Remedies Act* as allowed pursuant to that Act.

c) The City may retain from the Contract Price the amounts required as a Completion Retention and a Deficiency Retention. The Completion Retention and a Deficiency Retention are subject to a further *Construction Remedies Act* Holdback in the amount of ten percent (10%) of monies due to the Contractor for a period sixty-one (61) days after the Certificate of Final Completion has been issued.

d) Where the Contractor does not provide a Statutory Declaration or does not complete the Work as directed by or to the satisfaction of the Engineer, the City may withhold payment of the monies which would otherwise have become due, and during this time, the City shall not be required to pay interest.

e) The City may retain additional amounts, under the contract, for any known claims, unpaid amounts due to subcontractors, labourers or suppliers, defective workmanship, equipment, materials, penalties and liquidated damages.

6.21.03 Final Payment

The Final Payment Certificate will be issued after the Work has been completed to the satisfaction of the Engineer and as soon as the Contractor provides an up-to-date Clearance Certificate from WorkSafeNB and releases in writing the City from any and all further claims relating to the Contract.

6.22 LIQUIDATED DAMAGES FOR LATE COMPLETION

Time is of the essence.

In the event that the Contractor fails to complete the Work on the day fixed in the Contract for completion, or on the day to which the time for completion may be extended by the Engineer, the Contractor shall forfeit and pay to the City the sum of one thousand dollars ($1,000) for each calendar day of delay, as liquidated damages and not as a penalty. The payment recognizes both the extra cost to the City of the continued observation of the Work by the Engineer, and/or the loss of revenue or additional cost incurred by the City by virtue of the delay. The City may deduct the amount of such Liquidated Damages from any monies payable to the Contractor under the Contract.

6.23 BOOKS AND RECORDS OF THE CONTRACTOR AND SUBCONTRACTORS

The Contractor shall keep proper books and records showing names, trades and addresses of all workers in the Contractor's employ and wages paid to and the time worked by such workers. Also records, books and invoices showing all costs and expenditures related to the Work must be made available to the Engineer upon request.

All records of the Contractor, relevant to the evaluation of the Work, including payrolls, time books, books of account, invoices and statements, shall be maintained on the Site, or at some other place approved by the Engineer, and shall be open at all reasonable times for inspection by the Engineer. The Contractor shall in every way assist such inspection for the purpose of establishing and determining labour costs, the cost of additional work, and progress payments to be made.

The Contractor shall require that any subcontractors, doing part of the Work in this Contract, shall keep proper books and records and make such books and records available for inspection in the manner as is required of the Contractor.

6.24 CONTRACTOR TO PAY PROMPTLY

The Contractor shall pay any and all accounts for labour, services, and materials used by the Contractor for the purpose of the fulfillment of this Contract as and when such accounts become due and payable and shall provide the Engineer with proof of payment of such accounts in such form and as often as the Engineer may request.

6.25 WAGES

The Contractor shall pay fair wages in accordance with the New Brunswick *Employment Standards Act*, and amendments thereto, and shall pay rates of wages and allowances to various classes of labour not less favorable than those prevailing in the areas where the Work is being performed.

Vacation Pay, Provincial Social Service and Education taxes, where applicable, shall be the responsibility of the Contractor. The Contractor shall comply with all laws and regulations in any way affecting those engaged or employed upon or in the conduct of the Work. The Contractor shall indemnify and save harmless the City from and against all claims or demands arising out of or based on the violation of any such laws or regulations.

6.26 SUSPENSION OF WORK AND INCLEMENT WEATHER

The Contractor shall obtain the written permission of the Engineer before making any interruption to the agreed Schedule of Work.

The Engineer may, by an order in writing, at any time stop or suspend any part of the Work, or direct any portion to be commenced or completed in priority to any other part or portion, or may cancel the order to proceed with the Work, or with any part thereof, and the Contractor shall not thereby be entitled to any additional payment, or to claim for loss of profit or anticipated profit, or for damages or for any other loss whatsoever caused by reason of such order. The Contractor shall, in the event that the Engineer has ordered or permitted work to be done during freezing weather, or has ordered work to be discontinued for the winter, forthwith place the Work in proper and satisfactory condition for the safety and accommodation of the public and for its effectual protection against damage from rain, snow, frost, ice or other causes upon receiving a notice from the Engineer to do so, and shall so maintain it for as long as is necessary without any additional cost to the City.

6.26 SUSPENSION OF WORK AND INCLEMENT WEATHER (Cont'd)

The Contractor shall, when work is ordered or permitted by the Engineer to be done during freezing weather, provide the means needed for heating all the materials required in the Work. In a situation where any work may suffer damage as a result of frost or in a situation where the Engineer is of the opinion that work should not proceed because of weather conditions or lack of materials, the Contractor shall at its own expense put the Work into a condition that is satisfactory to the Engineer and maintain and protect it against damage by frost, unless otherwise directed in writing by the Engineer. Work that has been suspended due to freezing weather shall not be resumed without written direction from the Engineer.

6.27 DISMISSAL OF CONTRACTOR

If the Contractor does not comply with the provisions of the Contract to the satisfaction of the Engineer, the City may enter on the Site and all equipment, temporary works and materials located thereon and intended to form part of the Work shall immediately become the property of the City. The City may discharge the Contractor from further execution of the Work and employ some other person or persons to complete and maintain the Work. In the event that the City discharges the Contractor, the City shall not, under any circumstances, be liable for the loss of or damages to any of the Construction Equipment, equipment, temporary works, or materials used by the Contractor in the performance of the Work.

The entire cost of the employment of such other person or persons as may be necessary to complete and maintain the Work shall be chargeable to and recoverable from the Contractor, and may be set off against monies owed to the Contractor under the Contract.

The employment of such other person or persons shall in no way relieve the Contractor of any of the Contractor's obligations under the Contract, nor limit the rights and remedies of the City under the Contract.

In the event of the dismissal of the Contractor in accordance with this section:

a) The City shall not pay any monies due to the Contractor under the Contract until all costs and charges to the City for the completion and maintenance of the Work, including damages for delay (if any) in the completion of the Work, are paid to the City by the Contractor.

b) The City may set off the cost incurred for completing and maintaining the Work against any monies owed to the Contractor under the Contract.

c) If the costs incurred by the City exceed the amount to which the Contractor is entitled under the Contract, the difference shall be a debt due by the Contractor to the City.

d) The Contractor may reclaim the Construction Equipment, and any surplus of the temporary works and materials located on the Site at the dismissal of the Contractor if, in the Engineer's opinion, they are no longer required for the purpose of the Work.

The removal of said equipment and materials from the Work Site shall be at the discretion of the City and at the expense of the Contractor.

6.28 BANKRUPTCY AND INSOLVENCY

Should the Contractor become bankrupt, or insolvent, or compound with creditors, or propose any composition or scheme to creditors for the settlement of the Contractor's debts, or shall commit any act of insolvency, the City may request the Bonding Company (see section 6.7, "Bonds") without previous notice and without process or suit at law, to take the Work or any part of the Work out of the hands of the Contractor, and either assign the same to any other person without being previously advertised or employ workers and provide materials, construction equipment, and other necessary things at the expense of the Contractor, or take such other steps as may be considered necessary, in order to secure the completion of the Work, in accordance with the Contract.

6.29 STANDARD SPECIFICATIONS

The properties of all materials and the design, performance and construction of all items for this Contract shall, where not otherwise specified, comply with the latest applicable Canadian Standards, and if no Canadian Standards exist with the latest applicable American or British Standards.

Recognized authorities for these Standard Specifications are listed below together with accepted abbreviations of their names:

Table 6.1: Recognized Authorities

RECOGNIZED AUTHORITIES	ABBREVIATIONS
American Association of State Highway and Transportation Officials	AASHTO
American Concrete Institute	ACI
American National Standards Institute	ANSI
American Standards Association	ASA
American Water Works Association	AWWA
American Society of Mechanical Engineers	ASME
American Society for Testing and Materials	ASTM
British Standards Specification	BSS
Canadian General Standards Board	CAN/CGSB
Canadian Standard Association	CAN/CSA
Corrugated Steel Pipe Institute	CSPI
Dominion Board of Insurance Underwriters	DBIU
Factory Mutual	FM
National Electrical Manufacturers Association	NEMA
National Sanitation Federation	NSF
New Brunswick Department of Transportation and Infrastructure	NBDTI
Underwriters Laboratories	UL

All electrical, plumbing, building, etc. materials, equipment, methods of installation and general Works shall comply with the requirements of the applicable codes, latest editions.

6.30 CONTRACT DOCUMENTS AVAILABLE ON SITE

The Contractor shall, during the Contract, keep one (1) set of all Drawings and Specifications, etc. on the Work Site. Such Drawings and Specifications, etc. shall be available at all reasonable times for the inspection and use of the Engineer. The Contractor shall have a copy of the latest edition of the City of Saint John General Specifications available on site, at all times, during construction.

6.31 NOTICES

Any notice, order or instructions issued by the City to the Contractor may be served electronically (email) to the Contractor or by delivering the document to the Contractor at its principal place of business or to the Contractor's Representative at the Work Site office, or by sending the document by prepaid mail or prepaid courier to the Contractor at its principal place of business or to the Contractor's Representative at the Work Site office.

Any notice to be given by the Contractor to the City under the Contract shall be served electronically (email) to the Engineer or by delivering it to the office of the Engineer or by sending it by prepaid mail or prepaid courier to the Engineer at the Engineer's office.

A document that is sent by prepaid mail or prepaid courier shall be deemed to have been served on the third day following the date that the document was sent.

6.32 NOTICE OF LIEN

If the Contractor files a lien pursuant to the *Construction Remedies Act,* the Contractor is required to properly serve the Clerk of the City. In addition, the Contractor is required to simultaneously provide notice to the Engineer and the office of the General Counsel by electronic means with a request to acknowledge receipt. In the event the office of the General Counsel or the Engineer does not acknowledge receipt, notice shall be provided by personal service at the office of the General Counsel and the office of the Engineer.

6.33 WAIVER

No action or want of action on the part of the City or Engineer to exercise any right or remedy conferred upon them under the Contract shall be deemed to be a waiver of such right or remedy.

6.34 DISPUTES - ARBITRATION

6.34.01 Engineer to Decide Contract Related Issues

If at any time before the Work has been completed and the Engineer has issued their Certificate of Final Completion, any question arises as to whether anything has been done as required by the Contract or as to what the Contractor is required by the Contract to do, and in particular, and without limiting the generality of the foregoing, as to

a) the meaning of anything in the plans and specifications,

b) the meaning to be given to the plans and specifications in case of any error therein, and omission therefrom, or an obscurity or discrepancy in the wording or intention thereof,

6.34.01 Engineer to Decide Contract Related Issues (Cont'd)

c) whether the quality or quantity of any material or workmanship meets the requirements of the Contract,

d) whether the plan, material or workmen provided by the Contractor for executing the Work and carrying out the Contract are adequate to ensure that the Work will be executed in accordance with the Contract and that the Contract will be carried out in accordance with its terms,

e) what quantity of any kind of Work has been completed by the Contractor, or

f) the timing and scheduling of the various phases of the execution of the Work, the question shall be decided by the Engineer whose decision is final and binding.

6.34.02 Notice of Claim for Additional Time or Money

The Contractor shall, where the Contractor intends to submit a claim for additional time or money arising out of the construction of the Work, give written notice of an intention to claim

a) In the case of changes or alterations of the Work ordered by the Engineer, within ten (10) Working Days of receipt of the Notice of Change, and

b) In the case of a dispute arising out of the interpretation of the Contract, within twenty (20) Working Days of the first occurrence of the circumstances giving rise to the dispute.

6.34.03 Barred Claims

The Contractor may submit a claim for additional time or money only on those matters covered by the Notice of Intention to Claim given under section 6.34.02 and such claim if not submitted within twenty (20) Working Days of the occurrence of the portion of the Work out of which the claim arises shall be barred.

6.34.04 Engineer's Decision

The Engineer shall within twenty (20) Working Days of receipt of a Notice of Claim under this section render their decision in writing to the Contractor.

6.34.05 Contractor's Obligations Following the Engineer's Decision

The Contractor shall construct the Work in accordance with the decisions and directions of the Engineer given under this section and in accordance with any consequential decisions and directions given by the Engineer.

6.34.06 Arbitration

a) After the procedure outlined at sections 6.34.01 to 6.34.05 has been completed and the Contractor received the Engineer's decision pursuant to section 6.34.04, either party to the Contract may, upon written notice to the other, refer the dispute for determination to a Board of Arbitration (the "Tribunal") consisting of three persons, one chosen by and on behalf of the City, one chosen by and on behalf of the Contractor and the third chosen by these two.

6.34.06 Arbitration (Cont'd)

b) In case of failure of the two arbitrators appointed by the Parties hereto to agree upon a third arbitrator, such third arbitrator shall be appointed by a Judge of the Court of Queen's Bench of New Brunswick.

c) No one shall be appointed or act as arbitrator who is in any way interested, financially or otherwise, in the conduct of the work or in the business or other affairs of either Party.

d) Notwithstanding the provisions of the New Brunswick *Arbitration Act*, and amendments thereto, the Tribunal, upon such terms as are deemed by it to be appropriate, may allow a Party to amend or supplement its claim, defence or reply at any time prior to the date at which the Parties have been notified of the arbitration hearing date, unless the Tribunal considers the delay in amending or supplementing such statements to be prejudicial to a Party. The Tribunal will not permit a Party to amend or supplement its claim, defence or reply once the arbitration hearing has been scheduled.

e) The Tribunal may encourage settlement of the Dispute and, with the written agreement of the Parties, may order that mediation, conciliation or other procedures be used by the Parties at any time during the arbitration proceedings to encourage settlement.

f) If, during the arbitration proceedings, the Parties settle the Dispute, the Tribunal shall, upon receiving confirmation of the settlement or determining that there is settlement, terminate the proceedings and, if requested by the Parties, record the settlement in the form of an arbitration award on agreed terms.

g) Subject to paragraph (h), any determination made by the Tribunal shall be final and binding upon the Parties and the cost of such determination shall be apportioned as the Tribunal may decide.

h) Either Party may appeal an arbitration decision to The Court of Queen's Bench of New Brunswick: (i) on a question of law; or (ii) on a question of fact; or (iii) on a question of mixed fact and law.

i) The place of arbitration shall be the City of Saint John and Province of New Brunswick and the provisions of the *Arbitration Act*, New Brunswick, shall apply to the arbitration.

6.35 CONSTRUCTION REMEDIES ACT LIENS

The Contractor will pay promptly all indebtedness for labour, services, materials, tools and equipment used in the supply and performance of Work and Contractor will observe and comply with, and cause all Subcontractors to observe and comply with, all statutory holdback, trust and deemed trust obligations pursuant to applicable Laws. Before the Contractor is entitled to receive any payment, it will (if required, or if requested by the City) furnish evidence satisfactory to the City including, without limitation, Statutory Declarations of full payment of such indebtedness.

Contractor will not permit any lien, charge or encumbrance to attach to the Work, City property, or the Holdback. If any lien, charge or encumbrance do attach, the Contractor will immediately discharge, bond or otherwise secure against, and cause all Subcontractors and suppliers to

6.35 CONSTRUCTION REMEDIES ACT LIENS (Cont'd)

immediately discharge, bond or otherwise secure against, any liens, charges or encumbrances which may arise in connection with the Work. All payments by the City to Contractor hereunder will be in accordance with, and subject to, all applicable Laws, including any applicable holdback requirements under *Construction Remedies Act*, sales tax or other laws.

If any lien, charge or encumbrance do attach, the City may, without notice, discharge such lien, charge or encumbrance by securing the discharge, bond or otherwise by application to Court. The City may withhold payment from the Contractor to the extent of such lien, charge or encumbrance exist and the City shall be entitled to deduct the costs of such application including legal fees on a solicitor and client basis.

6.36 EQUIVALENTS

Where any particular brand of manufactured articles is specified, it is to be regarded as a standard, but another brand equally as good may be accepted, at the discretion of the Engineer. No change in the Specification will be made prior to the acceptance of the Tenders. A written ruling on equivalents prior to tender opening may be obtained from the Engineer upon request from a tenderer. All requests for equivalents must be submitted in writing to the Engineer at least five (5) Working Days prior to the Tender Closing. Such requests will be accompanied by complete descriptive and technical information so that a proper evaluation can be made. The evaluation shall be made only with the information received. Only Tenderers can request a ruling on equivalents.

When a request for approval of an equivalent product is made, the Engineer may grant approval and will issue a notification to this effect to Tenderers. If an item is approved as an equivalent, Tenderers may use that item in place of the specified item. In submission of bids incorporating approved equivalents to products specified, Tenderers shall include in their bid price any changes required in the Work to accommodate such approvals. Tenderers shall not have any claim against the City for an addition to the Contract price because of changes in work necessitated by use of approved equivalents.

If the Contractor wishes to substitute an equivalent after the Contract has been awarded, the Contractor shall, seek in writing, the Engineer's permission, stating differences in cost in each case. The Contractor will be held to the terms of the Contract unless they have received the Engineer's permission in writing to substitute an equivalent. No change or substitution can be made without the written consent of the Engineer.

Proposals for substitution will only be considered by the Engineer if:

a) Products selected by Tenderer from those specified, are not available; or

b) Delivery date of products selected from those specified would unduly delay completion of Contract; or

c) Alternative products to those specified, which are brought to the attention of and considered by the Engineer as equivalent to those specified, will result in a credit to the Contract in an amount acceptable to the City, or the quality of the product is deemed by the Engineer to be superior to those specified.

Where the Contractor proposes to use an item of equipment or product other than that specified or detailed on the Drawings, and which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or civil layout, all such redesign, and

6.36 EQUIVALENTS (Cont'd)

all new drawings and detailing required therefor, shall be prepared by the Contractor at the Contractor's own expense for approval by the Engineer. If a product is accepted as an equivalent, the Contractor shall be responsible for all related costs associated with any required modifications.

6.37 VERBAL ARRANGEMENTS

In all cases of misunderstandings and disputes, verbal arrangements will not be considered. The Contractor shall produce written authority from the City in support of the Contractor's contentions, and shall advance no claim in the absence of such written authority, or use, attempt to use, any conversation with any parties against the City, or in prosecuting any claim against the City.

This Contract contains and constitutes the entire agreement between the parties with respect to the Work; and supersedes all prior proposals, negotiations, commitments, representations, undertakings or agreements of any kind with reference thereto. Contractor acknowledges and agrees that neither has made any representations, promises or warranties to induce the execution of this Contract except as expressly set forth in this Contract or the Tender Documents.

6.38 OTHERS' RIGHTS

The Contractor shall allow reasonable access to other Contractors and their employees who are carrying out work, and to person(s) owning or operating any railway, tramway, wires, pipes or conduits, or works, or property on, along or near where the Work is being carried out. The Contractor shall notify all such owners and operators before interfering with any of their property rights, or privileges, and must work in harmony with them. The Contractor shall notify the Engineer in writing as to any difficulty which they have encountered with such persons and has not been able to overcome. The Engineer shall attempt to resolve any such problem and the Contractor shall abide by the Engineer's decision and direction.

The Contractor shall handle with care any property which the Engineer requires the Contractor to move. The Contractor shall neatly pile and preserve such property in such a manner as to prevent injury or loss to any persons and shall return the property to its appropriate place at the appropriate time. All such work must be done by the Contractor to the satisfaction of the Engineer and without extra charge to the City.

The Engineer has the right at all times to grant permission for an opening to be made or left by the Contractor in the ground or roadway, as the said Engineer may deem advisable, for the purpose of examining, repairing or laying any water, sewer, gas or other pipe, drain, tract or other underground or surface construction or to cause any such work as the Engineer may deem necessary or advisable to be done. Such permission, or the exercise of such rights, either by the Engineer or by the other person(s) or corporation having the requisite authority (either statutory or otherwise) shall not relieve the Contractor from any liability, nor shall the opening up of any portion of the Work for these or any other purposes, or by any other parties, relieve the Contractor of such liability.

6.39 CLAIMS OF CONTRACTORS

It is intended that every allowance to which the Contractor is fairly entitled will be included in the Engineer's monthly certificate but, should the Contractor at any time have additional claims of any kind which are not included in the said monthly certificate, such additional claims shall be made in writing to the Engineer within seven (7) Working Days of the discovery of said additional claim for work performed that month. Failure to present such additional claims in writing to the Engineer within the specified time will invalidate said additional claim, and cause the Contractor to lose its

6.39 CLAIMS OF CONTRACTORS (Cont'd)

right to recover same. The Contractor, in presenting claims of the kind referred to above, must accompany them with satisfactory evidence of their accuracy and the reasons why the Contractor thinks they should be allowed.

6.40 ELECTED MEMBERS

No member of the Legislative Assembly of the Province of New Brunswick shall be entitled to any share or part of the Contract or to any benefit arising therefrom.

No member of the House of Commons of Canada and the Senate of Canada shall be entitled to any share or part of the Contract or to any benefit arising there from if Government of Canada funds are involved, whether directly or indirectly, in the payment for or financing of such Contract.

6.41 NIGHT, SATURDAY, SUNDAY AND HOLIDAY WORK

The Engineer may order or the Contractor may request, Work to proceed in whole or in part at night, on Saturdays, Sunday or holidays if it is deemed necessary or expedient in order to preserve and maintain traffic over or on any street or road or to complete any work that are of an urgent nature. Such night or overtime work shall be performed by the Contractor at no additional cost to the City.

The Contractor shall, as far as possible, refrain from performing the Work on statutory holidays in the Province of New Brunswick. If work must be carried out on such a holiday the Contractor must notify the Engineer in writing at least four (4) Working Days in advance of such holiday stating those places where work will be conducted and what Engineering assistance may be required.

If the Contractor fails to give such notice in advance of any holiday, no Work requiring the presence of the Engineer is to be done by the Contractor on such a holiday.

6.42 RIGHT OF SET OFF

Without restricting any right of set off given or implied by law, the City may set off against any amounts payable to the Contractor under the Contract, any payment due to the City by the Contractor under this Contract or the Engineer's estimate of the dollar value of deficiencies which the Engineer identified under this Contract. Without restricting the generality of the foregoing, the City may, when making payment pursuant to section 6.21 - "Payment Certificates", deduct from the amount payable by virtue of the right of set off from the Contractor.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 7

CONSTRUCTION OF MUNICIPAL SERVICES

City of Saint John

TABLE OF CONTENTS

DIVISION 7 – CONSTRUCTION OF MUNICIPAL SERVICES

City of Saint John

TABLE OF CONTENTS

DIVISION 7 – CONSTRUCTION OF MUNICIPAL SERVICES

CONSTRUCTION OF MUNICIPAL SERVICES

7.1 GENERAL NATURE OF THE WORKS

The Works to be constructed under this Contract are shown on the Contract Drawings and described in the Contract Specifications. The nature of the Works is, in general, the construction and installation of such Municipal Works that are normally connected with the construction of roads, treatment plants, pumping stations and conveyance of sanitary sewage, storm water and/or water, recreation & parks facilities, and all the necessary Works required to put the same into operation.

7.2 SETTING OUT OF THE WORKS

The Engineer shall provide the primary field layout, which includes only the layout of the structures, road centerline and control points, at selected locations as shown on the Drawings. The Contractor shall be responsible for all other layout and all subsequent layouts and levels for the preservation of all survey reference points, control points and levels as shown on the Construction Drawings.

The Contractor shall lay out the work from the aforementioned control points and levels and shall be responsible for the correctness of such layout. If at any time during the progress of the Works any error shall appear or arise in the positions, levels, dimensions or alignments of any part of the Works, the Contractor shall, at the Contractor's expense, rectify such error to the satisfaction of the Engineer. The checking of any line or level by the Engineer shall not in any way relieve the Contractor of the responsibility for the correctness thereof.

The Contractor's instrument person responsible for all survey work required for the project shall be a certified Engineering Technician/Technologist, a registered Land Surveyor, an engineering Member-in-Training, or a Professional Engineer.

The Contractor shall use laser equipment for control of the vertical and horizontal alignment during the installation of both the gravity sanitary and storm sewer mains.

The Contractor shall inform the Engineer a reasonable time in advance of the times and places at which the Contractor wishes to do the work, in order that information, lines, elevations and grades may be confirmed, and necessary measurements for record and payment purposes may be made with minimum of inconvenience. No payment shall be made for the cost to the Contractor of any work or delay occasioned by establishing or checking lines or grades or making other measurements, and no extension of time shall be allowed for any delay occasioned thereby.

The whole of the Works shall rigidly agree in all particulars with the levels, measurements and details contained in the Drawings accompanying this Specification, and with such other drawings or information as may from time to time be supplied by the Engineer or may be supplied by the Contractor and approved by the Engineer.

7.3 SHOP DRAWINGS

For any portions of the work to be done under the Contract for which detailed drawings and specifications must be supplied by the Contractor, the Contractor shall submit such drawings and specifications to the Engineer for approval. No order shall be given for such work without such approval having been granted, nor will the Engineer accept such work unless such approval shall have first been granted. Approval of the Contractor's drawings by the Engineer shall not relieve the Contractor of the responsibility for the correctness thereof, nor from the results arising from any error or omission in details of design. Approval of drawings and specifications shall in every case be subject to final approval of the equipment and/or materials after they have been put in commission, all guarantees have been fulfilled, and the general operation of the equipment and/or materials have been found satisfactory by the Engineer.

7.4 INSTALLATION, OPERATION AND MAINTENANCE MANUALS

The Contractor, where applicable, shall supply two (2) hard copies and one electronic version (USB flash drive) of the operating and maintenance manuals, including operational equipment, parts listed with catalogue numbers for ordering and instructions for installation, adjustment, operation, lubrication and cleaning schedules, maintenance of each item of equipment, as well as overhaul and adjustment schedules. For hard copy submissions, the Contractor shall catalogue and bind all information for all equipment in alphabetical order in two (2) sets of hard-covered three-ring binders. To be included in each manual are copies of the shop drawings (see Section 7.3, “Shop Drawings”) revised to show construction revisions. In addition the information shall include:

(a) Title sheet, labeled “Operating and Maintenance Instructions”, containing project name and date;

(b) List of names, addresses and phone numbers of sub-contractors and suppliers who can repair or perform maintenance on equipment;

(c) List of contents;

(d) One page narrative explaining the operational philosophy; function of, and relationship between, the components and the controlling parameters;

(e) Schematic diagram(s) that show design levels, equipment start/stop/alarm levels, pipe inverts and any relevant dimensions;

(f) Copies of all control programs installed or modified during start-up and commissioning. Copy shall be provided on a USB flash drive;

(g) Complete set of final reviewed shop drawings;

(h) “Maintenance Summary Sheet” that lists, in chart form, all pieces of equipment and the recommended frequencies for preventative maintenance activities such as cleaning, lubrication, replacement of consumable parts, oil changes, etc;

(i) Guarantees

Each USB flash drive shall contain a table of contents, linkable to the applicable section. All documents shall be included with each USB flash drive and be in PDF format. The number of USB flash drives in a set is to be kept to a minimum with as much information as possible contained on each individual USB flash drive.

7.5 AS-BUILT INFORMATION

Immediately following the installation of any manhole or catch basin and associated inlet and outlet pipes as required, the Contractor shall record the as-built invert pipe elevations for all inlet and outlet pipes. This as-built information shall be provided to the Engineer before advancing more than one (1) length of pipe beyond the structure. The Contractor shall also record the as-built pipe elevations for all new watermain installations. Elevations shall be taken and recorded at 20 m intervals and at all significant changes in elevation caused by vertical bends, etc. The Contractor shall follow and record field information as per the sample provided to the Contractor by the City of Saint John. All the as-built information shall be neatly recorded in a City supplied hard covered field survey book which shall be returned to the Engineer within five (5) working days after substantial completion of the Site Work.

The elevations provided by the Contractor shall be referenced to the benchmarks provided by the City. The elevations of the benchmarks are provided on the Contract Drawings.

7.6 MATERIALS AND EQUIPMENT

7.6.01 Samples

When ordered by the Engineer, and before a material of any kind is used on the Works, the Contractor must submit samples thereof for the approval of the Engineer and no material shall be used which is in any way inferior to the approved samples. It shall also be understood that the approval of any material shall not subject the City to pay for the same, or prevent the rejection afterwards of any portion thereof which may turn out to be unsound or unfit to be used, in the judgment of the Engineer, nor shall such approval be considered as any waiver or objection to the work at any subsequent period, on account of the unsoundness or imperfection of the materials used, or on any other account.

7.6.02 Supply, Delivery and Storage

Unless otherwise noted, it is the Contractor's responsibility to order and arrange for delivery of all materials and equipment necessary for the completion of the work. Failure to have any materials or equipment on Site at the time that they are required for construction will be the Contractor's responsibility and expense and shall not result in an extension to the completion date or an extra to the Contract. The Contractor shall keep the Engineer fully advised of the orders and delivery dates of all materials.

All materials furnished by or to the Contractor shall be delivered and distributed at the Site by the Contractor unless otherwise specified. A Contractor must not load or permit to be loaded any part of the work with a weight or force that will endanger the work.

The cost of any demurrage or other charges which may be incurred by reason of the Contractor's failing to proceed promptly and efficiently to take delivery of any consignment, shall be chargeable to the Contractor.

7.6.02 Supply, Delivery and Storage (Cont'd)

The Contractor's responsibility for materials furnished by the City shall begin at the point of delivery thereof to said Contractor. Materials already on the Site shall become the Contractor's responsibility on the day of the award of the Contract. The Contractor shall examine all materials furnished by the City at the time and place of delivery to the Contractor and shall reject all defective materials. Any material furnished by the City and installed by the Contractor without discovery of such defects will, if found defective prior to final acceptance of the work, be replaced with sound material by the City. The Contractor, however, shall, at the Contractor's expense, furnish all labour and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the Engineer.

The Contractor shall be responsible for the safe storage of materials furnished by or to the Contractor, and accepted by the Contractor and intended for the Works, until it has been incorporated in the completed Contract. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

All materials furnished by the City that becomes damaged after acceptance by the Contractor shall be replaced by the Contractor at the Contractor's expense.

7.6.03 Quality of Materials and Workmanship

All equipment, materials and workmanship shall be the best of the respective kinds described in the Specifications and in accordance with the manufacturer's instructions and shall be subjected from time to time to such standard tests as the Engineer may direct at the place of manufacture or fabrication, on the Site, or at an independent testing laboratory. The use of any such materials may be forbidden if, upon delivery, they are found to be defective or if they are considered unsuitable for incorporation in the Works. The Contractor shall provide such assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing the Works and the quality, weight or quantity of any materials used and shall supply samples of materials before incorporation in the Works for testing as may be selected and required. The cost of this testing shall be deemed to be incidental and included in the Contract Unit Prices.

The Contractor shall have no claims against the City in respect of any financial loss which the Contractor may suffer from the rejection of such materials and shall also bear the cost of removing the materials from the Site and replacing with sound materials.

The judgment and decision of the Engineer as to whether the materials supplied and the work done under this Contract comply with the requirements of these Specifications will be conclusive and final. In all matters of detail not specifically covered by the Specifications, the work shall be well and skillfully done in accordance with the best trade or art customs and standards for work of like character and purpose and in full compliance with the manufacturer's specifications and instructions, where applicable.

7.6.04 Improper or Defective Materials and Workmanship

When the work completed or being done or the kind of quality of the equipment or materials supplied or being supplied does not meet Specifications or is not satisfactory to the Engineer, notice will be given verbally or in writing and the Contractor shall immediately, upon receipt of such notice, reconstruct the work and replace the equipment, all in accordance with the Specifications. All such reconstruction, replacement and repair shall be done at the expense of the Contractor.

Should the Contractor refuse or neglect to comply with the Engineer's requirements within two (2) working days from the receipt of such notice, the City will consider the Contractor to have forfeited the Contract. The provisions of Section 6.27, "Dismissal of Contractor", will then be exercised.

The fact of the Engineer not having disapproved of, or rejected any part or parts of the Works or any of the materials or equipment supplied in connection therewith at the time of making any Interim Payment hereunder, or at any other time during the continuance of this Contract, shall not be construed to be an acceptance of any such part or parts of the work or any such material.

Should the Contractor have any doubt about anything to be done or supplied, or as to any other matter, the Contractor shall clarify the matter with the Engineer before such item is commenced or delivered.

7.7 METRIC UNITS AND CONVERSIONS

(a) The following are the most commonly used metric units and abbreviations in City Contracts. Others may also be used, if necessary.

Table 7.1: Metric Units and Abbreviations

Quantity	SI Unit	SI Symbol
LENGTH	millimetre centimetre metre kilometre	mm cm m km
AREA	square millimetre square centimetre square metre square kilometre hectare	mm^2 cm^2 m^2 km^2 ha
VOLUME	cubic metre litre	m^3 L
MASS	gram kilogram tonne	g kg t
OTHERS	each lump sum pascal megapascal kilopascal micro degree celsius	ea LS Pa MPa kPa µ ^oC

(b) The following conversions are to be used in City Contracts if and when it becomes necessary. Any other conversions are to be approved by the Engineer.

Table 7.2: Conversions

Imperial to Metric			Metric to Imperial		
1 in	=	2.540 cm	1 cm	=	0.3937 in
1 ft	=	0.3048 m	1 m	=	3.280 ft
1 yd	=	0.9144 m	1 m	=	1.094 yd
1 mi	=	1.609 km	1 km	=	0.6214 mi
1 ft^2	=	0.0929 m^2	1 m^2	=	10.764 ft^2
1 yd^2	=	0.8361 m^2	1 m^2	=	1.196 yd^2
1 ac	=	0.4047 ha	1 ha	=	2.471 ac
1 yd^3	=	0.7646 m^3	1 m^3	=	1.3079 yd^3
1 imp. gal	=	4.546 L	1 L	=	0.219 imp. gal
1 lb	=	0.4536 kg	1 kg	=	2.205 lb
1 mi/hr	=	1.61 km/hr	1 km/hr	=	0.6214 mi/hr
1 psi	=	6.895 kPa	1 kPa	=	0.1450 psi
1 ton	=	0.9072 t	1 t	=	1.1023 ton
1 ft^3/s	=	28.32 L/s	1 L/s	=	0.0353 ft^3/s
1 ft-lb	=	0.7375 Nm	1 Nm	=	1.356 ft-lb

7.8 MATERIALS PRICE LIST

When the signed Form of Agreement is delivered to the City by the Contractor, the supporting documentation shall include a copy of a quoted price list from all material suppliers, on the supplier's letterhead. This price list will not form part of the Contract but will be used for information purposes only by the City when preparing future estimates.

7.9 PRECAUTIONS FOR THE SAFETY OF PERSONS AND PROPERTY

All work done under City of Saint John Contracts must comply with the latest revision of the following:

- The New Brunswick Occupational Health and Safety Act (NBOHSA)
- NBOHSA General Regulations 91-191
- City of Saint John Safety Policies and Procedures
- City of Saint John Work Zone Safety Manual
- City of Saint John Drug and Alcohol Policy
- City of Saint John Workplace Conduct Policy

As a condition of beginning construction, all prospective Contractors

(1) May be required to attend a safety orientation on the City of Saint John's Safety Policies and Procedures;

(2) Shall have familiarity with the City of Saint John Safety Policies and Procedures, including the City of Saint John Work Zone Safety Manual, the City of Saint John Drug and Alcohol Policy and the City of Saint John Workplace Conduct Policy; and

(3) Shall ensure that required City of Saint John Safety Policies and Procedures, including the City of Saint John Work Zone Safety Manual, the City of Saint John Drug and Alcohol Policy and the City of Saint John Workplace Conduct Policy, are available to and communicated to all persons on the Site.

The Contractor shall ensure attendance at said safety orientation (referred to in [1] above) by the owner or manager of the construction company and the foreman or foremen to be assigned.

The Contractor, the Contractor's agents and all persons employed by the Contractor, or under the Contractor's control, shall use due care in the execution of the Works so that no person or property is injured, and that no rights are infringed by any act, omission, neglect or default of the Contractor. The Contractor must obey the directions of the Engineer, Compliance Officers of WorkSafeNB, and the City employee assigned responsibility for coordinating occupational health and safety, at all times in this regard.

If in the opinion of the Engineer, the Contractor is not conducting construction of the Works with proper safety precautions or if the Contractor's employees are not wearing the proper personal protective equipment (aluminized vest, hard hat and safety boots) in accordance with the WorkSafeNB regulations, the Engineer may by giving notice in writing to the Contractor stop the work. Upon receipt of the written notice the Contractor shall immediately cease operations until the provisions of the WorkSafeNB regulations have been complied with to the satisfaction of the Engineer. No extension of time or monetary compensation shall be made to the Contractor for loss or delay arising from any stoppages in work due to non-compliance with the WorkSafeNB regulations.

7.9 PRECAUTIONS FOR THE SAFETY OF PERSONS AND PROPERTY (Cont'd)

The Contractor alone shall at all times be responsible for the safety, adequacy, and sufficiency of the Construction Equipment and the methods for executing the Works of this Contract, and shall also comply with the requirements of all regulations, etc., and of any relevant Engineer's instructions for the safety of all persons on the Site.

Without affecting the generality of the Contractor's liabilities under this Contract, the Contractor shall, at the Contractor's expense, provide and maintain whatever light, fencing, guards, barriers, shoring, timbering, watching and traffic directions and all other things and services as may be necessary for the safety of persons and the protection of the Site, the Works, and all materials and equipment thereon, and for the safety and convenience of third parties.

Should the Contractor neglect or be unable to carry out the above requirement, the Engineer is hereby authorized to place such watchmen, lights, barriers, etc., as are required, and charge the cost to the Contractor, without relieving the Contractor of any claims for damages or accidents.

The Contractor must comply with the provisions of the Worker's Compensation Act and all other appropriate Acts.

During the progress of the Works, the Contractor shall, at all times, provide and maintain in easily accessible positions on the Site adequate First Aid Outfits equal to those required by the NBOHSA Regulation 91-191 for the free use as necessary of all persons on Site.

The cost of the foregoing shall be deemed to be included in, distributed over and covered in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

7.10 PUBLIC RELATIONS

During the progress of the Works, the convenience of the public and the residents affected by the construction must be provided for. Convenient access to driveways, homes and buildings along the street must be maintained wherever possible. Pedestrian access past the Site must be maintained in order to ensure the safe and proper re-routing of pedestrians. Access to commercial and specifically designated properties must be maintained at all times.

The Contractor is required to notify the City of Saint John in writing 48 hours in advance when necessary interruption of water or sanitary services are required during the construction. Convenience and good public relations with the residents, where possible, must be maintained by all persons involved with the Works.

7.11 NOTIFICATION OF OFFICIAL AGENCIES

The Contractor shall be responsible for carrying out the Works in strict accordance with all Federal, Provincial and Municipal Laws, Acts, Regulations, by-laws, codes, etc., governing all or any part of the work under this Contract.

These requirements may affect methods of installation and/or construction and may include written notification and/or permits of the appropriate authority prior to commencement of the Contract. Where written notification and/or permits of the above authorities is required, a copy of the said notification and/or permits shall be submitted to the Engineer.

7.12 ENVIRONMENTAL COMPLIANCE

The City of Saint John will obtain the necessary Certificates of Approval to Construct and Watercourse Alteration Permits (as required) from the New Brunswick Department of Environment and Local Government for all projects, unless noted otherwise. A copy of the certificate, including Conditions of Approval, will be forwarded to the Contractor when the certificate(s) and permit(s) are received. A copy of the certificate must be available on the job site for the duration of the project.

The Contractor shall adhere to all conditions as outlined in the Certificates and/or Permits issued by the New Brunswick Department of Environment and Local Government.

At no time shall work on the project commence unless all necessary Environmental Approvals, Permits and Certificates have been received by the City of Saint John and copies provided to the Contractor.

7.13 SITE ACCESS

During the construction of the Works, the Contractor shall maintain proper access to and within the Site for all persons and vehicles entitled to such access, and shall maintain existing roads and paths in reasonable condition or provide suitable detours. The Site shall, at all times, be kept as clean and in good order as possible and shall, as soon as practicable, be cleared of all surplus construction equipment and material and left clean and in good order to the satisfaction of the Engineer.

7.14 INSPECTION OF THE WORKS

The Engineer may provide inspection for all materials used and work done under the Contract. The Contractor shall furnish the Engineer with access to all information regarding the Works and the materials which the Engineer may deem necessary or pertinent and with such samples of materials as may be required. No payment shall be made for the cost to the Contractor of any work or delay occasioned by such inspection and no extension of time shall be allowed for any delay occasioned thereby.

No work shall be covered up, or put out of view until it has been examined, measured and approved by the Engineer and the Contractor shall afford full opportunity for the Engineer to examine and measure any Works which is about to be covered up or put out of view and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Engineer whenever any such work or foundations are ready or about to be ready for examination and the Engineer without unreasonable delay (unless the Engineer considers it unnecessary and informs the Contractor accordingly), attend for the purpose of examining and measuring such work or of such foundations.

If any work should be covered without the approval or consent of the Engineer, it must, if required, be uncovered for examination and made good at the Contractor's expense.

The Contractor shall uncover any part or parts of the Work or make openings in or through the same as the Engineer may, from time to time, direct and shall reinstate and make good such part or parts to the satisfaction of the Engineer. If any such part or parts of the Work have been covered up or put out of view after compliance with the requirements of this Section and are found to be executed in accordance with the Contract, the expense of uncovering or making openings, reinstating and making good the same shall be borne by the City, but in any other case

7.14 INSPECTION OF THE WORKS (Cont'd)

all expenses shall be borne by the Contractor, and shall be recoverable from the Contractor by the City or may be deducted by the City from any monies due or to become due to the Contractor.

No approval by an Engineer's Representative shall be taken as, or construed into, an acceptance of defective or improper work or material, which must, in every case, be removed and properly replaced whenever discovered at any stage of the Works.

7.15 WATER, ELECTRICITY, TELEPHONE AND SANITATION

The Contractor shall, at the Contractor's expense, make all necessary arrangements for the supply of water, electricity, telephone and sanitation facilities for the construction of the Works.

7.16 PUMPING AND DRAINAGE

The Contractor shall bear all costs in connection with the dewatering of excavations, the removal of accumulations of water from the finished structures prior to being taken over for use, the pumping and removal of water from existing water or sewer mains where connections are to be made or appurtenances installed, the pumping and diversion of sewage and sludge necessary for the completion of the Works and any other pumping and drainage necessary at the Site for the proper construction and inspection of the Works.

The Contractor shall make provision for the discharge of any water, whether foul or discoloured, or otherwise in such a manner as shall be satisfactory to the Engineer and to any persons having rights over the lands or watercourses over or down which such water is discharged. The Contractor shall exercise due care to prevent the fouling of streams by persons or animals. The Contractor shall hold the City indemnified against any claim that may be made through non-compliance with this Section.

7.17 FLOATATION

The Contractor is warned that the ground water table at the Site may on occasion rise to such a level as to cause floatation or other damage to the structures. The Contractor shall observe all precautions against floatation of the structures during construction, and shall be responsible for any damage caused by floatation.

7.18 CARE OF THE WORKS

From the commencement to the completion of the Works, the Contractor shall take full responsibility for the care and protection thereof, and of all equipment and material(s) delivered to the Site, and of all temporary works required in the construction of the Works.

The Contractor shall, at the Contractor's expense, take special precautions to prevent fire occurring in or about the Works, and shall observe and comply with all laws and regulations in force respecting fires, and comply with any special instructions given by the Engineer with respect to the prevention and extinguishing of fires, and will pay all wages and disbursements occasioned by reason of the observance or compliance with such laws, regulations and instructions.

7.18 CARE OF THE WORKS (Cont'd)

The Contractor shall at all times keep the Site free from accumulation of waste material and rubbish. On the completion of the Works, the Contractor shall clear away and remove from the Site all Construction Equipment, surplus materials, rubbish and temporary works of every kind and leave the whole of the Site and Works clean and in a condition satisfactory to the Engineer. The Contractor shall be responsible for sweeping and removing all foreign matter from the Site or trucking routes that have had material deposited from the Works.

7.19 LOSS OR DAMAGE TO WORK OR PRIVATE PROPERTY

The Contractor shall bear all loss and damage whatsoever, and from whatever cause, arising which may occur on or to the Works during the fulfillment of this Contract. If any such loss or damage occurs, the Contractor shall immediately make good any such loss or damage, and in the event of the Contractor refusing or neglecting to do so, the City may employ some other person or persons to make good any such loss or damage and the expense of employing such person or persons, to make good any such loss or damage shall be charged to the Contractor, and any such action by the Engineer as the Engineer is herein empowered to take, shall not in any way relieve the Contractor or the Contractor's surety from any liability under the Contract.

The Contractor shall be responsible for reinstatement of any damage outside the limits of the Contract to lawns, fences, retaining walls, shrubbery, asphalt, private property, etc., at no cost to the Contract, if, as decided by the Engineer, the extent of the Site that was torn up was not kept to a minimum. As well, the Contractor shall be responsible for any damages to City owned infrastructure directly affected as a result of the Work including, but not limited to, sanitary sewers, storm sewers, watermains, pumping stations, and treatment facilities.

7.20 TRAFFIC DIRECTION AND CONTROLS

The Contractor shall be required to submit a traffic control plan consisting of traffic detour and work zone safety plans and drawings at least fourteen (14) days prior to start of construction, unless the traffic control plans are provided in the contract documents. The traffic control plan must be approved by the Engineer before work commences on the site.

When carrying out work on any street, the Contractor shall provide and maintain competently trained flaggers, for traffic direction and control when the Contractor is working. As a minimum one (1) flagger at each end of the project and one (1) flagger per crew are required unless otherwise directed by the Engineer. Each flagger must use the standard New Brunswick Department of Transportation and Infrastructure 600 mm stop/slow signs and wear proper personal protective equipment. All flaggers shall have successfully completed the New Brunswick Safety Council "Highway Signalers Course" and possess a Certificate of Completion. The Contractor shall also provide barriers, signs, and lights as required by the Engineer, City of Saint John Safety Policies and Procedures, WorkSafeNB, Saint John Police Force, Royal Canadian Mounted Police, and/or New Brunswick Department of Transportation and Infrastructure, for the safety and convenience of the public. In addition, the Contractor may be required at the discretion of the Engineer, to supply two (2) highway style "flashing arrow" signs, Amida Model DLS or as approved by the Engineer, in addition to standard flashers to alert traffic of lane changes in both directions. These signs shall be in place at all times, both day and night. The Contractor shall be deemed to have included in the tender, for all costs of traffic direction and control.

7.20 TRAFFIC DIRECTION AND CONTROLS (Cont'd)

Two-way traffic shall be maintained during construction unless otherwise approved by the Engineer. There will be no parking on this section for the duration of the Works. Within a minimum of three (3) working days prior to any street closing or traffic rerouting, the Contractor must arrange with the Engineer a meeting to coordinate construction scheduling and the responsibilities of both the Contractor (notifying essential services, etc.) and the City (traffic lighting, etc.) during the actual construction. No streets or sections of streets can be closed without the prior notice as stated above and approved by the Engineer. The Contractor shall notify the Public Safety Communications Centre (648-3333) of all traffic disruptions, delays or detours resulting from their work. For long duration traffic disruptions, delays or detours the contractor shall notify the PSCC one week in advance of the disruption, delay or detour. The Contractor shall notify the PSCC when the disruption, delay or detour is no longer in effect.

All necessary lights will be kept working from sunset to sunrise. Barricades will be provided around all excavations for the prevention of accidents. All signs must be approved New Brunswick Department of Transportation and Infrastructure signs. All sign stands must be collapsible metal stands, NCHRP 350 tested. Signs must be maintained in such a manner so as to be clearly visible to the traveling public at all times.

The Contractor shall install and maintain such approved barriers, signs, lights and signalers as may be necessary for the safety and convenience of the public and work area. All signage, whether held by flaggers or stationary, for use at work Sites in public areas including on streets and roadways, shall be bilingual (English and French) pursuant to Section 3 of New Brunswick Regulation 2002-63 established under the Official Languages Act of New Brunswick (June 27, 2002), and Section 36 of the Official Languages Act. The cost associated with providing this signage shall be deemed to be distributed among and included in the Contract Unit Prices.

The work shall be done in a manner which creates the least interference with traffic, consistent with the faithful performance of the work. At the discretion of the Engineer, normal traffic may be diverted from a street undergoing major construction, but safe and convenient access to existing private entrances shall be maintained insofar as practicable.

Before removing any traffic control devices, written permission must be obtained by the Contractor from the Engineer. Failure to do so may result in charges being laid under Section 124 of the New Brunswick Motor Vehicle Act for the unlawful removal of the traffic control device without the consent of the Engineer. Existing, permanent signage removed by the Contractor for the duration of the Work must be replaced with temporary approved signage, as directed by the Engineer. All signs must be permanently reinstated when the Work is completed.

The cost of the foregoing shall be deemed to be included in, distributed over and covered in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

7.21 DISRUPTION OF SERVICES

The Contractor shall ensure uninterrupted service to homeowners and/or businesses. Any damage to existing water or sewer services caused by the Contractor shall be repaired by the Contractor at the Contractor’s expense. The City may be contacted for assistance in locating the above mentioned private services.

7.22 OPERATION OF VALVES OR OTHER CONTROLS

No valve or other control on any existing water or sewer system shall be operated for any purpose by the Contractor. An authorized person from the City's - Water and Wastewater Systems will operate these controls.

If the Contractor requires the main to be opened or closed, arrangements should be made with the City's - Water and Wastewater Systems with at least forty-eight (48) hours' notice. If any call out is required after regular working hours, it shall be at the Contractor's expense unless otherwise specified by the Engineer. The City shall not be liable for delay in construction due to operation of valves, controls, etc., by the City.

Operation of any valve or other control on any existing water or sewer system by anyone other than an authorized person from the City's – Water and Wastewater Systems, will result in a penalty to the Contractor of one thousand dollars ($1,000) per incident which will be deducted from any monies payable to the Contractor under the Contract.

7.23 CONNECTIONS TO OR CONFLICT WITH OTHER UTILITIES OR STRUCTURES

It may be necessary for the Contractor to make connections to lines which are controlled by another utility company other than the City. In such event, the Contractor will carry out such connection in accordance with the specific instruction of the representative utility concerned, or pay for the services rendered by the utility company.

Certain underground and aboveground facilities may be located along the construction route and it is the responsibility of the Contractor to maintain liaison with the appropriate utility authorities to ensure that no damage is affected to these facilities. The Contractor shall also be responsible to request that the underground utilities be located and marked out in the field prior to commencement of construction. This includes, but is not limited to, all water, sewer, gas pipes, oil pipelines, culverts, all telephone, telegraph, electric power lines, cables, poles, conduits, etc.

The approximate location of the facilities may be shown on the Drawings, but the Engineer accepts no responsibility for the accuracy or completeness of this information.

Any damage caused to any water and sewer pipes, catch basins pipes, culverts, etc., will be immediately repaired by the Contractor. The Contractor will bear the cost of all repairs to any pipe that is shown on the Drawings or is readily visible or is marked out on the Site.

No claim will be entertained for any damage or any slowdown of work due to any involvement with the aforementioned utilities.

7.24 WORKING WITHIN FLOODPLAINS

No excavated material is to be disposed of on any property located within the area controlled by the City of Saint John Flood Risk Area By-Law. The Contractor shall contact the City's Buildings and Inspection Services Department for information on the location and limits of the Flood Risk Area.

7.25 GRAVEL PITS

Gravel pits must be left in such a condition that they comply with the City of Saint John By-Laws and legislation regarding gravel pits. Material used on City projects may be sourced from a Pit or Quarry located outside of the City or, if sourced from a Pit or Quarry located within the City, the Pit or Quarry must be properly licensed pursuant to Section 680 of the Saint John Zoning By-Law. Contact the Buildings and Inspection Services Department for further details.

7.26 TRUCK ROUTES

All heavy equipment, including trucks, hauling imported material or empty, shall use a designated City truck route where possible, otherwise shall proceed to and from the work Site by taking the shortest route to and from the nearest City truck route. Route to be used shall be approved by the Engineer.

7.27 WORKING NEAR EXISTING TREES AND SHRUBS

The Contractor shall use care and caution while working adjacent to existing City or private trees or shrubs in the path of water, sewer, curb, sidewalk, and road construction. If the root structure of a tree or shrub is encountered, the Contractor must immediately contact the City of Saint John's Leisure Services Department for inspection of the roots, and for procedures for preserving the tree or shrub.

7.28 EXCAVATION AND CONSTRUCTION NEAR NATURAL GAS PIPELINES

Prior to the start of any of the following construction activities anywhere within the City of Saint John, the Contractor shall contact Maritimes & Northeast Pipeline, Emera New Brunswick (owner of Brunswick Pipeline) and Liberty Utilities and obtain a field gas pipeline locate. The Contractor shall obtain a completed Line Locate Request Form from the gas pipeline company signed by both the Contractor and the gas pipeline company. A copy of the signed Line Locate Request Form must be given to the Engineer by the Contractor before the start of any construction activities. The Contractor's copy of the signed Line Locate Request Form must be available for review at the construction site for the duration of the project.

The construction activities include but are not limited to:

- All excavation work
- Ground disturbance
- Ploughing below 300 mm
- Ground leveling
- Installing drainage systems
- Augering
- Fencing
- Blasting

Construction activities near Maritimes & Northeast Pipeline and Brunswick Pipeline are governed by the National Energy Board and construction activities near Liberty Utilities pipelines are governed by the New Brunswick Energy and Utilities Board. The Contractor shall adhere to the regulations of the appropriate authority when carrying out construction activities near the following natural gas pipelines:

7.28 EXCAVATION AND CONSTRUCTION NEAR NATURAL GAS PIPELINES (Cont'd)

Maritimes & Northeast Pipeline

All construction activities within the Maritimes & Northeast Pipeline right-of-way and within the thirty (30) metre Prescribed Area on either side of the pipeline centerline shall be carried out in strict accordance with the National Energy Board *Pipeline Damage Prevention – Ground Disturbance, Construction and Vehicle Crossings* document, latest edition as well as the Maritimes & Northeast Pipeline *Requirements for Construction Near Company Pipelines (TG-010C)* guideline, latest edition. All activities within the right-of-way and within the thirty (30) metre Prescribed Area on either side of the pipeline centerline are governed by the National Energy Board Act and easement agreements negotiated between the landowner and the gas pipeline company. Unauthorized construction or excavation across, on, along or under a right-of-way or unauthorized excavation using power-operated equipment within the thirty (30) metre Prescribed Area on either side of the pipeline centerline is illegal. Use of explosives within 152 metres of the pipeline centerline requires company review and written permission.

The Contractor shall contact Maritimes & Northeast Pipeline well in advance of the Contractor's proposed construction start date and obtain written permission from the gas pipeline company for mechanical excavation and construction work within the right-of-way or for mechanical excavation work within the thirty (30) metre Prescribed Area on either side of the pipeline centerline. The gas pipeline company will respond in writing within ten (10) working days from date of Contractor's submission.

The Contractor shall provide the Engineer with a copy of the Contractor's submission to the gas pipeline company and with a copy of the gas pipeline company's written response as soon as is practical but in all cases before start of any construction activities.

A copy of the National Energy Board's *Pipeline Damage Prevention – Ground Disturbance, Construction and Vehicle Crossings* document may be obtained from the National Energy Board or the Government of Canada. The *Requirements for Construction Near Company Pipelines (TG-010C)* guideline may be obtained from Maritimes & Northeast Pipeline.

Brunswick Pipeline

All construction activities within the Brunswick Pipeline right-of-way and within the thirty (30) metre Prescribed Area on either side of the pipeline centerline shall be carried out in strict accordance with the National Energy Board *Pipeline Damage Prevention – Ground Disturbance, Construction and Vehicle Crossings* document, latest edition as well as the Brunswick Pipeline *Requirements for Construction Near Company Pipelines (TG-010C)* guideline, latest edition. All activities within the right-of-way and within the thirty (30) metre Prescribed Area on either side of the pipeline centerline are governed by the National Energy Board Act. Unauthorized construction or excavation across, on, along or under a right-of-way or unauthorized excavation using power-operated equipment within the thirty (30) metre Prescribed Area on either side of the pipeline centerline is illegal. Use of explosives within 152m of the pipeline centerline requires company review and written permission.

The Contractor shall contact Emera New Brunswick (owner of Brunswick Pipeline) well in advance of the Contractor's proposed construction start date and obtain written permission from the gas pipeline company for mechanical excavation and construction work within the right-of-way or for mechanical excavation work within the thirty (30) metre Prescribed Area on either side of the pipeline centerline. The gas pipeline company will respond in writing within ten (10) working days from date of Contractor's submission.

7.28 EXCAVATION AND CONSTRUCTION NEAR NATURAL GAS PIPELINES (Cont'd)

The Contractor shall provide the Engineer with a copy of the Contractor's submission to the gas pipeline company and with a copy of the gas pipeline company's written response as soon as is practical but in all cases before start of any construction activities.

A copy of the National Energy Board's *Pipeline Damage Prevention – Ground Disturbance, Construction and Vehicle Crossings* document may be obtained from the National Energy Board or the Government of Canada. The *Requirements for Construction Near Company Pipelines (TG-010C)* guideline may be obtained from Emera New Brunswick (owner of Brunswick Pipeline).

Liberty Utilities New Brunswick

All construction activities near the Liberty Utilities New Brunswick Pipelines shall be carried out in strict accordance with the latest edition of the New Brunswick Energy and Utilities Board – Guidelines for Excavations in the Vicinity of Pipelines and Liberty Utilities New Brunswick - Third Party Requirements in the Vicinity of Natural Gas Facilities documents. A copy of these documents can be obtained from the New Brunswick Energy and Utilities Board and from Liberty Utilities New Brunswick. The City of Saint John encourages all Contractors working on City projects to contact Liberty Utilities New Brunswick to receive training on excavating in the vicinity of natural gas pipelines.

All costs for excavation and construction near natural gas pipelines in accordance with the respective regulations shall be deemed to be distributed among and included in the Contract Unit Prices.

7.29 UTILITY POLES

If required, the Contractor shall make necessary arrangements with the proper utility and pay all costs associated with temporary removal of any guy wires and temporary support of utility poles including reinstatement of guy wire anchors. The cost for the above work shall be deemed to be distributed among and included in the Contract Unit Prices.

7.30 SURFACE MAINTENANCE AND REINSTATEMENT

The Contractor shall cut neatly the concrete or asphalt required for the execution of the Contract before the start of the work and shall maintain all cuts level with the road surface with granular base material.

Granular base backfill material, where specified, shall be placed and compacted in accordance with the Specifications as initial backfilling operations proceed such that all granular surfaces open to traffic shall be granular base material.

In cases where the concrete or asphalt is damaged during construction, the edges shall be trimmed to neat, straight lines before reinstatement work is commenced by the Contractor (see Section 13.5.01, "Removal of Pavement, Curbs, and Sidewalks"). If any deficiencies arise during the maintenance period (see Section 6.18, "Maintenance Period"), the Contractor, at the Contractor's expense, must locate, repair, maintain and reinstate as necessary to the satisfaction of the Engineer.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 10

WATER SYSTEMS

City of Saint John

TABLE OF CONTENTS

DIVISION 10 – WATER SYSTEMS

City of Saint John

TABLE OF CONTENTS

DIVISION 10 – WATER SYSTEMS

WATER SYSTEMS

10.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, material, plant and equipment for the supply and installation of watermains, services and all appurtenances as per the Drawings and Specifications.

10.2 DEFINITIONS

Not applicable to this Division.

10.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract.....Div. 6

(b) Construction of Municipal Services.....Div. 7

(c) Manholes, Catch Basins, and Valve Chambers .....Div. 12

(d) Excavation, Trenching and Backfill Requirements .....Div. 13

(e) Restoration.....Div. 21

(f) Standard Drawings

10.4 MATERIALS

All materials and equipment installed that may come in contact with potable water must be certified to NSF/ANSI Standard 61: Drinking Water System Components including Annex G.

10.4.01 Pipes

The latest editions of AWWA, CSA and NSF Specifications are considered as part of these Specifications.

Pipes generally are to be in accordance with details shown on the Drawings and are to be suitable for the purpose for which the pipes are specified. If requested by the Engineer, the manufacturer's name and test certificate shall be submitted by the Contractor.

The following information shall be clearly marked on each section of pipe:

(a) Date of manufacture;
(b) Name or trademark of the manufacturer;
(c) ASTM pipe class;
(d) Diameter of the pipe; and
(e) CSA Standard.

10.4.01 Pipes (Cont'd)

Ductile iron pipes 100 mm to 300 mm diameter shall be pressure class 350 unless otherwise specified. The Pressure Class of ductile iron pipes 400 mm diameter and larger shall be as specified. Ductile iron pipes shall be cement mortar lined, and shall conform to the latest CSA B131.10, AWWA C104, C105, C111, C150, C151, C153 Standard Specifications of mechanical joint and tyton joint, all of which shall be approved by the Engineer. The pipes, bends, tees, etc. shall be coated internally and externally with compounds applied at the manufacturer's plant. All ductile iron pipes, 600 mm and greater that are to be cut, require factory gauging.

All ductile iron pipes shall be encased in one layer of 8 mil thick polyethylene encasement to ANSI/AWWA C105/A21.5. All joints are to be taped with 50 mm wide tape as recommend by the pipe manufacturer. When installing ductile iron pipe, polyethylene encasement shall include vertical hydrant piping, all valves, bends, tees, caps and reducers. The Contractor is to provide on-site services from the ductile iron pipe supplier for training and inspecting the Contractor's methods for the polyethylene encasement of the ductile iron pipe, unless approved otherwise by the Engineer.

All concrete pressure pipe (400mm and larger) shall be bar wrapped steel cylinder type manufactured in accordance with the latest AWWA C303 Specification for diameters of 350 to 500 mm diameter or prestressed concrete cylinder pipe, manufactured in accordance with the AWWA C301 Specification for diameters of 600 mm and larger. The pipe shall be furnished complete with gaskets, diapers for mortar, pre-packaged bags of dry pre-mixed grout and lubricant as required.

The Engineer must specify the required internal working pressure, field test pressure, the maximum earth cover and required corrosion protection to determine the pipe class to be manufactured. All specials and fittings required for bends, branches, closures, and connections shall be designed according to the latest AWWA M-9 Manual Guidelines.

Concrete pressure pipe shall not be used for distribution mains nor have service connections. Grout used in conjunction with concrete pressure pipe repairs only shall be Sika Top 123 Plus, or approved equivalent.

Polyvinyl chloride (PVC) pipes shall conform to the latest AWWA C900, and CSA B137.3 Standards. All PVC pipes shall have an integral bell joint feature and gasket as recommended by the manufacturer. The pipes shall be DR18, Class 150 and with cast iron outside diameter unless specified otherwise. Colour coding shall be blue.

All new PVC watermain installation shall include tracer wire in accordance with Section 10.5.25 "Installation of Tracer Wire".

10.4.02 Fittings

All fittings shall be gray-iron 1725 kPa and meet the requirements of the latest AWWA Standard C110, or ductile-iron fittings meeting the requirements of AWWA C153, 2415 kPa. PVC pressure fittings shall meet the requirements of

10.4.02 Fittings (Cont'd)

AWWA C907 and CSA B137.2, Class 150, latest editions (for sizes 100 mm through 200 mm only). Joints for gray-iron fittings will be a mechanical type, meeting the requirements of the latest AWWA Standard C111 for rubber-gasket joints for ductile-iron pressure pipe and ductile-iron and gray-iron fittings. Fittings will be complete with component parts. PVC pressure fittings shall be the push-on bell and spigot type.

10.4.03 Gate Valves

Gate valves shall be used for all valves up to and including 300 mm diameter, unless otherwise specified by the Engineer. All gate valves shall be FM approved and ULC listed.

If an installed valve is to be "normally closed", a gate valve is to be used.

All gate valves are to be resilient seated unless otherwise specified. Valves for underground applications shall be mechanical joint unless noted otherwise.

All resilient wedge gate valves shall conform to the latest AWWA C509 or C515 Standards. The wedge shall be of cast or ductile iron completely encapsulated with rubber. The wedge shall have a non-rising stem, unless specified otherwise, which shall be threaded so that the valve opens when the stem is rotated clockwise. The stem and thrust collar shall be integrated and made of manganese bronze or stainless steel. The top of the stem shall be supplied with a 50 mm square operating nut. The sealing rubber shall be permanently bonded to the wedge to meet ASTM D429 Standard for bonding.

Valves shall be coated with fusion bonded epoxy, both on the exterior and interior, and shall be supplied with o-ring seals at all joints. No flat gaskets are permitted. All valve coatings shall be NSF approved.

Acceptable Manufacturers:
Clow
Mueller Canada
AVK

10.4.04 Butterfly Valves

General

Butterfly valves shall be used for all valves greater than 300 mm diameter.

All butterfly valves shall be short body, Class 150B, of the rubber-seated tight-closing type, designed, manufactured, tested, and conforming to the latest AWWA C504 Standard.

Both valve ends shall be mechanical-joint (unless Class 125 flanged ends to ASNI V16.1 are specified) as per AWWA C111. Accessories (bolts, glands, and gaskets) shall be supplied by the valve manufacturer. Flanges are to be drilled and faced in accordance with ANSI B16.1 Class 125.

10.4.04 Butterfly Valves (Cont'd)

All valves must use full AWWA C504 Class 150-B valve shaft diameter and full Class 150-B underground-service-operator torque rating throughout entire travel to provide capability for operation in emergency service.

Valve body shall be cast-iron with mechanical joint ends. Mechanism shall be cast-iron, cast steel, alloy cast-iron or ductile-iron disc, type 304 stainless steel shafts to ASTM A276, rubber seated for positive shut-off at minimum 1 MPa differential pressure, either direction.

The valve body is to be epoxy coated both on the interior and exterior with minimum of 150 microns coating. All valve coatings shall be NSF approved.

Valve

Rubber seat shall be a full circle, 360 degrees, not penetrated by the valve shaft. Valve shaft shall be one piece, 304 stainless steel, extending full size through the entire valve and operator with no neck-down, keyways or holes to weaken it. Valve disc shall rotate 90 degrees.

Operator

Valve operator shall be of the traveling-nut type, sealed, gasketed, and lubricated for underground buried service. It shall be capable of withstanding an overload input torque of 610 Nm at full-open or closed position without damage to the valve or valve operator. It shall be designed to resist submergence in water to 7.5 m head pressure. Number of turns to operate valve shall be as listed in Table 10.1 in order to closely resemble conventional distribution valve practices, and to minimize water hammer.

Table 10.1: Turns To Close (Butterfly Valve)

Valve Size (mm)	Number of Turns to Close
350 - 500	30 - 50
600 - 900	40 - 100
1050 - 1200	90 - 220

Valves shall be capable of easy closure by one person using standard valve key, even under emergency line-break conditions as severe as those that would cause a valve maximum opening torque requirement of as much as two (2) times AWWA Class 150-B Standard.

All valves shall open clockwise (right), and be equipped with 50 mm AWWA operating nut. Valve operator shall have easily adjusted stops in both open and closed positions. A hand wheel operator is to be provided that will fit over the 50 mm operating nut, when the valve is installed in a larger than normal man-entry chamber or above-ground control room.

10.4.04 Butterfly Valves (Cont'd)

Tests

All valves shall be tested for leakage at rated working pressure of 1034 kPa by the manufacturer.

In addition, a hydrostatic test with vane partially open shall be given to the assembled valve at a working pressure of 2060 kPa.

Factory testing certificates, stamped by an engineer, detailing the leakage test must be supplied to the City prior to installation. Each valve must be marked with a unique identifier that can be matched to the certificate and verified in the field before installation.

After installation, each valve shall be pressure tested in the closed position in conjunction with the pipeline pressure test. This may require multiple pressure tests to ensure that all valves are tested.

Acceptable Products: Clow M&H Style 4500 and 1450
Mueller Lineseal III
Val-Matic American-BFV

10.4.05 Combination Air Valves

Combination air valves shall be Apco Valve Model 145C, Val-Matic Model 202C.2, Crispin Valve UL Series Model UL20, Vent-O-Mat Model 050 RBX 2521 or approved equivalent.

Unless otherwise specified, inlet size shall be 50 mm (large) and 2.3 mm (small). A 50 mm corporation main stop shall be installed to allow isolation of the air valve. Refer to the respective Standard Drawing.

10.4.06 Valve Boxes and Valve Chambers

Valve boxes shall be used on all butterfly valves and on gate valves up to and including 300 mm in size unless otherwise specified. Cast-iron valve boxes shall be regular style 130 mm slide valve boxes complete assembly (bell bottom, guide plate, locking ring, top cover and any extensions required). Refer to respective Standard Drawing(s).

Acceptable Manufacturers: Bibby Ste-Croix
Mueller Canada
Star Pipe Canada
DomCast Components & Assemblies

Adjustable Valve Boxes shall be used in all road surfaces unless specified by Engineer. Adjustable valve boxes shall be complete with polymer bottom section, 686 mm ductile iron adjustable top section, cast-iron lid and guide plate.

10.4.06 Valve Boxes and Valve Chambers (Cont'd)

Valve chambers (1050 mm minimum) shall be used on all gate valves larger than 300 mm, unless otherwise specified. All valve chambers shall conform to Division 12, "Manholes, Catch Basins and Valve Chambers".

10.4.07 Service Pipe

Service pipe shall be a minimum of 25 mm diameter, unless otherwise specified. Service pipe shall be installed in accordance with the Standard Drawings.

Acceptable Products: Type "K" seamless copper tubing to ASTM B88
Q-Line (PEX-AL-PEX) tubing to CSA B137.10
Municipex (PEXa) tubing to CSA B137.5
Blue904 (PEX) tubing to CSA B137.5

Q-Line, Municipex and Blue904 tubing shall be blue in colour. All service pipe shall include tracer wire in accordance with Section 10.5.25 "Installation of Tracer Wire".

Brass corporation fittings, for Q-Line tubing (main stops, curb stops, couplings, etc.) shall be specifically designed for use with Q-Line tubing and shall meet the requirements of AWWA Standard C800.

10.4.08 Service Boxes

Service boxes shall be cast iron, 105 mm diameter, and slide. Boxes shall be located at the street/property line whenever possible, or as directed by the Engineer. Service box installation shall include tracer wire in accordance with Section 10.5.25 "Installation of Tracer Wire".

Acceptable Manufacturers: Bibby Ste-Croix
Mueller Canada
Sigma
Star Pipe Canada

10.4.09 Corporation Main Stops

Corporation main stops shall be brass and shall be ball valve type with inlet end having the standard corporation threads to ANSI/AWWA C800 and outlet having copper compression type connection.

Acceptable Products: A.Y. MacDonald Mfg. Co.
Cambridge Brass, Model No. 301
Ford Meter Box Company, Inc.
Mueller Canada Series B25008

10.4.10 Adaptors

Adaptors shall be brass, compression style, to the latest ANSI/AWWA C800 Standard, Mueller Canada Series H-15512N, H-15509N, H-15403, Cambridge Brass Model #118NL, Model #119NL, or approved equivalent.

10.4.11 Curb Stops

Curb stops shall be brass and shall be ball valve type with both inlet and outlet ends having copper compression type connection. Curb stops to meet the latest ANSI/AWWA C800 Standard.

Acceptable Products: A.Y. MacDonald Mfg. Co.
Cambridge Brass, Model No. 202
Ford Meter Box Company, Inc.
Mueller Canada Series B25209

10.4.12 Hydrant Anchor Tees

Hydrant anchor tees shall be mechanical joint by swivel, complete with swivel gland, ductile iron class 350 as per ANSI/AWWA C153/A21.53, latest editions.

Acceptable Products: Bibby Ste. Croix
Sigma
Star Pipe Products

10.4.13 Fire Hydrants

Fire hydrants shall be complete with safety flange, for 1.8 m depth of cover over the hydrant lead, with 150 mm mechanical joint. They shall be equipped with two hose nozzles and one pumper nozzle. Hose connection shall be 2.997 inch OD, 8 threads per inch. Pumper connection shall be 4 inch (100mm) Storz pumper connection. The hydrant valve shall close when the operating nut is rotated clockwise. Fire hydrants and connections shall be in accordance with the latest AWWA C-502, ULC and FM Standards. They shall have a maximum working pressure of 1034 kPa; 2068 kPa test pressure. Hydrants shall be compression type complete with safety flange. All weather-proof caps shall be 31mm square nuts.

The drain holes in the boot of the hydrant shall be permanently plugged internally.

Fire hydrant installation shall include tracer wire in accordance with Section 10.5.25 “Installation of Tracer Wire”.

Hydrants to be installed at locations as indicated on the Drawings.

Acceptable Products: Canada Valve Century
Clow McAvity Brigadier M-67
Mueller Modern Centurion
Mueller Super Centurion*****
McAvity M-67B Heritage*****
American AVK Company 2780*

***** for use in designated Heritage areas only as directed by the Engineer.

10.4.14 Corrosion Protection

Bolts

The Contractor shall protect the bolts on all buried mechanical fittings on distribution mains. Bolts shall be protected from corrosion by using ¾"x10 UNC zinc Cor-Cap nuts as supplied by Interprovincial Corrosion Control Company Limited, ¾-10NC Zinc Caps as supplied by Integrity Pipeline Products Limited, ¾ NPT zinc Bren Sac caps as supplied by Bren Technologies Inc, or approved equivalent.

Anodes

Anodes shall be ASTM B418 Type II and have zinc ingot weights of (5.5 kg) or (11 kg), with a 100 mm diameter permeable cardboard tube. Filler material shall have a composition of gypsum - 77%, bentonite - 15%, and sodium sulfate - 8%.

Anodes shall be kept dry prior to installation. Anodes shall carry a label identifying the manufacturer, the product I.D. number, the type and weight of the anode, metal and filler composition.

To guarantee the quality of the high-purity zinc, an Affidavit stating the metallurgical analysis of the anode composition shall be supplied by the supplier, when requested by the Engineer, prior to the start of construction.

Acceptable Products: Interprovincial Corrosion Control
Corrosion Service
Exothermal Industries
Integrity Anode Corporation
Bren Technologies Inc.

Protective Coating for Fittings

Anti-corrosion petrolatum paste, tape and mastic shall be installed on all fittings where specified or shown on the Drawings. The Contractor shall transport and store coating materials at temperatures between 5°C and 30°C. The Contractor shall ensure surface to be coated is free of loose coating, rust, soil, and other foreign matter; apply priming paste to areas after surface preparation is complete; apply mastic to irregular surfaces to ensure smooth surfaces and no air pockets; apply tape spirally to areas receiving paste or mastic using a 55% overlap wrapping technique; and wrap protected areas with 200 micron polyethylene sheet prior to backfilling.

Acceptable Products: Petro Coating Systems
PetroWrap
STAC
Trenton
Winn & Coales (Denso) Ltd.
PetroGuard

10.4.15 Couplings

Couplings shall be epoxy or nylon coated, ductile iron or steel, complete with T304 or T316 stainless steel bolts and nuts and suitable for a minimum working pressure of 1034 kPa. Bolts are to be to latest AWWA C111 Standard.

10.4.15 Couplings (Cont'd)

Couplings are to be suitable for the type of pipe being connected. The Contractor is responsible to confirm the actual OD of the pipes and ensure proper coupling sleeve lengths. Gaskets shall be provided by the Contractor to suit the range in pipe size for specific application.

The minimum coupling sleeve length shall be 178 mm (7 in.) for pipe diameters 100 mm - 200 mm. Acceptable Manufacturers: Robar Industries Ltd., Romac Industries, Inc., Smith-Blair and Ford, Krausz Industries Ltd.

The minimum coupling sleeve length shall be 200 mm (8 in.) for pipe diameters 250 mm - 300 mm. Acceptable Manufacturers: Krausz Industries Ltd., Robar Industries Ltd., Romac Industries, Inc., Smith-Blair and Ford.

The minimum coupling sleeve length shall be 250 mm (10 in.) for pipe diameters 350 mm and larger. Acceptable Manufacturers: Dresser Inc., Krausz Industries Ltd., Robar Industries Ltd., Romac Industries, Inc., and Smith-Blair.

10.4.16 Tapping Sleeves

Tapping sleeves shall be epoxy coated carbon welded steel, or stainless steel with gasket to provide 360 degree seal complete with 304 or 316 stainless steel bolts and nuts. Tapping sleeves shall be suitable for a minimum working pressure of 1034 kPa.

Acceptable Products:
Dresser Inc. Style 610, 620, 630
Smith – Blair, Inc. Style 622
Smith – Blair, Inc. Style 622 with MJ Outlet
Ford, Style C207 with MJ Adapter
Robar 6606 Stainless Steel Tapping Sleeve

10.4.17 Pipe Restraints for Mechanical Joint (MJ) Fittings

PVC pipe restrainers shall be in accordance with the latest edition of ASTM F1674, FM approved, and designed for use on AWWA C900 PVC pipe.

Acceptable Products:
Clow 300 C Restrainer
EBAA IRON Series 2000 PV
Uni-Flange Series 1300, 1500
Sigma One-Lok SLC Series
Star Pipe Products PVC Stargrip Series 4000
Star Pipe Products ALL Stargrip Series 4300
Tyler Union - Clow TUFGrip Dual Wedge Universal Restraint

Ductile iron pipe restrainers shall be UL listed and FM approved.

Acceptable Products:
EBAA IRON Megalug Series 1100
Star Pipe Products Stargrip Series 3000
Sigma One-Lok SLD Series
Romac Industries RomaGrip
Star Pipe Products ALL Stargrip Series 4300
Tyler Union - Clow TUFGrip Dual Wedge Universal Restraint

10.4.18 Bell and Spigot Restrainers for Watermains

Bell and spigot restrainers for PVC watermains shall be as follows:

Acceptable Products: Clow Series 300
EBAA IRON Series 1600 and Series 2800
Uni-Flange Series 1350 or 1390

A steel connecting restraint rod shall be installed in each flange hole of the restrainer. Each of these rod units and fittings shall be covered with "Protective Coating" as per Section 10.4.14, "Corrosion Protection".

Bell and spigot restrainers for ductile iron watermains shall be as follows:

Acceptable Products: EBAA IRON Megalug Series 1100HD
Star Pipe Products Stargrip Series 3100
Uni-Flange Block Buster Series 1390-C Pipe restraint for ductile iron pipe (100mm - 400mm)

A steel connecting restraint rod shall be installed in each flange hole of the restrainer. Each of these rod units and fittings shall be covered with "Protective Coating" as per Section 10.4.14, "Corrosion Protection".

10.4.19 Service Saddles

For PVC watermains (AWWA C900 pipe), a single or double stainless steel strap, cast ductile iron service saddle is required for all service connections. Service saddles shall be supplied with either a fusion-bonded epoxy or nylon coating. Alternatively, an 18-8 type 304 stainless steel saddle can be used with a minimum width of 150mm. Service saddles shall be suitable for a minimum working pressure of 1034 kPa.

Acceptable Products: Robar 2506
Romac 202NS
Ford FC202
Cambridge Brass 8403 Teck Stainless Steel Saddle

10.4.20 Insulation

Insulation for watermains and service laterals shall be rigid, 50 mm thick, extruded polystyrene foam board.

Acceptable Products: Styrofoam HI 40
Foamular 400

Insulation on curved surfaces including: valve chambers and air valve chambers, etc., where specified, shall be P2000 Insulation Systems, or approved equal.

P2000 Insulation shall be EPS (expanded polystyrene) core with woven white polypropylene radiant blocker facing, laminated both sides of core. The white laminated facing shall be treated for acid and UV resistance and have a bursting strength of 172 lbs/sq.inch, accepting backfill or fresh concrete placement. The facing shall extend beyond the edge along the length of sheets and rolls, forming a self adhesive overlap flap.

10.4.20 Insulation (Cont'd)

The insulation system shall be flexible and conform to the particular radius of pipe or chamber. Clean all mud, aggregate and sharp objects from surface. Cut insulation to length with a utility knife and manually wrap P2000 Insulation firmly around pipe or manhole. To secure in place, over wrap with P2000 Heavy Duty White Industrial Tape where required. All exposed edges shall be sealed with the adhesive flap or the above tape. P2000 Insulation should only be applied after pipe or manhole is in place, if pipe or manhole must be moved after application of P2000 Insulation, contact Manufacturer's Agent for instructions to protect the insulation ie: use of web slings and scrap insulation for padding rather than chains.

10.4.21 Bell Joint Leak Clamps

As required or directed, the City shall supply any bell joint clamps required for installation on existing 600 mm diameter cast iron watermains. The Contractor shall install these City supplied clamps. Bell joint leak clamps shall be Smith-Blair Model 274.

10.4.22 Tracer Wire

Tracer wire shall be RWU90, 10 gauge (AWG), single-strand, insulated copper wire with cross-linked polyethylene (XLPE) insulation, specifically manufactured for direct burial applications.

All spliced or repaired wire connections in the tracer wire system shall be made using DryConn Direct Bury Lug-Aqua connectors by King Innovation, or approved equivalent.

Bare ends of tracer wire shall be enclosed with waterproof DryConn King 6 Blue connectors, by King Innovation, or approved equivalent.

Tracer wire shall be attached to the top of the pipe at every fitting, valve and at intervals not exceeding 1.0 m by the use of 50 mm wide T-Tape Gray PE, by Tapecoat, or approved equivalent. T-Tape shall also be used to attach the tracer wire to valve boxes.

10.5 CONSTRUCTION METHODS

10.5.01 Temporary Water Service

When required by the Contract, the Contractor shall supply all necessary equipment, labour and materials required for temporary water service between the water supply (source) and the buildings.

Temporary pipe shall conform to the latest CSA, AWWA, NSF 61 and National Plumbing Code of Canada standards. Temporary pipe shall be impact and sunlight resistant, rigid PVC. Joints shall be either permanent, solvent- cemented or splined.

Acceptable products: Aquamine series 2900 by Victaulic
Yelomine Certa-Lok by Certainteed

10.5.01 Temporary Water Service (Cont'd)

Temporary hose shall be flexible, UV resistant and NSF 61 compliant. Hose shall be blue in colour.

Acceptable products: Nexbraid PW series 128 by Parker Canada
Series K6136 Potable Water Hose by Kuri Tec

The Contractor shall submit to the engineer a detailed plan showing the locations of the temporary water source, pipe and hose route(s), street, sidewalk and driveway crossings, valves and flushing / sampling points. This plan shall be submitted to the Engineer for approval no less than two (2) weeks before installation of the temporary piping commences.

The Contractor shall meet with each property owner to obtain permission to access their property for the purpose of placing temporary pipe and connection of the temporary hose to the building.

Installation of temporary water service shall be performed in such a way as to minimize disturbance to public and private property. Street crossings shall be installed in a casing pipe, placed below the existing asphalt grade, backfilled and compacted. Sidewalk crossings shall be made with wooden ramps not less than 1m on each side of the temporary pipe and the full width of the sidewalk. Driveway crossings, when necessary, shall be ramped with asphalt or wood. Ramps and crossings shall be clearly marked with signs when requested by the Engineer. Maintenance of all crossings, ramps and signs are the responsibility of the Contractor. All damage to public or private property shall be repaired at the Contractor's expense.

All temporary water sources shall be fitted with an approved reduced pressure (RP) backflow device. Backflow devices shall be supplied by the Contractor and shall be certified by a backflow tester licensed by the Province of New Brunswick. The Engineer must be provided a copy of the backflow report which shall be reviewed and approved by the plumbing inspector prior to the temporary water service being disinfected. Backflow devices must be certified each time they are installed or relocated. All costs associated with certification are the responsibility of the Contractor.

Each branch of temporary piping shall be fitted with an isolation valve, 25mm drain for disinfection and a 50mm drain for flushing. All disinfection, sampling and flushing locations must be safely accessible to Saint John Water staff.

The Contractor, Engineer and representatives from Saint John Water will meet on site and review the installation prior to disinfection. The Contractor shall contact Saint John Water in order to fill the temporary supply piping. Saint John Water will chlorinate, flush and sample the temporary water piping only after it has been determined that no leaks exist. The Contractor shall provide three (3) working days notification to Saint John Water for scheduling of disinfection.

Temporary supply hoses shall not be connected to the temporary main until disinfection, flushing and sampling is complete and all necessary bacteriological tests have passed. Each outside faucet shall be fitted with a "wye" adapter to allow use of the outside faucet while the temporary hose is connected.

House to house connections are not permitted without the approval of the Engineer.

10.5.01 Temporary Water Service (Cont'd)

No claims for delay as a result of the disinfection process or failed bacteriological test will be paid.

Once the temporary water system is functional Saint John Water will take over the operation and maintenance of the piped system only. Once the use of the permanent water supply is approved the temporary water piping shall be promptly removed. Dismantling and removal shall be the responsibility of the Contractor.

Temporary water service piping and hoses shall not be installed during times when freezing temperatures may occur.

10.5.02 Connections

The Contractor shall make connections to watermains where required by the Engineer, including mechanical sleeve connections, jointing and all excavation necessary to allow operation of the mechanical cutter. The Contractor shall field verify the outside diameter of existing mains and do such machining of castings as is necessary to fit the existing pipe as shown on the Drawings. Connections to watermains under pressure shall be done by the City. Any direct tapping (dry taps) of watermains by Contractor, shall be as per the tapping requirements listed by AWWA and the watermain manufacturer's recommendations. Tapping saddles are to be supplied and installed by the Contractor; the City will complete the live tap to the existing main.

All active lead and 16 mm copper services are to be renewed with minimum 25 mm water service pipe, as directed by the Engineer. All corporation stops shall be minimum 25 mm diameter.

Where existing water service is required to be renewed from the new watermain to the property line, the new water service shall be a minimum 25 mm diameter Type "K" seamless copper tubing with 25 mm curb stop at the property line.

Where renewing curb stop only and not the entire water service, the new curb stop shall be a minimum of 25 mm or as directed by the Engineer.

Bedding material used around the water service pipe shall be in accordance with Division 13, Section 13.4.02, "Bedding Material".

10.5.03 Operation of Valves

Refer to Division 7, Section 7.22, "Operation of Valves or Other Controls".

10.5.04 Pipe Laying

The Contractor shall adhere to the requirements of the latest AWWA Standards; ie: AWWA C600 for ductile iron, AWWA C605 for PVC, etc.

Each pipe shall be inspected for defects and all foreign matter or dirt shall be removed from the interior of the pipe before lowering it into position in the trench. All lumps, blisters and excess coating shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean before the pipe is laid.

10.5.04 Pipe Laying (Cont'd)

During laying operations no debris, tools, clothing or other foreign matter shall be placed in the pipe.

Every precaution shall be taken to prevent foreign matter from entering the pipe while it is being installed. A watertight plug shall be supplied by the Contractor and shall be used to prevent foreign matter or water from entering the end of the pipe. The plug shall be left in place until the connection is made to the adjacent pipe.

When pipe laying is not in progress, the open ends of the pipe shall be closed with an approved watertight plug acceptable to the Engineer. The plug shall remain in place until the trench is completely dewatered prior to commencing pipe laying.

After placing a length of pipe in the trench, the ends shall be centered and brought to correct line and grade. Backfill the pipe with specified bedding and backfill as per Division 13, "Excavation, Trenching and Backfill Requirements". Cutting of pipe for insertion of valves, fittings or closure pieces shall be done in accordance to the manufacturer's recommendations without damage to the pipe and so as to leave a smooth end at right angles to the axis of the pipe. Only approved cutting tools shall be used.

Pipe shall be laid with the bell or fixed flanged ends facing in the direction of laying, unless directed otherwise by the Engineer. Lay pipe and complete beveling of pipe ends in accordance with the manufacturer's recommendations.

Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or to plumb stems, or where long radius curves are permitted, the amount of deflection of each joint shall not exceed that specified by the manufacturer, be approved by the Engineer and be completed at no additional cost to the City.

No pipe shall be laid or jointed when the trench bottom is frozen or under water when, in the Engineer's opinion, the trench conditions or the weather are unsuitable for such work, and no pipe joints in the trench shall be left incomplete. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the watertight plug shall remain in place until the trench is dewatered to a state where trench water will not enter the pipe and bedding can be placed in suitable conditions. Whenever water is excluded from the interior of the pipe, adequate backfill shall be deposited on the pipe to prevent floating. Any pipe which has floated shall be removed from the trench and be re-laid as directed by the Engineer.

10.5.05 Pipe Jointing

All pipes shall be installed as per the manufacturer's recommendations. The last 200 mm of the outside of the spigot and inside of the bell of the push-on joint pipe shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint. The rubber gasket will be wiped clean, flexed, and placed in the bell in accordance with the manufacturer's recommendations. The gasket groove must be located on the retaining bead and the gasket heel firmly bedded in its seat. Ensure that the gasket fits snugly in its seat around its entire circumference. Apply a thin film of lubricant to the inside surface of the gasket which will be in contact with the entering spigot,

10.5.05 Pipe Jointing (Cont'd)

and also to the outside surface of the entering spigot for about 25 mm back from the end. Use only lubricant recommended by the pipe manufacturer.

Extreme care must be taken to keep the entering spigot from contacting the ground. Align spigot of pipe being joined and carefully enter into bell until it makes contact with the gasket. Complete the joint assembly by pushing the entering pipe past the gasket (which is thereby compressed). This can be accomplished by pushing against the face of the entering pipe with a crowbar solidly wedged in the ground, or by carefully pushing against face of entering pipe with the bucket of the backhoe used for excavating, if allowed by the Engineer. A block of wood must be placed between the pipe and the crowbar or bucket. Pipe can also be assembled by using a forked tool or ratchet jack.

Pipe that is not furnished with a depth mark will be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field cut pipe lengths shall be filed or ground to resemble the spigot end of such as manufactured.

Whenever it is necessary to deflect push-on joint pipe from a straight line, either in the vertical or horizontal plane, or where long radius curves are required, the maximum permissible pipe deflections must not be exceeded. These are given in Table 4 of AWWA C600 for Installation of Cast Iron Watermains. Notwithstanding the foregoing, no pipe length will be deflected to such a degree that the joint cannot be made properly, and the Engineer may, in any event, direct the Contractor to use deflections less than those shown.

10.5.06 Mechanical Joints

Mechanical joints including bolt type, screw, gland, tyton, etc. shall be made strictly in accordance with the instructions of the manufacturer, and in accordance with the latest AWWA, C110 and CSA B131.10 Standards.

The outside diameter of the spigot end of the bell and spigot pipe varies with the type, size and class of pipe. Appropriate adaptors shall be used, as required to create a complete functional system. The pipe end shall be prepared in accordance with the manufacturer's recommendations for connection to mechanical joint fittings.

The last 200 mm outside of the spigot and inside of the bell of mechanical-joint pipe shall be thoroughly cleaned to remove oil, grit and other foreign matter from the joint.

The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint and then the joint restraint shall be moved along the pipe into position for fixing and tightened up evenly. This is to conform to the latest AWWA C600 Standard.

10.5.07 Couplings

When couplings are required, they shall be installed by the Contractor to the satisfaction of the Engineer, and in accordance with the manufacturer's recommendations. All bolts, nuts, couplings, rubber rings and connecting pieces shall be thoroughly cleaned and the rubber rings shall be coated with a solution of soap suds before installation.

10.5.08 Electrical Continuity for Ductile Iron Pipe

Ductile iron pipe shall be installed without the use of conductoflex strips or lockwedges for joint continuity.

10.5.09 Thrust Blocks and Restrainers

Cast-in-place thrust blocks shall be installed on all tees, bends, caps, etc. Thrust block design and dimensions shall be as shown on the Standard Drawings. All thrust blocks shall bear against undisturbed ground. Approved mechanical restrainers shall be used in addition to thrust blocks for all valves, bends, tees, reducers, caps, etc. All concrete utilized for thrust blocks shall be ready-mix concrete from a supplier certified under ASTM C94 and CSA-A23.1, and shall have a minimum concrete strength of 32 MPa. All fittings shall be wrapped with 8 mil polyethylene sheet before pouring thrust blocks. Pre-cast thrust blocks will not be permitted unless approved by the Engineer.

10.5.10 Pipe Restraint for Vertical Bends

Where vertical bends are required and a thrust block is not specified, the Contractor shall restrain the fitting and the bell and spigot joints as required. It shall be the Contractor’s responsibility to determine the total length of pipe restraint by an approved pipe thrust restraint program or method. The length of restraint shall be submitted to the Engineer for approval in advance of installation. Mechanical joint pipe restraints shall be installed in accordance with the manufacturer's recommendations.

10.5.11 Gate Valves at Dead Ends

All gate valves on dead end mains, fire hydrants, etc. shall be installed using thrust blocks and restrainers to prevent gate valves from blowing off under pressure.

10.5.12 Valve Boxes

Valve boxes shall be installed where shown on the Drawings as per the manufacturer’s recommendations. Valve boxes shall not transmit shock or stress to valves and shall be centered and plumb over the wrench nuts of valves, with the box covers flush with the surface of the finished pavement or such other level as may be directed by the Engineer.

10.5.13 Setting Hydrants

Hydrants shall be located as shown on the Drawings, or as directed by the Engineer, and in such a manner to provide complete accessibility, and also in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.

When set in the lawn space between the curb and the sidewalk or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 300 mm of the sidewalk, unless authorized otherwise by the Engineer.

Where no sidewalk exists, and where the right of way permits, the fire hydrant shall be located a minimum of 3.4 m from the edge of asphalt, or as directed by the Engineer.

All hydrants shall stand plumb and shall have nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb, except those hydrants having two (2) hose nozzles 90 degrees apart shall be set with each nozzle facing the curb at an angle of 45 degrees. The hydrant's base flange shall be set so as to be between 100 mm – 150 mm above final grade.

In all cases the valve shall be located as close to the watermain as possible but in no case closer than one metre (1 m) from the hydrant. Refer to the respective Standard Drawing.

The ductile iron hydrant lead piping including vertical hydrant piping and all valves, bends & tees on the hydrant lead shall be encased in one layer of 8 mil thick polyethylene encasement to ANSI/AWWA C105/A21.5.

All hydrant leads installed shall include tracer wire in accordance with Section 10.5.25 “Installation of Tracer Wire”.

The elbow of each hydrant shall have a thrust block installed against unexcavated earth at the end of the trench and it shall be secured to the pipe with suitable restraints as shown on the respective Standard Drawing, or as directed by the Engineer.

The drain holes in the boot of the hydrant shall be permanently plugged internally. Hydrant extensions are to be installed, where required, so that the bury line of the fire hydrant is at grade, as per the Standard Drawing.

10.5.14 Watermain Pipe Plugs

When pipe laying is not in progress, the open ends of pipe shall be closed by an approved watertight plug acceptable to the Engineer. The plug shall remain in place until the trench is pumped completely dry.

10.5.15 Field Observations of Watermains

The Engineer, will carry out fulltime or periodic observations of the work to verify that it is in general conformance with the Drawings and Specifications.

10.5.15 Field Observations of Watermains (Cont'd)

No pipelines or structures shall be accepted by the Engineer should the tests indicate leakages greater than the allowable. It is the Contractor's responsibility to repair the unaccepted pipelines or structures or any other work, which the Engineer may have classified as unacceptable.

10.5.16 Disinfection Procedures When Cutting into and Connecting to Existing Watermains

When the Contractor cuts into an existing watermain to connect a new watermain and the connection is not included in the disinfection procedure carried out by the City, then the interior of all pipe and fittings included in the connection to the existing watermain shall be swabbed or sprayed with a 1% sodium hypochlorite solution, before they are installed, in accordance with the latest AWWA C651 Standard.

10.5.17 Pressure and Leakage Tests

After the pipe has been laid and backfilled to a minimum depth of 600 mm, all new watermains shall be subjected to a hydrostatic pressure test in accordance with the latest AWWA C600 Standard from valve to valve or capped end at 1.5 x the working pressure at the low end of the line with a minimum pressure of 1034 kPa.

The test pressure shall not be less than 1.25 x the working pressure at the highest point along the test section but shall not exceed the pipe or thrust restraint design pressures. The duration of the test shall be at least two (2) hours.

Firelines shall be tested in accordance with the requirements of the NB Department of Public Safety, Office of the Fire Marshal.

The test pressure shall not exceed twice the rated pressure of the valves of hydrants when the pressure boundary of the test section includes closed gate valves or hydrants and shall not exceed the rated pressure of the valves if resilient-seated butterfly valves are used.

Each valved section of pipe shall be slowly filled with water and the required test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection and all necessary apparatus shall be furnished by the Contractor.

The Engineer is to be present during the test and shall have a minimum of twenty-four (24) hours' notice prior to the beginning of the test. The Engineer shall provide a signed copy of the test results to the Contractor.

Before applying the specified test pressure, all air shall be expelled from the pipe.

All exposed pipes, fittings, valves, hydrants and joints will be carefully examined during the test. Any cracked or defective pipes, fittings, valves or

10.5.17 Pressure and Leakage Tests (Cont'd)

hydrants discovered in consequence of this pressure test shall be removed and replaced by the Contractor with sound materials. Testing shall be repeated until satisfactory to the Engineer.

The allowable leakage shall be determined by the following formula:

$$Q = \frac{LD\sqrt{P}}{795{,}000}$$

where: Q - allowable leakage in litres per hour (L/h)
L - length of pipe being tested (m)
D - nominal diameter of the pipe in millimeters (mm)
P - average test pressure in kilopascals (kPa)

Testing of tapping sleeves for "live taps" is to be pressure tested by the City's Water and Wastewater Systems Division prior to the City's "live" tapping of the watermain. Only the City will perform "live" taps on watermains.

10.5.18 Flushing and Disinfection of Watermains

All disinfection shall be carried out in accordance with the latest AWWA C651 Standard. Flushing and disinfection of all watermains or water services larger than 50 mm, including firelines, shall be done by the City of Saint John. The Contractor shall tap new watermains and install 25 mm IPT threaded corporation stops and 50 mm IPT threaded corporation stops at locations as shown on Drawings in watermains up to 600 mm in diameter. All corporation stops used for flushing and disinfection of watermains shall be Mueller Co. part number B20045N, Cambridge Brass Model #301NL, or equivalent. In lines of greater diameter, tap sizes and locations will be as shown on Drawings.

All chlorination chambers shall have an IPT threaded corporation stop on the new side of the valve complete with a PEX service tubing. The PEX service tubing must have an Everloc fitting at both ends. The free end of the PEX service tubing shall have a ball valve attached using an Everloc fitting. The ball valve must be accessible from the opening of the valve chamber without the need for confined space entry (i.e. the ball valve shall be within 300mm of the ground surface). The free end of the PEX service tubing shall be secured to the chamber so that the ball valve is supported. If the Everloc fittings are not properly installed or if the PEX service tubing appears to have been stressed or damaged, the City reserves the right to refuse to disinfect.

The Contractor shall ensure that all new valves within the section of pipe being disinfected (with the exception of the ball valves) are opened prior to flushing. As per the City of Saint John General Specification, all isolation valves shall be operated by City staff.

Disinfection water sample(s) shall be taken by the City for testing; the watermain shall not be put in operation before acceptable results have been received by the Engineer. Once accepted by the Engineer, the City will commission the new watermain.

10.5.18 Flushing and Disinfection of Watermains (Cont'd)

The Contractor shall close all corporation stops and remove all temporary service tubing used for flushing and disinfection after the acceptance of all tests by the Engineer. Where a flushing or chlorination point is installed outside a chamber the Contractor shall remove the main stops and install brass plugs in the service saddles. The Contractor shall exercise caution to ensure that no debris or dirty water enters the watermain while installing the brass plug.

10.5.19 Abandoned Watermains and Appurtenances

Abandoned watermains shall be blocked with bricks and mortar or other approved methods to prevent foreign matter from entering, at no additional cost to the Contract. Removal of the watermain and appurtenances outside the normal excavation limits may be requested by the Engineer and will be paid for on the basis of pay items for excavation. The Contractor shall excavate, remove and dispose of abandoned watermains at an approved off-site location.

10.5.20 Corporation Stops - Temporary Box

When installing corporation stops on new watermains which have to be tested and old services that are not renewed, the corporation stops shall be installed in the closed position with a section of 100 mm PVC pipe (temporary box) over it so that the corporation stop can be turned on after testing and chlorination are completed. The 100 mm PVC pipe is to be removed and the hole backfilled with sand before completing the Contract. The installation and removal of temporary boxes for corporation stops shall be incidental to the contract.

10.5.21 Existing Materials

Existing watermain materials that are requested by the Engineer to be salvaged shall be neatly stockpiled on the Site by the Contractor. The materials shall be delivered by the Contractor to an approved location, unless specified otherwise.

10.5.22 Early Installation of Gate Valves

The gate valves at the Contract limits may have to be installed before renewing watermains so that temporary services may be limited to the Contract location. During installation of any valve, the work shall be continuous and water service shall not be off for more than eight (8) hours unless otherwise approved by the Engineer. The Contractor is reminded that only City of Saint John personnel are permitted to operate existing valves or valves on new watermains that have been put into service as per Section 7.22, "Operation of Valves or Other Controls". The Contractor is to notify affected Utility customers as per Section 7.10, “Public Relations”.

10.5.23 Installation of Insulation for Water Services and Watermains

All new and renewed water service installations are to be insulated and the insulation shall be centered over the pipe and laid on top of the bedding material. Where shown on the Drawings or requested by the Engineer the Contractor shall insulate the watermain or sections thereof. The insulation shall be laid in a strip of at least 1200 mm wide, or as directed by the Engineer,
for the full length of the section to be insulated. Pipe larger than 300 mm diameter shall have width of insulation reviewed by the Engineer.

10.5.24 Bell Joint Leak Clamps

The Contractor must use due care while working around the existing 600 mm diameter cast iron watermains. All joints exposed during excavation shall be viewed by the Engineer. The Contractor shall be responsible for the delivery of the bell joint leak clamps from the City's stock room at 175 Rothesay Avenue, Saint John, NB to the Site. The Contractor shall install the bell joint leak clamps on all exposed bell and spigot joints, or as directed by the Engineer, and shall install these clamps as per the manufacturer's recommendations.

10.5.25 Installation of Tracer Wire

Tracer wire shall be installed on all non-ductile iron watermains, sewage forcemains, hydrant piping and water services. The wire shall be installed in such a manner as to be able to properly trace all watermains, sewage forcemains, hydrant laterals and water services without loss or deterioration of signal or without the signal migrating off the tracer wire. Refer to the respective Standard Drawing(s).

At the point of connection between the cast or ductile iron watermains, and any non-iron watermain, the tracer wire shall be connected to the first new valve box, or valve chamber, or as directed by the Engineer.

Tracer wire shall be laid flat and securely affixed to each fitting, valve, and top of the pipe at 1.0 m intervals, and to valve boxes and chambers using 50 mm wide T-Tape. Each piece of T-Tape shall be a minimum of 50 mm x 150 mm. Pipe shall be dry and cleaned of all dirt or dust where tape is to be applied.

The wire shall be protected from damage during the excavation or backfilling of the Works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At water service saddles, the tracer wire shall not be allowed to be placed between the saddle and the watermain.

Except for approved spliced connections, tracer wire shall be continuous and without splices from valve to valve, valve box to hydrant, service box to watermain and house shut off to service box.

Prior to cutting the tracer wire for connections, the tracing wire shall be loose and not taut to avoid stretching. The tracing wire shall be stripped the length required for the electrical connector using an appropriate wire-stripping tool. The exposed copper wire shall be free of nicks or scores. Wire ends that will

10.5.25 Installation of Tracer Wire (Cont'd)

be used for connecting the tracing device shall be stripped of insulation and have waterproof caps installed.

An approved electrical connector shall be placed over the exposed area of the main tracer wire. The connecting tracer wire shall be carefully inserted into the connector up to the insulation. The connection shall be tightened and the waterproof covers sealed shut. Connections shall be snug and free from exposed copper. The Engineer reserves the right to reject any improper connections. Rejected connections shall be cut and redone to the satisfaction of the Engineer, at the Contractors expense.

Continuity tests shall be conducted by the Contractor. Testing shall be done in the presence of and to the satisfaction of the Engineer. Tracing wire installations that fail the continuity testing shall be corrected and retested to the satisfaction of the Engineer. The Contractor shall provide the Engineer with sufficient notification of any testing.

The Contractor shall supply all necessary testing equipment and materials. The Contractor shall provide, to the Engineer, documentation verifying the testing, including the name of the person conducting the test, date and time of test, location of section being tested, and any other pertinent information.

The tracer wire system shall be tested for functionality by City staff only after the Contractor has confirmed and demonstrated that the entire tracer wire system is installed and is functioning properly. The Contractor shall request that the City perform this functionality test prior to placement of asphalt.

10.5.26 Installation of Anodes

Anodes shall be installed as follows:

Cast-iron and plain ductile iron tees, crosses, bends, etc., and valves 200 mm diameter and smaller: one (1) packaged 5.5 kg zinc anode on each fitting and valve. All larger diameter fittings and valves require 11 kg zinc anodes.

Hydrants: one (1) packaged 11 kg zinc anode shall be installed on each hydrant boot unless stainless steel tee-bolts and nuts are used.

Copper services (all sizes): one (1) 11 kg zinc anode at each curb stop and one (1) 11 kg zinc anode at the corporation stop. Copper services longer than 20 m in length shall receive one (1) additional 11 kg zinc anode for each 20 m of additional length or part thereof. Protective coating shall be applied with 25 mm minimum overlap in accordance with manufacturers' suggested application procedures.

When replacing a watermain, one (1) packaged 11 kg zinc anode shall be installed on all exposed copper services.

Anodes shall be installed using exothermic welding "Cadweld" tools and products, or by wrapping around bolts and securing with a second nut.

10.6 METHOD OF PAYMENT

10.6.01 Measurement for Payment

Measurement for payment for watermain pipe and water service laterals shall be per metre (m) of completed pipe. The measurement of completed watermain and water service laterals shall include the supply of all labour, materials and equipment for excavation, disposal of unsuitable or surplus excavated material, shoring, dewatering, bedding, supply & installation of pipe, polyethylene encasement, backfilling, compaction, testing of pipe and all incidental items. The length of installed pipe shall be measured horizontally with no deduction for valves or fittings. Supply and installation of tracer wire is incidental and shall be considered as included in the Contract Unit Price for the item requiring tracer wire.

Measurement for payment for valves, valve boxes, bends, tees, hydrants, curb stops, corporation main stops complete with saddles, anodes, etc. shall be based on each unit, including all labour, materials and equipment required to properly supply and install these units. Payment shall include supply, excavation, dewatering, bedding, installation, thrust blocks, backfilling, plus all other incidental items.

Measurement for payment for bell and spigot restrainers shall be based on each bell and spigot restrainer unit and shall include all items required to restrain a complete bell and spigot joint.

For purpose of measurement, a hydrant shall be considered as all the material and labour necessary to supply and install the hydrant including the 150 mm gate valve, 130 mm valve box, the restraints, anchor tee, vertical piping and thrust blocks. Payment for the supply and installation of a hydrant extension, where required, will be on a per unit basis. Payment for the horizontal hydrant lead shall be made as watermain pipe. Payment shall include connecting the hydrant to the gate valve, the gate valve to the hydrant anchor tee, excavation and backfilling, polyethylene encasement of the vertical hydrant piping, and all incidental items.

All labour, materials and equipment for the installation of corporation stops, saddles, anodes and flushings for testing and chlorinating as shown on the Contract Drawings shall be included in the Contract Unit Price of the pipe. If the initial bacteriological test fails, the City shall re-flush and clean the watermain in accordance with the latest AWWA C651 Standard. The Contractor shall pay for the re-flushing, cleaning, re-chlorinating, re-testing and any other associated costs. There will be no compensation for delays due to this testing procedure. Disinfection procedures when cutting into and connecting to existing watermains shall be considered as incidental to the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications. Removal and off-site disposal of existing watermain and fittings outside of the normal trench excavation shall be measured for payment at the Contract Unit Prices for common excavation and backfill.

Payment shall include excavation, removal, off-site disposal and backfilling of trench.

10.6.01 Measurement for Payment (Cont'd)

Service box and/or curb stop renewals where existing water service lateral piping does not require renewal shall be measured for payment on a per unit basis including all excavation, backfilling, connections to existing and incidentals.

There shall be no separate measurement for payment for thrust blocks. Include costs in items requiring thrust blocks with such items as bends, tees, caps, etc.

There shall be no separate measurement for payment for restrainers. Include costs in items requiring restrainers with such items as valves, bends, tees, reducers, caps, etc. Zinc nuts are incidental to the supply and installation of fittings, valves and restrainers.

Measurement for payment for air valves shall be on a per unit basis for each complete valve installed including corporation main stops, saddles, nipples, etc., connection to watermain, chamber, insulation of chamber, complete with vent pipe assembly, as per the Standard Drawing.

Measurement for payment for insulation shall be on a square metre (m^2) basis and to be based on 50 mm thickness.

Measurement for payment for bell joint leak clamps shall be based on each complete unit installed for one bell and spigot joint. Payment shall include delivery, installation, bedding, backfilling, and all other incidental items.

Measurement for payment for temporary water piping shall be on a per metre basis and includes all pipe, backflow devices, isolation valves, fittings, drains, casing pipes, sidewalk, driveway and roadway crossings, and access ramps.

Measurement for payment for temporary water hose connection to buildings shall be on a per unit basis and includes all hose, fittings, connection to temporary water pipe, and connection to the exterior faucet of the building. Connection to building includes "wye" faucet adapter.

Plumbing modifications to the building required to facilitate connection of the temporary water hose shall be charged against a plumbing contingency allowance provided in Division 4.5 – Schedule of Quantities and Unit Prices. No part of this allowance shall be expended without the approval of the Engineer, and any part not so expended shall be deducted from the plumbing contingency allowance. All plumbing costs shall be submitted to the Engineer for review before proceeding with the work.

10.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 11

SEWER SYSTEMS

City of Saint John

TABLE OF CONTENTS

DIVISION 11 – SEWER SYSTEMS

City of Saint John

TABLE OF CONTENTS

DIVISION 11 – SEWER SYSTEMS

SEWER SYSTEMS

11.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, material, plant and equipment necessary for the installation of sewer (storm and sanitary) mains, laterals and all appurtenances as per the Drawings and Specifications.

11.2 DEFINITIONS

Not applicable to this Division

11.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Manholes, Catch Basins, and Valve Chambers ..... Div. 12

(d) Excavation, Trenching and Backfilling Requirements ..... Div. 13

(e) Restoration ..... Div. 21

(f) Standard Drawings

11.4 MATERIALS

11.4.01 General

All AWWA, CSA and ASTM specifications and latest revisions are considered as part of this Specification.

Pipes generally are to be in accordance with details shown on the Drawings and are to be suitable for the purpose specified. If requested by the Engineer, the manufacturer's name and test certificate shall be submitted by the Contractor.

The following information shall be clearly marked on each section of Pipe:

(a) Date of manufacture;
(b) Name or trademark of the manufacturer;
(c) ASTM pipe class;
(d) Diameter of the pipe; and
(e) CSA certification for concrete and PVC pipe, "Tested" if required.

The minimum size of sanitary sewer mains shall be 200 mm and minimum size of storm mains shall be 300 mm.

11.4.02 Reinforced Concrete Sewer Pipe

Reinforced concrete sewer pipe shall comply with the latest CSA A257.2 and ASTM C-76 Standards, minimum class 65 D, or as specified on the Drawings or in the Specifications.

All concrete pipe for sewers shall have approved synthetic rubber gasket joints which comply with the latest ASTM C443 Standard. The rubber gasket shall be stored in a cool place; preferably 20°C or less. The rubber gasket, whether applied on the pipe or stored separately, shall be protected from exposure to the direct rays of the sun. The gasket shall be kept out of the snow, rain or mud, etc. as per the manufacturer's recommendations.

All concrete pipe for sanitary and storm sewers shall be pre-tested for leakage. The minimum number of pipes to be tested at once shall be three (3). After testing, each section of the pipe shall be stamped "Tested" and the Contractor shall supply to the City the manufacturer's written guarantee of the product, if requested.

11.4.03 PVC Gravity Sewer Pipe

Polyvinyl chloride (PVC) gravity sewer pipe shall be certified to the latest CSA B182.2 and ASTM D3034 or ASTM F1760 Standards. The pipe shall have a standard dimensional ratio (SDR) of 35 or as specified. Jointing shall be bell and spigot type with rubber gaskets conforming to ASTM F477. Fittings shall be in accordance with CSA B182.2.

11.4.04 PVC Pressure Sewer Pipe

Polyvinyl chloride (PVC) sewer pipe which may be used under pressure shall be of the class, series, or dimensional ratio (DR) as specified and shall be green in colour with "Sanitary Forcemain" printed in block lettering by the pipe manufacturer. Each project using sewage forcemains, shall have an Engineer to select the proper pipe strength based on pressure calculations, and considering the operations of the pumps and water hammer. In no case shall the pipe wall be thinner than SDR21 PVC. PVC pressure pipe shall be certified to meet the latest AWWA C900 and CSA B137.3 Standards, and have an integral bell joint feature and approved rubber gaskets as recommended by the manufacturer. Glued joints will not be accepted.

Fittings for PVC Pressure Sewer Pipe shall be in accordance with watermain fittings as specified in Section 10.4.02, "Fittings". All forcemain fittings shall be complete with joint restraints and thrust blocks.

All buried pressure sewer pipe shall include a continuous non-degradable marker tape installed 600 mm above the centerline of the pipe. The marker tape shall have the words "Pressure Sewer Pipe" or "Sanitary Forcemain" permanently and continuously printed on the tape. Supply and installation of the marker tape shall be incidental to the costs for the supply and installation of the pressure sewer pipe.

PVC Pressure Sewer Pipe installation shall include tracer wire in accordance with section 10.5.25 "Installation of Tracer Wire".

11.4.05 PVC Profile Pipe

Polyvinyl chloride (PVC) gravity storm sewer mains shall be extruded, ribbed, seamless, smooth bore pipe with minimum pipe stiffness of 320 kPa and conforming to the latest CSA B182.4 and ASTM F794 Standards. Fittings to be in accordance with CSA B182.4. Pipe gaskets shall be to CSA B182.4 and ASTM F794.

11.4.06 Corrugated Steel Pipe

Corrugated steel pipe (CSP) shall be round, Type II aluminized steel, size and minimum gauge as specified and shall meet the requirements of the latest CSA G401, AASHTO M36 and CSPI Standards. Steel coupling bands shall be used for pipe joining, and shall be manufactured to same standards as the CSP pipe. The use of CSP shall be as approved by the Engineer.

11.4.07 Catch Basin Laterals

Catch basin laterals shall be polyvinyl chloride (PVC) with a minimum dimensional ratio (DR) of 35 and shall be 200 mm minimum diameter meeting the requirements of the latest CSA B182.2 and ASTM D3034 Standards.

11.4.08 Sanitary and Storm Sewer Laterals

Sewer lateral pipe shall be polyvinyl chloride (PVC) – dimensional ratio (DR) 35 sewer pipe meeting the requirements of the latest ASTM D3034 and CSA B182.1 Standards. Joints shall be bell and spigot type with locked in rubber gasket. Minimum size for sanitary and storm sewer laterals shall be 100 mm.

Sewer lateral pipe, tees, wyes, long sweep bends, couplings, rings, fittings, elbows, caps, plugs and saddles, etc. shall conform with the City of Saint John Standards. Plugs for ends of sewer lateral pipe shall be pre-molded PVC.

Sanitary laterals shall be colour coded green, and storm laterals shall be colour coded white.

Lateral connections shall be as specified in Section 11.4.11, “Sewer Service Connections”.

11.4.09 Insulation

Insulation for sewer mains and laterals shall be 50 mm thick Styrofoam HI 40 or Foamular 400 or approved equivalent. For insulating curved surfaces, where specified, including culverts and chambers, refer to Section 10.4.20, “Insulation”, for details.

11.4.10 Couplings/Connections

Couplings are to be supplied for the size and type of pipes to be joined. Couplings for connecting sewer main and sewer service pipe shall be:

(a) For PVC to PVC connections, use a solid PVC repair coupling with no pipe stop and two gaskets to ASTM D3034 F1336 and CSA B182.2.

(b) For connecting dissimilar sewer pipe materials, use a flexible rubber repair coupling, with stainless steel bands and a stainless steel shear ring for added strength and rigidity. If it is impossible to use the shear ring due to connecting different sized pipes, the joint can be made with a heavy-walled rubber coupling such as the Non-Shear Coupling from DFW/HPI, or approved equivalent.

Acceptable Manufacturers: Mission
Fernco
Indiana Seal

11.4.11 Sewer Service Connections

Connection of sanitary and storm laterals to new PVC sewer mains shall be made using a PVC tee wye or wye, unless otherwise directed by the Engineer.

Sewer service connections to existing mains shall be as listed below and shall only be used where specified or as authorized by the Engineer.

(a) Connections to PVC sewers shall use Inserta Tee, Fernco QwikSeal, or approved equivalent.

(b) Connections to concrete sewers shall use a Kor-N-Tee by NPC, Fernco QwikSeal, or approved equivalent.

(c) Connections to terra cotta sewers shall use a flexible rubber saddle connection and stainless steel straps as fabricated by Mission, or approved equivalent.

11.4.12 Inspection Chambers

Sanitary or storm service inspection chambers shall be used where specified or as authorized by the Engineer. Inspection chambers shall be PVC complete with a backwater valve and shall be Le Ron Inspection Chambers, or approved equivalent.

11.4.13 Inlet Control Devices

Inlet control devices (ICD's) shall be installed as indicated on the Contract Drawings. ICD's shall be constructed of a PVC cap complete with a drilled hole in the centre, or an approved equal. The PVC cap shall be fastened to the pipe in a manner acceptable to the Engineer.

11.5 CONSTRUCTION METHODS

11.5.01 Method of Laying Pipe

Sewer pipe shall be installed according to the sizes, locations and grades as indicated on the Drawings. Installation of all sewer pipe shall be in strict accordance with pipe manufacturer's recommendations.

Proper equipment, implements, tools, and facilities shall be provided and used by the Contractor for safe and efficient execution of the Works. Pipe and fittings shall be carefully lowered into the trench in such a manner as to prevent damage to them. Under no circumstances shall pipe or fittings be dropped into the trench.

Pipe shall be laid with bell at high end and the direction of laying shall be from low elevation to high elevation.

Trenches where pipe laying is in progress shall be kept dry. No pipe shall be laid in water or upon a wet bed. The Contractor shall dewater the trench or tunnel prior to and during installation of sewer mains and structures.

When renewing a live sewer, the Contractor must maintain the flow and functioning of the system. Redirecting the flow of the sewer around the Site by means of by-pass pumping or by other methods shall be considered incidental to the work. As pipes are laid, pipes shall be thoroughly cleaned and protected from foreign matter and water. No water shall be allowed to flow in newly laid pipe during construction, except with the permission of the Engineer. No length of pipe shall be laid until the preceding length has been thoroughly embedded and secured in place to prevent any movement or disturbance of the finished joint.

No walking on or working over the pipe shall be allowed unless covered by at least 300 mm of compacted backfill, except as may be necessary in refilling the trench and compacting the backfill.

All foreign matter shall be kept out of the pipe before, during and after installation. When pipe laying is not in progress, open ends of pipe shall be temporarily closed by a watertight plug or by other means approved by the Engineer.

Insulation shall be installed over sewer mains and service laterals where indicated on the Drawings or as directed by the Engineer.

11.5.02 Catch Basin Laterals

Laterals shall be installed to connect all catch basins to the manhole and have a minimum slope of 1.0%, unless otherwise directed by the Engineer. The laterals shall be placed and bedded in dewatered trenches as per Division 12, "Manholes, Catch Basins and Valve Chambers".

11.5.03 Defective Pipes

The Contractor shall inspect all pipes in the field before and after laying pipe. Any damaged or defective pipe will be rejected by the Engineer and shall be immediately removed from the Site and replaced with new sound material at the Contractor's expense.

11.5.04 Cutting Sewer Pipes

Sewer pipes shall be cut whenever necessary for construction of manholes, catch basins, branches, junctions, tees, etc. at the desired positions. The pipe shall be cut neatly and at right angles to the axis of the pipe. Pipe ends must be beveled and a reference mark located accurately as per the manufacturer's recommendations.

11.5.05 Alignment and Grade

Setting grades and alignment shall be as shown on the Drawings and shall be the responsibility of the Contractor, refer to Section 7.5, “As-Built Information”. Profiles shall be checked at the commencement of the work and the grades and depth confirmed by the Contractor. Any variation from the design grade and alignment shall be made only with the approval of the Engineer.

Laser beam equipment shall be installed in the pipe, just above the pipe or in the bottom of the manhole. Installation of the laser contrary to the aforementioned shall require the approval of the Engineer. Pipe shall be laid true to line and grade with uniform bearing under the full length of the barrel of the pipe. No backfilling shall be carried out until permitted by the Engineer. The pipe shall be laid on bedding material approved by the Engineer and as specified in the Specifications and/or Drawings. No pipe shall be laid on frozen material.

Suitable excavation shall be made to receive the bell or collar which shall not bear upon the subgrade or bedding. Any pipe which is not in true alignment or shows any undue settlement after laying shall be taken out and relaid at the Contractor's expense. Ponding of any water in gravity sewers will not be allowed.

11.5.06 Deviation Due to Existing Structures

Wherever existing structures or branch connections leading to main sewers or drains or other conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, such obstructions shall be permanently protected, supported, removed, relocated or reconstructed as directed by the Engineer, at the Contractor's expense, provided said obstructions are shown on the Drawings.

In instances where it is impractical to relocate or reconstruct the obstructions, or where long radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory jointing as recommended by the manufacturer and approved by the Engineer.

11.5.07 Patch Work

External patching of defective pipes or joints must first be approved by the Engineer. The maximum allowable number of patched joints in any 90 m interval shall be two (2) and no two (2) consecutive joints may be patched unless otherwise approved by the Engineer. Completed patchwork must first be inspected and approved by the Engineer before backfilling commences. Patchwork on the inside of the pipe shall not be allowed unless approved by the Engineer.

11.5.08 Visual Inspections

As directed by the Engineer, all sewers will have a visual inspection. The interior of the pipes shall be thoroughly cleaned by the Contractor of all foreign matter of any description by flushing, cleaning buckets or by hand at the Contractor's expense.

Alignment for all sewer lines shall meet the following requirements: a minimum of one-half (½) the diameter of the end of the pipe at a light source at one manhole shall lie visible from any adjacent manhole, when viewed in either direction. Water ponding in gravity sewers shall not be allowed. Water ponding that can not be eliminated by flushing and cleaning will be considered as pipe settlement. Any and all defects, such as water ponding, leaking joints, sags, improper grade or alignment, excessive deflection, obstructions, etc. shall be cause for rejection and such defects must be repaired by the Contractor at the Contractor's expense.

11.5.09 Methods of Testing

General

All sanitary and storm sewers 900 mm in diameter or less shall be leakage tested either by water tightness test or air tightness test. Sewers above 900 mm in diameter shall have an interior visual inspection and be leakage tested either by water tightness test, air tightness test, or individual joint test. All tests shall be conducted by the Contractor, in the presence of the Engineer, who must give the City forty-eight (48) hours notification of completion of the sewer line and subsequent request for testing. Should there be any branch or sewer lateral connections on the line being tested, the Contractor shall temporarily plug all such openings.

If directed by the Engineer, after sewers have been laid and backfilled, the Contractor shall have a mandrel pulled through each section of the sewer from manhole to manhole. The mandrel shall be sized to be 95% of the diameter of the pipe. Any restrictions in the line shall be corrected by the Contractor at the Contractor's expense. The Contractor shall supply all necessary materials (including plugs, etc), equipment and labour in connection with the testing. Mandrel testing will not be measured separately for payment but shall be considered incidental to the work. The Contractor shall be required to supply all water necessary to complete the water tightness test. Testing shall be done between adjacent manholes except as may be otherwise authorized by the Engineer.

If the Engineer has any reason for suspecting that on any portion of the sewer, the pipes or joints have been damaged during the backfilling of the trench, or any other cause or reason that the portion of the sewer would no longer comply with the requirements of the test, the Contractor may be instructed to carry out a second test and should the length of sewer prove defective, the Contractor shall repair or make good the defect or relay the length of sewer at the Contractor's expense. The cost of the second test shall be borne by the Contractor if the test proves to be defective.

11.5.09 Methods of Testing (Cont'd)

General

During the Maintenance Period, Section 6.19, and before the Certificate of Final Acceptance, Section 6.20.03, has been issued, the Engineer may view any or all sections of sewers by means of video inspection. If any repairs are necessary, the cost of these repairs and testing shall be borne by the Contractor, if liable, as set out in Section 6.19, "Maintenance Period".

The allowable leakage limits for gravity sewer lines shall meet the following requirements:

Water Tightness Test

The Contractor is responsible to carry out all tests; the Engineer shall be present to witness tests.

The Contractor shall supply all necessary pumps, equipment, water, plugs and related materials for filling the pipe and removing the water following the test. The discharge of test water shall be done in such a manner so as to avoid damage to adjacent properties and shall be done to the Engineer's approval.

Sanitary Sewers: Leakage in any section of the sewer shall not exceed 25 litres per mm (25 L/mm) of internal pipe diameter per km of pipe per day for infiltration. For exfiltration, the allowable leakage is 25% higher than that allowed for infiltration.

Storm Sewers: The allowable leakage in any section of the sewer shall not exceed 100 litres per mm (100 L/mm) of internal pipe diameter per km of pipe per day of infiltration.

Force mains shall be subjected to a water pressure/leakage test as per Section 10.5.17, "Pressure and Leakage Tests".

If the leakage exceeds acceptable limits for a sewer using the air tightness test, a water tightness test may also be used to determine if the amount of leakage falls within acceptable limits; however, the expense of additional testing shall be borne by the Contractor.

Air Tightness Test

The Contractor shall be responsible to carry out all tests; the Engineer shall be present to witness tests. Air tests shall be in accordance with ASTM C924, latest edition.

11.5.09 Methods of Testing (Cont'd)

Air Tightness Test

The pipe shall be plugged at the lower and upper ends with airtight plugs. The line shall then be filled with air to a pressure of 28 kPa and be allowed to stabilize for a period of at least 5 minutes. This will allow time for temperature equilibrium. After the pressure has been allowed to stabilize for the 5 minute period, the air supply shall be disconnected, and the pressure shall be decreased or increased to 24 kPa. A stopwatch will be started to determine the time required for the pressure to drop to 17 kPa.

Sanitary Sewers - the allowable time for loss of pressure from 24 kPa to 17 kPa shall not exceed the values based on Table 11.1: Time Requirements for Air Testing.

Storm Sewers the allowable time for loss of pressure from 24 kPa to17 kPa shall be one quarter (¼) the allowable time for sanitary sewers.

Table 11.1: Time Requirements for Air Testing

Pipe Diameter (mm)	Minimum Time (min:sec)	Length of Pipe for Minimum Time (m)	Time for Longer Length (sec)
100	1:53	182	0.62 x L
150	2:50	121	1.40 x L
200	3:47	91	2.49 x L
250	4:43	73	3.89 x L
300	5:40	61	5.61 x L
375	7:05	48	8.76 x L
450	8:30	41	12.60 x L
525	9:55	35	17.20 x L
600	11:20	30	22.40 x L

Where: L = Length of test section in metres (m)

As directed by the Engineer, any sewer lines may be tested for infiltration. The flow shall be measured by a "V" notch weir.

Individual Joint Test

Individual joint tests may be required on any or all sections of the sewer main. The Contractor shall supply the joint tester including all necessary labour and equipment necessary to complete the test. All tests shall be conducted in the presence of the Engineer.

Test all pipes 900 mm in diameter or greater one joint at a time. The maximum allowable leakage per joint tested individually shall be calculated for a one (1) metre length of pipe of that diameter at the rate of 0.001 m^3 per minute per square metre (m^2) of internal pipe surface area.

11.5.09 Methods of Testing (Cont'd)

Individual Joint Test

For the joint test, the Contractor must pressurize the void volume to 24 kPa greater than the pressure exerted by groundwater. If the pressure holds, or drops less than 7 kPa in 5 seconds, the joint is acceptable.

All testing must be in accordance with ASTM C1103, latest edition.

11.5.10 Video Inspection

After all construction is complete but prior to the asphalt upper course placement, the Contractor shall do a closed circuit television inspection (CCTV) of the sanitary and storm sewer mains and catch basin laterals, including the existing sewer downstream of the new construction extending a minimum distance of 90 m to the next downstream manhole, or as directed by the Engineer.

The entire length of each sewer line between manholes shall be videoed, as well as through each manhole (the camera shall pan the interior of all manholes and catchbasins). This will allow for viewing pipe-to-manhole joints, benching and connections of new sewers to existing sewers. Just prior to conducting the television inspection the Contractor shall run 3700 litres (L) of clear water through the new sewer main. The camera shall travel in the same direction as flow unless impractical due to location. The Contractor shall notify the Engineer a minimum of 24 hours in advance of video inspection work as the Engineer's Representative shall be present when the water is introduced into the sewer and when the sewer is being video inspected.

The Contractor shall use a colour pan and tilt camera specifically designed and constructed for sewer inspection. Lighting for the pan and tilt camera shall provide a clear picture of the entire periphery of the sewer. The pan and tilt camera shall pause, pan and visually inspect all service connections, pipe ends and maintenance or structural defects. The speed of travel shall be slow enough to inspect each pipe joint, tee connection, structural deterioration, infiltration and inflow sources, and deposits. The travel speed of the camera shall not, at any time, exceed nine metres per minute (9m/min).

The camera must be centered in the pipe to provide accurate distance measurements to locations of features in the sewer and these measurements shall be displayed and documented on the video. The video of the main lines for each street shall be completed on the same day and shall be continuously metered from the access manhole. All television inspection reports shall be within +/- 0.6m of the measured linear distance between manholes/points along the sewer centerline from the start of pipe to end of pipe.

All CCTV work shall conform to current National Association of Sewer Service Companies (NASSCO) – Pipeline Assessment Certification Program (PACP) standards. All CCTV inspections will be delivered entirely in electronic format (NASSCO export file) via external hard drive with the file named with the CCTV Contractor Company Name (eg. "Smith Video Services) as well as PDF pipe run reports. The entire survey shall be recorded in an approved electronic format submitted with electronic links between the data and the video.

The camera operator shall be a PACP certified operator and proof of certification shall be submitted with the reports. All PACP required header information must be fully and accurately entered on all CCTV reports in accordance with PACP Guidelines. Manhole ID (as per drawings) and Pipe ID (format to be "Upstream MH

11.5.10 Video Inspection (Cont'd)

ID – Downstream MH ID") for sewer line sections to be videoed shall be entered correctly in the PACP required header fields. All PACP Observations shall be identified on PACP reports.

The Contractor must consider weather conditions to obtain the best video image of the sewer. This may require the Contractor to delay any video work after major rain events until the system can return to lower dry weather flow.

The video inspections and PDF pipe run reports shall include all mandatory NASSCO fields as well as:

(a) Time;
(b) Weather; and
(c) Use of sewer.

Manhole deficiencies noted during panning are to be recorded as MGO (Miscellaneous General Observation) with comments.

Water ponding in gravity sewers that cannot be eliminated by flushing and cleaning will be considered as evidence of pipe settlement. Any and all defects such as water ponding, leaking joints, sags, improper grade or alignment, excessive deflection, obstructions, etc. shall be cause for rejection and such defects must be repaired by the Contractor at no expense to the City. The initial video inspection shall be at the cost of the Owner. Any costs for re-video of sewer mains required to inspect repaired defects will be at the Contractor's expense. If the video report shows that debris is present in the pipe the Contractor shall flush and clean the pipe and re-video the line at the Contractor's expense.

All CCTV inspections in electronic format (including PDF pipe run reports) shall be submitted to and approved by the Engineer prior to placement of upper course asphalt.

City policy restricts the use of fire hydrants to fire protection only. Potable water can be obtained by the Contractor at the Champlain Drive Water Pumping Station, 784 Loch Lomond Road, Saint John, NB, with the proper permit.

11.5.11 Abandoned Sewers (Pressure Grout)

The Contractor shall supply all labour, materials, plant and equipment to fill the existing sewer, where shown on the Drawings, with grout.

The grout mix shall be in accordance with the following proportions per m^3:

390 kg	Cement
1,630 kg	Sand (Blending)
240 kg	Water
2 Litres	WRDA

- Plasticizer may have to be added at Site: 3 litres/m^3 and fly-ash can replace up to 25% of cement for pumpability.

11.5.11 Abandoned Sewers (Pressure Grout) (Cont'd)

Grout shall be pumped into the sewer, utilizing a high pressure concrete pump, Model 40 Powercrete, or approved equivalent. Contractor shall engage and pay for the services of a recognized company experienced in high pressure grouting applications.

11.5.12 Abandoned Sewer Mains and Appurtenances

Abandoned sewer mains shall be blocked with bricks and mortar or other approved methods to prevent foreign matter from entering, at no additional cost to the Contract. Removal of the sewer mains(s) and appurtenances outside the normal excavation limits may be requested by the Engineer and will be paid for on the basis of pay items for excavation. The Contractor shall excavate, remove and dispose of abandoned sewer mains at an approved off-site location.

11.6 METHOD OF PAYMENT

11.6.01 Measurement for Payment

Measurement for payment for sewer main pipe and sewer laterals shall be per metre (m) of completed pipe. Sewer mains shall be measured between centres of manholes. In the case of storm outfalls, measurement shall be from the centre of the manhole to the end of the pipe installed. The length of installed pipe shall be measured horizontally. The measurement for payment of completed sewer main and sewer laterals shall include the supply of all labour, materials and equipment for excavation, disposal of surplus or unsuitable excavated materials, shoring, dewatering, by-pass pumping, bedding, supply & installation of pipe, backfilling, compaction, flushing, testing of pipe and all incidental items.

Measurement for payment for connecting each sewer lateral shall be on a per unit basis and shall include all necessary labour, material and equipment to connect the lateral to the sewer main or manhole. This shall include, where necessary, the following:

(a) The proper "tee wye" or "wye" on the main or proper manhole connection, and;

(b) Any necessary bends, plus any other labour and materials necessary for making the connection.

Measurement for payment for insulation to be on a square metre (m^2) basis and to be based on 50 mm thickness.

Measurement for payment for inlet control devices (ICDs) shall be based on a unit price basis.

Measurement for payment for sanitary or storm service inspection chambers shall be measured for payment on a per unit basis including all excavation, backfilling, connections and incidentals.

11.6.01 Measurement for Payment (Cont'd)

Measurement for payment for forcemain shall be per metre (m) of forcemain installed measured horizontally. The measurement of completed forcemain shall include the supply of all labour, materials and equipment for excavation, disposal of surplus or unsuitable excavated materials, shoring, dewatering, bedding, supply & installation of pipe, backfilling, compaction, flushing, testing of pipe and all incidental items.

Measurement for payment for forcemain fittings such as bends, tees, etc. shall be based on each unit, including all labour, materials and equipment, thrust blocks, restrainers, excavation, bedding and backfilling plus all incidental items.

Measurement for payment for abandonment of sewer mains with grout to be based on theoretical pipe volume per cubic metre (m^3) basis and shall include the supply and installation of grout and all incidentals. Any losses in volume pumped are to be considered incidental.

Measurement for payment for video inspection shall be measured on a per metre (m) basis from center of manhole to center of manhole and payment shall be based on a unit price basis.

11.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 12

MANHOLES, CATCH BASINS AND VALVE CHAMBERS

City of Saint John

TABLE OF CONTENTS

DIVISION 12 – MANHOLES, CATCH BASINS AND VALVE CHAMBERS

MANHOLES, CATCH BASINS, AND VALVE CHAMBERS

12.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, materials, plant and equipment necessary for the complete installation of all sanitary and storm manholes, catch basins and valve chambers and appurtenances as per the Drawings and Specifications.

12.2 DEFINITIONS

Not applicable to this Division.

12.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Water Systems ..... Div. 10

(d) Sewer Systems ..... Div. 11

(e) Excavation, Trenching and Backfill Requirements ..... Div. 13

(f) Restoration ..... Div. 21

(g) Asphalt Concrete ..... Div. 27

(h) Standard Drawings

12.4 MATERIALS

12.4.01 Precast Concrete Sections

Manholes and catch basins shall be of precast concrete sections, supplied by the Contractor, which will meet the requirements of the latest CSA A 257.4 and ASTM C478 Standards for precast reinforced concrete and shall be of dimensions as shown on the Drawings. Manholes and catch basins shall be built watertight and the sections will have approved gasketed joints which comply with the latest ASTM Specification C443.

In addition to the O-ring gaskets, joints in precast sections below the concrete manhole cover shall be sealed with (19mm x 9.5mm) butyl rubber sealant CONSEAL CS102, or approved equivalent, and installed in accordance with the manufacturer's instructions.

12.4.01 Precast Concrete Sections (Cont'd)

Manhole base sections shall be of precast concrete with reinforced concrete slabs within. Sanitary manhole bases will have cast in wedge-type gasket or approved equivalent to suit the OD (outside diameter) of the inlet and outlet pipe and factory installed "U" - shaped benching as per the Standard Drawings. Storm manholes do not have benching or wedge-type gaskets; refer to respective Standard Drawings for details. Catch basins shall be the type, or size as indicated on the Drawings, with precut holes of sufficient size to fit the OD of the storm lateral(s). Sumps shall be provided with concrete bases on catch basins according to details as indicated on the Drawings.

Approval of shop drawings for all precast concrete structures shall be the responsibility of the Contractor; however, if the Engineer deems a structure to be defective or if the structure does not conform to Specifications, the structure must be replaced at the Contractor's expense.

12.4.02 Cast-In-Place Manholes and Catch Basins

Concrete used for manholes and catch basins shall have a minimum twenty-eight (28) day compressive strength of 30 MPa, an air content between 5% and 7% and the maximum size of coarse aggregate shall be 20 mm. The forms shall be left in place at least twenty-four (24) hours or until the concrete has set sufficiently so that, in the opinion of the Engineer, the forms can be removed without damage to the manhole. If the temperature during the time of placing concrete is below 5^{o}C, the procedure shall follow the approved practice of cold weather concreting (refer to Division 23, "Portland Cement Concrete").

12.4.03 Frames and Covers

Adjustable manhole frames and covers shall be used for all road surfaces and shall be Model AJ633ESR resilient seated seat with conical guide as manufactured by Mueller Canada, Bibby Ste. Croix, DomCast Components & Assemblies or approved equal. The diameter of the cover shall be 624 mm or as specified or directed by the Engineer. The adjustable manhole frames and covers shall conform to ASTM A536 for ductile iron and ASTM A48, Class 30, for cast iron and shall be as shown on the respective Standard Drawings. The Contractor is to provide on-site services from the adjustable manhole cover supplier for training and inspecting the Contractor's methods for the installation of adjustable manhole covers, unless directed otherwise by the Engineer. Standard (off-road) manhole frames and covers shall be cast iron conforming to ASTM A48, Class 30, and shall be as shown on the respective Standard Drawings.

Catch basin frames and grates and standard manhole frames and covers shall be cast iron to ASTM A48, Class 30, and shall be as shown on the respective Standard Drawings

The Contractor shall supply and install the catch basin frames and grates and manhole frames and covers in accordance with the Standard Drawings. Where directed by the Engineer, standard manhole frames and covers shall be supplied with a manhole cushion, trade name "RAP-O" or equivalent. All standard frames and covers shall be machined for close fit to prevent rattling due to the passage of traffic.

12.4.03 Frames and Covers (Cont'd)

If the existing cast iron frames and covers are to current City Standards the frames and covers shall be reused on new structures as directed by the Engineer. The Contactor shall give the City a Change Order Credit for the reused material(s) in the amount of the material cost for each frame and cover reused.

12.4.04 Valve Chambers

All gate valves larger than 300 mm shall be enclosed in a concrete chamber which shall be placed on concrete base pads. Chamber size shall be as noted on the Drawings.

All valve chambers shall be constructed from straight length, circular sections of concrete having a minimum compressive strength of 30 MPa after twenty-eight (28) days. The sections shall be precast sections and be a minimum of 1050 mm in diameter or larger as noted on the Drawings. The top section shall be 200 mm high with a 600 mm diameter hole in the centre, unless noted otherwise. All the precast sections shall be smooth on the inside and free from fins or any protuberances. All concrete sections shall comply with the latest ASTM C478 Standard.

The chambers for the combination air valves shall be precast concrete as per the Standard Drawing and meeting the requirements for precast concrete sections given in Section 12.4.01, "Precast Concrete Sections".

Combination air valve chambers shall have a minimum 100 mm diameter air inlet pipe, and be insulated as shown on the Standard Drawing.

The base pads on which precast sections will rest shall be made of concrete with a minimum compressive strength of 30 MPa after twenty-eight (28) days. The base pads shall be sized to suit the chamber. Refer to the Standard Drawings for base pad dimensions.

12.4.05 Drop Manholes

A drop manhole is required on all sanitary sewer mains whenever the inlet invert is greater than 600 mm above the outlet invert. Unless otherwise specified, the internal drop shall be Reliner, by RELINER-Duran Inc. or approved equivalent, as shown on the Standard Drawing. The manhole diameter shall be a minimum 1200 mm, or as shown on the Drawings.

12.4.06 Rubber Adjustment Rings

Rubber adjustment rings shall be FLEX O RING BE800 Series (flat or sloped) as manufactured by American Steel and Rubber, Infra-Riser, Ring-o-Riser as manufacturer by RG2S Solutions or an approved equivalent.

The rubber adjustment ring shall consist of no less than 80% by weight recycled rubber from tires and no less than 10% by volume shredded fibres. The ring shall meet the requirements of Table 12.1 when tested on units no less than twenty four (24) hours old and not more than sixty (60) days old and maintained at 23°C ± 2°C for at least twelve (12) hours prior to and during testing.

12.4.06 Rubber Adjustment Rings (Cont'd)

Table 12.1: Physical Properties of Rubber Adjustment Rings

Physical Property	Test Method	Requirement
Density	ASTM C642	1120 kg/m^3
Durometer Hardness: -Moulded surface -in the mass	 ASTM D2240 ASTM D2240	 75A ± 10 75A ± 10
Tensile Strength	ASTM D412	1.6 MPa (not < 1 MPa)
Compression deformation: -Initial compression deformation -Final compression deformation	 ASTM D575 ASTM D575	 6 ± 2% at 1 MPa 6 ± 2% at 1 MPa
Compression set	ASTM D395	Under 1 MPa 0.4%
Brittleness at Low temperature	ASTM D746	-40°C
Freeze and Thaw when exposed to deicing chemicals	ASTM 672	No loss after 50 cycles
Thermal expansion coefficient	ASTM C531	1.5 x 10^{-4} mm/mm/°C
Weather 70 hours at 70°C -Hardness retained -Compressive Strength -Tensile Strength -Elongation retained	 ASTM D573	 100% (±5%) 100% (±5%) 100% (±5%) 100% (±5%)

The manufacturing process shall be such that individual units are consistent in quality and appearance. All rough edges shall be trimmed prior to shipping.

The thickness of the rubber adjustment ring shall be within 3 mm of the manufacturer's stated dimensions. All other dimensions shall be within 5 mm.

12.4.07 Reinforced Concrete Grade Rings

Reinforced concrete grade adjustment rings shall be circular and comply with the latest edition of ASTM C478 and be free from cracks, voids, and other defects.

Concrete grade adjustment rings shall have a minimum height of 100 mm, and an inside diameter of 600 mm, or 750 mm as specified.

12.5 CONSTRUCTION METHODS

12.5.01 Locations

Manholes and Catch Basins shall be installed at locations indicated on the Drawings, or as directed by the Engineer.

12.5.02 Bedding and Backfilling

The excavation for manholes and catch basins shall be dewatered, dry and any soft or foreign matter removed. The base sections shall then be set on a minimum of 300 mm of bedding material. A minimum thickness of 300 mm of the same bedding material shall surround the structure. All structures must be constructed plumb.

The backfill material (bedding material) shall be carefully placed and compacted in 150 mm layers by mechanical and/or hand tampers to a height of at least 300 mm over the top of the pipe, to fill completely all spaces under and adjacent to the pipe. The remainder of the backfill shall be placed in layers not exceeding 300 mm and each layer shall be compacted to at least 95% of the maximum Standard Proctor density as determined by ASTM D698, latest edition. Bedding and backfill material shall be in accordance with Division 13, “Excavation, Trenching and Backfill Requirements”.

The outside walls shall be left free of ties or sharp protrusions liable to injure maintenance workers. Lifting holes (maximum of two [2] in each section) shall be plugged and made watertight with non-shrink grout.

12.5.03 Height Adjustments

The standard frame and cover shall be set flush with the existing or proposed pavement level and shall conform to the crown of the road. The catch basin frame and grate in curbs and gutters shall be placed in accordance with the respective Standard Drawing. The frame and cover shall be temporarily ramped, if required, to avoid danger to traffic. The Contractor is responsible to set the frame to the height specified or as directed by the Engineer.

Adjustment units for final height and grade of standard frames and covers and catch basin frame and grates for all surfaces shall be with rubber risers for all riser sections less than 75 mm. Adjustment greater than 75 mm shall be accomplished utilizing a combination of concrete grade rings and rubber risers. Bricks and steel shims shall not be permitted unless authorized by the Engineer.

Each manhole, catch basin and valve chamber must have at least one 100 mm concrete grade ring installed.

For the standard manhole frames and covers and catch basin frames and grates, a rubber riser must form the final surface for installation of the frame.

Rubber risers may be used with Adjustable Frames & Covers to make final adjustments to the height of the conical guide frame.

12.5.03 Height Adjustments (Cont'd)

The Contractor shall have available at the Site a variety of flat and tapered rubber adjustment rings varying in thickness of 12 mm to 75 mm by multiples of 12 mm. Cutting of rubber adjustment rings shall not be permitted under any circumstances.

Concrete and rubber adjustment rings shall be bonded to adjacent surfaces (manhole frames, other rings and concrete cover) by laying a continuous bead, 8mm thick, cold applied polyurethane or butyl sealant. Sealant shall be single-component, flexible, water-resistant, non-shrinking and VOC compliant. The sealant shall be placed on the bottom surface of the riser, at a diameter 25mm smaller than the outside diameter of the riser.

Acceptable Products: PL Premium Construction Adhesive
PL Polyurethane Concrete Crack & Masonry Sealant
PL S40 Polyurethane Window, Door & Siding Sealant
Tremco Butyl Sealant

The Contractor is to ensure that the surfaces receiving the joint sealant are clean, dry, and free of grease and oils. No more than two (2) rubber adjustment rings shall be stacked to make up the 100 mm rise.

12.5.04 Valve Chambers

The concrete pads shall be laid over the well-compacted bedding material of the watermain having its bottom coinciding with centre line of the watermain or the forcemain as shown on the Standard Drawings. The precast sections shall be laid on top of pads and brought to final grade with precast concrete sections as required. Final height adjustment of the frame and cover shall be as per Section 12.5.03, “Height Adjustments”. The Contractor shall ensure that the centre of plug is located vertically at the top of the square nut of the valve.

12.5.05 Structure Observations and Testing

All structures shall be viewed by the Engineer. Any leaks, wet spots or flaws in the structure, as well as defective joints, that the Engineer finds detrimental to the quality of the structure, shall be repaired at the Contractor’s expense and to the approval of the Engineer.

All manholes and catch basins shall be kept thoroughly cleansed of silt, debris and foreign matter and shall be free from such an accumulation at the time of acceptance by the City. The City shall reserve the right to survey the locations and elevations to ensure the structures have been set as per the elevations and coordinates given on the Drawings. If, for any reason any structure location or elevation is different from that specified or shown on the Drawings, the Contractor, at the Contractor’s expense, shall rectify such height or location deficiency as instructed by the Engineer.

12.5.05 Structure Observations and Testing (Cont'd)

If the Engineer has any reason for suspecting a manhole has been damaged during the installation and/or backfilling of the structure or by any other cause, such that the manhole will no longer comply with the requirements of the General Specifications or ASTM C969, the Engineer may request the Contractor to carry out an exfiltration or infiltration test in a manner acceptable to the Engineer in accordance with ASTM C969. If the measured rate of leakage is not acceptable according to ASTM C969 and the Engineer deems the manhole defective, the Contractor shall repair the defects to the satisfaction of the Engineer and this work shall be at the Contractor's expense.

If the Contractor is installing a new sanitary system and the Contractor is not required to maintain the sanitary flow of the sanitary system during construction, the Engineer may request the Contractor to carry out an exfiltration or infiltration test on the manholes in a manner acceptable to the Engineer in accordance with ASTM C969. If the measured rate of leakage is not acceptable according to ASTM C969 and the Engineer deems the manhole defective, the Contractor shall repair the defects to the satisfaction of the Engineer and this work shall be at the Contractor's expense.

12.5.06 Adjustment and Rebuilding of Existing Structures

Adjustment of structures with standard frames and covers means that the top of the structure will be changed by 50 mm or less.

Rebuilding of structures with standard frames and covers means that the top of the structure will be changed by more than 50 mm and to a maximum of 300 mm.

Adjustable frames and covers shall be adjusted as per the manufacturer's recommendations.

Prior to adjustment or rebuilding, the existing standard frame and cover or frame and grate shall be carefully removed and salvaged. Once a manhole or catch basin has been adjusted or rebuilt, the salvaged frame and cover shall be set to the correct elevation on the adjusted or rebuilt structure.

Where asphalt must be removed to adjust or rebuild a structure, the edges of the pavement shall be neatly cut. Asphalt reinstatement shall be in accordance with Division 21, "Restoration".

For adjustment or rebuilding of manholes and catch basins with standard frames and covers, concrete rings shall be used for adjustments of 100 mm or greater. Adjustments less than 100 mm shall be with circular rubber adjustment rings for manholes and square rubber adjustment rings for catch basins. Frames and covers are to be adjusted flush with final asphalt surface.

On streets where asphalt cold milling is to be carried out, the Contractor shall take due care with respect to adjustments. No compensation shall be made for structures adjusted unnecessarily or to the wrong grade due to cold milling.

When adjusting frames and covers, the Contractor shall take due care with respect to the longitudinal and cross slopes of the street surface as well as the amount of padding, if any, to be used, prior to adjusting them to their final

12.5.06 Adjustment and Rebuilding of Existing Structures (Cont'd)

grades. No additional payment shall be made for readjustments due to omissions, errors or mistakes made by the Contractor.

The Contractor is to take all necessary precautions to prevent dirt and foreign matter from entering into the structures while working and paving around or adjusting them. All structures shall be left clean by the Contractor following construction, if not, they will be cleaned by the City at the Contractor's expense.

All excavation, bedding, backfill, and compaction shall be in accordance with Division 13, "Excavation, Trenching and Backfill Requirements".

12.6 METHOD OF PAYMENT

12.6.01 Measurement for Payment

Measurement for payment shall be the total number of complete manholes, catch basins and valve chambers of each unit installed, or adjusted.

The unit price shall include all labour, materials and equipment necessary for the full completion of the work, including excavation, backfill, compaction, installation of the adjustable or standard frame, cover or grate, as well as other work described in this Specification.

Measurement for payment for adjustment of existing structures with adjustable frames and covers shall be made on a per unit basis. The price shall include all labour, materials and equipment, including asphalt placement underneath the flange of the inner frame, to adjust the structure to the required elevations.

Measurement for payment for adjustment of existing structures with standard frame and covers shall be on a unit basis. The price shall include all labour, materials and equipment, including asphalt padding around frame, to adjust structure to required elevations.

Adjustment shall not be measured for new structures. The cost of adjustment for new structures shall be included by the Contractor in the unit prices for these structures.

All structures other than new structures, shall be measured for adjustment, even when rebuilding must take place.

Measurement for payment for additional height for rebuilding structures with standard frames and covers shall be on a vertical lineal measurement basis. It shall be measured from the top of the undisturbed surface of the structure to the bottom of the frame less 50 mm. Payment for the top 50 mm is included in the unit price of adjustment.

The "collaring", permanent or temporary, of the adjusted standard frames and covers with asphalt concrete shall be considered incidental to the Contract and no additional payment shall be made for any labour, materials or equipment, including asphalt concrete. Asphalt thickness for this purpose shall be a minimum of 75 mm.

12.6.01 Measurement for Payment (Cont'd)

In high volume traffic areas, streets are to be returned to normal use after each day's work by the Contactor, as directed by the Engineer. Temporary asphalt concrete collaring of standard frames and covers for this purpose shall also be considered incidental to the Contract, as specified with respect to "collaring" above.

Measurement for payment for frame and cover cushions shall be made on a per unit basis.

12.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4.5 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 13

EXCAVATION, TRENCHING AND BACKFILL REQUIREMENTS

City of Saint John

TABLE OF CONTENTS

DIVISION 13 – EXCAVATION, TRENCHING AND BACKFILL REQUIREMENTS

EXCAVATION, TRENCHING AND BACKFILL REQUIREMENTS

13.1 SCOPE OF WORK

The Work included in this Division consists of the excavation and disposal of excavated materials, bedding, backfilling and compaction necessary for the installation of water and sewer mains, laterals and appurtenances as per the Drawings and Specifications. Topsoil and/or any other excavated materials will be stockpiled when and as directed by the Engineer.

13.2 DEFINITIONS

13.2.01 Common Excavation

Common excavation shall include the excavation and disposal of all materials of whatsoever nature except that included in the classification of Rock Excavation. Common excavation shall include the removal of:

(a) Frozen earth material.

(b) Pavement, curbs and sidewalks.

(c) Loose and shattered rock of fragment volume less than one half cubic metre (0.5 m^3).

(d) Boulders and rock fragments, regardless of the fragment volume, excavated from earth borrow pits and incorporated in the project.

(e) Existing pipes, manholes, valves, chambers, wood timbers, steel rails, etc.

13.2.02 Rock Excavation

Rock excavation shall include the removal of:

(a) Material(s) excavated from solid masses of igneous, sedimentary or metamorphic rock, which prior to removal, was integral with the parent mass.

(b) Boulders and rock fragments measuring in volume one half cubic metre (0.5 m^3) or more.

(c) But not withstanding (a) and (b), the removal of dense tills, hard pan and any other similar materials shall not be Rock Excavation for purpose of payment.

(d) Large masses of concrete meeting the requirements of (b).

Any materials not meeting the above criteria for Common or Rock Excavation shall be classified by the Engineer.

13.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Water Systems ..... Div. 10

(d) Sewer Systems ..... Div. 11

(e) Manholes, Catch Basins and Valve Chambers ..... Div. 12

(f) Restoration ..... Div. 21

(g) Roadway Construction ..... Div. 24

(h) Standard Drawings

13.4 MATERIALS

13.4.01 Excavated Materials

Materials to be excavated shall include removal of disintegrated rock, shale, hardpan, clay, boulders, earth or any other material. All excavated materials shall be classified as "Common Excavation" or "Rock Excavation" as per Section 13.2, "Definitions".

13.4.02 Bedding Material

Bedding material shall consist of approved well graded sand or granular material free of clay, frozen lumps, organic or deleterious matter, and meet the gradation limits as specified in Table 13.1.

Table 13.1: Bedding Material

Sieve Size (mm)	Percentage By Weight Passing (%)
37.5	100
25.4	95 - 100
19.0	90 - 100
9.5	60 - 100
4.75	35 - 80
2.36	15 - 60
0.300	0 - 30
0.075	0 - 10

13.4.02 Bedding Material (Cont'd)

The Contractor shall dewater the trench for the placement of bedding material. Stone bedding may be used only if authorized by the Engineer. Stone bedding shall consist of approved, well graded material free of clay, frozen lumps, organic or deleterious matter; and meet the gradation limits as specified in Table 13.2.

All bedding material (stone and sand bedding) test results must be completed within the calendar year the work is to be completed and provided to the Engineer for approval two weeks before the work commences.

When using stone bedding, the entire pipe bedding zone shall be enveloped with geotextile fabric to prevent the migration of fines from the surrounding soil. Refer to Sections 24.4.03 and 24.5.13, "Geotextile Fabric", for geotextile specifications.

Table 13.2: Stone Bedding Material

Sieve Size (mm)	Percentage By Weight Passing (%)
25.4	100
19.0	75 - 100
9.5	0 - 75
4.75	0 - 15
2.36	0 - 5

13.4.03 Selected Backfill

Selected material from excavation for the work may be used for backfilling only where shown on the Drawings, as required in the Contract Specifications, or authorized by the Engineer. Selected material for backfilling shall be free of clay, frozen lumps, rubbish, organic material or any other deleterious materials, and shall contain no boulders or broken rock larger than 200 mm greatest dimension. No frozen materials shall be used for backfilling. Selected material from excavation for the work shall be subject to the approval of the Engineer.

13.4.04 Granular Base and Subbase

Aggregate shall be comprised of clean, hard, sound, durable, uncoated particles that do not contain friable, soluble or reactive minerals or other deleterious materials or conditions that would make the aggregate prone to decomposition or disintegration, or present any environmental hazard, from the presence of the parent material or its by-products, when exposed to the natural elements after placement. Aggregates shall meet the requirements of Table 13.3.

13.4.04 Granular Base and Subbase (Cont'd)

Table 13.3: Properties of Rock and Gravel Aggregate

Test Method	Aggregate Type	Maximum
Micro Deval (MTO LS-618)	Cover Material	22% Loss
	Aggregate Base	25% Loss
	Aggregate Subbase and Shoulder Material	30% Loss
Freeze Thaw (MTO LS-614)	All Highway Aggregates	20% Loss
Flat & Elongated Particles @4:1 (MTO LS-608)	All Highway Aggregates	35% Flat/Elong.
Plasticity Index (ASTM D4318)	Aggregate Base/Subbase	Max. 5

Crushed Rock Base/Subbase

Crushed Rock Base/Subbase shall be produced by the processing of rock to conform to the grading limits as set out in Table 13.4, when tested in accordance with ASTM C136 and C117, latest editions.

Table 13.4: Grading Limits - Crushed Rock Base/Subbase

ASTM Sieve Size (mm)	Aggregate Base 25 mm (% Passing)	Aggregate Base 31.5 mm (% Passing)	Aggregate Subbase 75 mm (% Passing)
90.0	—		100
75.0	—		95 - 100
63.0	—		85 - 100
50.0	—		73 - 95
37.5	—	100	58 - 87
31.5	100	95-100	—
25.0	95 - 100	81-100	—
19.0	71 - 100	66-90	35 - 69
12.5	56 - 82	50-77	—
9.5	47 - 74	41-70	25 - 54
4.75	31 - 59	27-54	17 - 43
2.36	21 - 46	17-43	12 - 35
1.18	13 - 34	11-32	8 - 28
0.300	5 - 18	4-19	4 - 16
0.075	0 - 8	0-8	0 - 9

13.4.04 Granular Base and Subbase (Cont'd)

Crushed Gravel Base/Subbase

Crushed Gravel Base/Subbase shall be produced by the processing of gravel to conform to the grading limits of Table 13.5 when tested in accordance with ASTM C136 and C117, latest edition.

Table 13.5: Grading Limits - Crushed Gravel Base/Subbase

ASTM Sieve Size (mm)	Aggregate Base 25 mm (% Passing)	Aggregate Base 31.5 mm (% Passing)	Aggregate Subbase 75 mm (% Passing)
100.0	—		—
90.0	—		100
75.0	—		95 - 100
63.0	—		86 - 100
50.0	—		75 - 95
37.5	—	100	61 - 87
31.5	100	95-100	—
25.0	95 - 100	83-100	—
19.0	75 – 100	70-90	38 - 70
12.5	60 - 82	55-78	—
9.5	52 - 75	45-72	28 – 56
4.75	36 - 61	30-57	19 - 46
2.36	25 - 48	20-46	13 - 37
1.18	16 - 38	14-35	9 – 30
0.300	5 - 16	5-19	4 - 16
0.075	0 - 6	0-6	0 - 7

Gravel Base shall have a minimum of 40% of the particles, by mass, having at least one fractured face, when tested in accordance with the latest edition of MTO LS-607 on a combined sample composed of the sieve size ranges set out in Table 13.6. The material shall be divided into the ranges in accordance with ASTM C136, latest edition.

Table 13.6: Crushed Particle Sieve Size Ranges

Passing Sieve Size (mm)	Retained on Sieve Size (mm)	Minimum Mass (g)
25	12.5	1000
12.5	9.5	500
9.5	6.3	200
6.3	4.75	75

All gravel base and subbase test results (Test Method MTO LS-607 and Table 13.3, 13.4, 13.5, 13.6) must be completed within the calendar year the work is to be completed and provided to the Engineer for approval two weeks before the work commences.

13.4.05 Pit Run Gravel Subbase

Pit run gravel subbase material shall be used for backfill in all excavations unless otherwise approved by the Engineer. In cases where selected excavated material is approved by the Engineer for use as backfill material, then the Contractor shall provide a change order credit to the Contract equal to the cost of the supply of pit run gravel subbase material.

Pit run gravel subbase shall be gravel that conforms to the grading limits set out in Table 13.7, when tested in accordance with ASTM C136 and C117, latest editions. Oversized rocks in the pit run material shall be removed from the Works. All pit run gravel subbase test results must be completed within the calendar year the work is to be completed and provided to the Engineer for approval two weeks before the work commences.

Table 13.7: Grading Limits - Pit Run Gravel Subbase

ASTM Sieve Size (mm)	Aggregate (% Passing)
125.0	100
100.0	95 - 100
75.0	82 - 100
50.0	62 - 100
37.5	52 - 100
19.0	30 - 90
9.5	22 - 79
4.75	16 - 66
2.36	12 - 55
1.18	9 - 44
0.300	4 - 25
0.075	0 - 7

13.4.06 Unshrinkable Fill

Unshrinkable fill shall be used as backfill material in confined areas under existing pipes or other areas, as shown on the contract drawings or as directed by the Engineer, where the specified compaction cannot be achieved using conventional granular backfill materials.

The manufacture and placement of unshrinkable fill shall be governed by CSA A23.1 and A23.2. Unshrinkable fill shall have the following qualities:

- Type 10 Portland cement content shall be 25 kg/m3
- Maximum compressive strength of 0.4MPa at 28 days.
- Slump shall be between 150 mm – 200 mm
- Aggregates shall be the type used for concrete consisting of clean, hard, durable stone or pea gravel free from lumps, soft and flaky particles, organic matter, salt, alkali and adherent coatings. No more than 10% by weight of the aggregate shall be finer than (passing) the 0.075 mm sieve.
- Material shall be designed so that it can flow into the excavation and fill the entire space without vibration or segregation.

13.4.06 Unshrinkable Fill (Cont'd)

The mix design for the unshrinkable fill shall be reviewed by the Engineer before placement of any unshrinkable fill.

13.5 CONSTRUCTION METHODS

13.5.01 Removal of Pavement, Curbs and Sidewalks

For open cut excavation, the Contractor shall break out and remove the pavement, curbs and sidewalks for such lengths and widths as required to prevent undermining by the trench excavation or as safety requirements and soil conditions permit.

Pavements, curbs and sidewalks shall be carefully cut along neat straight lines prior to excavation. Edges of broken pavement shall be trimmed to neat lines before reinstatement work is commenced. Breaking with free falling objects or ripping by excavation machinery of the pavement, curbs or sidewalks will not be permitted.

The Contractor shall clear the surface on the line of work and shall properly store all materials in approved locations, guard and preserve all materials suitable for future use in the Works.

13.5.02 Obstruction of Streets and Hydrants

During the entire construction period, the Contractor shall maintain all operational fire hydrants, sidewalks, pedestrian crosswalks, driveways and other crossings free from obstructions. To keep excavated materials from falling on private property outside the right-of-way, a suitable guard shall be placed by and at the expense of the Contractor in a location satisfactory to the Engineer.

13.5.03 Hauling Materials on Streets

When hauling surplus excavated materials, the Contractor shall not permit the accumulation of deposits and droppings on the streets or pavements. In all cases where materials are dropped from the trucks or wheels of trucks of the Contractor, the Contractor shall clean up same as often as directed, and should the Contractor refuse or neglect to do so promptly, the Engineer shall order others to carry out this work and the costs incurred by this operation shall be charged to the Contractor.

13.5.04 Pumping

The Contractor shall keep excavations, trenches or tunnels free from water, while the work is in progress. The Contractor shall build dams and other work necessary for this purpose, and shall provide and keep in operation on the Site, as required, a pump or pumps of sufficient capacity for this purpose.

The Contractor shall provide for the disposal of water removed from the excavations in such a manner as shall not be a danger to public health, the environment, private property, any portion of the Works completed or under

13.5.04 Pumping (Cont'd)

construction either by this Contractor or any other Contractor, the surface of streets, and in such a manner as shall cause no impediment to the use of the streets or roads by the public.

The Contractor shall provide for the removal of sand and mud when directed by the Engineer. The Contractor shall also clean out catch basins that have filled with sand and mud during construction of the Works; all at no cost to the City.

The Contractor shall not hold the City liable for leakage encountered in the Works from existing sewers, watermains or drains, or from other sewer or drains under construction.

Under extreme conditions of water in the excavation, the Contractor shall employ such methods as are necessary to control the water.

13.5.05 Gutters to be Kept Clean

Gutters shall be kept free at all times for surface draining, and no damming or ponding of water in gutters or other waterways will be permitted. The Contractor shall not direct the flow of water across or over pavement, except through approved pipes or other methods approved by the Engineer.

13.5.06 Sheeting and Shoring

Sheeting and shoring shall be installed in trenches in strict accordance with Regulation 91 - 191 under the Occupational Health & Safety Act of the Province of New Brunswick, latest revision.

Where, due to the nature of the work, the Contractor sheathes, shores, or braces the excavation and/or trenches, then such sheeting, shoring or bracing shall be supplied, installed, maintained, removed, or left in place as part of the work, all at the Contractor's expense.

All work behind the shoring shall be filled with native backfill, or other material, as the Engineer directs, and compacted as the sheeting is placed.

The Contractor has the option of removing the sheathing before backfilling, or leaving it in place, provided however, no sheathing shall be left in place within one metre (1m) of subgrade.

In trench work, sheathing shall not be removed until the required bedding has been placed and compacted.

13.5.07 Excavation Grade and Foundations

The bottom of the trench shall be shaped accurately as shown on the Standard Drawings to provide a cradle for the pipe on a properly compacted granular bedding, and it shall be supported evenly for its full length except at joints where additional excavation will be allowed to permit making of the joints.

Any part of the trench excavated below the specified grade shall be corrected with granular fill material and shall be thoroughly compacted. There shall be

13.5.07 Excavation Grade and Foundations (Cont'd)

no obstructions such as stones, boulders, etc., along the bottom of the trench and any that occur which could result in unsatisfactory bedding conditions shall be removed and replaced with granular material.

If during the progress of the work, and before installing any piping, the natural soil of the trench bottom becomes soft due to excessive water infiltration, the material so impaired shall be removed by the Contractor and replaced with suitable materials acceptable to the Engineer.

The Contractor shall be responsible for all settlement of pipe, which may be due, in the opinion of the Engineer, to the improper preparation and protection of the trench bottom. The Contractor shall bear all costs of removing, rebuilding and replacing work which may become defective by reason of such neglect, or of failure to properly construct, place and backfill around and over the pipe.

The Contractor shall be responsible for the condition of all excavations. All slides and cave-ins shall be removed without extra compensation at whatever time and under whatever circumstances they may occur.

The foundations in the trench shall be formed to prevent any subsequent settlement and thereby prevent excessive pressure on, and a consequent rupture of, the pipes.

13.5.08 Length of Trench to be Opened

The maximum length of trench to be opened at one time or place shall be thirty metres (30 m). In general, backfilling shall begin as soon as practicable after the bedding and pipe laying have been completed.

If work is stopped on the whole or any part of the trench and the trench is left open for any length of time in advance of the construction of the pipe lines, the Contractor shall, when directed by the Engineer, refill such trench or part thereof and shall not again open up such trench or part thereof until the Contractor is ready to proceed with the construction of the pipe lines. Should the Contractor refuse, neglect or fail to completely refill such trench within twenty-four (24) hours after the receipt of notice in writing to do so, the Engineer may order the refill of said trench, and the cost and expense thereof shall be charged to the Contractor.

13.5.09 Explosives and Blasting

Blasting shall be under the control of an experienced licensed powder man. No explosives shall be stored on the Site. The Contractor shall supply all necessary notices as per Section 7.11, "Notification of Official Agencies".

Prior to any blasting operations being undertaken the Contractor shall furnish a separate general liability insurance policy or rider satisfactory to the City covering all aspects of the intended blasting activities, and obtain written approval from the Engineer.

No explosives shall be stored on the Site nor shall any blasting be done without prior approval in writing by the Engineer and then only in such places and at

13.5.09 Explosives and Blasting (Cont'd)

such times as the Engineer may permit. Such approval shall not relieve the Contractor of the sole responsibility for any damage or accident to adjoining utilities, properties, structures, wells and persons as a result of blasting operations.

The control, general safety, handling, record keeping, and conducting of blasting operations shall be carried out in accordance with the latest edition of New Brunswick Regulations 91-191 under the Occupational Health and Safety Act.

Areas to be blasted shall have the surface stripped of grubbed materials prior to blasting.

Areas to be blasted shall be covered with proper mats and shields adequate to prevent flying rock and debris.

All cost of rock excavation such as those of explosives, supplies, equipment, labour and any other costs shall be included in the price per cubic metre (m^3) for 'Rock Excavation', as bid on in the tender.

In no case shall the spacing of the drill holes exceed the depth of the cut at the point of drilling. The depth of cut shall be considered that depth from the rock surface at the point of drilling to the elevation of the bottom of shatter. Shattering or over-blasting of rock below the specified grade and imported granular fill to correct over blasting will not be measured for payment.

The type of explosives, drilling and method of blasting to be used must be submitted to the Engineer, if requested. The use of explosives in large blasts, as in seams, drifts, shafts, pits or holes, or in similar devices, is prohibited, unless done on the written authority of the Engineer.

Protective measures shall be used where blasting may damage adjoining property or public utilities. Under Division 6, Section 6.7.04, "Loss or Damage", the Contractor shall be responsible for all damages.

Notwithstanding any authorization of the Engineer in regard to explosives, drilling or methods of blasting used, the Contractor shall take all precautions necessary to ensure the safety of persons and adjoining property and structures, including public utilities and shall be responsible for all claims whatsoever, arising from the hauling, handling, use of, and storing of explosives, and all affects, direct or indirect of the blasting operations, including but not limited to vibration, concession, flying material, movement of silt, interruption of ground water supplies, etc.

Maximum Particle Velocity

No person shall carry out or cause to be carried out blasting which results in a Particle Velocity which exceeds the limits set out in Table 13.8.

13.5.09 Explosives and Blasting (Cont'd)

Table 13.8: Particle Velocity Limits

Frequency of Ground Vibration in Hertz	Maximum Allowable Peak Particle Velocity in millimeters per second
15 or less	12.5
16 to 20	19.0
21 to 25	23.0
26 to 30	30.5
31 to 35	33.0
36 to 40	38.0
40 or greater	50.0

Maximum Air Blast

No person shall carry out or cause to be carried out blasting which results in an Air Blast which exceeds 128 decibels as measured on the linear scale.

Blast Monitoring

No person shall carry out or cause to be carried out blasting unless a qualified person monitors each blast with a Particle Velocity meter and Air Blast sensor which are located outside of the property on which blasting is being carried out and are:

(a) At the structure which is located nearest to the blast hole.

(b) At any other structure or utility required by the Engineer.

Submit Records

A qualified person shall compile the monitoring data into Air Blast and Particle Velocity monitoring reports. This report shall be submitted to the Engineer weekly.

If a blast exceeds an allowable limit for Air Blast and Particle Velocity the Engineer shall be notified immediately and the qualified monitor shall submit the Air Blast and Particle Velocity monitoring reports within 24 hours of the blast. These monitoring reports shall be accompanied by a written explanation for the excessive Air Blast and Particle Velocity level(s) as well as a recommendation for corrective action.

Pre-Blast Survey

No person shall carry out or cause to be carried out blasting unless a pre-blast survey is completed on every structure within a distance in all directions from the blasting area of 32 m/kg^{½}. The blasting area shall be a zone extending 50 metres (m) in all directions from the location where explosives are handled, prepared, or used, or in which unexploded charges exist. The scaled distance shall mean the actual distance from a blasting hole measured in a horizontal

13.5.09 Explosives and Blasting (Cont'd)

Pre-Blast Survey (Cont'd)

line, divided by the square root of the maximum charge weight per delay in that hole. If conditions warrant and if deemed necessary by the Engineer this distance may be increased. If the Contractor's Insurance Company requires a pre-blasting survey for a larger distance from the blasting area or requires more information than the City of Saint John General Specifications, the Contractor shall remain in compliance with the Insurance company's requirements. The pre-blast survey shall meet the following requirements:

- A letter of introduction containing a project description, the blasting contractor's name, the name of the firm conducting the survey, and an approximate start and completion date for the project is distributed to all property owners in the area to be surveyed;
- Appointments are made and the survey is carried out in a timely manner;
- Each property owner is contacted in person and if the homeowner cannot be contacted, notification is to be sent via registered mail, advising the owner who to contact to schedule an appointment;
- The survey consists of high quality video photography of the exterior of the structure, in reproducible format, and which shows an overview of every side of the structure, and includes details of any deficiencies noted at any location on the exterior;
- The survey shows fences, sidewalks, trees, and other similar features if the structure is within 15 metres (m) of the construction site;
- Video surveys are carried out on the interior of the structure with the owner's consent, or in sketch format if the owner does not consent to video;
- The survey is carried out under normal lighting conditions from a distance of 1-2 metres (m), objects such as furniture are not moved during the survey, all deficiencies are noted, and the video record is supplied for review to the property owner upon request;
- A written report which includes still photographs of all existing deficiencies is compiled for each structure and a copy to be delivered to the property owner;
- If the structure is connected to a well, a report on the age and condition of the well; and
- If the structure is connected to an on-site sewage disposal system, a report on the age and condition of the on-site sewage disposal system.

If a structure within the pre-blast survey area is connected to a well, the Contractor shall ensure that three (3) bacteriological and one (1) general

13.5.09 Explosives and Blasting (Cont'd)

Pre-Blast Survey (Cont'd)

chemical analyses are performed on water from the well before blasting has commenced and the same number of tests after blasting has been completed.

In addition to the above the City of Saint John may require other structures to be surveyed and in addition other water tests to be performed. This pre-blast survey must be witnessed by the Property Owner, the Property Owner's Agent, or a Third Party and shall be made available to the City on request.

Notification

No person shall carry out or cause to be carried out blasting unless notice is delivered by hand after the blasting permit is issued and at least four (4) days prior to the commencement of blasting, to every property owner or business within the affected Community which shall contain:

- The name of the person or company responsible for the blasting, including a contact person and telephone number;
- The intended date and time when blasting shall commence and its expected duration period; and
- The location of the blasting.

If a public information meeting is required by the City of Saint John no person shall carry out or cause to be carried out blasting prior to the public information meeting being held.

No person shall carry out or cause to be carried out blasting within 300 metres (m) of a school, hospital, or other health care facility unless such notice has been given to the senior administrator of the school, hospital or other health care facility, and; the senior administrator is also informed at least two (2) hours prior to each blast.

Immediately prior to a blast, the Contractor shall clear the blasting area of all residents, vehicular and pedestrian traffic and shall post flagmen at each road entering the blasting area who shall stop all traffic and shall prevent such traffic from entering the area until the blast has taken place. The Contractor shall provide and use a siren to warn the public and the workers that a blast is to be set off, and to indicate the 'All Clear' after the blast has taken place. Four (4) short soundings of the siren two (2) minutes before detonation of a blast shall be used for warning and protection, and one (1) long seven (7) second sounding of the siren will be used to give the 'All Clear' signal.

13.5.10 Conflict with and Removal of Existing Utilities and Structures

Certain underground and aboveground facilities may be located along the construction route. This includes, but is not limited to, all water, sewer, gas pipes, culverts, telephone, electric power lines, cables, poles, conduits, etc. If watermains and sewer mains or branch lateral pipes exist in various locations along the construction route, it is the responsibility of the Contractor to maintain

13.5.10 Conflict with and Removal of Existing Utilities and Structures (Cont'd)

liaison with the various authorities responsible for these installations to ensure that no damage is affected to these facilities.

The approximate location of existing utilities may be shown on the Drawings for guidance purposes only, but the Engineer accepts no responsibility for the accuracy or completeness of this information. It is the responsibility of the Contractor, prior to commencing work, to verify the extent and location of existing utilities whether or not shown on the Drawings.

Any damage caused to any watermains, sewer mains, services, gas lines, catch basins, culverts, etc., shall be immediately repaired by the Contractor, to existing or better condition. The repairs shall be carried out at no additional cost to the Owner.

No claim will be entertained for any damage or any slowdown of work due to any involvement with the aforementioned utilities. It is the responsibility of the Contractor to maintain liaison with the appropriate utility authorities to ensure no damage is caused to those facilities.

The Engineer may order the Contractor to remove, realign or reconstruct the facility in such manner and in such location as the Engineer may deem advisable. Payment for such work shall be made at the unit rate submitted in the Form of Tender or according to the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

13.5.11 Removal of Foreign Matter

Prior to bedding and backfilling any constructed pipelines, earth from cave-ins, accumulations of water and mud and all other objectionable matter shall be removed, damaged sections repaired or removed and replaced, and any other repair or attention required shall be performed. No trench shall be left open overnight but rather in a condition so as to preclude damage by cave-ins, falling stones or other causes.

13.5.12 Bedding

Once the trench has been excavated to the required grade, bedding methods and materials must conform with the pipe manufacturer's requirements for all materials being bedded. The bedding under the pipe shall be placed in maximum 150 mm layers to a minimum depth of 150 mm in common excavation or 300 mm in rock excavation and compacted to a density of 95% of maximum dry density as determined by ASTM D698, latest edition.

Bedding shall be placed in 150 mm lifts to a minimum height of 300 mm over the top of the pipe. The bedding shall be tamped or rodded by hand under the haunches of the pipe upon placing of the first lift. Succeeding layers shall then be placed and compacted to a density of 95% of maximum dry density as determined by ASTM D698, latest edition. Pipe bedding shall not be placed in water or in trenches having soft or unstable bottom conditions. Bedding shall be in accordance with, Section 13.4.02, "Bedding Material".

Should, in the opinion of the Engineer, field conditions require a different type of granular bedding, the Engineer's decision will be binding.

13.5.13 Backfilling

Once the pipe bedding material has been placed to the required depth and degree of compaction, pit run gravel subbase backfill shall be placed in layers not exceeding 300 mm in thickness and shall be compacted to at least 95% of the maximum dry density as determined by ASTM D698, latest edition.

Under all paved and concrete surfaces, curbs, sidewalks, shoulders, driveways and gravel surfaces the top 150 mm of the trench shall be backfilled with granular base and compacted to at least 95% of the maximum dry density as determined by ASTM D698, latest edition. Granular base shall be in accordance with Section 13.4.04, “Granular Base and Subbase”.

The Contractor shall carry out compaction testing on trench backfill material. If requested, the Contractor shall excavate test pits for the Engineer to carry out additional compaction tests. There shall be no additional cost for delays or excavating test pits as requested by the Engineer.

The Contractor shall be responsible for quality control (QC) testing for the compaction stage of the work (based on calibrated nuclear density gauge testing) to ensure that density conforms to the requirements of the Specifications.

The Contractor shall coordinate and pay for the testing as outlined in Table 13.9. The Contractor shall engage a qualified engineering firm to perform the testing and submit the results to the Engineer as soon as the tests are completed.

13.5.13 Backfilling (Cont'd)

Table 13.9: Minimum Testing Frequency (For Compaction of Soils)

Item No.	Description	Test Method	Testing Frequency	Remarks
1	Trench Work (Water & Sewer)	ASTM D698	Minimum of one Proctor test is required per material type prior to placement. Nuclear density testing done to create a compaction pattern for both bedding and backfill to establish a benchmark to continue until a noticeable change in material. Once procedure is established, Contractor must ensure that the recommended method is followed on all trenches. During pipe trench backfilling, minimum of one (1) nuclear density test per 100m of trench work, for each 300mm lift, or equivalent for shorter trenches.	Nuclear gauge testing. Inspector to make field notes on method and results.
2	Subgrade Testing (Borrow or Fill Sections)	ASTM D698 Proof Rolling	Minimum of one Proctor test is required per material type prior to placement. One nuclear density field test section per material type - to develop a definite compaction procedure (equipment, lift thickness, moisture application and number of passes), which will produce the required density. Visual deflection test of all subgrade surfaces with a fully loaded tandem truck. Minimum one (1) nuclear density test per 20 m of street, for each 300 mm lift.	Nuclear gauge testing.
3	Subgrade Testing (Cut Sections)	Proof Rolling	Carry out visual deflection test of all subgrade surfaces with a fully loaded tandem truck.	Inspector must verify in his field notes that this was carried out and record the results.
4	Granular Base and Subbase	ASTM D698	Minimum one (1) test per 20 m of street, for each lift of material added.	Nuclear gauge testing.
5	Concrete Curb and Gutter	ASTM D698	Minimum one (1) test per 50 m of curb.	Nuclear gauge testing.
6	Concrete Sidewalk	ASTM D698	Minimum one (1) test per 50 m of sidewalk.	Nuclear gauge testing.
Notes: Frequency or numbers of tests may be increased at any time by the Engineer when deemed necessary or if unfavourable results are recorded. The Engineer may request proof rolling of the granular base or subbase by the Contractor. Items #4, 5 & 6 must also have Proctor and rolling patterns established as per Item #1.				

13.5.13 Backfilling (Cont'd)

As a minimum, the number of nuclear density tests required to ensure proper compaction of backfill for trench work (water & sewer) shall be determined by the following formula, unless otherwise directed by the Engineer:

Minimum number of nuclear density tests per day:

$$= \frac{\text{total length of trench per day (m) x greatest trench depth (m)}}{0.300 \text{ m} \times 100 \text{ m}}$$

The frequency of testing will not vary for multiple pipe trenches and the above formula shall apply to single pipe trenches and multiple pipe installations in common trenches.

The Contractor shall be responsible for the interpretation of the QC test results and the determination of any action to be taken to ensure that all materials and work conform to the requirements of the Contract.

Should there be any deficiency of the proper materials for backfilling, the Contractor shall furnish same at the Contractor's expense, and all trenches shall be filled to the height and level with the original surface as it existed prior to the commencement of the work, unless the Engineer, in writing, shall otherwise direct. Should any settlement below the required height take place before completion of all Works on the Contract, the Contractor shall provide suitable compaction methods and re-compact the material above the pipelines, and shall furnish additional suitable material and refill the trench to the required height, all at the Contractor's expense.

Trench shoring which is to be removed, shall be withdrawn as the level of the compacted backfill material rises in the excavation in such a manner that no voids are left in the compacted bedding or backfill after the complete withdrawal of the shoring.

Excess backfill material shall be cleaned up and disposed of at the end of the day's work or as instructed by the Engineer. The Contractor shall dispose of unsuitable and surplus material off-site.

13.6 METHOD OF PAYMENT

13.6.01 Measurement for Payment

All excavation, disposal of excavated material, sand bedding, stone bedding, backfill and compaction necessary for the installation of water and sewer mains, manholes, catch basins, valve chambers, and all appurtenances shall be incidental to the unit price of the water and sewer main, water and sewer lateral pipe, manhole, valve chamber, catch basin or related appurtenances.

Excavation for Buildings or Other Structures

The unit price for common excavation shall include for the removal and disposal of any existing concrete retaining walls, foundations, etc. The quantities shall be based on a theoretical width which shall be 1200 mm beyond the vertical wall or 300 mm beyond the footing, whichever is greater and to be 150 mm below the footing in common excavation or as specified by the Engineer.

13.6.01 Measurement for Payment (Cont'd)

Backfill for Buildings or Other Structures

Payment for backfilling for buildings shall be limited to the quantity required to fill between the approved limits of excavation minus the volume taken up by the structure in that excavation, and to the new finished elevations shown on the Drawings. Measurement for payment to be on a cubic metre (m^3) basis of backfill material, compacted in place.

Unshrinkable Fill

Measurement for payment for unshrinkable fill material shall be on a cubic metre (m^3) in place basis.

Rock Excavation

Rock excavation, as per the definition in Section 13.2.02, "Rock Excavation", shall be paid on a cubic metre (m^3) basis including blasting, excavation and disposal.

Measurement for Rock Excavation in new trenches shall be in accordance with the Standard Drawing for Trench Layout and Payment Limits for Rock Excavation.

For rock excavation, the Contractor shall notify the Engineer if, during excavation, material which appears to conform to the classification for rock excavation is encountered. Material shall be stripped or exposed to such an extent that, in the opinion of the Engineer, elevations can be taken to calculate rock quantities. If the Contractor fails to give notice, the Engineer will not approve any quantity of excavated material as rock excavation before the Engineer sees it in its original state prior to its excavation.

Geotextile Fabric

Geotextile fabric as specified on the Drawings or as requested by the Engineer shall be paid on a square metre (m^2) basis. Measurement for payment will be the total horizontal or vertical area laid, but will not consider extra fabric used in wrinkles, folds or overlapping the edges. The unit rate will include the supply, placement and the preparation of the surface on which it is to be laid. Staking of the fabric on steep slopes shall be considered incidental to the work.

Rock Cuts in Existing Trench

When renewing water and sewer mains where the existing trench or part of it was in rock, the average end area of rock will be paid on the basis of average depth of the rock by the Outside Diameter (O.D.) of the pipe plus 600 mm, minus the average depth of the rock by the Outside Diameter (O.D) of the pipe plus 300 mm. Depth is to a maximum of 300 mm below the invert of the new pipe.

13.6.01 Measurement for Payment (Cont'd)

Average End Area of Rock:

Average End Area = ([Average Depth of Rock] x [O.D.+ 600 mm]) – ([Average Depth of Rock] x [O.D.+ 300 mm])

= (300 mm x [Average Depth of Rock])

13.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 16

ELECTRICAL SYSTEMS

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

Section **Page**

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

Section **Page**

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

Section **Page**

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

Section **Page**

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

Section **Page**

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

Section **Page**

City of Saint John

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL SYSTEMS

Section **Page**

ELECTRICAL SYSTEMS

16.1 SCOPE OF WORK

The Work included in this Division consists of the supply and installation of all labour, material, and equipment for the installation and connection of a complete electrical system as per the Drawings and Specifications.

16.2 DEFINITIONS

"**C. E. C."** shall mean the latest edition of the Canadian Electrical Code.

16.2.001 Electrical General Provisions

This section covers items common to sections of Division 16. This Section supplements requirements of Division 7. Reference to Division 15 Mechanical and Division 14 Elevator Services relates to Special Building Services with separate specifications for a specific project.

Where specific standards are referenced, the latest issued specific standard shall apply.

Do complete installation in accordance with CSA C22.1 latest edition, except where specified otherwise.

Do overhead and underground systems in accordance with CSA C22.3 latest edition, except where specified other-wise.

Abbreviations for electrical terms: to CSA Z85.

Care, Operation & Start-Up

Instruct Engineer and operating personnel in the operation, care and maintenance of equipment.

Arrange for manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

Voltage Ratings

Operating voltages: to CAN3-C235.

Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standards. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

16.2.001 Electrical General Provisions (Cont'd)

Permits, Fees & Inspections

Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

Pay associated fees.

Engineer will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.

Notify Engineer of changes required by Electrical Inspection Department prior to making changes.

Furnish Certificate of Acceptance from Electrical Inspection Department on completion of work.

Materials & Equipment

Provide materials and equipment in accordance with Division 7.

Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

Factory assembly control panels and component assemblies.

Electric Motors, Equipment & Controls

Supplier, installer and wiring responsibility is indicated on electrical drawings and related mechanical responsibility is indicated on mechanical drawings.

Control wiring and conduit is specified in Division 16 except for conduit, wiring and connections which are related to control systems specified in Division 15 and shown on mechanical drawings and specifications as being by Division 15.

Coordinate final connection to all mechanical equipment and controls with Division 15.

Finishes

Shop finish metal enclosure surfaces by application of rust-resistant primer inside and outside, and at least two coats of finish enamel. Aluminum and Stainless Steel enclosures shall not be painted.

(a) Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
(b) Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

Clean and touch up surfaces on shop-painted electrical equipment scratched or marred during shipment or installation to match original paint.
Clean, prime and paint exposed non-galvanized hangers, racks and fastenings to prevent rusting.

16.2.001 Electrical General Provisions (Cont'd)

Equipment Identification

Identify electrical equipment with name plates as follows.

Nameplates: Lamicoid 3mm thick plastic engraving sheet, white face, black core, mechanically attached unless specified otherwise.

Table 16.1: Nameplate Sizes

Size 1	10 x 50 mm	1 Line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

Wording on nameplates to be approved by Engineer prior to manufacture.

Allow for average of twenty-five (25) letters per nameplate.

Identification to be English or French, depending on predominant language in area.

Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

Disconnects, starter and contactors: indicate equipment being controlled and voltage.

Terminal cabinets and pull boxes: indicate system and voltage.

Transformers: indicate capacity, primary and secondary voltages.

Wiring Identification

Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Heat-shrinkable markings shall be used on conductors #10 AWG and smaller.

Maintain phase sequence and colour coding throughout.

Colour code: to CSA C22.1.

Use colour coded wires in communication cables, matched throughout system.

16.2.001 Electrical General Provisions (Cont'd)

Conduit & Cable Identification

Colour code conduits, boxes and metallic sheathed cables.

Code with plastic tape or paint at points where conduit or cable enters wall, ceiling or floor, and at 15m intervals.

Colours to be 25mm wide prime colour and 20mm wide auxiliary colour.

Table 16.2: Conduit & Cable Identification Colours

Type	Prime	Auxiliary
Up to 250V	Yellow	
Up to 600V	Yellow	Green
Up to 5KV	Yellow	Blue
Up to 15KV	Yellow	Red
Telephone	Green	
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow
Other Communications Systems	Green	Blue

Wiring Terminations

Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

Manufacturers & CSA Labels

Visible and legible after equipment is installed.

Warning Signs

As specified and to meet requirements of Electrical Inspection Department and Engineer.

Use decal signs, minimum size 175mm x 250mm size.

Single Line Electrical Diagrams

Provide single line electrical diagrams in plexiglass frames as follows:

Electrical distribution system: locate in main electrical room.

Provide fire alarm acrylic silk screened graphic display indicating zoning of building in plexiglass frame at fire alarm control panel and annunciator.

Drawings: 600mm x 600mm minimum size.

16.2.001 Electrical General Provisions (Cont'd)

Location of Outlets

Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.

Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.

Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms and elevator machine rooms on latch side of doors.

Mounting Heights

Mounting height of equipment is from finished floor to centreline of equipment, unless specified or indicated otherwise.

If mounting height of equipment is not indicated, verify before proceeding with installation.

Install electrical equipment at the following heights unless indicated otherwise.
(a) Local switches: 1000mm
(b) Wall receptacles:
(c) General: 450mm
(d) Above top of continuous baseboard heater: 200mm
(e) Above top of counters or splash back: 150mm
(f) In mechanical rooms: 1450mm
(g) Panelboards: 1500mm or as required by Code.
(h) Telephone outlets: 450mm
(i) Television outlet: 450mm
(j) Computer outlets: 450mm
(k) Wall-mounted telephone outlet: 1000mm
(l) Fire alarm stations: 1000mm
(m) Fire alarm bells: 2200mm
(n) Doorbell pushbuttons: 1000mm
(o) Intrusion alarm detectors: 2200mm
(p) Clocks: 2200mm
(q) Wall-mounted speakers: 2200mm
(r) Thermostats: 1000mm

Load Balance

Measure phase current to panelboards with normal loads and lighting operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

Submit, at completion of work, a report listing all phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

16.2.001 Electrical General Provisions (Cont'd)

Conduit & Cable Installation

Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: sheet metal, sized for free passage of conduit, and protruding 50mm.

Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

Field Quality Control

Conduct and pay for the following tests:
(a) Power distribution system including phasing, voltage, grounding and load balancing,
(b) Circuits originating from branch distribution panels,
(c) Lighting and its control,
(d) Motors, heater and associated control equipment including sequenced operation of systems where applicable,
(e) Systems: fire alarm system, communications, etc.

Furnish manufacturer's certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions.

Insulation resistance testing:
(a) Megger circuits, feeders and equipment up to 350V with a 500V instrument.
(b) Megger 350 - 600V circuits, feeders and equipment with a 1000V instrument.
(c) Check resistance to ground before energizing.

Carry out tests in presence of Engineer and City Staff.

Provide instruments, meters, equipment and personnel required to conduct tests during, and at conclusion of, project.

Submit test results for Engineer's review.

Core Drilling of Concrete Walls & Floors

Refer to structural specifications and drawings for requirements of core drilling of concrete walls and floors. Openings 100mm and larger to be sleeved prior to concrete pour. Openings less than 100mm may be core drilled. Maximum conduit size run in slab to be 25mm. Seal around all penetrations, with a suitable sealer, to prevent the passage of liquids or gasses through the penetration.

Coordination of Protective Devices

Ensure circuit protective devices such as over current trips, relays and fuses are installed to values and settings as indicated.

16.2.001 Electrical General Provisions (Cont'd)

Access Doors

Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under section erecting the walls or ceilings.

Access doors shall be flush mounted 600mm x 600mm for body entry and 300mm x 300mm for hand entry unless otherwise noted. Doors shall open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Steel shall be prime coated. Doors shall be of approved manufacturer with published literature. Door flanges to have pre-punched holes so that drywall compound will conceal flange and only steel door is visible.

Acceptable Manufacturers: Zurn
Le Hage
Buensod
Acudor #DW-5040

Sprinklered Electrical Equipment

Where electrical equipment vaults or rooms are sprinklered in accordance with the National Building Code of Canada, the electrical equipment contained in such vaults or rooms are to have enclosures which comply with the Canadian Electrical Code Rule 26-008.

Site Visit

Contractor to visit the site and familiarize himself with the job and all conditions which may affect his costs. Ignorance of existing conditions will not be considered as basis for extra claims.

As-Built Drawings

At completion of project and prior to interim inspection, the electrical contractor, at his own expense, shall neatly transfer all electrical addendums, change orders, site instructions and other changes marked in red on blueprint record drawings. These "Redline" drawings shall be submitted to the Engineer for incorporation into As-Built drawings.

Shop Drawings, Product Data & Samples

Submit shop drawings, product data and samples in accordance with Division 7.

Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

Where applicable, include wiring, single line and schematic diagrams.

Include wiring drawings or diagrams showing interconnection with work of other sections.

16.2.001 Electrical General Provisions (Cont'd)

Operation & Maintenance Data

Provide operation and maintenance data for electrical work for incorporation into maintenance manual specified in Division 7.

Include in operations and maintenance data:

(a) Details with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
(b) Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.
(c) Wiring and schematic diagrams and performance curves.
(d) Names and addresses of local suppliers for all items included in maintenance manual.

Maintenance Materials

Provide maintenance materials in accordance with Division 7.

Protection

Protect exposed live equipment during construction for personnel safety.

Shield and mark all live parts "LIVE 120 VOLTS" or with appropriate voltage in English or French, depending on predominant language in area.

Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

Fireproofing & Soundproofing

Where cables or conduits pass through floors and fire-rated walls, pack space between wiring and sleeve full with asbestos-free fire stop.

Where cables or conduits pass through acoustically-rated walls, floor and ceiling, pack space between wiring and conduit/sleeve full with asbestos-free soundproofing material.

See architectural specifications for fireproofing and soundproofing materials.

Cleaning

At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

16.2.001 Electrical General Provisions (Cont'd)

Equipment Pads

Mount base-mounted equipment on reinforced concrete housekeeping pads to Division 23. Pads to have chamfered edges, be a minimum of 100mm high and 50mm larger than the equipment dimensions all around.

Co-ordination with other Trades

Div. 16 electrical contractor shall totally review all architectural, structural and mechanical drawings and specifications to coordinate and determine work associated with Div. 16 work prior to submitting tender price. Also, review all Addendums associated with all trades.

After review of all documents associated with other trades, forward any questions and obtain answers prior to tender submission.

Submission of tender by Div. 16 electrical contractor acknowledges co-ordination with other trades.

16.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Excavation, Trenching and Backfill Requirements ..... Div. 13

(d) Restoration ..... Div. 21

(e) Portland Cement Concrete ..... Div. 23

(f) Chain Link Fencing ..... Div. 25

(g) Landscaping ..... Div. 26

(h) Standard Drawings

16.4 MATERIALS

All equipment and material is to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

16.4.001 Electrical – Removals

Not applicable to this Section.

16.4.002 Trenching for Cables & Ducts

Description of Work

Work included in this section consists of the excavating, backfilling and trenching as per Division 13 required to install cables and ducts by general contractor and supply and installation of ducts, spacers and marker tape by Division 16.

Related Work

Concrete-encased underground cable duct: Section 16.5.003.

Utility Lines

Before commencing work, establish location and extent of underground utility lines in area of excavation. Notify Engineer of findings.

Make good damage to existing utility lines resulting from work.

Permits, Fees

Obtain prior approval from the Municipality/Owner for street cuts. Pay any fees required.

Repairs to meet Municipality/Owner standards and approval.

Cable Marker Sheet

Polyethylene marker sheet: to be 150mm wide for burial below grade directly over buried cable.

Marker sheet to be orange in colour with the following words printed in large black block letters: "CAUTION CAUTION CAUTION - BURIED ELECTRIC LINE BELOW".

The above-described message is to be printed every 914mm minimum of marker sheet.

16.4.003 Concrete-Encased Duct Banks

Related Work

Trenching for Cables and Ducts: Section 16.5.002.

Portland Cement Concrete: Division 23.

Materials

PVC underground telecommunications cable ducting: to CSA B196.3.

Plastic underground power cable ducting: to CSA B196.1 and C22-2 No. 211.1.

PVC Ducts

PVC ducts, type DB2, encased in reinforced concrete, size as indicated for power and telephone.

Rigid PVC opaque solvent welded type couplings, balloon-end fittings, plugs, caps, adapters as required to make complete installation.

Expansion joints as indicated.

Rigid PVC 5° angle couplings as indicated.

Base and intermediate plastic spacers as required.

Rigid Steel Conduits

To Section 16.4.007.

Couplings, reducers, plugs, caps, adapter and supports as required to make a complete installation.

Use long sweep bends only.

Cable Pulling Equipment

6mm stranded polypropylene bare pull rope tensile strength 5kn continuous throughout each duct run with 3m spare rope at each end.

Markers

Over all underground duct and pipe runs, install continuously, at 300mm below grade, 75mm wide electrical underground polyethylene marking tape with warning "CAUTION CAUTION CAUTION, UNDERGROUND LINES BELOW".

16.4.004 Installation of Cables in Trenches & In Ducts

Power wires and cables to Section 16.4.014 and communications cables to Section 16.4.015.

16.4.005 Direct-Buried Underground Cable Ducts

Materials

PVC underground telecommunications cable ducting: to CSA B196.3.

Plastic underground power cable ducting: to CSA B196.1 and C22.2 No. 211.1.

PVC ducts, type DB2, size as indicated for power and telephone.

Rigid PVC opaque solvent welded type couplings, plugs, caps, adapters as required to make complete installation.

Expansion joints as indicated.

Rigid PVC 5° angle couplings as indicated.

Cable Pulling Equipment

6mm stranded nylon pull rope tensile strength 5kn.

Markers

75mm wide polyethylene marker tape with wording "CAUTION CAUTION CAUTION - UNDERGROUND CABLES BELOW", installed continuously over all underground ducts, 150mm below finished grade.

16.4.006 Pole Lines & Hardware

Description of System

Overhead electrical distribution system, including supply and installation of poles, conductors, foundations, grounding, lightning arresters, disconnect switches. Arrangement of pole assembly, conductor configuration and line layout as indicated and to meet requirements of Saint John Energy Standard Construction Practices.

Supply system data, ratings as indicated on drawings, 60Hz, wye connected, 3 phase, 4 wire, grounded neutral.

Shop Drawings

Submit shop drawings for wood poles and all pole line hardware and accessories in accordance with Section 16.2.001.

Materials

Wood preservation: to CSA 080.

Power line hardware: to CSA C83, CSA C83S1, CSA C83S2.

16.4.006 Pole Lines & Hardware (Cont'd)

Poles

Jack, red or lodge pole pine: to CSA 080.4 Class 4, pressure-treated with CCA preservative.

10.7m-long poles for primary and secondary circuits.

Crossarms

Wood crossarms: to CSA 080.25M pressure-treated with CCDA preservative:
(a) For primary circuits, 3 per pole, pin as indicated.
(b) For dead-end corner transformer poles, double arms as indicated.
(c) For mounted primary isolating switches, double arms as indicated.
(d) For mounted primary load-break switches, double arms as indicated.
(e) For each crossarm:
    .1 Insulator pins: to CSA 0124 as indicated.
    .2 Two 32mm x 6mm galvanized steel braces.
    .3 One 9mm x 38mm galvanized steel lag screw.
    .4 Two 9mm x 114mm galvanized steel bolts.
    .5 Through bolts and double arm bolts as required.

Insulators

Primary insulators: Pin type: to ANSI C29.5 ANSI C28.50 for low and medium voltages, nominal rating 25KV, for primary conductors. Voltage required due to salt air conditions.

Secondary insulators: Spool type: to EEMAC 2B, 3, 4, mounted on secondary racks, for secondary runs as indicated.

Guy strain insulators: Strain type: to EEMAC 1B-1, nominal rating 25KV, one per guy wire. Voltage required due to salt air conditions.

Guys & Anchors

Guy wire: to CSA G12, 9mm nominal diameter, stranded, galvanized steel for dead ends and guys.

Guy clamps, three-bolt heavy duty or perform-grip type.

19mm thimble eye bolt, length to suit, four-hole guy straps and 16mm machine bolt with square washer to attach guy wire to pole.

Anchor rod 19mm diameter x 2.7m long, galvanized steel with thimble eye.

Anchor, heavy-duty expanding type, four-way, expanded.

Guy guard, plastic, coloured yellow 2.1, 2.7m long.

16.4.006 Pole Lines & Hardware (Cont'd)

Primary Conductors

To Section 16.4.013.

Fuse Cutouts

To Section 16.4.037.

Lightning Arresters

To Section 16.4.035.

Wire Connectors

To Section 16.4.024.

Ground Rods & Ground Conductors

To Section 16.4.039.

Equipment Identification

Rustproof nails to mark each pole with 50mm-high designated number as indicated.

16.4.007 Conduits, Conduit Fastenings & Conduit Fittings

Conduits

Rigid galvanized steel threaded conduit: size as indicated.

Electrical metallic tubing (EMT), with steel set screw couplings, size as indicated.

Rigid PVC conduit: size as indicated.

Flexible metal conduit and liquid-tight flexible metal conduit: size as indicated.

Electrical non-metallic tubing (ENT) sized as indicated.

Conduit Fastenings

One-hole steel straps to secure surface conduits 50mm and smaller. Two-hole steel straps for conduits larger than 50mm. PVC Coated metal straps for corrosive or wet areas.

Beam clamps to secure conduits to exposed steel work.

Channel-type supports for two or more conduits at 1.5m oc.

6mm diameter threaded rods to support suspended channels.

16.4.007 Conduits, Conduit Fastenings & Conduit Fittings (Cont'd)

Conduit Fittings

Fittings manufactured for use with conduit specified. Coating: same as conduit.

Factory "ells" where 90-degree bends are required for conduits larger than 40mm.

Fish Cord

Polypropylene.

16.4.008 Surface Raceways

Product Data

Submit product data in accordance with Section 16.2.001.

Indicate types of raceways with terminology similar to that used in this section.

Surface Raceway System (Wiring Pulled In)

One-piece steel assembly free of sharp edges manufactured so that wiring is pulled into raceway.

Corners, pull boxes, elbows, tees, two-piece assembly to facilitate site wiring.

Cross-section dimensions: 127mm x 87mm and 191mm x 135mm as required.

Finish: buff enamel.

Necessary extension boxes, adapter and utility fittings required for completion of installation.

Elbows, tees, couplings and hanger fittings: manufactured as accessories to raceway supplied.

Acceptable Products: Wiremold Type 200 and 500, sized to number of wires.
Approved Equal

16.4.009 Underfloor Distribution System

Product Data

Submit product data in accordance with Section 16.2.001.

Distribution Ducts

Minimum 35mm x 73mm galvanized steel rectangular duct suitable for installation of capped outlets as required.

Matching 90° wall elbows and 90° floor elbow.

16.4.009 Underfloor Distribution System (Cont'd)

Junction Boxes

Junction boxes suitable for size and number of incoming and outgoing ducts, complete with means of adjusting junction box position to suit position of duct prior to placing of concrete.

Service Fittings

To Section 16.4.017.

Supports

Adjustable duct supports at 1.5m centers in concrete slab.

Acceptable Products: Nepcoduct Type "K"
Approved Equal

16.4.010 Cabletroughs

Shop Drawings & Product Data

Submit shop drawings and product data in accordance with Section 16.2.001.

Cabletrough

Cabletroughs and fittings: to EEMAC F5-1.

Ventilated type, Class D1.

Galvanized steel tray, width as indicated.

Fittings: manufactured accessories for the cabletrough supplied.

Supports

Provide supports as indicated and/or as required.

Acceptable Manufacturers: Pilgrim
Pursley
Electrovert

16.4.011 Busways

Shop Drawings & Product Data

Submit shop drawings and product data for busways in accordance with Section 16.2.001.

Indicate in detail, exact routing of busways throughout building and in relation to column lines and structural slabs and walls. Provide voltage drop test results for each size of busway.

16.4.011 Busways (Cont'd)

Busway Characteristics

Full capacity neutral, as indicated on the drawings.

Totally enclosed in CSA weatherproof housing.

Low impedance feeder, copper type.

Joints: silver-plated and of bolt type construction.

Line to line voltage drop not exceeding 3V per 30m at rated current with distributed load at any system power factor.

Designed for one length or fitting to be removable without disturbing rest of run.

Cold rolled copper bars with 98% minimum conductivity.

Internal fire barriers at penetrations of fire rated walls in horizontal runs. Wall flanges at wall penetrations.

Expansion joints on horizontal busway runs at locations recommended by manufacturer and where busway crosses building expansion joint.

Fittings, factory manufactured to suit type of busway used and as required or as indicated including cable top-off boxes, elbows, tees, offsets, enclosures and end closures.

16.4.012 Indoor Service Poles

Submit product data in accordance with Section 16.2.001.

Indoor Service Poles

Indoor service pole assembly to meet telephone company requirements.

Indoor service poles: extruded aluminum sections to CSA HA Series, brushed aluminum, anodized finish of 109 micrometres thickness.

Nominal length of poles: 3m from floor to ceiling, with ± 50mm adjustment. Total adjustment: 100mm.

Service poles approximately 50mm square with snap-on covers to provide access to wiring without removing unit. Barrier to isolate power from communications systems.

Service poles with fastening accessories at top of pole to secure to inverted T-bar ceiling using set screws to permit relocation. Flange at ceiling to conceal wiring.

Metal sleeve at bottom of pole to conceal vertical adjustment. Reversible grip-tight devices for carpet and tile floors to prevent movement of poles.

16.4.012 Indoor Service Poles (Cont'd)

Service poles with two pre-wired CSA 5.15R duplex receptacles, two knockout holes for telephone Amphenols and one for communications. Cord with moulded set extending 3m from top of pole.

16.4.013 Power Cable & Overhead Conductors 1001 - 15000V

Primary Overhead Cable

Bare high strength aluminum alloy seven strand #1/0 Canada Wire and Cable type ARVIDAL.

Wire connectors and terminations: Section 16.4.024.

16.4.014 Wires & Cables 0 - 1000V

Submit product data in accordance with Section 16.2.001.

Building Wires

Conductors: minimum size #12 AWG for power and lighting, #14 AWG for control; stranded for all size conductors.

Copper conductors: size as indicated, minimum size #2 AWG with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90 as required.

Copper conductors for #4 AWG and smaller, sized as indicated with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90 as required.

TECK Cable

Conductors:
(a) Grounding conductor: copper.
(b) Circuit conductors: copper, size as indicated.

Insulation: Chemically cross-linked, thermo-setting, polyethylene-rated, Type RW90, 1000V.

Inner jacket: polyvinyl chloride material.

Armour: flat interlocking aluminum.

Overall covering: thermoplastic poly-vinyl chloride material, FT4-rated.

Fastenings:
(a) One-hole steel straps to secure surface cables 50mm and smaller. Two-hole steel straps for cables larger than 50mm. PVC Coated metal straps for corrosive or wet areas.
(b) Channel-type supports for two or more cables at 1500mm centres.
(c) Six mm diameter threaded rods to support suspended channels.

Connectors: Watertight, approved for TECK cable.

16.4.014 Wires & Cables 0 - 1000V (Cont'd)

Armoured Cables

Conductors: insulated copper, minimum size #14 AWG unless indicated otherwise.

Type AC90.

Armour: interlocking-type fabricated from aluminum strip.

Control Cables

Type LVT: number of soft annealed copper conductors and size as indicated, minimum size #18AWG, with thermoplastic insulation, outer covering of thermoplastic jacket. Alternately, jacket to meet UL, NBC and CSA requirements for installation in an air plenum.

16.4.015 Communications Conductors

Installation of Cables in Ducts: Section 16.5.004.

Polyethylene Insulated Cables

Conductors #19 or #22 AWG as indicated, soft copper made into cables as follows:

(a) Number of pairs: 25 or 100 as indicated.
(b) Insulation: foam/skin in which the inner layer is an expanded polyolefin and the outer layer is a solid polyolefin.
(c) Cores filled with a parafinic hydrocarbon compound to prevent water migration.
(d) Colour coded in 25 pr groupings with non-hygroscopic coloured binders for each 25 pr group.
(e) Sheath:
    .1 An inner jacket of polyethylene extruded over the core wrap.
    .2 8 mil aluminum tape shield, coated on each side with a 2 mil polymer coating applied longitudinally over the core wrap and heat sealed to the other jacket. Tape is overlapped and heat sealed at the overlap, not corrugated.
    .3 A black high molecular weight polyethylene jacket extruded over aluminum.
    .4 Jacket printing at 0.5m intervals with sequential marking in white, corrections in yellow. Cable code and year of manufacture printed between length markings.

16.4.016 Splitters, Junction, Pull Boxes & Cabinets

Splitters

Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

At least three spare terminals on each set of lugs in splitters less than 400A.

16.4.016 Splitters, Junction, Pull Boxes & Cabinets (Cont'd)

Junction & Pull Boxes

Welded steel construction with screw-on flat covers for surface mounting.

Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.

Cabinets

Type E: sheet steel, hinged door and return flange overlapping sides, handle and catch for surface mounting.

Type T: sheet steel cabinet with hinged door, latch, lock, two keys, containing sheet steel backboard for flush mounting.

16.4.017 Outlet Boxes, Conduit Boxes & Fittings

Outlet & Conduit Boxes - General

Size boxes in accordance with CSA C22.1.

102mm square, or larger, outlet boxes as required for special devices.

Gang boxes where wiring devices are grouped.

Blank coverplates for boxes without wiring devices.

347V outlet boxes for 347V switching devices.

Combination boxes with barriers where outlets for more than one system are grouped.

Sheet Steel Outlet Boxes

Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76mm x 50mm x 38mm, or as indicated. 102mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102mm x 54mm x 48mm. Use only above concealed ceilings.

102mm square or octagonal outlet boxes for lighting fixture outlets.

102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

Masonry Boxes

Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

16.4.017 Outlet Boxes, Conduit Boxes & Fittings (Cont'd)

Concrete Boxes

Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

Floor Boxes

Concrete tight electro-galvanized sheet steel floor boxes for flush mounting with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate two duplex receptacles and two telephone/data jack brackets. Minimum depth for receptacles and communications equipment: 73mm.

As a standard of quality, flush floor boxes shall be Walker Resource RFB4 multi-service series, complete with two individual power and one common communications compartment and RAKMII flush access cover. Use matching carpet trim rings for carpeted areas.

Conduit Boxes

Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

Fittings

Steel bushing and connectors.

Knockout fillers to prevent entry of foreign materials.

Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.

Double locknuts and insulated bushings on sheet metal boxes.

16.4.018 Underground Distribution & Splice Boxes

Below Grade Service Enclosure

One-piece body moulded of high density polyethylene, black; 8mm minimum thickness; for long life in underground environment. Dimensions: 620mm (W) x 930mm (L) x 368mm (H).

One-piece cover moulded of fiberglass reinforced polyester; light green colour.

Cover and body designed with reinforcing ribs to withstand backfilling pressures in all types of soil. Although not designed for street or sidewalk installation, it must support the occasional weight of a standard size passenger automobile.

Polyester covers furnished with stainless steel locking stud and pentahead bolt. Locking studs accommodate ring lock, crimp, cap or padlock.
Adjustable side support brackets mounted on cover limit flexure of vault sides from soil pressure and aid in reclosing cover.

16.4.018 Underground Distribution & Splice Boxes (Cont'd)

Cover surface textured for increased skid resistance.

Cover permanently inscribed with moulded in "ELECTRIC".

Vaults stackable for pallet shipment and storage.

Acceptable Products: Blackburn #SDR
Approved Equal

Grade Level Handhold

Unit consists of 356mm I.D. bituminous fiber vault with 4.8mm thick green fiberglass cover. Overall height: 400mm.

Cover slips over vault and secured with stud on one side, and stainless steel locking device on opposite side.

Locking device secured with padlock, meter-seal, or self-lead seal crimped with .840 die or pliers.

Complete with plastic Abell-jar@ liner and tie-down cords.

Acceptable Products: Blackburn #SDG
Approved Equal

16.4.019 Wiring Devices

Switches

15A, 120V, single pole, double pole, three-way, four-way switches as indicated.

Manually operated, general purpose AC switches as indicated and with following features:
(a) Terminal holes approved from #10 AWG wire,
(b) Silver alloy contacts,
(c) Urea or melamine moulding for parts subject to carbon tracking,
(d) Suitable for back and side wiring,
(e) Ivory toggle.

Toggle operated fully rated for tungsten filament and fluorescent lamp, and up to 80% of rated capacity of motor loads.

Switches, key operated or with neon pilot light as indicated.

Switches of one manufacturer throughout project.

Acceptable Products: Leviton
Hubbell No. 1201-I
Pass & Seymour
Cooper

16.4.019 Wiring Devices (Cont'd)

Receptacles

Duplex receptacles, CSA Type 5-15R, 125V, 15A, 'U' ground with the following features:
(a) Ivory urea moulded housing, nylon front,
(b) Suitable for No.10AWG for back and side wiring,
(c) Break-off links for use as split receptacle,
(d) Eight back-wired entrances, four side-wiring contacts,
(e) Double wipe contacts and riveted grounding contacts.

Receptacles of one manufacturer throughout project.

Acceptable Products: Leviton
Hubbell No. 5252-I
Pass & Seymour
Cooper

Other receptacles with ampacity and voltage as indicated.

Special Wiring Devices

Surge suppression receptacles:
(a) 15A, 125V duplex,
(b) Monitor/indicator light,
(c) Ivory coloured face.

Acceptable Products: Hubbell #5252-1S
Leviton #5280
Cooper

Coverplates

Coverplates for wiring devices from one manufacturer throughout project.

Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

Stainless steel 1mm thick coverplates, for wiring devices mounted in a flush mounted outlet box.

Sheet metal coverplates for wiring devices mounted in surface-mounted FS or FD-type conduit boxes.

Exterior Outlets

Weatherproof, flush enclosures for exterior outlets:
(a) Cast aluminum adapter, frame and lockable cover.
(b) Receptacle mounted in 100mm x 100mm back box.

Acceptable Product: Pass & Seymour #4600-8
Hubbell
Leviton
Cooper

16.4.020 Multi-Outlet Assemblies

Three piece assembly c/w section divider manufactured for mounting wiring devices and associated wiring.

Cross-section dimensions: 1100mm x 440mm. Finish: enamel.

Divider positioned to provide channels min. 550mm x 440mm.

Wiring devices: as indicated in Section 16.4.19.

Ground system through raceway.

As a standard of acceptability: Wiremold G-4000. c/w elbows, tees, couplings and hanger fittings manufactured as accessories to product line supplied.

16.4.021 Terminals & Connectors for Conductors - Communications

Submit product data in accordance with Section 16.2.001.

Provide terminals and connectors for 200 three-line telephone sets and 200 three-line data sets.

Telephone and data circuit terminals to be separately grouped.

Termination of Telephone Type Conductors

A modular cross connect system for use in building entry terminals and other cross connect fields with the following features:

(a) Single size module
(b) Positive field and pair identification
(c) Insulation slicing quick clips
(d) Quiet front; recessed clips
(e) Plug ended connector options
(f) Factory wired diode block for common ringing
(g) Single distribution ring for cross connect channel and cable distribution
(h) Fire retardant plastics
(i) Locking or non-locking covers
(j) CSA approved

Mounts to be beige coloured metal with two fire retardant plastic fanning strips and capable of mounting 10 connector strips and 5 designation strips.

Mount assembly to be beige coloured metal with eight fire retardant plastic fanning strips for mounting up to 40 connector strips and 20 designation strips.

Twenty-five pairs distribution connectors for single pair terminations for use with mounts made of fire retardant beige coloured plastic material with double sided insulation-slicing quick clips for terminating 22, 24, 26 gauge plastic insulated solid copper conductors.

Distribution rings of fire retardant plastic.

Designation strips of white fire retardant plastic strips which snaps into connector mount between connector positions.

16.4.022 Wire & Box Connectors 0 - 1000V

Pressure-type wire connectors: with current-carrying parts of copper sized to fit copper conductors as required. Use twist-on connectors for #14 to #8 wires.

Split-bolt connectors for #6 AWG conductors and larger.

Bushing stud connectors: to EEMAC 1Y-2 to consist of:
(a) Connector body and stud clamp for stranded round copper conductors;
(b) Clamp for stranded round copper conductors;
(c) Stud clamp bolts;
(d) Bolts for copper conductors;
(e) Sized for conductors as indicated.

Steel clamps or connectors for flexible conduit, as required.

16.4.023 Connectors & Terminations

Submit product data in accordance with Section 16.2.001.

Connectors & Terminations

Aluminum compression connectors the required size for conductors as indicators.

Contact aid for aluminum cables where applicable.

Epoxilator terminators to fit power cables in Section 16.4.013.

16.4.024 Connectors & Terminations - 15KV

Product Data

Submit product data in accordance with Section 16.2.001.

Qualification

Installation and termination of high voltage work to be performed only by tradesmen qualified and experienced in this line of work.

References

Separable Insulated Connector Systems: ANSI/IEEE Standard 386.

Stress Relief Terminations

Termination kits with stress relief for terminating 15kV cable at sectionalizing switchgear:

Acceptable Products: Raychem Type HVT
Approved Equal

16.4.024 Connectors & Terminations - 15KV (Cont'd)

Deadbreak Junctions

600A, 15KV class deadbreak junction providing two or four deadbreak interfaces as indicated bussed together and encapsulated in a precision moulded peroxide cured EPDM insulated rubber body with semi-conductive outer shield.

Acceptable Products: For two interfaces: RTE #2604670B05U
For four interfaces: RTE #2604670B07U
Approved Equal

Deadbreak Elbow Connectors

600A, 15KV class deadbreak fully shielded submersible elbow connector to terminate high voltage cables on deadbreak junctions. Complete with capacitive test point. Designed for use on a solid dielectric XLPE cable with extruded semi-conductive shields, concentric neutral and jacket.

Acceptable Products: For 1/0 cable - RTE #2638513B81U
For 3/0 cable - RTE #2638513B87U
For 350MCM cable - RTE #2638513B67U
Approved Equal

Connector size is dependant upon cable diameter and must be verified prior to ordering.

Loadbreak Junction

200A, 15KV class loadbreak junction to ANSI STD 386 providing two loadbreak interfaces. Fully rated for both single and three-phase operation, replaceable contacts, thermoplastic arc interrupter, moulded in elbow-locking ring and mounting bracket.

Acceptable Product: RTE #2637172B01M (LBC-2)
Approved Equal

Loadbreak Elbow Connectors

200A, 15KV class loadbreak junction to EPDM insulation with moulded semiconducting shield providing a fully shielded, submersible separable connection for loadbreak operation. Complete with capacitive test point. Designed for use on a solid dielectric XLPE cable with extruded semi-conductive shields, concentric neutral and jacket.

Acceptable Products: For 1/0 cable - RTE #2604599B33MA
Approved Equal

Connector size is dependant upon cable diameter and must be verified prior to ordering.

16.4.024 Connectors & Terminations - 15KV (Cont'd)

Insulated Protective Caps

15KV class insulated protective caps to provide an insulated fully-shielded submersible cover for a 15KV class loadbreak interface.

Acceptable Products: For 200A - RTE #2603711A12M
For 600A - RTE #2625041A01M
Approved Equal

Stand-Off Bushing

600A, 15KV class insulated stand-off bushing to provide temporary or permanent parking of an energized 600A, 15KV deadbreak connector.

Acceptable Products: RTE #2604791B01M
Approved Equal

16.4.025 Fastenings & Supports

Support Channels

U-shaped, size 41mm x 41mm, 2.5mm thick, surface mounted, suspended as required.

Acceptable Manufacturers: Burndy Ltd.
Electrovert Ltd.
Unistrut Ltd.

Communications Wiring/Cabling Fasteners

Each of the following are acceptable means of fastening communications cabling in accordance with Section 16.5.014. All systems are to be fastened with screws:

(a) Releasable Nylon 12 hanger straps - Thomas & Betts #TY544 (length to be determined).
(b) Multiple Bundle Mounting Strips - Thomas & Betts #TC1115.
(c) Adjustable Cable Clamps - Thomas & Betts #ULNY-023-8-C.

16.4.026 Wood Products

Product Data

Submit product data in accordance with Section 16.2.001.

All wood products shall be cut from live timber and must be free from physical defects such as surface rot, heart rot and loose knots.

Posts shall be finished S-P-F series lumber, sized as indicated and pressure treated. Use ACA or CCA treatment only.

16.4.026 Wood Products (Cont'd)

Framing and board lumber:
(a) S-P-F species, NLGA Grade #2 or better, S4S, 15% moisture content, NLGA Standard Grading Rules, paragraph 123a.
(b) Pressure treated. Use ACA or CCA treatment only.

Rough hardware: bolts, nuts, washers, lags, pin, screws; hot dipped galvanized.

Wood products shall be ordered to length. Should field cuts be necessary, apply same preservative as used to treat with.

16.4.027 Uninterruptible Power Systems - Static

Description of System

System to consist of:
(a) Rectifier cubicle,
(b) Invertor cubicle,
(c) Battery cubicle c/w batteries,
(d) Bypass switch cubicle,
(e) Controls and meters,
(f) Transformer on output.

System to use two normal power supply mains and battery to provide continuous, regulated AC power to isolated load.

Equipment to operate continuously and unattended.

Ensure that UPS is compatible with equipment that it feeds.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001, including:
(a) Outline sketch showing arrangement of cubicles, meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions'
(b) Shipping weight'
(c) Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps,
(d) Description of system operation, referenced to schematic diagram, for:
    .1 Manual control during initial start-up and load transfer to bypass and back to inverter output.
    .2 Inverter.
    .3 Bypass.
(e) System performance and reliability:
    .1 Consider any deviation from the required output power waveform as a failure in the UPS and include an estimate, with supporting calculations, of the mean time between failers (MTBF) expressed in hours.
    .2 Provide an estimate with supporting data for the mean time to repair factor (MTTR).
(f) Full load kVA output at unity power factor.
(g) Efficiency of system at 25%, 50%, 75% and 100% rated load.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

(h) Type of ventilation: natural or forced.
(i) Battery:
  .1 Number of cells.
  .2 Maximum and minimum voltages.
  .3 Type of battery.
  .4 Type of plates.
  .5 Catalogue data with cell trade name and type.
  .6 Size and weight of each cell.
  .7 Cell charge and discharge curves of voltage, current, time and capacity.
  .8 Derating factor for specified temperature range.
  .9 Nominal ampere hour capacity of each cell.
  .10 Maximum short circuit current.
  .11 Maximum charging current expected for fully discharged condition.
  .12 Recommended low voltage limit for fully discharged condition.
  .13 Expected life.
(j) Inverter:
  .1 Type and catalogue number.
  .2 DC current at minimum battery voltage to produce full load AC output.
(k) Rectifier:
  .1 Type and capacity, with catalogue number.
  .2 Battery charging sequence.
  .3 Current time data for SCR protective devices.
  .4 Guaranteed noise level.
  .5 Estimated life.
  .6 Metering.
  .7 Alarms.
(l) Manufacturer=s field experience with uninterruptible power system of similar ratings including engineering expertise, manufacturing facilities and listing of UPS units manufactured and installed during last 5 years including model, customer, location and installation dates.
(m) Evaluation of Canadian content.
(n) Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.
(o) Cooling air required in m^3/s.
(p) List of recommended spare parts, tools and instruments with catalogue numbers and current prices.
(q) Typical operation and maintenance manuals.
(r) Description of factory test facilities.
(s) Manufacturer's maintenance capabilities:
  .1 Willingness to undertake maintenance contract.
  .2 Number of trained personnel available.
  .3 Location of trained personnel and repair facilities.

Operation and Maintenance Data

Provide data for incorporation into operation and maintenance manual specified in Section 16.2.001.

Submit interim, draft final and final O & M manual. Final manual approved by Engineer. Submit interim copies to Engineer prior to notification of factory test date.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Operation and Maintenance Manual to include:
(a) Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations, maintenance and repair.
(b) Technical Data:
    1 Approved shop drawings in form of Acronoflex@ reproducible drawings (420 x 590mm) in size). Drawing symbols, lettering size, and line weight suitable for microfilming.
    .2 Characteristic curves for automatic circuit breakers and protective devices.
    .3 Project data.
    .4 Technical description of components.
    .5 Parts lists with names and addresses of suppliers.
(c) Three(3) copies of final manual.

Maintenance Materials

Provide maintenance materials in accordance with Section 16.2.001.

Include:
(a) Four sets of each type and size of fuses used.
(b) Four sets of indicating lamps.

Care, Operation and Start-Up

Arrange with Engineer:
(a) For factory service engineer to supervise start-up of system, checking, adjusting and testing on site.
(b) For instruction of three personnel on theory, construction, installation, operation and maintenance of system:

After installation and during site testing.

Advise on:
(a) Expected failure rate of equipment.
(b) Type of expected failures.
(c) Estimated time between major overhauls based on 20 year equipment life.
(d) Estimated cost of major overhaul based on current costs and excluding traveling expenses.
(e) Type and cost of test equipment needed for fault isolating and performing preventive maintenance.

Delivery and Storage

Crating:
(a) Adequately enclosed and protected from weather and shipping damage by use of minimum 12mm plywood with vapour barrier inside.
(b) For tractor, train or sea shipment, use double layer of vapour barrier and 19mm plywood covering.
(c) Subassemblies may be packed separately.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

(d) Label crates:
  .1 Shipping address.
  .2 Weight and dimensions.
  .3 Serial number of unit and brief description of contents.
  .4 Stenciled with durable paint on at least two sides of each crate.
  .5 List of contents:
(a) In weatherproof envelope stapled on outside of each crate.
(b) Copy placed inside crate.

Source Quality Control

Complete system including rectifier, inverter, bypass switch, remote annunciator panel, controls and battery factory tested in presence of Engineer.

Notify Engineer:
(a) One week in advance of date of factory test.
(b) That system has had preliminary testing and has met design requirements satisfactorily.

Test procedures:
(a) Prepare blank forms and check sheet with spaces for recording data.
(b) Mark check sheet and record test data on forms in duplicate as test proceeds. Attach meter recordings.
(c) Provide Engineers signature on form to indicated concurrence in results reported.
(d) Duplicate given to Engineer at time of test.
(e) Information from original presented as part of O & M Manual.

Test equipment:
(a) Indicating and recording instruments to satisfaction of Engineer.
(b) Instruments used during test, including indicating meters installed as part of system to have recent calibration certificate, or calibrated in presence of Engineer against instruments which have calibration certificates.
(c) Dummy load for testing, adjustable to factor lagging. Load on each phase adjustable from zero to 100% so that unbalanced output may be tested for 3 phase systems.

Tests:
(a) Visual inspection to determine that:
(b) Materials, workmanship and assembly conform with design requirements.
(c) Parts are new and free of defects.
(d) Battery and components are not damaged.
(e) Battery cells are of identical construction.
(f) Electrolyte in each cell is at manufacturer=s full level.
(g) Each battery cell polarity and polarity of connections to inverter are correct.
(h) Proper size fuses are installed.
(i) Meters have suitable range.
(j) Accessories are present.
(k) Portable meters for acceptance tests are suitable and instrument transformers connected correctly.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Demonstrate:
(a) System start-up and shut-down.
(b) Operation during mains power failure, recording output during failure and return of mains power, using oscilloscope and camera attachment. Repeat several times.
(c) Adjustable settings.
(d) Record values measured at test points using oscilloscope, digital multimeter, visicorder and camera attachment.
(e) That protective devices and indications function as designed. Record actual settings, and note operation of remote indications and transfer to bypass. Tests to include:
    .1 Annunciator lights correct indication.
    .2 Overcurrent on inverter output.
    .3 Overvoltage and undervoltage of inverter output.
    .4 DC input voltage to inverter too low. Gradually reduce DC input to inverter while delivering full load output and load to transfer automatically to bypass and inverter shut-down. Record input and output values.
(f) Simulate over temperature by applying heat to sensor with hot air blower.
(g) Simulate fuse blowing to test indications response.
(h) Simulate fan failure.
(i) Bypass switch automatic operations. Record with camera/oscilloscope absence of load disturbance during automatic bypass switching.
(j) Overvoltage of rectifier DC output.

Harmonic test:
(a) With system fully loaded, one-half loaded, and at no load, determine total harmonic content with harmonic distortion meter at output terminals.
(b) Determine each harmonic magnitude with harmonic wave analysis.
(c) Measure phase to neutral at 0.8 lagging power factor.

Transients:
(a) With normal power input, apply full load to system.
(b) Remove one-half load from each phase.
(c) Reapply one-half load instantly.
(d) Record voltages and currents using camera/oscilloscopes and/or visicorder for each phase.

Steady load:
(a) Switch system onto AC mains, start inverter and connect dummy (0.8) power factor load.
(b) Operate system at full rated load for 24 hr. and at 125% load for 10 min. in ambient temperature of 40°C.
(c) Record data at start of test and at half hour intervals thereafter, including:
    .1 Input frequency.
    .2 Input voltage (each phase).
    .3 Input current (each phase).
    .4 Input kW.
    .5 Output voltage (phase to phase, phase to neutral).
    .6 Output current (each phase).
    .7 Output kW.
    .8 Temperature of ventilating air-in.
    .9 Temperature of ventilating air-out.
    .10 Temperature at critical zones.

16.4.027 <u>Uninterruptible Power Systems – Static</u> (Cont'd)

.11 DC voltage to inverter.
.12 DC current to inverter.
.13 Rectifier DC current.

Varying loads:
(a) Take one set of readings as above of no load, 25% load, 50% load, 75% load, and 125% load.
(b) Calculate efficiencies of rectifier, inverter and complete system.

Unbalanced loads:
(a) Adjust loads on inverter to full load on two phases, 80% load on third phase.
(b) Adjust loads on inverter to zero load on two phases, 20% load on third phase.
(c) For both cases, record phase and line voltages and currents with phase angles to prove that phase relation remains unchanged with unbalanced loads.

Battery:
(a) Charge battery to ensure cells fully charged. When voltage reaches steady value at end of charge, record:
.1 Ambient temperature.
.2 Temperature of each cell.
.3 Voltage of each cell.
.4 Voltage of battery.
.5 Charging current.
.6 Specific gravity of each cell (lead acid battery only).
(b) Discharge battery by operating uninterruptible power system with AC mains open, at full rated output for duration quoted in design requirements. Record at 5 min. intervals.
.1 Voltage of battery.
.2 Current.
.3 Voltage of 10% random cells.
.4 Ambient temperature.
.5 Battery temperature.
.6 Specific gravity of 10% random cells (lead acid only).
(c) Recharge battery automatically by closing AC mains supply to system for 4-hour period, with dummy load connected. Record at 15 min. intervals.
.1 Battery voltage.
.2 Charging current.
(d) At start and finish of charge record ambient and battery temperatures, and specific gravity of each cell (lead acid only).
(e) Repeat discharge test and readings to prove battery was at least 95% recharged in 4 hr. charge period.
(f) Recharge battery.

Operating sound level:
(a) Measure sound level according to ANSI S1.13 using sound level meter conforming to ANSI S1.4.
(b) Operator to take reading by placing meter in front of him with microphone pointed at right angles to path of travel of generated sound, positioned at height of 1.5m and distance of 1m from equipment to be tested.
(c) Measure sound level during low ambient sound level.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Warranty

Provide a written guarantee, signed and issued in the name of Her Majesty the Queen in right of Canada, stating that the battery is guaranteed against defects in material and workmanship for a period of (20) years. This guarantee to be for 100% replacement for the first year and prorated in equal yearly decreasing increments for the remaining (19) years until the expiration of the guarantee at the end of (20) years from the date of the Final Certificate of Completion.

Uninterruptible Power System

Input power:
(a) As indicated.
(b) Normal supply from AC mains.
(c) Emergency supply from standby automatic diesel-electric unit.

Output power:
(a) As indicated.
(b) Full load output at 0.8 power factor lagging 30 kVA.
(c) Overload capability: 125% of rated full load current at 0.8 power factor and rated voltage for 10 min.
(d) Frequency - nominal 60Hz.
  .1 Adjustable from 58.5 to 61.5 Hz.
  .2 Maximum variation from set value under load changes, including transients, not to exceed 0.3 Hz.
  .3 Drift from set value - after two months normal operation within ambient temperature range of 0° to 40°C, not to exceed 0.6 Hz.
(e) Duration of full load output after mains failure not less than 15 min.
(f) Output voltage control:
  .1 Continuously adjustable on load at least 5% from rated value.
  .2 Voltage regulation: voltage not to change by more than 2% as load increased gradually from zero to 100% or for specified duration of full load after mains failure.
  .3 Transient voltage change not to exceed ∀ 10% of rated voltage upon 50% sudden load change, loss or return of AC input voltage to system when fully loaded or transfer of full load from inverter to bypass and vice versa, and return to normal within 3 Hz.
  .4 Harmonics over entire load range:
    (a) Total rms value not to exceed 5% rms value of total output voltage.
    (b) Single harmonic not to exceed 3% of total output voltage.
  .5 Proper angular phase relation maintained within 4 electrical degrees at up to 20% load unbalance.
(g) Efficiency: Overall system efficiency at rated load with battery fully charged not less than 75%.
(h) Interference suppression:
  .1 If UPS equipment generates electromagnetic rf interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference.
  .2 If harmonics reflected back to mains from rectifier adversely affect other loads connected to same bus, install suppression circuits to prevent that condition.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

System Performance

Normal operation: System operates on mains power when mains voltage is within ± 10% nominal value and mains frequency is between 59.5 and 60.5 Hz.

Battery operation:

(a) System transfers automatically to battery operation.
  .1 When manually selected at control panel.
  .2 When mains power fails.
  .3 When mains voltage varies more than 10% of nominal or mains frequency varies more than 0.5 Hz from 60 Hz.
  .4 When mains power is restored and mains voltage is within 10% of nominal and mains frequency is within 0.3 Hz of 60 Hz, system automatically resynchronizes with mains.
  .5 Slew rate of frequency during transition period of system output automatically synchronizing with mains and return to its internal frequency to be set between 0.5 and 1.0 Hz per second.

Bypass operation:

(a) For maintenance purposes, system can be bypassed automatically by manual selection at control panel to connect load directly to AC mains. Transfer without load interruption and leaving inverter energized.
(b) Load transfer from mains back to system automatically by manual selection at control panel when maintenance completed.
(c) Automatic retransfer of load to mains is not more than 1/4 cycle including sensing with inverter left energized but disconnect from load in case of:
  .1 Inverter overloaded.
  .2 Short circuit in load.
(d) Automatic transfer of load to system without load interruption when above conditions disappear.
(e) Automatic transfer of load to mains in not more than 1/4 cycle including sensing and shutdown of inverter in case of inverter internal malfunctions.
(f) Automatic transfer of load to mains without load interruption and inverter shutdown in case of:
  .1 Overtemperature harmful to system.
  .2 Loss of forced ventilation.
  .3 Low voltage of DC supply to inverter.
(g) Bypass capable of closing onto and withstanding momentary fault current of 800% of rating for 0.01 s.

System Protection

Circuit breakers in system used to isolate it from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during work on inverter.

Automatic circuit breakers and protection included in:

(a) AC input to rectifier.
(b) Battery input.
(c) Bypass circuit input.
(d) Inverter output.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Surge suppressors:
(a) To protect system against supply voltage switching transients.
(b) To protect internal circuits where necessary against transients.

Current limiting devices, with panel front indication of device operation to protect inverted SCR's.

Suitable devices. With panel front indication of device operation, to protect rectifier diodes.

Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

Electrical Requirements

Bring out test points to protected coded pinjacks at convenient locations to permit testing without hazard, including:
(a) Inverter output ahead of output switch, 3 phase and neutral.
(b) Mains power, 3 phase and neutral.
(c) Voltage across each SCR.
(d) Points requiring monitoring for on-site alignment, for determination of faulty sub-assemblies or printed circuit cards, including indication of oscillator pulse and operation of voltage control.

No battery, other than main battery incorporated in design.

Wires number tagged or colour coded with same designation on drawings. Tags: non-deteriorating type.

Variable resistors: fine adjustment rheostat type.

Phasing marked on input and output terminals, viewed from front of equipment:
(a) Left to right.
(b) Tope to bottom.
(c) Front to back.

Indicator lamps: long life incandescent or neon, rated for continuous duty, with sockets having adequate heater dissipation of lamps and dropping resistor if used.

Solid-state circuits used where more reliable than mechanical timers or control relays.

Standard components available from commercial sources throughout, with 10 years minimum shelf life.

Arrangement to permit easy removal of defective components to facilitate servicing, by replacing with stock spares.

Small components, related to specific function, removal plug-in modular sub-assembly or printed circuit card.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Heavy sub-assemblies easily accessible, or slide on runners of anti-friction material, and have flexible leads and bolted connections.

Components and sub-assemblies accurately made for interchangeability.

Enclosure

Dead front free-standing sheet steel minimum 2.5mm thick, CSA Enclosure 1.

Access preferably from front only, or from front and rear.

Meters, indicating lamps and controls grouped mounted in panel front.

Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping. Doors formed wraparound type, rigid, to open and close smoothly, locking type handle with 2 keys. Hinges to permit doors to be lifted off cubicle.

Cubicle height not to exceed 1.8m.

External cable connections at top of cubicle through bolted plate for drilling at site to suit.

Ambient temperature range during operation 20EC to +40EC. Natural or forced ventilation as required. For forced ventilation power from inverter output and fan directly driven by single phase motor mounted on vibration isolators. Each enclosure to have redundant fans, with fan failures alarmed. Air inlet and outlet openings protected with screens and metal guards.

Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.

Maximum operating sound level not to exceed 80 db (a) as measured on sound level meter with A weighting and slow response, at a distance of 1.8m.

Enclosure frames interconnected by ground bus with ground lug for connection to ground.

Rectifier

Input power supply from:
(a) AC mains.
(b) Automatic diesel engine driven generating unit.

Input disconnect: bolt-on moulded case three pole air circuit breaker, quick-make, quick-break type for manual or automatic operation, temperature compensated for 40EC ambient, magnetic instantaneous trip element.

Isolating transformer: connected between AC input and rectifier input.

Surge suppressor: to protect equipment
from supply voltage switching transients.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Rectifier: Silicon controlled rectifier assembly or sealed silicon diodes.

Filter: for rectifier DC output.

Fuse: to protect DC output.

Meters:
(a) DC voltmeter, switchboard type, accuracy ∀ 2% of full scale, to measure rectifier output voltage.
(b) DC ammeter, switchboard type, accuracy ∀ 2% of full scale, to measure rectifier output current.

Adjustments and controls:
(a) Line voltage adjusting taps to allow for ±10% variation from normal.
(b) Manual adjustment of float voltage with range of ±5%.
(c) Manual adjustment of equalizing voltage.
(d) Automatic current limiting on rectifier adjustable between 80 and 120% of normal rating.
(e) Provision to disconnect rectifier from inverter and battery if rectifier DC output exceeds safe voltage limits of battery.

Meters, adjustments and controls to be grouped on front panel.

Performance of rectifier:
(a) Automatically maintain battery in fully charged state while mains power available and maintain DC float voltage within ±1% of setting, no load to full load, during mains voltage variations up to ±10%.
(b) Battery charging rate such that after battery has provided full load power output for specified duration, charger returns battery to 95% of fully charged state in 4 hours.
(c) Automatic equalize charging circuit to initiate equalize charging of battery for 24 hours after discharge of 5% of ampere hour battery rating.
(d) Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hr. to return unit to float charge.

Inverter

Input power supply from:
(a) Rectifier DC output.
(b) Battery DC output.

Input disconnect: bolt-on moulded case, single pole, circuit breaker, quick-make, quick-break type, for manual or automatic operation, temperature compensated for 40°C ambient, magnetic instantaneous trip element.

Input filter: with separately fused computer grade capacitor banks and indicator lights, to eliminate inverter source noise and restrictions on input cable length.

Power stage: high frequency switching type, dual cooled disc type silicon controlled rectifier (SCR). Components, solid state devices capable of satisfactory operation under ambient conditions of -35EC to +55EC.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Logic module:
(a) Integrated circuit logic.
(b) Silicon semiconductors.
(c) Plug-in modules.
(d) Gold-plated plug-in connector.
(e) Front accessible field adjustments for voltage and frequency.
(f) Front accessible test points: suitably protected coded pin jacks.
(g) Frequency reference module.
(h) Current limiting module, automatic high speed by controlled reduction of output voltage.
(i) Voltage regulator.

Output filter: output of high frequency switching stage contains elements of carrier frequency which are filtered to low harmonic sine wave.

Meters:
(a) AC voltmeter: switchboard type, accuracy ∀ 2% of full scale, to measure inverter output voltage with 7 position selector switch to select phase to neutral, phase to phase, off.
(b) AC ammeter: switchboard type, accuracy ∀ 2% of full scale, to measure inverter output current with 4 position selector switch to select each phase and off.
(c) Wattmeter: switchboard type, accuracy ∀ 2% of full scale to measure inverter load.
(d) Frequency meter: switchboard type, scale 58 to 62 Hz, pointer type, to measure inverter output frequency.
(e) Synchroscope: with switch to check inverter output potential against supply mains potential.

Output disconnect: bolt-on, moulded case, three pole circuit breaker, quick-make, quick-break type, for manual or automatic operation, temperature compensated for 48EC ambient, magnetic instantaneous trip element.

Meters and controls: grouped on front panel.

Transformer

General: The UPS shall contain an electrostatically shielded isolation transformer rated at 75kVA. The isolation transformer shall also provide voltage step-down for the system, if required. The transformer shall be a dry type, three-phase, common-core, convection air-cooled transformer. The transformer shall conform to ML-T-27B, with Class H, 220EC minimum insulation. All transformer windings shall be copper. Audible noise levels of the transformer shall be to ANSI C89 Standards.

Typical characteristics: The following are typical characteristics exhibited by the UPS transformer:
(a) Percent Impedance: 3.5%.
(b) Percent Reactance: 3.0%.
(c) Common Mode Noise Attenuation: 55db min.
(d) Common/Transverse Conversion Mode Noise Attenuation: 80db.
(e) Harmonic Distortion: 0.5%.
(f) Full-load Efficiency: 97%.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Transformer taps: The isolation transformer shall be provided with six full capacity compensation taps at 2.5% increments to accommodate field adjustment to match the source voltage. These compensation taps shall be easily accessible by removal of one exterior panel. Taps changes include:
(a) Two, 2.5%, full-capacity, above nominal (maximum, 5% above nominal).
(b) Four, 2.5%, full-capacity, below nominal (maximum, 10% below nominal).

Thermal overload: The UPS shall be provided with additional thermal overload protection for the transformer. An alarm shall notify personnel if the transformer temperature reaches 180EC. The UPS shall automatically shut-down if the transformer temperature reaches 200EC.

Battery

Battery rack: provided by battery supplier to hold required number of batteries c/w battery disconnect switch.

Battery to be sealed, maintenance-free type and electrical characteristics: discharge current to supply inverter at full load output, for 5 min.

Static Bypass Switch

Two solid state closed circuit automatic transfer switches.

Logic unit with three normal source voltage sensors, which monitor overvoltage, undervoltage and loss of voltage.

High speed automatic transfer from normal voltage to alternate source when:
(a) Normal source voltage lost: transfer time and sensing 1/4 cycle.
(b) Normal source: undervoltage at 80% of nominal value adjustable.
(c) Normal source: overvoltage at 110% of nominal value.
(d) Loss of normal source static switch continuity.
(e) Short circuit on normal source trips normal source breaker.

Return to normal source: when normal source remains within return voltage limits of 95% to 100% of nominal value (adjustable) for approximately 1 s timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.

Switch position lights and contacts.

Synchronizing verification light.

Manual reset pushbutton:
(a) Transfer test switch.

Alternate power source monitor light.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Accessories:
(a) Manual bypass switch for maintenance and testing without load disturbance.
(b) Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.
(c) Alternate power source loss alarm contacts.

Operating Devices

Operating accessories:
(a) Counter for number of failures of normal mains AC power: non-reset type, zero to 99,999 operations.
(b) Elapsed time meter indicating accumulated time of battery discharge in minutes non-reset type, zero to 99,999.9 minutes.
(c) Elapsed time meter indicating accumulated time of inverter operation in hours, non-reset type, zero to 99,999.9 hours.

Mode lights mounted on front panel to indicate:
(a) AC output on inverter - green
(b) AC input available - green
(c) Inverter and AC input synchronized - green
(d) Inverter and AC input non synchronized - amber
(e) Static bypass switch in bypass position - red
(f) Overtemperature alarms:
    .1 Rectifier - red
    .2 Inverter - red
    .3 Bypass switch - red
(g) Cooling fan fuse open - red
(h) Inverter output overvoltage - red
(i) Inverter fuse/breaker open - red
(j) Battery overvoltage - red
(k) Battery undervoltage - red
(l) Inverter fuse/breaker open - red
(m) Rectifier fuse/breaker open - red
(n) Static bypass switch fuse/breaker open - red
(o) UPS on battery operation - red
(p) Rectifier in equalize mode - amber
(q) Battery discharging indicator - red to change from steady to flashing during final 5 to 10 min. of battery duration.

Alarms: audible alarm when any mode light shows red. Silence pushbutton not to extinguish trouble light.

Remote annunciator panel and alarms:
(a) One cabinet for remote point including:
    .1 Normal operating mode - green
    .2 UPS operating from battery - red
    .3 Bypass switch in operation - red
(b) Single stroke gong to sound when any mode light at main UPS panel shows red.
(c) Size of cabinet to suit equipment.
(d) Wiring between UPS and remote annunciator panel by Division 16.
(e) Power for remote lights and alarm from UPS output.

16.4.027 Uninterruptible Power Systems – Static (Cont'd)

Finishes

Apply finishes in accordance with Section 16.2.001.

Cubicles:
(a) Inside finish: white
(b) Exterior finish: manufacturer=s standard colour
(c) Exterior hardware and trim: corrosion resistant and not requiring painting such as stainless steel or aluminum

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

For major components such as AC input breaker, inverter breakers, bypass switch: size 4 nameplates.

For mode lights, alarms, meters: size 2 nameplates.

Fabrication

Shop assemble:
(a) Rectifier unit
(b) Inverter unit
(c) Bypass switch unit
(d) Battery rack and battery

Interconnect units, and add remote mode lights, alarms and controls to produce complete uninterruptible power system before requesting Engineer to witness factory tests.

Acceptable manufacturers/agents: Tripplite
Approved Equal

16.4.028 Unit Substation Structure to 15KV

Description of System

Indoor unit substation with:
(a) Primary switchgear
(b) Transformer
(c) Secondary switchgear

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Indicate:
(a) Flow and wiring method.
(b) Dimensioned foundation template.
(c) Dimensioned cable entrance and exit locations.
(d) Dimensioned cable termination heights.

16.4.028 Unit Substation Structure to 15KV (Cont'd)

Submit coordination study with shop drawings. Study to show coordination curves for protective devices from inside fuses and main secondary breaker. Recommend fuse link sizes and main secondary breaker setting. Shop drawings will not be accepted or reviewed without this coordination study.

Maintenance Data

Provide data for incorporation into maintenance manuals specified in Section 16.2.001.

Three (3) copies of maintenance data for complete substation assembly, including components, in one combined manual.

Maintenance

Provide maintenance materials in accordance with Section 16.2.001.

Include:
(a) Fuses:
(b) Three fuses for each type above 600A.
(c) Six fuses for each type up to and including 600A.

Materials

Unit substation: to NEMA 210.

Steel for cubicles: to CSA G40.21.

Insulators: to EEMAC G1-1.

Primary Switchgear

Primary switchgear: indoor, 15kV, 600A, 3-phase, 3-wire, interrupting capacity 25KA, BIL 90kV.

Primary Enclosure

Primary enclosure: metal enclosed free standing, floor mounted, dead front, indoor, non walk-in CSA Enclosure 1 cubicle unit. Constructed from rolled flat steel sheets. Size 2286mm high, 6705mm wide, 1524mm deep.

Provide sprinkler shield over entire length of substation.

Ventilating louvres.

Use non-corrodible bolts and hardware.

Access from front and back.

100mm steel channel sills for base mounting.

16.4.028 Unit Substation Structure to 15KV (Cont'd)

Full height outer door, hinges on right side, provision for multiple padlocking. Three point latch, stops, to open at least 135E with viewing windows of transparent shatterproof material for inspection of disconnecting switch position.

Inner door to open at least 90°.

Hinge doors of multi-cubicle switchboard on same side.

Removable cover bolts not accessible from outside of cubicle.

Interior hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts.

Storage container on inside surface of door to accommodate three (3) spare fuses.

Metal pocket on inside surface of door to accommodate drawing and diagram prints.

Bus Bars and Connections

Three-phase bare bus bars, continuous current rating 600A extending full width of multi-cubicle switchboard suitably supported on insulators.

Main connections between bus bars, major switching components and fuses of continuous current rating to match major switching components.

High conductivity copper for bus bars and main connections.

Brace bus bar system to withstand stresses resulting from short circuit currents specified.
Silver surfaced joints, secured with non-corrosive bolts and washers, tightened with torque wrench in accordance with manufacturer=s recommended load.

Identify phases of bus bars by suitable marking.

Bus bar connectors when switchgear shipped in more than one section.

Grounding

Copper ground bus not smaller than 50 x 6mm extending full width of multi-cubicle switchboard section and situated at bottom. Lugs at each end for size 3/0 AWG grounding cable.

Bond non-current-carrying metal parts, including switchgear, enclosure and bases to ground bus.

Load Interrupter Switch

To Section 16.4.038.

16.4.028 Unit Substation Structure to 15KV (Cont'd)

Lightning Arrestors

To Section 16.4.035.

Transformers

To Section 16.4.031.

Service Entrance Board

To Section 16.4.044.

Shop Fabrication

Shop assemble and test components of substation.

After completion of factory assembly and high potential test, prepare for shipment to site in three (3) sections, complete with hardware for re-assembly and re-connecting.

Finishes

Apply finishes in accordance with Section 16.2.001.

Cubicle exteriors: gray.

Cubicle interiors: white.

Supply two (2) spray cans touch-up paint.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Nameplates:
(a) Primary switchgear: white plate, black letters, size 7:
(b) Engraved: "Primary Cubicle".
(c) Engraved: "Main Switch".

Transformer Section: white plate, black letters, size 7:
(a) Engraved: "Transformer, 1500kVA, 12470V to 347/600V, 3-phase, 60Hz".

Service Entrance board: white plate, black letters, size 7:
(a) Engraved: "Low Voltage Cubicle".
(b) Engraved: "Main Breaker".
(c) Engraved: as indicated.

Warning Signs

Provide warning signs in accordance with Section 16.2.001.

16.4.028 Unit Substation Structure to 15KV (Cont'd)

Acceptable Manufacturers: Eaton Canada
Siemens Canada
Schneider Electric

16.4.029 Outdoor Substation Structure to 15KV

Related Work

Grounding - Primary: Section 16.4.039.

Supply System Data

Supply system data: 12470V, 1200A, 60Hz, wye connected, 3-phase, 4 wire, grounded neutral, 15 MVA, symmetrical fault current 3014A.

Verify coordination of substation protection with supply authority=s protection.

Requirements of Supply Authority

Submit shop drawings to supply authority and obtain certification that equipment meets their requirements, before submission of drawings to Engineer.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Obtain certification from inspecting authority, for all integrated items indicated on plot plan.

Indicate:
(a) Floor anchoring method and dimensioned foundation drawings.
(b) Foundation loadings under loaded conditions.
(c) Dimensioned position and size of bus bars and connections showing electrical clearances.
(d) Identified dimensioned layout of components.
(e) Protection coordination time current characteristics.
(f) Submit structure design criteria for Engineer=s review.

Operations & Maintenance Data

Provide operation and maintenance data for substation for incorporation into manual specified in Section 16.2.001.

Submit three (3) copies of maintenance data for complete substation, including components in combined manual.

Delivery & Storage

Ship foundation anchoring devices in advance of substation structure.

16.4.029 Outdoor Substation Structure to 15KV (Cont'd)

Protection Coordination

Coordinate time-current characteristics of protective fuses.

Materials

Steel structural members: to CSA G40.21.

Aluminum structural members: to CSA HA Series.

High tensile, hot-dipped galvanized bolts, nuts washers; to CAN3-S16.1.

Support insulators, station post type, coloured grey: to ANSI C29.9.

Cable Terminations

To Section 16.4.024.

Strain Insulators

To Section 16.4.006.

Substation Structure

Substation structure, corrosion resistant, bolted construction to form lattice-type columns and girders, for easy field assembly. Individual columns and girders supplied unassembled. Modular concept, minimum number of different parts, interchangeability, no need for field drilling or cutting.

Fabricate structure from galvanized steel.

Steel structural members hot-dipped galvanized after prefabrication completed, including cutting, punching, drilling. Galvanizing to be minimum of 0.6 kg/m2 zinc coating on members and 0.45 kg/m^2 zinc coating on bolts and threaded fasteners.

Each member identified with 12mm high characters indented into member (before galvanizing).

Structure to withstand effects of electrical faults, conductors with safety factor of 2.

Make girder and column bracing from formed angles notched to facilitate field assembly. Keep number of different braces to absolute minimum and fabricated in such a way that similarly identified components are completely interchangeable.

Structure complete with deformed bar anchor bolts and individual welded base plate assemblies to eliminate anchor bolt alignment problems.

Galvanize steel base plates, anchoring devices, strain U-bolts, strain insulator tower eyes.

16.4.029 Outdoor Substation Structure to 15KV (Cont'd)

Structure, equipment and lightning arrester grounding conductors complete with clamps and additional 1.2m conductor length beyond ground level for connection to station grounding system.

Lightning masts on structure to shield station and equipment under cone of protection sloping 1.5 to 1.

Bus & Connections

Three-phase high conductivity (copper) bus bars and connections suitably supported on insulators, including connectors.

Flexible phase and ground connections to components.

Identify phases of bus bars and connections by marking and/or by coloured paint.

Support clamps for bus bars and connections.

16.4.030 Distribution Transformers - Liquid Cooled

Related Work

Installation of anchor devices, setting templates.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Indicate:
(a) Dimensioned positions of mounting devices.
(b) Dimensioned positions of terminations.
(c) Identified internal and external component layout on assembly drawing.
(d) Insulating liquid capacity.

Maintenance Data

Provide maintenance data for liquid cooled transformers for incorporation into manual specified in Section 16.2.001.

Include insulating liquid maintenance data.

Delivery and Storage

Ship transformers empty, with first fill of liquid shipped separately for field filling.

Transformer Characteristics

Transformers: to CSA C2.

Liquid cooled, outdoor, distribution transformers, Type ONAN.

16.4.030 Distribution Transformers - Liquid Cooled (Cont'd)

Primary voltage: 7200V, 60Hz, wye connected, 1-phase, 2 wire, grounded neutral, 2 bushings.

Secondary voltage: 120V, wye connected, 1-phase, 2 wire, grounded neutral, 2 bushings.

Capacity as indicated.

Basic impulse level: 90kV.

Polarity: additive.

Impedance: not less than 2%, nor more than 3%.

Mounting

Transformers suitable for pole mount.

Vibration Dampers

Anti-vibration mountings to isolate not less than 90% of disturbing vibrations.

Voltage Taps

Four 2.5% taps, 2 - FCAN, 2 - FCBN.

High Voltage Bushings

Bushings: to EEMAC L9-2.

Two high voltage bushings on single phase transformers.

Insulating Liquid

Insulating liquid: transformer oil.

Impedance

Single-phase transformers with same impedance, from same manufacturer, when used in multi-phase configuration.

Accessories

Hanger irons and adapter plates.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Acceptable Manufacturers: Cartier
Cooper
Eaton Canada

16.4.031 Primary Dry Type Transformers

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Include:
(a) Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.
(b) Technical data:
  .1 kVA rating
  .2 Primary and secondary voltages
  .3 Frequency
  .4 Three-phase
  .5 Polarity or angular displacement
  .6 Full load efficiency
  .7 Regulation at unity pf
  .8 BIL
  .9 Insulation type
  .10 Impedance

Operation and Maintenance Data

Provide data for incorporation into maintenance manual specified in Section 16.2.001.

Operation and maintenance instructions to include:
(a) Tap changing
(b) Recommended environmental conditions
(b) Recommended periodic inspection and maintenance
(d) Bushing replacement

Storage

Store transformers indoors in a dry location.

Materials

Dry-type transformers: to CSA C9.

Bushings: to EEMAC GL1-2.

Transformer Characteristics

Type: AFC.

Rating: 1000kVA, 3-phase, 60Hz.

Insulation system Class H, 150°C temperature rise.

Impedance: standard.

Primary winding: As indicated on the drawings, delta, BIL standard.

Voltage taps: standard.

16.4.031 Primary Dry Type Transformers (Cont'd)

Secondary winding: as indicated on the drawings, BIL standard, four wire with neutral brought out and solidly grounded.

Transformer Cubicle

Fabricated from sheet steel to match primary switchgear and part of 15kV substation enclosure.

Bolted removable panels for access to tap connections, enclosed terminals, fan brackets and fans.

Conductor entry: Entry for bus bars.

Designed for floor mounting.

Indoor, ventilated, forced air cooled type. Temperature of exposed metal parts not to exceed 65EC rise. Install sprinkler shield over entire length of substation.

Tap Changer

Bolted-link type.

Windings

Primary and secondary coils: Copper

Coil and core assembly: Taps located at front of coils for accessibility.

Sound level: not to exceed 55dB.

Accessories

Winding temperature detector relay and sensing elements.

Digital type winding temperature indicator.

Digital type winding temperature indicator with alarm contacts, sequence contacts (3) required.

Fans for forced air cooling, 120V, 1-phase, 60Hz, with temperature indicator sequence contacts controls.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Equipment labels: nameplate size 7.

Acceptable Manufacturers:
Canadian General Electric Co.
Polygon Industries Ltd.
Eaton Canada
Delta Transformers
Marcus Transformers

16.4.032 Pad Mounted Distribution Transformers

Related Work

Concrete pad: Division 23.

Installation of anchor devices, setting templates.

Source Quality Control

Submit to Engineer six (6) copies of standard factory test certificates of each transformer type and test each transformer with high voltage accessories as provided by manufacturer.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Indicate:
(a) Anchoring method and dimensioned foundation template.
(b) Dimensioned cable entry locations.
(c) Dimensioned cable termination height.

Identified internal and external component layout on assembly drawing.

Insulation liquid capacity.

Impedance and X/R ratio.

Submit primary fuse time current characteristics.

Operation and Maintenance Data

Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 16.2.001.

Include insulating liquid maintenance data.

Maintenance Materials

Provide maintenance materials in accordance with Section 16.2.001.

Provide one complete set of primary fuses.

Equipment

Three-phase dead front pad mounted distribution transformers: to CSA C227.4.

Separable insulated connectors for power distribution systems above 600V: to ANSI/IEEE 386.

Oil-filled pad mounted distribution transformer complete with primary and secondary cable compartments, primary options and accessories to form complete factory assembled, self-contained, steel fabricated unit for mounting on concrete pad.

16.4.032 Pad Mounted Distribution Transformers (Cont'd)

High voltage bushing wells for connection to distribution system through separable insulated connectors for dead front operation.

Separable insulated connectors.

Loop feed primary.

Spade type low voltage terminals.

Connectors for primary and secondary cables.

Primary protection: dual element bayonet with current limiting backup fuses in series in load break dry well.

Three 3kV elbow valve arresters for placement in high voltage compartment.

Stays to hold compartment doors in 100E open position.

Transformer Characteristics

Primary voltage: as indicated on the drawings, 60Hz, delta connected, 3-phase, ungrounded.

Secondary voltage: as indicated on the drawings, wye connected, 3-phase, 4 wire, neutral grounded.

Capacity: as indicated.
Basic impulse level: standard.

Maximum rms short circuit: 12 times base current for 6 cycles.

Four, 2.5%, voltage taps 2-FCAN, 2-FCBN, tap changer with padlocking facilities.

Accessories

Liquid temperature thermometer with one set of contacts.

Liquid level gauge with one set of contacts.

Pressure relief device.

25mm drain valve.

25mm filler plug.

Voltage selector tap switch.

Grounding

Copper grounding bus size 4 x 6mm.

Connectors for grounding conductors size 4/0.

16.4.032 Pad Mounted Distribution Transformers (Cont'd)

Finish

Finish exterior of unit in accordance with Section 16.2.001.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Nameplate showing information in accordance with CSA C2.

Warning Signs

Provide warning signs in accordance with Section 16.2.001.

16.4.033 Concrete Transformer Pad

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

References

The product qualification procedures outlines in Saint John Energy Customer Services Division, Specification No. NB5031 are applicable to the design, fabrication and supply of these components.

Standards

Transformer pad dimensions shall conform to Saint John Energy standard construction practice drawings ED9U-30 (single phase transformers); ED9U-35 (3-phase transformers up to 300KVA); ED9U-40 (3-phase transformers from 500 to 1000KVA); and ED9U-45 (3-phase transformers from 1500 to 2500KVA).

Warranty

The manufacturer shall warranty the pad against defects in workmanship and materials for a period of 18 months after installation.

Pad construction to meet or exceed Saint John Energy specifications for transformer weight being supported.

Pad dimensions to meet Saint John Energy specifications for transformer size being installed.

Pad openings to conform to Saint John Energy specifications for transformer KVA rating.

Pad shall be equipped with manufacturer's nameplate complete with model number and date of construction.

16.4.033 Concrete Transformer Pad (Cont'd)

Bollards

Supply and install concrete-filled 150mm schedule 40 steel pipe bollards as indicated.

Bollard installation to conform to Saint John Energy Standard ED9U-60.

Bollards to be primed and painted with two coats of international orange enamel.

Grounding

Transformer pad and associated bollards, etc. shall be grounded in accordance with Saint John Energy Standard #ED9U-55.

Manufacturers

Concrete transformer pads are available from the local Saint John Energy stores.

Acceptable Manufacturers: Vaner
Structural Glass Ltd.
Nordic Fiber Glass

Transformer pads supplied by others than Saint John Energy shall require prior approval by Saint John Energy.

16.4.034 Pad Mounted Sectionalizing Switchgear

Related Work

Concrete pad: Division 23.

Installation of anchor devices, setting templates.

Source Quality Control

Submit to Engineer six (6) copies of standard factory test certificates of each sectionalizing switchgear.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Indicate:
(a) Anchoring method and dimensioned foundation template.
(b) Dimensioned cable entry locations.
(c) Dimensioned cable termination height.

Identified internal and external component layout on assembly drawing.

16.4.034 Pad Mounted Sectionalizing Switchgear (Cont'd)

Operation and Maintenance Data

Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 16.2.001.

Include insulating liquid maintenance data.

Maintenance Materials

Provide factory recommended maintenance materials, special tools and spare parts.

Equipment

Outdoor 14.4KV pad mounted sectionalizing gear, containing 600-ampere external handle-operated mini-interrupter switches for three-hole live switching of three-phase circuits.

Enclosures are temper-resistant, free-standing, self-supporting construction with provisions for cable entrance and exit through the bottom. Access is controlled by automatic door latching and permits padlocking only when the door is securely latched. The door can be opened only with a pentahead socket wrench or tool. The enclosure roof is undercoated with an insulating Ano-drip@ compound. A resilient closed-cell gasket on the enclosure bottom flange
protects the finish from being scratched during installation and isolates it from the alkalinity of a concrete foundation. Finish is outdoor equipment green.

Interphase and end barriers of fibreglass-reinforced polyester are provided with each switch where required to achieve published BIL ratings. Additional barriers of the same material separate the front compartments from the rear compartments and isolate the tie bus. Full-length steel barriers separate adjoining compartments. A folding switch-operating handle, secured inside the switch-operating-hub pocket, is provided with each interrupter switch.

All terminal pads can accommodate a variety of cable-terminating devices for cable sizes through 1000kc mil for switch and bus terminals. The cable-terminating devices must be equipped either with an offset spade-type compression terminal for bolting directly to the terminal pad or with a rod-type compression terminal for attachment to a connector.

Interrupter Switches

Rating:
(a) Voltage: 14.4KV nominal, 17.0KV maximum, 95KV BIL
(b) Amperes, RMS: 600A continuous, 600A load-splitting and dropping
(c) Duty cycle fault closing, two time (ASYM): 22,400A
(d) Momentary: 22,400A
(e) 1 sec symmetrical: 14,000A

Cypoxy insulators.

Quick-make, quick-break mechanism.

16.4.034 Pad Mounted Sectionalizing Switchgear (Cont'd)

Multipurpose, one-piece, formed hard-drawn copper blade with silver-clad contact surfaces on both sides.

Multifinger, convex, silver-clad copper jaw contacts provide equalized, four-point pressure on the blade=s silver-clad contact surfaces.

Arc compressor

A unified insulated shaft with blade supports and journals permanently moulded in place to position blades in Afixtured@ alignment.

Pure-silver buttons cold-headed into four independently sprung contact fingers, with equalized pressure applied by flat stainless-steel loading springs to provide efficient current transfer at the silver-clad blade-support contact.

Strain-guard terminal protects against damage from excessive cable or foundation movement.

Ground stud for each switch or bus terminal and ground pad.

Cable guides, one at each terminal in switch and bus compartments.

Surge arresters base-mounted at switch terminals.

Key interlocks as indicated.

Grounding

Ground as indicated.

Finish

Finish exterior of unit in accordance with Section 16.2.001.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Nameplate showing information in accordance with CSA C2.

Warning Signs

Provide warning signs in accordance with Section 16.2.001.

16.4.035 Primary Lightning Arresters

Submit product data in accordance with Section 16.2.001.

Materials

Arrester component parts to CSA C233.

Arrester characteristics:
(a) Station intermediate distribution arrester.
(b) System highest voltage 15kV.
(c) Rated voltage of arrester: 7.8kV.
(d) BIL: 90kV.
(e) Indoor type.
(f) Indicating type.

Acceptable Manufacturers: Eaton Canada
S & C Electric Canada Ltd.
Gould-ITE Canada Ltd.
Cooper

16.4.036 Primary Switchgear Assembly to 15KV

Related Data

Installation of anchor devices, setting templates: Division 23.

References

CSA C22.2 No. 14 Industrial Control Equipment.

CAN/CSA-G40.21 Structural Quality Steels.

EEMAC G1-1 Indoor and Outdoor Switch and Bus Insulators.

Description of System

Primary switchgear assembly to include:
(a) Enclosure
(b) Load Interrupter Switches
(c) Busbar
(d) Meters

Source Quality Control

Engineer will conduct Plant inspection.

Provide manufacturer=s type test certificates indicating switchgear cubicles and components tested as integrated assembly.

Submit to Engineer test procedures, as least 10 days prior to testing.

Submit six (6) copies of production test results to Engineer before equipment is shopped from factory.

16.4.036 Primary Switchgear Assembly to 15KV (Cont'd)

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Indicate:
(a) Floor anchoring method and dimensioned foundation template.
(b) Dimensioned cable entry and exit locations.
(c) Dimensioned cable termination and pothead height.
(d) Dimensioned position and size of busbars and details of provision for extension.
(e) Dimensioned positions of main connections, including air clearances and support insulators.
(f) Layout of internal and front panel components suitably identified.
(g) Time current characteristics curves of protection devices.

Maintenance Data

Provide maintenance data for primary switchgear assembly for incorporation into manual specified in Section 16.2.001.

Include three (3) copies of maintenance data for complete switchgear assembly, including components.

Delivery & Storage

Ship and store switchgear assembly in upright position.

Store in weather protected, warm dry enclosure.

Keep doors locked and protect instruments from damage and dust.

Ship channel base sills, anchoring devices in advance of switchgear.

Protection Coordination

Coordinate time-current characteristics of protective fuses.

Requirements of Supply Authority

Submit shop drawings to supply authority and obtain certification that equipment meets their requirements, before submission of drawings to Engineer.

Materials

Switchgear assembly: to CSA C22.2 No 31, EEMAC G8-2.

Steel for cubicles: to CSA G40.21, ANSI #70 grey.

Insulators to EEMAC G1-1.

Insulmastic on roof interior.

16.4.036 Primary Switchgear Assembly to 15KV (Cont'd)

Primary Switchgear

Primary switchgear: ratings as indicated on drawings, BIL standard.

Bay No. 1
Incoming, approximate dimensions 965mm wide x 1524mm deep.

(a) One (1) only S & C Alduti-Rupter switch, three pole, complete with quick-make, quick-break operating mechanism, switch rated 1200 amperes continuous and interrupting; 61,000 amperes momentary, and 61,000 amperes fault closing at 13.8KV.
(b) Three (3) only incoming roof bushings, 15KV, 1200 amperes.
(c) Three (3) only 12KV intermediate class lightning arresters.
(d) One (1) only safety glass viewing window for observation of switch contacts.
(e) One (1) only hinged access and bolted access on front of bay.
(f) One (1) only key interlock sequence to prevent access to PT fuses in Bay 3 unless switch is locked in the OPEN position.
(g) One (1) only 250 watt strip heater, (120 volts is required), to provide circulation and reduce condensation.
(h) Ground bus bolted to welded bracket, complete with clamp-type connector.
(i) Lamicoid nameplate.
(j) Colour coded phase markers.
(k) All necessary 1200 ampere copper buswork, barriers, interconnection, ratings plates, etc.

Bay No. 2

Utility metering, approximate dimensions: 965mm wide x 1524mm deep.

This bay will be constructed with sufficient space and all necessary structural supports to accommodate current and potential metering transformers supplied by others and installed at S & C Electric Canada Ltd. Unit will be complete with:

(a) Provision only for three (3) current transformers.
(b) Provision only for Sadrem RY15 potential transformers.
(c) One (1) only swing-out carriage for potential transformers.
(d) One (1) only hinged access door on front of bay.
(e) One (1) only 250 watt strip heater, (120 volts is required), to provide circulation and reduce condensation.
(f) All necessary terminal blocks for wiring connections.
(g) Ground bus bolted to welded bracket, complete with clamp-type connector.
(h) Lamicoid nameplate.
(i) Colour coded phase markers.
(j) All necessary 1200 ampere copper buswork, barriers, interconection, ratings, plates, etc.

16.4.036 Primary Switchgear Assembly to 15KV (Cont'd)

Bay No. 3

Customer metering, approximate dimensions: 965mm wide x 1524mm deep.

This bay will be constructed with sufficient space and all necessary structural supports to accommodate current and potential metering transformers supplied by others and installed at S & C Electric Canada Ltd. Unit will be complete with:

(a) Provision only for three (3) current transformers.
(b) Provision only for potential transformers.
(c) One (1) only ACM-3710 digital logic power monitor.
(d) One (1) only low voltage compartment to isolate high voltage equipment from ACM-3710.
(e) One (1) only hinged access door on front of bay.
(f) One (1) only key interlock sequence to prevent access to fuses unless switch in Bay 1 is locked in the OPEN position.
(g) One (1) only 250 watt strip heater, (120 volts is required), to provide circulation and reduce condensation.
(h) All necessary terminal blocks for wiring connections.
(i) Ground bus bolted to welded bracket, complete with clamp-type connector.
(j) Lamicoid nameplate.
(k) Colour coded phase markers.
(l) All necessary 1200 ampere copper buswork, barriers, interconnection, ratings, plates, etc.

Bay No. 4

Feeder, approximate dimensions: 965mm wide x 1524mm deep.

(a) One (1) only S & C fused Mini-Rupter switch, three pole, complete with quick-make, quick-break operating mechanism, switch rated 600 amperes continuous and interrupting; 40,000 amperes momentary; and 40,000 amperes fault closing at 13.8KV.
(b) Three (3) only S & C type SM-40 power fuse and fittings, 45" opening, disconnect, 400E amperage maximum current-carrying capacity; and 600 MVA symmetrical maximum interrupting capacity at 13.8KV.
(c) Six (6) only S & C type SMU-40 fuse units 13.8KV (3 required initially, 3 spares).
(d) Space below outgoing cable and street cones.
(e) Clamp-type connectors provided suitable for No. 2 solid through 500MCM conductor.
(f) One (1) only spare refill container on the inside of the fuse compartment.
(g) One (1) only safety glass viewing window for observation of switch contacts.
(h) One (1) only hinged access door on front of bay.
(i) One (1) only mechanical interlock sequence to prevent access to fuses unless switch is open.
(j) One (1) only horizontal protecting barrier between interrupter switch compartment and fuse compartment.
(k) One (1) only hinged bolted vertical screen in front of interrupter switch compartment to prevent inadvertent contact with five parts when servicing fuses.

16.4.036 Primary Switchgear Assembly to 15KV (Cont'd)

(l) One (1) only 250 watt strip heater, (120 volts is required), to provide circulation and reduce condensation.
(m) Three (3) only 600 volt window type current transformers, ratio 400/5 amperes.
(n) One (1) only ammeter and selector switch.
(o) Provision for future extension to side complete with coverplate.
(p) Ground bus bolted to welded bracket, complete with clamp-type connector.
(q) Lamicoid nameplate.
(r) Colour coded phase markers.
(s) All necessary 1200 ampere copper buswork, barriers, interconnection, racing plates, etc.

Bay No. 5

Feeder, approximate dimensions: 965mm wide x 1524mm deep.

Identical to Bay No. 4.

Bay No. 6

Feeder, approximate dimensions: 965mm wide x 1524mm deep.

Identical to Bay No. 4.

Bay No. 7

Feeder, approximate dimensions: 965mm wide x 1524mm deep.

Identical to Bay No. 4.

Bay No. 8

Blank enclosure, approximate dimensions 965mm wide x 1524mm deep.

One (1) only hinged access door on front of bay.

16.4.037 Fuse Cutouts & Fuses - Outdoor

Shop Drawings

Submit shop drawings and product data in accordance with Section 16.2.001.

Fuse Cutouts

Outdoor open cutout, vertical angle mounted, expendable cap fuseholder, continuous rating 100 at 15kV, interrupting rating nomenclature HD, hook stick operated. Arc chute equipped.

Fuses
Fuse holders, automatic indicating drop out type, 100A rating. Fuse links, electrically and mechanically interchangeable between various makes and types, button head design. ANSI Type T, sized as indicated.

16.4.038 Load Interrupters

Submit product data in accordance with Section 16.2.001.

Load Interrupter Switch

Indoor load interrupter switch: to CSA C105.

Three pole, quick-make, quick-break assembly, stored energy operating mechanism manually operated.

Continuous full load rating: 600A, interrupting rating: 25kA, symmetrical.

Voltage rating: 7.8kV.

Interphase barriers.

Fixed operating handle.

Power fuses: 150A.

Enclosed in switchgear cubicle.

Fabrication

Factory assemble and adjust 3-pole gang operated switch, operating assembly, interphase barriers and interlocks.

Acceptable Manufacturers:
Gould-ITE Canada Ltd.
S & C Electric Canada Ltd.
Eaton Canada
Siemens Canada
Schneider Electric

16.4.039 Grounding - Primary

Reference Standards

Do grounding work to CSA C22.3 No. 2 except where specified otherwise.

Foundation grounding detail to Saint John Energy Drawing #STDS-59100-3001-001-DD-B, Rev. 02.

Grounding connections at transformers to Saint John Energy Drawing #STDS-59100-3000-010-DD-B, Rev. 00.

Fence grounding details to Saint John Energy Drawing #STDS-59140-3001-001-DD-D, Rev. 05.

Grounding of steel structures to Saint John Energy Drawing #STDS-59100-3000-009-DD-A, Rev. 00.

16.4.039 Grounding – Primary (Cont'd)

15KV, 138KV, switch base ground connections to Saint John Energy Drawing #STDS-59100-3000-008-DD-A, Rev. 00.

Tying neutrals together to Saint John Energy Drawing #STDS-59100-3000-007-DD-A, Rev. 00.

Resistivity Study

The electrical contractor is to allow in his tendered price for a resistivity study of the substation yard area as detailed in the ASimplified Rules for Grounding Customer-Owned High Voltage Substations@, Canadian Electrical Association document #249D541. The results of the resistivity study may require additional grounding which will be carried out as an extra to the contract.

Materials

Rod electrodes: copper clad steel, 19mm dia. x 3m long, as indicated.

Plate electrode: galvanized, steel.

Conductors: bare stranded, untinned soft annealed copper wire, size 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

Use #6 AWG ground wire down pole to ground rod on butt ground as indicated for poles without transformers. Use #4 AWG ground wire down pole to ground rod on butt ground as indicated for poles with transformers. Butt grounds to be configured to meet Saint John Energy Standard Construction Practices.

Conductors: bare, PVC insulated, coloured green, stranded, untinned soft annealed copper wire, size #4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.

Conductors: PVC insulated coloured green, stranded untinned soft annealed copper wire #10 AWG for grounding meter and relay cases.

Accessories: non-corroding, necessary for complete grounding system, type, size, material as indicated, including:
(a) Grounding and bonding bushings
(b) Protective type clamps
(c) Bolted type conductor connectors
(d) Thermite welded type conductor connectors
(e) Bonding jumpers, straps
(f) Pressure wire connectors

Bolted removable test links.

Gradient control mat: galvanized steel, copper, Size 4' x 6'.

Wire connectors and terminations: to Section 16.4.024.

16.4.040 Overhead Service

Coordination with Power Supply Authority

Coordinate and meet requirements of power supply authority. Ensure availability of power when required.

Materials

Service mast: rigid (fabricated, heavy-duty, galvanized steel, suitable for attachment of support clamps, insulator rack, weatherhead, service drop fittings.

Service mast support devices.

Weatherhead: cast to approval of supply authority.

Rigid steel galvanized conduit, necessary fittings: to Section 16.4.007.

Service drop conductors by Saint John Energy.

Meter socket and meter cabinet: to Saint John Energy requirements.

16.4.041 Underground Service

Related Standards

To Saint John Energy Service Entrance Standards.

Coordination With Power Supply Authority

Coordinate and meet requirements of local power supply authority. Ensure availability of power when required.

Arrange for primary line extensions, utility installation and energization.

Materials

Underground ducts: to Section 16107.

Rigid steel galvanized conduit and fittings: to Section 16.4.007.

RW90 copper conductors from utility transformer to main breaker as indicated.

16.4.042 Capacitors for Power Factor Correction

References

CAN3-C155 Shunt Capacitors for AC Power Systems.

EEMAC 6G-1 Shunt Capacitors.

Capacitors

Capacitor unit for power factor correction: to CAN3-C155, EEMAC 6G-1.

Capacitor characteristics:
(a) 200KVAR, 15KV insulation class,
(b) 7200V, 1 ¯, 60Hz, 2 wire, wye connected, grounded neutral,
(c) Enclosure: outdoor, weatherproof,
(d) Non-propagating liquid insulated,
(e) Discharge device: to 50V in 1 minute,
(f) Clamp connector, threaded stud terminal.

Apply finishes in accordance with Section 16.2.001.

16.4.043 Service Equipment

Related Standards

Complete service entrance to conform to Saint John Energy Single Phase Service Entrance Standards.

Product Data

Submit product data in accordance with Division 7.

Supply Data

Service equipment suitable for incoming supply: ratings as indicated on the drawings, c/w grounded neutral.

Equipment

Combination service entrance panel to Section 16.4.044.

Cabinet for utility revenue metering to Utility standards.

Multiple Meter Centre

Rated as required, built from CSA specified steel.

The meter centre enclosure to be CSA 1 indoor construction and consist of the required vertical sections bolted together to form one rigid structure.

The man busbar to be aluminum tin plated of sufficient size to limit the temperature rise to 50EC rise based on CSA tests, and supported on glass polyester supports.

16.4.043 Service Equipment (Cont'd)

The meter centre to be painted a light ASA 61 grey and constructed and labeled in accordance with the latest CSA standards.

The bottom incoming service compartment shall be terminated at a service entrance main switch bussed into the meter center. The switch to be quick-make, quick-break, utilizing the double break principal of circuit rupturing to minimize arcing and pitting. The switch to have provision for padlocking and be equipped with sealing provisions for utility usage. The main switch to be rated 600A at 250V and have provision for Class >J= fusing.

The metering modules to be equipped with vertical bus to suit the required load. Each sub-service to be separated from each other by metal barriers, with the unmetered bus to be completely barriered to prevent unauthorized access to the current. Each separate sub-service compartment to be equipped with sealing provisions and have a padlocking attachment for each sub-service breaker. The branch sub-services to be as follows and as indicated on the drawings:

(a) 2-pole, 120/240V, 14KA with a 100A, 5-jaw meter socket.
(b) 2-pole, 120/240V, 14KA with a 200A, 5-jaw meter socket.

The entire centre to be approved by the Utility for multiple meter use.

16.4.044 Service Entrance Board

Description of Equipment

Service entrance board incorporates service entrance main breaker, customer metering in one section and distribution panelboard in another section, factory assembled in one two vertical section enclosure.

Shop Drawings & Product Data

Submit shop drawings and product data in accordance with Section 16.2.001.

Indicate:

(a) Floor anchoring method and foundation template,
(b) Dimensioned cable entry and exit locations,
(c) Dimensioned position and size of bus,
(d) Overall length, height and depth,
(e) Dimensioned layout of internal and front panel mounted components.

Maintenance Data

Provide maintenance data for service entrance board for incorporation into maintenance manual specified in Section 16.2.001.

Submit three (3) copies of maintenance data for complete assembly including components.

Maintenance Materials

One set spare parts as recommended by manufacturer.

16.4.044 Service Entrance Board (Cont'd)

Power Supply

Power supply: 347/600V, 3 ⎓, 4 wire, grounded neutral, 60Hz, short circuit current 22kA rms symmetrical.

Service Entrance Board

Rating: as indicated.

Cubicles, self supporting, dead front as indicated.

Barrier metering section from adjoining sections.

Provision for installation of customer metering.

Distribution section.
Hinged access panels with captive knurled thumb screws.

High conductivity copper bus for phase, neutral and ground.

Bus from load terminals of main breaker via metering section to main lugs of distribution section.

Identify phases with colour coding.

Solid-State Trip Circuit Breakers (Main Breaker)

Moulded case circuit breaker CSA rated for 100% current-carrying capacity to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long-time, short-time tripping for phase and ground fault short circuit protection.

Moulded Case Circuit Breakers (Distribution Breakers)

Bolt-on moulded case circuit breaker: quick-make, quick-break for manual and automatic operation, with temperature compensation for 40°C ambient.

Common trip with single handle for multi-pole operations.

Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 10-12 times current rating.

Circuit breakers with interchangeable trips on units over 100A.

Grounding

Copper ground bus extending full width of cubicles and located at bottom.

Lugs at each end for size 3/0 grounding cable.

16.4.044 Service Entrance Board (Cont'd)

Bond non-current-carrying metal parts to ground bus.

Customer Metering

Secondary instrument transformers: Current transformers: to CSA C13, dry type, epoxy moulded, for indoor use with following characteristics:
(a) Nominal voltage class: as indiciated on the drawings.
(b) Rated frequency: 60Hz.
(c) Basic impulse level: standard.
(d) Metering accuracy rating: 10KV.
(e) Rated primary and secondary current: as indicated on the drawings.
(f) Continuous current rating factor: 1.5.
(g) Short-time mechanical current rating 90 times primary rating.
(h) Short-time thermal current rating 80 times primary rating.
(i) Positive action automatic short-circuiting device in the secondary terminals.

Digital metering system, CSA approved:
(a) Microprocessor based metering package measuring RMS value to the seventh harmonic.
(b) Displays voltage and current for each phase, KVA, KVAR, KW, PF, Hz and accumulated KWHR and KW demand.
(c) Monitors and stores in non-volatile memory minimum values of volts and PF, maximum values of amps, KW, KVA, KVAR, KW demand. All values can be called up and displayed.
(d) Field programmable.
(e) Programmable set points for load shedding or alarm, with one set of 1A, 120V dry contacts.
(f) An RS232C port for connection to a VDT.
(g) Power supply: 120V AC 15VA @ .25 maximum, 25A fuse and fuseholder supplied with each unit.
(h) Operating environment: Temperature: 10°C to 40°C, Storage temperature: -20°C to +70°C, Humidity: 0 - 90%
(i) Unit to include a transducer to allow for output related to varying pulse and also output related to 4-20ma signal.

Acceptable Products: Schneider Electric
Power Measurements Ltd. "3600ACM"
Eaton Canada

Finishes

Apply finishes in accordance with Section 16.2.001.
(a) Service entrance board exterior grey.
(b) Supply two spray cans touch-up enamel.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Nameplates:
(a) White plate, black letters, size 7,
(b) Complete board labeled: "600V",

16.4.044 Service Entrance Board (Cont'd)

(c) Main disconnect labeled: "Main Breaker",
(d) Branch disconnects labeled: "Feeder No.1", "Feeder No.2", "Feeder No.3", etc.

Shop Fabrication

Assemble and wire complete service entrance board.

Energize board.

Prepare board for shipment to site.

Acceptable manufacturers to meet institutional standards.

Acceptable Manufacturers: Schneider Electric
Siemens Canada
Eaton Canada

16.4.045 Disconnect Switches - Fused & Non-Fused - Up to 1000V

Disconnect Switches

Fusible disconnect switch in CSA Enclosure 1 unless indicated otherwise. Sized and weatherproof as indicated.

Non-fusible disconnect switch in CSA Enclosure 1 unless indicated otherwise. Sized and weatherproof as indicated.

Provision for padlocking in ON-OFF switch position by three locks.

Mechanically interlocked door to prevent opening when handle is in ON position.

Quick-make, quick-break action.

ON-OFF switch position indication on switch enclosure cover.

Acceptable Manufacturers: Schneider Electric
Siemens Canada
Eaton Canada

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Indicate name of load controlled on Size 4 nameplate.

16.4.046 Grounding - Secondary

Clamps for grounding of conductor, size as required, to electrically conductive underground water pipe.

Rod electrodes, copper clad steel 19mm diameter by 3.0m long.

System and circuit, equipment, grounding conductors, bare stranded copper, untinned, soft annealed, size as indicated.

Insulated grounding conductors: green, to Section 16.4.014.

Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
(a) Grounding and bonding bushings,
(b) Protective-type clamps,
(c) Bolted-type conductor connectors,
(d) Thermit welded type conductor connectors,
(e) Bonding jumpers, straps,
(f) Pressure wire connectors.

Acceptable Manufacturers: Burndy Corp.
Erico Inc.
Cadweld Division

16.4.047 Dry-Type Transformers Up to 600V Primary

Use transformers of one manufacturer throughout project.

Design 1:
(a) Type: ANN,
(b) 3 phase, ratings as indicated, 60Hz,
(c) Insulation: Class H, 150EC temperature rise,
(d) Windings: copper,
(e) Taps: 22% - 2 FCAN, 2 FCBN,
(f) Basic Impulse Level (BIL): standard,
(g) Hipot: standard,
(h) Average sound level: standard,
(i) Impedance at 170EC: standard,
(j) Enclosure: air ventilated, sprinklerproof, removable metal front panel,
(k) Finish: in accordance with Section 16.2.001.

Acceptable Manufacturers: Polygon Industries Ltd.
Eaton Canada
Delta
Marcus

16.4.048 Loadcentres - Breaker Type

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Loadcentres

Loadcentres: to CSA C22.2 No. 29.

Loadcentres to be product of one manufacturer.

250V loadcentres: bus and breakers rated for 10,000A symmetrical interrupting capacity or as indicated.

Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.

Loadcentres: mains, number of circuits, and number and size of branch circuit breakers as indicated.

Aluminum bus with neutral of same ampere rating as mains.

Mains suitable for bolt-on or plug-in breakers.

Finish trim and door baked grey enamel.

Acceptable Manufacturers: Siemens Canada
Schneider Electric
Eaton Canada

Breakers

Breakers to Section 16.4.052.

Breakers with thermal magnetic tripping in loadcentres except as indicated otherwise.

Main Breaker: when indicated, separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Nameplate for each loadcentre size 4, engraved as indicated.

Complete circuit directory and type-written legend showing location and load of each circuit.

16.4.049 Panelboards - Breaker Type

Install circuit breakers in panelboards before shipment.

In addition to CSA requirements, manufacturer's nameplate must show fault current that panel, including breakers, has been built to withstand.

Panelboards

Panelboards to be product of one manufacturer.

250V and 600V panelboards: bus and breakers rated for 22,000A symmetrical interrupting capacity, or as indicated.

Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

Two keys for each panelboard and key panelboards alike.

Copper bus with neutral of same ampere rating as mains.

Mains: suitable for bolt-on breakers.

Trim and door finish: baked grey enamel.

Acceptable manufacturers to meet institutional standards.

Acceptable Manufacturers: Eaton Canada
Schneider Electric
Siemens Canada

Breakers

Breakers to Section 16.4.052.

Breakers with thermal magnetic tripping in panelboards except as indicated otherwise.

Lock-on devices for 10% of 15A to 30A breakers installed as indicated. Turn over unused lock-on devices to Owner.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Nameplate for each panelboard Size 4 engraved as indicated.

16.4.049 Panelboards - Breaker Type (Cont'd)

Nameplate for each circuit in distribution panelboards Size 2 engraved as indicated.

Complete circuit directory and type-written legend showing location and load of each circuit.

16.4.050 Panelboards - Switch & Fuse Type

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Drawings to include electrical detail and dimensions of panel. branch switch type, ampacity and quantity.

Plant Assembly

Assemble panelboard interior before shipment. Ship fuses loose for on-site installation.

In addition to CSA requirements, manufacturer=s nameplates must show fault current that panelboard has been built to withstand.

Construction Features

Panelboards: product of one manufacturer.

Sequence phase bussing with odd numbered sections on left and even on right, with each section identified by permanent number identification as to circuit number and phase.

Panelboards with mains, number os circuits, and number and size of branch sections as indicated.

Two keys for each panelboard and key panelboards alike.

Copper bus with neutral of same ampere rating as mains.

Suitable for bolt-on fusible sections.

Trim and door finish: baked grey enamel.

Fusible pull-outs or door-operated type switches not acceptable.

Fuse clips: suitable for type of fuses specified for each unit.

Fuses: to Section 16478, sizes as indicated.

Panelboards to have grounded ground terminal strip; isolated neutral terminal strip and isolated ground terminal strip.

16.4.050 Panelboards - Switch & Fuse Type (Cont'd)

Acceptable Manufacturers: Eaton Canada
Schneider Electric
Siemens Canada

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Nameplate for each panel size 4 engraved "PANEL DP, 400A, 120/208V, 3 ¯, 4W".

Nameplate for each circuit in distribution panels size 2 engraved "NAME OF LOAD" as indicated.

Complete circuit directory with typewritten legend showing location and load of each circuit. Install circuit directory under plastic protective cover on front of panel.

16.4.051 Air Circuit Breakers

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Include time-current phase protection coordination characteristic curves for breakers.

Air Circuit Breaker

Air circuit breaker to: ANSI/IEEE C37.13.

Drawout type, 600V class:
(a) Continuous current rating: 1600A.
(b) Trip rating: 800A.
(c) Interrupting rating: 42kA, rms symmetrical.

Solid-state tripping system consisting of one (1) current sensor per pole, one (1) solid-state trip unit and self-powered trip actuator. Equipped with long, short, instantaneous, ground fault function and phase overload, ground fault indication.

Breakers with normal stored energy, closing mechanism to provide quick-make operation for all ratings.

Breakers with ON-OFF indicator and spring charged/discharged indicator.

Interlocks to prevent circuit breaker drawout when in closed position and to prevent closing unless fully engaged or in test position.

Optional Features

Shunt trip.

16.4.051 Air Circuit Breakers (Cont'd)

Auxiliary switches: 1 N.O., 1 N.C.

Undervoltage tripping device with time delay.

Alarm switch.

Pilot light.

Acceptable Manufacturers: Eaton Canada
Schneider Electric
Siemens Canada

16.4.052 Moulded Case Circuit Breakers

Include time current characteristic curves for breakers with ampacity of 400A and over.

Breakers General

Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40EC ambient.

Common-trip breakers with single handle for multi-pole applications.

Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3 - 10 times current rating.

Circuit breakers with interchangeable trips as indicated.

Thermal Magnetic Breakers

Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping.

Optional Features

Include ground fault interrupting capability (5ma maximum) where indicated.

Include shunt trip where indicated.

Acceptable manufacturers to meet institutional standards.

Acceptable Manufacturers: Eaton Canada
Schneider Electric
Siemens Canada

16.4.053 Fuses

Maintenance Materials

Provide maintenance materials in accordance with Section 16.2.001.

Two spare fuses of each type and size installed up to and including 600A.

Delivery & Storage

Ship fuses in original containers.

Do not ship fuses installed.

Store fuses in original containers in storage cabinet.

Fuses General

HRC fuses: to have interrupting capability of 200,000A symmetrical.

Fuses: product of one manufacturer.

Fuse Types

HRC-1 fuses (formerly Class L):
(a) Type L1, time delay, capable of carrying 50% of its rated current for 10 s minimum.
(b) Type L2, fast acting.

HRC1-J fuses (formerly Class J):
(a) Type J1, time delay, capable of carrying 50% of its rated current for 10 s minimum.

Acceptable Manufacturers: English Electric
GEC Canada Ltd.
Gould-Shawmut Company
Littelfuse

Fuse Storage

Fuse storage cabinet, "E"-type cabinet 750mm high, 600mm wide, 300mm deep, hinged, lockable front access door, finished in accordance with Section 16.2.001. Provide intermediate shelving in cabinet.

16.4.054 Contactors

Submit product data in accordance with Section 16.2.001.

Contactors

Contactors: to EEMAC No. 1CS.

Electrically-held, controlled by pilot devices as indicated, and rated for type of load controlled. Half-size contactors not accepted.

16.4.054 Contactors (Cont'd)

Complete with normally open and normally closed auxiliary contacts unless indicated otherwise.

Mount in CSA Enclosure 1 unless indicated otherwise.

Include following options in cover as indicated:
(a) Red indicating lamp,
(b) HAND-OFF-AUTO selector switch,
(c) START/STOP pushbutton.

Control transformer in contactor enclosure where indicated.

Acceptable Manufacturers: Eaton Canada
Schneider Electric
Siemens Canada

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Size 4 nameplate indicating name of load controlled.

16.4.055 Ground Fault Circuit Interrupters - Class "A"

Submit shop drawings and product data in accordance with Section 16.2.001.

Components comprising ground fault protective system to be of same manufacturer.

Breaker-Type Ground Fault Interrupter: Single pole ground fault circuit interrupter, as indicated, complete with test and reset facilities.

16.4.056 Lighting Equipment

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Submit complete photometric data prepared by independent testing laboratory for fixtures where specified, or when requested for review by Engineer.

Equivalent

The manufacturer and catalogue numbers used herein are to establish an acceptable standard of quality. Equivalent products by the listed luminaire manufacturers may be used as alternatives subject to verification of photometric data and construction material at the shop drawing stage.

Acceptable Manufacturers: Cooper Lighting
Holophane
Philips Lighting
Metalumen
Hubbell
Lithonia Lighting

16.4.056 Lighting Equipment (Cont'd)

Lamps

Spare lamps as follows, minimum of one of each type:
(a) 10% incandescent,
(b) 5% of all fluorescent and HID lamps.

Table 16.3: Incandescent Lamps

Lamp Design	Bulb Shape Wattage	Base	Initial Lumen	Life h	Description
I1	A19-60	medium	865	1000	coated 3000K
I2	A19-100	medium	1710	750	coated 3000K
I3	A21-150	medium	2850	750	coated 3000K
I4	PAR38-150	medium	1700	2000	flood 3000K
I5	G25-60	medium		1500	Fat Albert 3000K

Table 16.4: Halogen lamps

Lamp Design	Bulb Shape Wattage	Base	Initial Lumen	Life h	Description
T1	PAR20-50	medium	590	2000	flood 2800K
T2	PAR30-50	medium	610	3000	flood 2800K
T3	PAR38-50	medium	850	3000	flood 2810K
T4	PAR30-75	medium	1030	3000	flood 2830K
T5	PAR38-90	medium	1260	2000	flood 2870K
T6	PAR38-100	medium	1400	2000	flood 2900K
T7	MR16-50	GX5.3		6000	flood 3050K

Table 16.5: Fluorescent Lamps

Lamp Design	Bulb Shape Wattage	Base	Initial Lumen	Life h	Description
2-PIN					
F1	PLC-13	GX23-2	860	10000	3500K
F2	PLC-18	G24d-2	1250	10000	3500K
F3	PLC-26	G24d-3	1800	10000	3500K
4-PIN - DIMMING					
F4	PLC-13	G24q-1	900	10000	3500K
F5	PLC-18	G24q-2	1250	10000	3500K
F6	PLC-26	G24q-3	1800	10000	3500K
LONG-BIAX					
F7	PLL-18	2G11	1250	12000	4100K
F8	PL-24	2G11	1800	12000	4100K
F9	PLL-36	2G11	2900	12000	3500K
F10	PLL-38	2G11	3300	20000	3500K
F11	PLL-50	2G11	4300	14000	3500K
TRIPLE TUBE - 4-PIN					
F12	PLT-18	GX24q-2	1200	10000	3500K
F13	PLT-26	GX24q-3	1800	10000	3500K
F14	PLT-32	GX24q-3	2400	10000	3500K
F15	PLT-42	GX24q-4	3200	10000	3500K

16.4.056 Lighting Equipment (Cont'd)

Lamp Design	Bulb Shape Wattage	Base	Initial Lumen	Life h	Description
STANDARD T5					
F16	T5-14	min.bipin	1350	16000	549mm 3500K
F17	T5-21	min.bipin	2700	16000	849mm 3500K
F18	T5-28	min.bipin	2900	16000	1149mm 3500K
F19	T5-35	min.bipin	3650	16000	1449mm 3500K
HIGH OUTPUT T5					
F20	T5-24	min.bipin	2000	16000	549mm 3500K
F21	T5-39	min.bipin	3500	16000	849mm 3500K
F22	T5-55	min.bipin	5000	16000	1149mm 3500K
F23	T5-80	min.bipin	7500	16000	1449mm 3500K
T8					
F24	T8-17	med.bipin	1400	20000	610mm 3500K
F25	T8-25	med.bipin	2100	20000	914mm 3500K
F26	T8-32	med.bipin	2950	20000	1219mm 3500K
F27	T8-40	med.bipin	3775	20000	1524mm 3500K
F28	T8-59	med.bipin	5900	15000	2438mm 3500K
T-12					
F29	T12-20	med.bipin	1220	9000	635mm 4200K
F30	T12-32	med.bipin	2850	20000	1219mm 3500K

Table 16.6: Metal Halide Lamps

Lamp Design	Bulb Shape Wattage	Base	Initial Lumen	Life h	Description
PULSE START					
M1	ED17-32	medium	2400	10000	coated 3200K
M2	BD17-50	medium	3500	5000	coated 4000K
M3	BD17-70	medium	4500	12000	coated 4000K
M4	BD17-100	medium	7600	15000	coated 4000K
M5	BD17-50	medium	11200	15000	coated 4000K
M6	ED232-175	mogul	1770	15000	coated 4000K
M7	BD17-175	medium	16400	15000	coated 4000K
M8	BD28-250	mogul	21500	15000	coated 3900K
M9	ED37-400	mogul	42000	20000	coated 4000K
STANDARD					
M10	BD17-175	medium	11900	6000	coated 3900K
M11	ED28-175	mogul	11900	6000	coated 3900K
M12	ED28-250	mogul	18200	6000	coated 3900K
M13	ED37-400	mogul	32200	15000	coated 3700K
M14	BT56-1000	mogul	91800	9000	coated 3400K
HIGH OUTPUT					
M15	ED232-175	mogul	16300	10000	coated 3200K
M16	ED28-250	mogul	19700	15000	coated 3600K
M17	ED37-400	mogul	41000	20000	coated 3700K
M18	BT56-1000	mogul	110000	12000	coated 3400K
M19	BT56-1500	mogul	155000	3000	clear 3600K

16.4.056 Lighting Equipment (Cont'd)

Table 16.7: High Pressure Sodium Lamps

Lamp Design	Bulb Shape Wattage	Base	Initial Lumen	Life h	Description
S1	B17-35	medium	2150	16000	coated 1900K
S2	B17-50	medium	3800	24000	coated 1900K
S3	B17-70	medium	5950	24000	coated 1900K
S4	B17-100	medium	8800	24000	coated 2000K
S5	ED232-150	mogul	15000	24000	coated 2000K
S6	ED28-250	mogul	26000	24000	coated 2100K
S7	ED28-400	mogul	47500	24000	coated 2100K
S8	E25-1000	mogul	14000	24000	clear 2100K

Table 16.8: Low Pressure Sodium Lamps

Lamp Design	Bulb Shape Wattage	Base	Initial Lumen	Life h	Description
L1	T16-18	B22d	1800	18000	clear 1800K
L2	T16-35	B22d	4600	18000	clear 1800K
L3	T16-55	B22d	7650	18000	clear 1800K
L4	T21-90	B22d	12750	16000	clear 1800K
L5	T21-135	B22d	22000	20000	clear 1800K
L6	T21-180	B22d	32000	16000	clear 1800K

Ballasts

Fluorescent ballast - CBM certified, high frequency, 20kHz minimum, rapid-start electronic type:

(a) Rating: 120V, 60Hz, 1 or 2 265mA rapid-start T8 lamps, from 610 to 1524mm in length.
(b) Totally encased and designed for maximum 15EC temperature rise over 40°C ambient temperature.
(c) Power factor: minimum 90% @ 25% output.
(d) Ballast factor: minimum 95%.
(e) Crest factor: minimum 1.5.
(f) Thermal protection: Class P, auto reset.
(g) Total harmonic distortion: maximum of 10% to ANSI and IEEE specifications.
(h) CSA approved to operate lamps within the ANSI lamp specification and FCC Rules and Regulations, Part 18, for Class "A".
(i) Continuous operation: monitor and maintain constant light output. 90% to 110% of rated supply voltage on load or on open circuit.
(j) Soft start: minimum 0.5 second preheat with maximum 20mA glow current and maximum 4 watts starting filament power.
(k) Auto surge protection: to ANSI C62.41 (IEEE 587), Category A and IEC 929, Clause 14.

16.4.056 Lighting Equipment (Cont'd)

(l) Lamp life: lamp current crest factor of 1.5 with continuous heating of filaments during lamp operation to ANSI C78.1.
(m) Physical characteristics: inter-changeable with standard magnetic ballasts.
(n) Ballast noise: 75% below "A" sound rating.

(o) Warranty: minimum 60 months with rated life expectancy of minimum 20 years.
(p) Ballast protection: automatic switch OFF/ON:
  .1 Incorrect output connections
  .2 Shorted or arcing output leads
  .3 Open output circuit
(q) High current protection: integral fuse to disconnect ballast from line on internal component failure.

Acceptable Manufacturers: Philips/Advance
Magnetek
Osram/Sylvania
GE/Motorola
Flotronic Technology

Fluorescent ballasts - ballasts for compact fluorescent (T4) PL-C lamps shall be high frequency, rapid start electronic type.

(a) Rating: 120V, 60Hz, 1 or 2 rapid-start T4, 7W PL-C, 4-pin lamps.
(b) Totally encased and designed for maximum 15EC temperature rise over 40°C ambient temperature and -15EC starting.
(c) Power factor: minimum 90% @ 90% output.
(d) Minimum operating frequency: 20kHz.
(e) Thermal protection: Class P, auto reset.
(f) Total harmonic distortion: maximum of 10% to ANSI and IEEE specifications.
(g) CSA approved to operate lamps within the ANSI lamp specification and FCC Rules and Regulations, Part 18, for Class "A".
(h) Continuous operation: monitor and maintain constant light output. 90% to 110% of rated supply voltage on load or on open circuit.
(i) Soft start: minimum 0.5 second preheat with maximum ma glow current and maximum 4 watts starting filament power.
(j) Auto surge protection: to ANSI C62.41 (IEEE 587), Category A and IEC 929, Clause 14.
(k) Lamp life: lamp current crest factor of 1.5 with continuous heating of filaments during lamp operation to ANSI C78.1.
(l) Ballast noise: 75% below "A" sound rating.
(m) Warranty: minimum 60 months with rated life expectancy of minimum 20 years.
(n) Ballast protection: automatic switch OFF/ON:
  .1 Incorrect output connections
  .2 Shorted or arcing output leads
  .3 Open output circuit
(o) High current protection: integral fuse to disconnect ballast from line on internal component failure.

Acceptable Manufacturers: Philips/Advance
Magnetek
Osram/Sylvania
GE/Motorola
Flotronic Technology

16.4.056 Lighting Equipment (Cont'd)

Fluorescent ballasts - CBM certified, high frequency, rapid-start electronic dimming type:

(a) Rating: 120V, 60Hz, 2-265mA rapid-start T8 lamps, from 610 to 1524mm in length.
(b) Totally encased and designed for maximum 15EC temperature rise over 40°C ambient temperature.
(c) Power factor: minimum 95% @ 90% output; minimum 90% @ 25% output.
(d) Minimum operating frequency: 25kHz.
(e) Thermal protection: Class P, auto reset.
(f) Total harmonic distortion: maximum of 13% to ANSI and IEEE specifications.
(g) CSA approved to operate lamps within the ANSI lamp specification and FCC Rules and Regulations, Part 18, for Class "A".
(h) Continuous operation: monitor and maintain constant light output. 90% to 110% of rated supply voltage on load or on open circuit.
(i) Dimming range: 1% to 100% with smooth flicker-free operation over entire dimming range.
(j) Auto surge protection: to ANSI C62.41 (IEEE 587), Category A and IEC 929, Clause 14.
(k) Lamp life: lamp current crest factor of 1.5 with continuous heating of filaments during lamp operation to ANSI C78.1.
(l) Ballast noise: 75% below "A" sound rating.
(m) Warranty: minimum 36 months with rated life expectancy of minimum 20 years.
(n) Ballast protection: automatic switch OFF/ON:
    .1 Incorrect output connections
    .2 Shorted or arcing output leads
    .3 Open output circuit

Acceptable Products: Lutron FDB Series; Approved Equal

Metal Halide Ballast: design MH1

(a) Rating 120V, 60Hz, for use with 1-150W, 1-175W or 1-250W metal halide lamp.
(b) Totally encased and designed for 40°C ambient temperature.
(c) Power factor: minimum 95% with 95% of rated lamp lumens.
(d) Type: constant wattage auto transformer, pulse start.
(e) Capacitor: non-PCB.
(f) Input voltage range: 10% to minus 0% of nominal.
(g) Minimum starting temperature: -29°C at 90% line voltage.
(h) Mounting: integral with luminaire.
(i) Epoxy potted for noise reduction.

High pressure sodium ballast: to ANSI C82.4, design SB1:

(a) Rating: 120V, 60Hz for use with 1-100W, 1-150W, 1-250W high pressure sodium lamp.
(b) Totally encased and designed for 40°C ambient temperature.
(c) Power factor: minimum 90% with 95% of rated lamp lumens.
(d) Type: constant wattage auto transformer.
(e) Capacitor: non-PCB.
(f) Input voltage range: 10% to -10% of nominal.
(g) Minimum starting temperature: -27°C at 90% line voltage.
(h) Mounting: outdoor, integral with luminaire.

16.4.056 Lighting Equipment (Cont'd)

Finishes

Baked enamel finish:

(a) Conditioning for metal before painting:
  .1 For corrosion resistance conversion coating to CGSB 31-GP-103M.
  .2 For paint base, conversion coating to CGSB 31-GP-105M, CGSB 31-GP-106A.

Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel to give smooth, uniform appearance, free from pinholes or defects.

Reflector and other inside surfaces finished as follows:

(a) White, minimum reflection factor 85%.
(b) Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fadeometer not to exceed 0.05.
(c) Film thickness, not less than 0.3mm average, and in no areas less than 0.025mm.
(d) Gloss not less than 80 units as measured with Gardner 60° glossmeter.
(e) Flexibility: withstand bending over 12mm mandrel without showing signs of cracking or flaking under 10 times magnification.
(f) Adhesion: 24mm square lattice made of 3mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if not coating removed.

Alzak finish:

(a) Aluminum sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:
  .1 Finish for mild commercial service: minimum density of coating 0.8mg/sq.cm., minimum reflectivity 83% for specular and 75% for diffuse.
  .2 Finish for regular industrial service: minimum density of coating 1.2mg/sq.cm., minimum reflectivity 82% for specular and 73% for diffuse.
  .3 Finish for heavy-duty service: minimum density of coating 1.5mg/sq.cm.; minimum reflectivity 78% for specular, 65% for diffuse.

16.4.056 Lighting Equipment (Cont'd)

Table 16.9: Luminaires

FIXTURE SYMBOL		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		305 x 1220mm RECESSED FLUOR. -	2-F32 T8	T-BAR
		ECONO		
		METALUX # GR8-232A-120-EB81		
	A1	CFI # AA248-120 SO VA		
		HOLOPHANE # EGS14DNA12O42EP11		
		THOMAS # 1GRS232-FS01-120-EB		
		LITHONIA # GT 232 A12 120GEB10		
		610 x 1220mm RECESSED FLUOR. -	2-F32 T8	T-BAR
		1 BALLAST - ECONO		
		METALUX # 2GR8-232A-120-EB81		
	A2	CFI # AA2W8-120 SOVA		
		HOLOPHANE # EGS24DNA12O42EP11		
		THOMAS # 2GRS232-FS01-120-EB		
		LITHONIA # 2GT8 2 32 A12 120 GEB10		
		610 x 1220mm RECESSED FLUOR. -	3-F32 T8	T-BAR
		1 BALLAST - ECONO		
		METALUX # 2GR8-332A-120-EB81		
	A3	CFI # AA348-120 O3 VA		
		HOLOPHANE # EGS24DNA12O43EP11		
		THOMAS # 2GRS332-FS01-120-1/21-EB		
		LITHONIA # 2GT8332A12 120 1/3		
		610 x 1220mm RECESSED FLUOR. -	3-F32 T8	T-BAR
		2 BALLAST - ECONO		
		METALUX # 2GR8-332A-120-EB82		
	A4	CFI # AA348-120 SOD VA		
		HOLOPHANE # EGS24DNA12O43EP21		
		THOMAS # 2GRS332-FS01-120-1/21-EB		
		LITHONIA # 2GT8 332 A12 120 GEB10		
		610 x 1220mm RECESSED FLUOR. -	4-F32 T8	T-BAR
		1 BALLAST - ECONO		
		METALUX # 2GR8-432A-120-EB81		
	A5	CFI # AA448-120 O4 VA		
		HOLOPHANE # EGS24DNA12O44EP11		
		THOMAS # 2GRS432-FS01-120-EB		
		LITHONIA # 2GT8432 A12 120 ¼ GEB10		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE SYMBOL		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		610 x 1220mm RECESSED FLUOR. –	4-F32 T8	T-BAR
		K12 - 2 BALLAST - ECONO		
		METALUX # 2GR8-432A-120-EB82		
	A6	CFI # AA448-120 SOD VA		
		HOLOPHANE # EGS24DNA12O44EP21		
		THOMAS # 2GRS432-FS01-120-2/2-EB		
		LITHONIA # 2GT8432 A12 120 GEB10		
		305 x 1220mm RECESSED FLUOR. -	2-F32 T8	T-BAR
		1 BALLAST - SPEC. GRADE		
		METALUX # GC8-232A19-120-EB81		
	A7	CFI # SQS1GFSKA232120SO		
		HOLOPHANE # TGS14 NH24O42EP11		
		THOMAS # 1DCG232F19 120 EB		
		LITHONIA # SPG232A19 120 GEB10		
		610 x 1220mm RECESSED FLUOR. -	2-F32 T8	T-BAR
		1 BALLAST - SPEC. GRADE		
		METALUX # 2GC8-232A19-120-EB81		
	A8	CFI # SQS2GFSKA232 120 SO		
		HOLOPHANE # TGS24SNH24O42EP11		
		THOMAS # 2DCG232F19 120 EB		
		LITHONIA # 2SP8G232A19 120 GEB10		
		610 x 1220mm RECESSED FLUOR. -	3-F32 T8	T-BAR
		1 BALLAST - SPEC. GRADE		
		METALUX # 2GC8-332A19-120-EB81		
	A9	CFI # SQS2GFSKA332 120 O3		
		HOLOPHANE # TGS24SNH24O43EP11		
		THOMAS # 2DCG332F19 120 EB		
		LITHONIA # 2SP8G332 A19 120 1/3		
		610 x 1220mm RECESSED FLUOR. -	3-F32 T8	T-BAR
		2 BALLAST - SPEC. GRADE		
		METALUX # 2GC8-332A19-120-EB82		
	A10	CFI # SQS2GFSKA 332 120 SOD		
		HOLOPHANE # TGS24SNH24O43EP21		
		THOMAS #2DCG332F19 120 1/21 EB		
		LITHONIA # 2SP8G332 A19 120 GEB10		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE SYMBOL		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		610 x 1220mm RECESSED FLUOR.-K19	4-F32	T-BAR
		1 BALLAST - SPEC. GRADE		
		METALUX # 2GC8-432A19-120-EB81		
	A11	CFI # SQS2GFSKA432 120 O4		
		HOLOPHANE # TGS24SNH24O44EP11		
		THOMAS # 2DCG432 F19 120 EB		
		LITHONIA # 2SP8G432 A19 120 1/4		
		610 x 1220mm RECESSED FLUOR. -	4-F32	T-BAR
		2 BALLAST - SPEC. GRADE		
		METALUX # 2GC8-432A19-120-EB82		
	A12	CFI # SQS2GFSKA 432 120 SOD		
		HOLOPHANE # TGS24SNH24O44EP21		
		THOMAS # 2DCG432 F19 120 2/2 EB		
		LITHONIA # 2SP8G432 A19 120 GEB10		
		305 x 1220mm PARABOLIC FLUOR.	1-F32 T8	T-BAR
		1 BALLAST		
		METALUX # EP3GX132S16I-120-EB81		
	A13	CFI # DPA1G6LS132120SO		
		HOLOPHANE # PGS14SNS16O40EP11		
		THOMAS # 1LP3CGS132-16AL 120 EB		
		LITHONIA # PM3GB1326LD120 GEB10		
		305 x 1220mm PARABOLIC FLUOR.	2-F32 T8	T-BAR
		1 BALLAST		
		METALUX # EP3GX232S16I-120-EB81		
	A14	CFI # DPA1G6LS232 120SO		
		HOLOPHANE # PGS14SNS16O42EP11		
		THOMAS # 1LP3CGS232-16AL 120 EB		
		LITHONIA # PM3GB2326LD 120 GEB10		
		610 x 610mm PARABOLIC FLUOR.	3-F17 T8	T-BAR
		1 BALLAST		
		METALUX # 2EP3GX317S33I-120-EB81		
	A15	CFI # PLA2G9LP32U120 03		
		HOLOPHANE # PGS22SNS33O23EP11		
		THOMAS # 2LP3CGS317-33 AL 120 EB		
		LITHONIA # 2PM3NGB317 9LD 120 1/3		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE SYMBOL		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		610 x 1220mm PARABOLIC FLUOR.	3-F32 T8	T-BAR
		1 BALLAST		
		METALUX # 2EP3GX332S36I-120-EB81		
	A16	CFI # PLA2G18LP332 12003		
		HOLOPHANE # PGS24SNS36O43EP11		
		THOMAS # 2LP3CGS332-36AL-120 EB		
		LITHONIA # 2PM3NGB332 18LD 120 1/3		
		305 x 1220mm RECESSED FLUOR.	2-F32 T8	T-BAR
		1 BALLAST		
		METALUX # RDI232 RP 120 EB81		
	A17	CFI # QVS1GPF0240 120 S0		
		HOLOPHANE #		
		THOMAS # 1AVCG232 PMW120-1/2-		
		LITHONIA # AVG232 MDR 120 GEB10		
		610 x 610mm RECESSED FLUOR.	2-F17 T8	T-BAR
		1 BALLAST		
		METALUX # 2RDI217RP120EB81		
	A18	CFI # QVS2GPFOS2U4 120 SB		
		HOLOPHANE #		
		THOMAS # 2AVCG217PMW120EB		
		LITHONIA # 2AVG217MDR 120 GEB10		
		610 x 1220mm RECESSED FLUOR.	2-F32 T8	T-BAR
		1 BALLAST		
		METALUX # 2RDI232RP120EB81		
	A19	CFI # QVS2GPFOS240 120 SO		
		HOLOPHANE #		
		THOMAS # 2AVCG232 PMW 120 EB		
		LITHONIA # 2AVG232 MDR 120 GEB10		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE TYPE		MANUFACTURE	ACCESSORIES / OPTIONS		
PRESENT TYPE	TYPE		DRYWALL KIT		
		METALUX #	/DF-14-W		
	A1, A7	CFI #	/FK91X4		
		HOLOPHANE #			
		THOMAS #	/FMK-14		
		LITHONIA #	GTF2 Y; SPF2 ...		
		METALUX #	/DF-24-W		
	A2-A6	CFI #	/FK92X4		
		HOLOPHANE #			
		THOMAS #	/FMK-24		
		LITHONIA #	2GT8F2 Y;2SP8FY		
		METALUX #	EP3FX Y		
	A13-	CFI #	/FK91X4		
		HOLOPHANE #			
		THOMAS #	1P3CF Y		
		LITHONIA #	PM3F Y		
		METALUX #	2EP3F Y		
	A15-	CFI #			
		HOLOPHANE #			
		THOMAS #	2P3CF Y		
		LITHONIA #	2PM3NF		
		METALUX #	/DF-14-W		
	A17	CFI #	/FK91X4		
		HOLOPHANE #			
		THOMAS #	/FMK14		
		LITHONIA #	/DGA		
		METALUX #	/DF-22-W		
	A18	CFI #	/FK92X2		
		HOLOPHANE #			
		THOMAS #	/FMK22		
		LITHONIA #	/DGA		
		METALUX #	/DF-24-W		
	A19	CFI #	/FK92X4		
		HOLOPHANE #			
		THOMAS #	/FMK24		
		LITHONIA #	/DGA		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		305 x 1220mm SURFACE FLUOR.	2-F32 T8	SURFACE
		1 BALLAST - BOX		ON
		METALUX # MC-232A-120-EB81		CEILING
	B1	CFI # SLB1SFSVA232120SO		
		HOLOPHANE # LST14ANA12O42EP11		
		THOMAS # 1SMC232-FS01-120-EB		
		LITHONIA # M232 A12-120-GEB10		
		610 x 610mm SURFACE FLUOR.	4-F17	SURFACE
		1 BALLAST - BOX		ON
		METALUX # 2M-417A-120-EB81		CEILING
	B2	CFI # SLB2SFSVA417120 O4		
		HOLOPHANE # LST22ANA12O24EP11		
		THOMAS # 2SMC417-FS01-120-EB		
		LITHONIA # 2M417 A12-120-1/4 GEB10		
		610 x 610mm SURFACE FLUOR.	4-F17 T8	SURFACE
		2 BALLAST - BOX		ON
		METALUX # 2M-417A-120-EB82		CEILING
	B3	CFI # SLB2SFSVA417120SOD		
		HOLOPHANE # LST22ANA12O24EP21		
		THOMAS # 2SMC417-FS01-120-2/2 EB		
		LITHONIA # 2M417 A12-120-GEB10		
		610 x 1220mm SURFACE FLUOR.	2-F32 T8	SURFACE
		1 BALLAST - BOX		ON
		METALUX # 2M-232A-120-EB81		CEILING
	B4	CFI # SLB2SFSVA232120SO		
		HOLOPHANE # LST24ANA12O42EP11		
		THOMAS # 2SMC232-FS01-120-EB		
		LITHONIA # 2M232 A12 120 GEB10		
		610 x 1220mm SURFACE FLUOR.	3-F32 T8	SURFACE
		1 BALLAST - BOX		ON
		METALUX # 2M-332A-120-EB81		CEILING
	B5	CFI # SLB2SFSVA332 120 03		
		HOLOPHANE # LST24ANA12O42EP11		
		THOMAS # 2SMC332-FS01-120-EB		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		610 x 1220mm SURFACE FLUOR.	3-F32 T8	SURFACE
		2 BALLAST - BOX		ON
		METALUX # 2M-332A-120-EB82		CEILING
	B6	CFI # SLB2SFSVA332 120 SOD		
		HOLOPHANE # LST24ANA12O43EP21		
		THOMAS # 2SMC332-FS01-120-1/21 EB		
		LITHONIA # 2M332 A12 120-GEB10		
		610 x 1220mm SURFACE FLUOR.	4-F32 T8	SURFACE
		1 BALLAST - BOX		ON
		METALUX # 2M- 432A-120-EB81		CEILING
	B7	CFI # SLB2SFSVA432 120 04		
		HOLOPHANE # LST24ANA12O44EP11		
		THOMAS # 2SMC 432-FS01-120-EB		
		LITHONIA # 2M432 A12 120-1/4 GEB10		
		610 x 1220mm SURFACE FLUOR.	4-F32 T8	SURFACE
		2 BALLAST - BOX		ON
		METALUX # 2M-432A-120-EB82		CEILING
	B8	CFI # SLB2SFSVA432 120 SOD		
		HOLOPHANE # LST24ANA12O44EP21		
		THOMAS # 2SMC 432-FS01-120-2/2 EB		
		LITHONIA # 2M432 A12 120-GEB10		
		1220mm SURFACE FLUOR.	2-F32 T8	SURFACE
		1 BALLAST - WRAP		ON
		METALUX # W232-120-EB81		CEILING
	B9	CFI # TX248-120-SO		
		HOLOPHANE # LBSN4ANACLO42EP11		
		THOMAS # JSTN232 120 EB		
		LITHONIA # SB232-120 GEB10		
		1220mm SURFACE FLUOR.	3-F32 T8	SURFACE
		1 BALLAST - WRAP		ON
		METALUX # W332A-120-EB81		CEILING
	B10	CFI # TX348-120-O3		
		HOLOPHANE #		
		THOMAS # CAW332 120EB		
		LITHONIA # SB332-120-1/3 GEB10		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		1220mm SURFACE FLUOR.	3-F32 T8	SURFACE
		2 BALLAST - WRAP		ON
		METALUX # W332A-120-EB82		CEILING
	B11	CFI # TX348-120-SOD		
		HOLOPHANE #		
		THOMAS # CAW332 120 1/21 EB		
		LITHONIA # SB 332120GEB10		
		1220mm SURFACE FLUOR.	4-F32 T8	SURFACE
		1 BALLAST - WRAP		ON
		METALUX # W432A-120-EB81		CEILING
	B12	CFI # TX448-120-O4		
		HOLOPHANE #		
		THOMAS # APW-W432 120 EB		
		LITHONIA # SB432120-1/4 GEB10		
		1220mm SURFACE FLUOR.	4-F32 T8	SURFACE
		2 BALLAST - WRAP		ON
		METALUX # W432A-120-EB82		CEILING
	B13	CFI # TX448-120-SOD		
		HOLOPHANE #		
		THOMAS # APW-W432 120 2/2 EB		
		LITHONIA # SB 432120-GEB10		
		305 x 1220mm SURFACE FLUOR.	2-F32 T8	SURFACE
		1 BALLAST - CLOUD		ON
		METALUX # WTS-232-D-W-120-EB81		CEILING
	B14	CFI # 10325/10306-120-SO		
		HOLOPHANE #		
		THOMAS # FC232 120-EB		
		LITHONIA # 1064032 GEB10		
		610 x 610mm SURFACE FLUOR.	4-F32 T8	SURFACE
		1 BALLAST - CLOUD		ON
		METALUX # WTS-417DW-120-EB81		CEILING
	B15	LSI # CL2417SSO-<10-120		
		HOLOPHANE #		
		THOMAS # FC 417 120 EB		
		LITHONIA # 10651 417-1/4 GEB10		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		330 x 1220mm - SURFACE	2-F32 T8	SURFACE
		1 BALLAST - GYM		ON
		METALUX # GYM-232-A19-120-EB81		CEILING
	B16	CFI # GM4B4SKA232 120 SO		
		HOLOPHANE #		
		THOMAS # GYMN232-19-120-EB		
		LITHONIA # GYM 232 A19 120-GEB10		
		METALUX #		
	B17	CFI #		
		HOLOPHANE #		
		THOMAS #		
		LITHONIA #		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		1220mm PENDANT FLUOR.	2-F32 T8	SUSPENDED
		FULL INDIRECT - 1 CIRCUIT		FROM
		CORELITE # AL-WN-2T8-1C-120-AC48-		CEILING
	C1	CFI # IMS1PWHSS240 120		
		HOLOPHANE # fixture is 5' long		
		THOMAS # A9C1MWU1232-00-120-1/3		
		LITECONTROL #PI9B24T8 ECB 1CWQ		
		PEERLESS #PRM1232 4FT R4 120		
		1220mm PENDANT FLUOR.	3-F32 T8	SUSPENDED
		FULL INDIRECT - 1 CIRCUIT		FROM
		CORELITE # AL-WN-3T8-1C-120-AC48-		CEILING
	C2	CFI #		
		HOLOPHANE # fixture is 5' long		
		THOMAS # A9C1MWU1332-00-120-1/3		
		LITECONTROL #PI9B34TB ECB 1CWQ		
		PEERLESS #PRM1332 4FTR4 120		
		1220mm PENDANT FLUOR.	4-F32 T8	SUSPENDED
		FULL INDIRECT - 1 CIRCUIT		FROM
		CORELITE # AL-WN-4T8-1C-120-AC48-		CEILING
	C3	CFI # 3 lamp max.		
		HOLOPHANE # 3 lamp max.		
		THOMAS # 3 lamp max.		
		LITECONTROL #PI9B44TB ECB 1CWQ		
		1220mm PENDANT FLUOR.	2-F32 T8	SUSPENDED
		PERFORATED - 1 CIRCUIT		FROM
		CORELITE #		CEILING
	C4	CFI # IMP1PWHSS240 120		
		HOLOPHANE # fixture is 5' long		
		THOMAS # N/A		
		LITECONTROL #PI9BPF24TI ECB		
		PEERLESS #PRM7232 4FTR4 120		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		1220mm PENDANT FLUOR.	3-F32 T8	SUSPENDED
		PERFORATED - 1 CIRCUIT		FROM
		CORELITE #		CEILING
	C5	CFI # IMP1PWHSS340120		
		HOLOPHANE # fixture is 5' long		
		THOMAS # N/A		
		LITECONTROL #PI9BPF34TI 5CB		
		PEERLESS #PRM 7332 4FTR4		
		1220mm PENDANT FLUOR.	4-F32 T8	SUSPENDED
		PERFORATED - 1 CIRCUIT		FROM
		CORELITE #		CEILING
	C6	CFI # 3 lamp max.		
		HOLOPHANE # 3 lamp max.		
		THOMAS # N/A		
		LITECONTROL #DI9B PF 44TB ECB		

FIXTURE TYPE		MANUFACTURE	ACCESSORIES / OPTIONS		
PRESENT TYPE	TYPE		2 - CiRCUIT	DIMMING	
		CORELITE #	Y T8-2C-120 Y	Y 2T8-1D-120 Y	
	C1-C6	CFI #	Y PWHDS240 Y	Y 120-PS	
		HOLOPHANE #			
		THOMAS #	Y1MWU2232 Y	Y 120-EBD	
		PEERLESS #	DCT	Y 120 ADEZ	
		LITECONTROL #	2CWQ	Y MKX ECB	

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		1220mm STRIP FLUOR.	1-F32 T8	SURFACE
				ON
		METALUX # SN-132-120-EB81		CEILING
	D1	CFI # SB148-120-SO		OR
		HOLOPHANE # SNS04DSNNNO40EP11		CHAIN HUNG
		THOMAS # STRIPN132-120-EB		
		LITHONIA # S132120-GEB10		
		1220mm STRIP FLUOR.	2-F32 T8	SURFACE
				ON
		METALUX # SS-232-120-EB81		CEILING
	D2	CFI # SB248-120-SO		OR
		HOLOPHANE #		CHAIN HUNG
		THOMAS # STRIPS232-120-EB		
		LITHONIA # C232 120-GEB10		
		2440mm STRIP FLUOR.	4-F32 T8	SURFACE
				ON
		METALUX # 8TSS-232-120-EB81		CEILING
	D3	CFI # SB248T-120-O4		OR
		HOLOPHANE #		CHAIN HUNG
		THOMAS # TSTRIPS232-120-EB		
		LITHONIA # TC232 120-GEB10		
		1220mm SURFACE FLUOR.	2-F32 T8	SURFACE
		WATER-TIGHT		ON
		METALUX # VT2-232DR-120EB81-WL		CEILING
	D4	CFI # VT248-120-SO-SW		
		HOLOPHANE # ESS04DSSSNO42EP11		
		THOMAS # VCAW232-120-EB		
		LITHONIA # DM232-120-GEB10		
		1220mm SURFACE FLUOR.	4-F32 T8	SURFACE
		HEAVY DUTY INDUSTRIAL		ON
		METALUX # DIM-432-120-EB81		CEILING
	D5	CFI # TU448-120 O4		OR
		HOLOPHANE #		CHAIN HUNG
		THOMAS #		
		LITHONIA # AF 432 120 1/4 GEB		

16.4.056 Lighting Equipment (Cont'd)

ACCESSORIES / OPTIONS		
CHAIN HANGER	REFLECTOR (SYMMETRICAL)	WIRE GUARD
/EYE CHAIN SET	/SNL-3IN-SYM-4FT-1LT-REFL	/WG/SN-4FT-U
/EE9HC	/SB9R6-48	/SB8G1-48
	SNS04DNNNSO40EP11	
/FKR-126		/G-22-4
/HC	/SSMR48	/WGS
/AYC-CHAIN/SET-U	/SSL-4IN-SYM-4FT-2LT-REFL	/WG/SS-4FT-U
/EE9HC	/SB9R6-48	/SB862-48
	SMS04DNNNSO42EP11	
/FKR-126		/G-32-4
	R232-120-GEB10	/WGCUN-no refl.; / WGRZ- refl.
/AYC-CHAIN/SET-U	/SSL-4IN-SYM-8FT-2LT-REFL	/WG/SS-8FT-U
/EE9HC	/SB9R6-96	/SB8G2-96
	SMS08DNNNSO41EP11	
/FKR-126		/G-32-8
/HC	R296T8-120-GEB10	/WGCUN- no refl.; /WGRZ - refl.
		/WG/DI-4FT-U
/HC		/WGAFPV

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		2-HEAD EMERGENCY C/W BATTERY	2-12W, 12V	SURFACE
		72 WATT CAPACITY	QUARTZ	ON WALL
		DUAL-LITE # CB-72-12V-T12		2.3m A.F.
	E1	LUMACELL # RG12-72QB		
		READY-LITE # LD12-75-VQ-12W		
		EMERGI-LITE # 12DEL72/2 Q12		
		LITHONIA # QB1272 120 H1212 LC		
		2-HEAD EMERGENCY C/W BATTERY	2-12W, 12V	SURFACE
		144 WATT CAPACITY	QUARTZ	ON WALL
		DUAL-LITE # CB-144-12V-T12		2.3m A.F.
	E2	LUMACELL # RG12-144QB		
		READY-LITE # LD12-144-VQ-12W		
		EMERGI-LITE # 12DEL144/2Q 12		
		LITHONIA # QB12150 H1212 LC		
		2-HEAD EMERGENCY REMOTE	2-12W, 12V	SURFACE
		CUBES ONLY	QUARTZ	ON WALL
		DUAL-LITE # CBR12-T-12V-12W		2.3m A.F.
	E3	LUMACELL # RSQB2		
		READY-LITE # VQ2		
		EMERGI-LITE # EF26DSQ		
		LITHONIA # ELATQRH1212		
		2-HEAD EMERGENCY REMOTE	2-12W, 12V	SURFACE
		CUBES WITH CENTER BODY	QUARTZ	ON WALL
				2.3m A.F.
	E4	LUMACELL # RSQBD		
		READY-LITE # VQW		
		EMERGI-LITE # EF26DQ		
		LITHONIA # ELA QBR H1212		
		2-HEAD EMERGENCY C/W BATTERY	2-12W, 12V	RECESSED
		72 WATT - WALL RECESSED	QUARTZ	IN WALL
		DUAL-LITE # F5-12-72NS		250mm A.F.
	E5	LUMACELL #		
		READY-LITE #		
		EMERGI-LITE # 12 RTL 72/2-12Q		
		2-HEAD EMERGENCY C/W BATTERY	2-12W, 12V	RECESSED
		144 WATT - WALL RECESSED	QUARTZ	IN WALL
		DUAL-LITE # F5-12-144NS		250mm A.F.
	E6	LUMACELL #		
		READY-LITE #		
		EMERGI-LITE # 12 RTL 144/2-12Q		

16.4.056 Lighting Equipment (Cont'd)

		MANUFACTURER	ACCESSORIES / OPTIONS		
PRESENT TYPE	TYPE		WIRE GUARD	347v	W/0 BATTERY
		DUAL-LITE #	- 40G	- 3K	
	E1. E2	LUMACELL #	- WG064	-347	
		READY-LITE #	- AWG	- U347	
		EMERGI-LITE #	- WG1	12DEL72-3/2Q12	
		LITHONIA #	- ELA	-347	
		DUAL-LITE #	- S6WG-2		
	E3	LUMACELL #	- WG057		
		READY-LITE #	- AWG-R		
		EMERGI-LITE #	- WG9		
		LITHONIA #	- ELA		
	E4	LUMACELL #	- WG056		
		READY-LITE #	- AWG-R		
		EMERGI-LITE #	- G26D		
		LITHONIA #	-		
		DUAL-LITE #			
	E5. E6	LUMACELL #			
		READY-LITE #			HIDE-R-WH-12VDC-
		EMERGI-LITE #		-3	12RTL2-12Q

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		WALL FLUOR.	2-F32 T8	SURFACE
		- BRACKET		ON WALL
		METALUX # BC-232-120-EB81		
	F1	CFI # CSW248-120SOZO		
		HOLOPHANE #		
		THOMAS # CUBEL232-WO-120-EB		
		LITHONIA # WC232-120-GEB10		
		WALL FLUOR.	2-F32 T8	SURFACE
		- CLOUD		ON WALL
		METALUX # 6434-232-120-EB81		
	F2	CFI # CCW232WH-120-SO		
		HOLOPHANE #		
		THOMAS # CLDW232SW-120-EB		
		LITHONIA # 11889 32 - GEB10		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		RECESSED FLUOR. POTLIGHT		RECESSED IN
		ECONO		CEILING
		HALO # H801HP/810	2-28W TT	
	G1	LIGHTOLIER # 1105TCL/1102T26HF120	2-26W QT	
		HOLOPHANE #		
		THOMAS #		
		LITHONIA #LF6 2/26DTT F602A	2-26W DTT	
		DMF# DHF72/260DTT D6061	2-26W DTT	
		RECESSED FLUOR. POTLIGHT		RECESSED IN
		ECONO		CEILING
		HALO # H801HP/810BA	2-28W TT	
	G2	LIGHTOLIER # 1105T/1102T26HF120	2-26W QT	
		HOLOPHANE #		
		THOMAS #		
		LITHONIA #LF62/26DTT F6133	2-26W DTT	
		DMF# DHF72/26DTT D6071	2-26W DTT	
		RECESSED FLUOR. POTLIGHT		RECESSED IN
		ECONO		CEILING
		HALO # H801HP/800	2-28W TT	
	G3	LIGHTOLIER #	2-26W QT	
		LITHONIA #KF6 2.26DTT F614	2-26W DTT	
		DMF#DHF72/26DTT D6171W	2-26W DTT	
		RECESSED FLUOR. WALL WASHER		RECESSED IN
		ECONO	2-28W TT	CEILING
		HALO # H801HP/810WW		
	G4	LITHONIA #LF6 2/26DTT F621A	2-26W DTT	
		DMF# DHF72/26DTT D6191		
		RECESSED FLUOR. POTLIGHT		RECESSED IN
			2-26W QT	CEILING
		HALO # H7871E/9870C		
	G5	LIGHTOLIER # 8056CL/7226HF120		
		HOLOPHANE #		
		THOMAS #		
		LITHONIA # AF2/26DTT BAR		
		DMF #DHFHB 2/26DTT DB06		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		RECESSED FLUOR. POTLIGHT		RECESSED IN
			2-26W QT	CEILING
		HALO # H7871E/9840BA		
	G6	LIGHTOLIER # 8056MG/7226HF120		
		HOLOPHANE #		
		THOMAS #		
		LITHONIA #AF 2/26DTT BMB		
		DMF# DHFHB 2/26DTT DB06		
		RECESSED FLUOR. POTLIGHT		RECESSED IN
			2-26W QT	CEILING
		HALO # C72261E/7280LI-1		
	G7	LIGHTOLIER # 8096PCLW/7226HF120		
		HOLOPHANE #		
		THOMAS #		
		LITHONIA #AF 2/26DTT BAR A12		
		DMF# DHF HB 2/26 DB161		
		RECESSED FLUOR. WALL WASHER		RECESSED IN
			2-26W QT	CEILING
		HALO # H7894CE		
	G8	LIGHTOLIER # 8044CLW/7226HF120		
		HOLOPHANE #		
		THOMAS #		
		LITHONIA #DFW 2/26 DTT 7ASL		
		DMF# DHF HB 2/26 DB14		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		QUARTZ TRACK LIGHT ON TRACK	1-75W PAR	MOUNTED ON
		STRAIGHT, L, T, X CONNECTORS &	QUARTZ	1-CIRCUIT TRACK,
		HALO # L4011P		HALO #L651P,
	I1	LIGHTOLIER # 55209WH		L653P; LIGHOLIER
		CAPRI # KT2335W		55004WH,55008WH,
		CON-TECH# CTL 2230 TRACK LT2,LT4,		55012WH; CAPRI #
				ST4W, ST8W,
				ST12W
		QUARTZ TRACK LIGHT ON TRACK	1-75W PAR	MOUNTED ON
		STRAIGHT, L, T, X CONNECTORS &	QUARTZ	2-CIRCUIT TRACK
		HALO # L4011P		HALO #L641P,
	I2	LIGHTOLIER # 55209WH		L643P; LIGHTOLIER
		CAPRI # KT2335W		6104WH, 6108WH,
		CON-TECH# CTL 2230 TRACK LT24,		6112WH; CAPRI #
				ST4W, ST8W,
				ST12W
		QUARTZ TRACK LIGHT ON TRACK	1-75W PAR	MOUNTED ON
		STRAIGHT, L, T, X CONNECTORS &	QUARTZ	4-CIRCUIT TRACK
		HALO # L4011P		HALO # L621P,
	I3	LIGHTOLIER # 55209WH		L623P; LIGHOLIER
		CAPRI # KT2335W		
				CAPRI #
		FLUORESCENT TRACK LIGHT ON	MOUNTED	
		FLEX, STRAIGHT, L, T, X		1-CIRCUIT TRACK
		HALO # L3232EP	2-32W F32	HALO # L651P,
	I4	LIGHTOLIER # 8277WH	2-27W TWIN	L653P; LIGHTOLIER
		CAPRI # KT9576	2-27W TWIN	55004WH,
		CON-TECH# CTL 1532P TRACK LT2,		55012WH; CAPRI #
		(32TRS) X 2		ST4W, ST8W,
				ST12W
		FLUORESCENT TRACK LIGHT ON	MOUNTED	
		FLEX, STRAIGHT, L,T,X CONNECTORS		2-CIRCUIT TRACK
		HALO # L3232EP	2-32W F32	HALO # L641P,
	I5	LIGHTOLIER # 8277 WH	2-27W TWIN	L643P; LIGHTOLIER
		CAPRI # KT9576W	2-27W TWIN	6104WH, 6108WH,
		CON-TECH# CTL 1532P TRACK LT24,		6112WH; CAPRI #
		(32TRS) X 2		ST4W, ST8W,
				ST12W

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
			1-28W PLC	SURFACE ON
				WALL
	J1	KEENE #VWXL28NFL-1		
		HUBBELL # ONLY 18W QUAD TUBE		
		GUTH # VPWF22CG	1-22W PLC	WALL MOUNT
		METALUX #		
	J2	CFI #		
		HOLOPHANE #		
		THOMAS #		
		LITHONIA #		

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION &	LAMP	MOUNTING
PRESENT TYPE	TYPE	SPECIFICTAION		
		EXTERIOR WALLPACK	1-250W MH	MOUNTED ON
		NO CUTOFF		EXTERIOR WALL
		LUMARK # MHWL250-120		300mm BELOW
	O1	KEENE # 553250MA-1		ROOF EAVE
		DAY-BRITE # LWL 250 MTT		
		LITHONIA # TWR2 250M 120/347		
		EXTERIOR WALLPACK	1-400W MH	MOUNTED ON
		NO CUTOFF		EXTERIOR WALL
		LUMARK # MHWL400-120		300mm BELOW
	O2	KEENE # 553400MA-1		ROOF EAVE
		DAY-BRITE # LWL400 MTT		
		LITHONIA # TWR2 400M 120/347		
		EXTERIOR WALLPACK	1-250W MH	MOUNTED ON
		45 - CUTOFF		EXTERIOR WALL
		PACE # LCWM-1640-250MH-120- 45 -		300mm BELOW
	O3	PAPPI # API (VOLTS) 250M FFLG		ROOF EAVE
		EXTERIOR WALLPACK	1-400W MH	MOUNTED ON
		45 - CUTOFF		EXTERIOR WALL
		PACE # LCWM-1640-400MH-120- 45 -		300mm BELOW
	O4	PAPPI #API (VOLTS) 400M FFLG		ROOF EAVE

16.4.056 Lighting Equipment (Cont'd)

FIXTURE		FIXTURE DESCRIPTION & SPECIFICTAION	LAMP	MOUNTING
PRESENT TYPE	TYPE			
		EXIT LIGHT C/W BATTERY	RED LED'S	SURFACE
		SINGLE FACE - UNIVERSAL MOUNT		ON WALL
		DUAL-LITE # CLXSRWE		OR
	X1	LUMACELL # LE460-SP		ABOVE DOOR
		READY-LITE # CX5100-SP		
		EMERGI-LITE # LPEX52W-I		
		LITHONIA # LESW 1/2 R120/347 ELN		
		EXIT LIGHT C/W BATTERY -	RED LED'S	SURFACE
		SINGLE FACE - UNIVERSAL MOUNT		ON WALL
		DUAL-LITE #CLCDRWE		OR
	X2	LUMACELL # LE400-B6L E/S-SP		ABOVE DOOR
		READY-LITE # CX5100-BGL-E-SP		
		EMERGI-LITE # LPEX72W-I		
		LITHONIA # LKSW1/2 R120/347		

FIXTURE TYPE		MANUFACTURE	ACCESSORIES / OPTIONS		
PRESENT TYPE	TYPE		GREEN LED'S		
		DUAL-LITE #	CLXSGWE Y		
	X1	LUMACELL #	GN - ...		
		READY-LITE #			
		EMERGI-LITE #	- GRN		
		DUAL-LITE #	CLXUGWE		
	X2	LUMACELL #	GN - Y		
		READY-LITE #			
		EMERGI-LITE #	- GRN		

16.4.057 Exit Lights

Submit product data in accordance with Division 7.

Housing: steel or anodized aluminum frame, white enamel finish.

Face plates: prismatic optical red diffuser of polycarbonate or acrylic over LED's, single or twin as indicated.

Light source: light emitting diodes (LED's), maximum power consumption of 5W.

Normal power: 120V AC.

Emergency power: 12V DC.

75mm high x 19mm wide letters, red on white faceplate, reading EXIT (top), SORTIE (bottom).

Universal mount and universal directional arrows.

Wire guard where indicated.

Maximum depth: 65mm.

Acceptable Manufacturers:
Lumacell
Emergi-Lite
Lumaid
Cooper
Philips
Lithonia
Hubbell

16.4.058 Floodlighting - Exterior

Submit shop drawings and product data in accordance with Section 16.2.001.

Indicate vertical and horizontal beam spread, beam lumens, beam efficiency and complete photometric data as shown by independent laboratory tests.

Computer printout for aiming angles.

Products
Outdoor weatherproof floodlight UL listed for marine use:

(a) Housing die-cast aluminum epoxy painted socket housing. Integral watertight entrance bushing with rubber gland. Aluminum yoke with bolt hole for mounting accessories. Degree-marked vertical pre-aiming quadrant with repositioning stop to automatically return fixture to original setting after servicing. Aiming sight anodized aluminum lens ring, gasket, and complete with stainless steel pressure clamps. Lens assembly captive to reflector by hinge chain.
(b) Lens: clear heat tempered, shock and impact resistant.
(c) Reflector: Alzak aluminum.
(d) Lamp: 1000W, 347V, metal halide with holder and socket.
(e) Ballast included as part of assembly: 347V, factory wired.

16.4.058 Floodlighting - Exterior (Cont'd)

(f) Beam spread: wide.
(g) Slipfilter for mounting on 50mm diameter conduit.

Acceptable Product: Appleton Kondu G6070.
Canlyte; Cooper

16.4.059 Unit Equipment for Emergency Lighting

Product Data

Submit product data in accordance with Section 16.2.001.

Data to indicate system components, mounting method, source of power and special attachments.

Guarantee

Provide a written guarantee, signed and issued in the name of the Owner, stating that the battery for emergency lighting is guaranteed against defects in material and workmanship for a period of ten years, with a no-charge replacement during the first lustrum and a pro-rate charge on the second lustrum, from the date of the Final Certificate of Completion.

Equipment

Supply voltage: 120V AC.

Output voltage: 12V DC.

Operating time 72W for 30 minutes, unless indicated otherwise.

Battery: sealed, maintenance-free.

Charger: solid-state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected, modular constructed.

Solid-state transfer.

Low voltage disconnect: solid-state, modular, operates at 80% battery output voltage.

Signal lights: solid-state, life expectancy 100,000 hours minimum, for "AC POWER ON" and "HIGH CHARGE".

Lamp heads: integral on unit or remote as indicated, 258E horizontal and 200E vertical adjustment. Lamp type: quartz halogen, 12W, glare-free mounted inside frosted lexan cubes.

Cabinet: suitable for direct mounting to wall and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.

Finish: white baked enamel.

16.4.059 Unit Equipment for Emergency Lighting (Cont'd)

Auxiliary equipment:
(a) Test switch,
(b) Battery disconnect device,
(c) AC input and DC output terminal blocks inside cabinet.

Acceptable Manufacturers: Dual-Lite
Emergi-Lite
Lumacell #RG12-72QB

Wiring of Remote Heads

Conduit: Type EMT, to Section 16.4.007.

Conductors: RW90 type, to Section 16.4.014, sized as indicated, minimum size #12 AWG.

16.4.060 Lighting - Central Emergency System

Shop Drawings & Product Data

Submit shop drawings and product data in accordance with Section 16.2.001.

Submit shop drawings and product data in accordance with Section 16.2.001.

Battery charge and discharge voltage/time characteristics.

System

Central system rated at (12)(24)(32)(48)(110)V DC with installed battery capacity of 10,000W for 1 hour and to produce not less than 91% of nominal DC system voltage with AC supply "OFF".

Battery Charger

Batteries & Racks

Auxiliary Equipment

Control panel containing:
(a) Battery and charger alarm panel
(b) Remote alarm panel
(c) Automatic overcharge cut-off timer
(d) Boost timer
(e) Brownout protector
(f) Low voltage disconnect
(g) Sequenced load disconnect
(h) Sustained emergency lights
(i) Electrolyte low level alarm
(j) Ground leakage alarm
(k) Battery load ammeter
(l) Trickle charge ammeter
(m) Ground fault detector.

16.4.060 Lighting - Central Emergency System (Cont'd)

Equipment Mounting

Enclosed system:
(a) Mounted in CSA type 1, free-standing enclosure
(b) Painted in accordance with Section 16.2.001.
(c) Front access only
(d) Charger mounted in isolated upper compartment.
(e) Batteries mounted in tier/step arrangement in ventilated lower compartment
(f) Both compartments with hinged lockable doors.

Open system:
(a) Charger in wall mounted 3mm thick sheet steel enclosure CSA type 1.
(b) Batteries mounted on a free-standing floor tier/step painted steel rack.

Wiring

Conduit: EMT type, to Section 16.4.007.

Conductors: type RW90, to Section 16.4.014.

Fixtures

Lighting fixtures: to Section 16.4.056.

Lamp heads: adjustable mounting, swivel type, c/w (tungsten-halogen) Par 36 sealed beam, glare free, minimum 800 lumen output lamps.

16.4.061 Street Lighting Poles & Luminaires

Submit product data in accordance with Section 16.2.001.

Steel poles: to NEMA SH5 designed for underground wiring and:
(a) Mounting on concrete anchor base without transformer base.
(b) Style: square monotube, minimum 4.8mm thick.
(c) Tenon for one luminaire mounting bracket.
(d) Access handhole 500mm above pole base for wiring connections, with welded-on reinforcing frame and bolted-on cover.
(e) Size: 127mm x 127mm x 9.15m.
(f) Anchor bolts: four, stainless steel, sized as per manufacturer=s recommendation with shims, nuts and covers.
(g) Finish: flat black.
(h) Grounding lug.

16.4.061 Street Lighting Poles & Luminaires (Cont'd)

Luminaire with cast aluminum weatherproof housing and:

(a) One 400W high pressure sodium lamp, Type S4 in accordance with Section 16.4.056.
(b) Ballast: one lamp, high pressure sodium, Type SB4 in accordance with Section 16.4.056.
(c) Optical assembly:
    .1 For high pressure sodium lamps:
    .2 Reflector: one piece multi-faceted specular Alzak.
    .3 Refractor: optically pure, tempered glass lens.
    .4 Gasket: seal between refractor and housing.
(d) Light distribution:
    .1 Type 3 cut-off.
(e) Self-locking latches of stainless steel and aluminum.
(f) Factory wired including integral ballast.
(g) Integral photocell.
(h) Finish: flat dark bronze.

Acceptable Products: Keene #SRB403LX.
Approved Equal

Fuses : Type "C" fuse fitting and Type "HRCII-C" miniature fuse, rated 15A and mounted in handhold of pole.

16.4.062 Lighting Control Equipment - Low Voltage

Description of System

Low voltage control system designed to provide remote switching of lighting loads by use of:

(a) Low voltage momentary contact switches,
(b) Low voltage relays,
(c) Control transformers.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Materials

Control system: by one manufacturer and assembled from compatible components.

Remote Control Switches: Single pole, double throw, momentary contact, standard duty, rated 1.5A, 24V AC, centre pivot rocker action with pilot lights.

Acceptable Products:	Single switch:	Douglas #WR-8501 General Electric
	Triple switch, single gang:	Douglas #WR-8503 General Electric

16.4.062 Lighting Control Equipment - Low Voltage (Cont'd)

Low Voltage Relays:
(a) Electrically operated by momentary impulse, mechanically latched until activated.
(b) Two-coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
(c) Operating voltage: 24V AC, rectified AC.
(d) Load contacts: 20A, 347V AC.
(e) Auxiliary contacts for pilot light.
(f) Coloured pre-stripped leads.
(g) Base for mounting in relay panels.

Acceptable Products: Douglas #WR-5321, Relay 2WR-6621 Base
General Electric

Coverplates: Stainless steel 1mm-thick coverplates suitable for number of gangs and devices as required.

Acceptable Products: Douglas #WN7600 Series
Approved Equal

Control: Low voltage power Class 2, input 347V AC, 60Hz, output 40VA at 24V.

Acceptable Products: Douglas #WR-2600
General Electric

16.4.063 Lighting Control Equipment - Photoelectric

Related Work: Lighting equipment: Section 16.4.056.

Submit product data in accordance with Section 16.2.001.

Photoelectric Lighting Control:
(a) Wall mounting.
(b) Capable of switching 1500W of lighting at 120V.
(c) Voltage variation: ∀ 10%.
(d) Temperature range: -40EC to 70EC.
(e) Switching on lights at 12 lx.
(f) Switching off lights as 110 lx maximum.
(g) Rated for 5000 operations.
(h) Options:
  .1 Lightning arrester,
  .2 Fail-safe circuit complete when relay de-energized,
  .3 Twist-lock type double pole receptacle switch,
  .4 Terminal strip.
(i) Switching time delay of 30 s.
(j) Wall mounting bracket.
(k) Colour coded leads: size 10AWG 460mm long.

16.4.064 Lighting Control Equipment - Dimming - Incandescent

Submit product data in accordance with Section 16.2.001.

All materials to be CSA approved.

Commercial Dimmers: Commercial dimmers designed to control brightness of incandescent lamps up to 20KW, three phase and consisting of:
(a) Intensity control kit,
(b) Power sections,
(c) Solid-state control,
(d) Motorized control unit.

Intensity control kit:
(a) Portable control station with 8.0m of cord, complete with plug for connecting to power section.
(b) Solid-state circuitry.
(c) Intensity control station with positive ON-OFF switch, and each channel controlled individually or from the Master Intensity Slider.
(d) As a standard of quality, acceptable manufacturer: Prescolite #PATS3-10.

Power sections:
(a) Basic dimmer control.
(b) Single-pole, 15A, magnetic only circuit breakers to supply ten output circuits.
(c) Lamp debuzzing coil to eliminate lamp buzzing and radio frequency interference.
(d) Rated: 2000W at 120V, 60Hz as indicated.
(e) Enclosure to be vented, lockable and be complete with connector for plugging in intensity control kit.

Acceptable Manufacturers: Lightolier
Lutron
Prescolite

Wall Box Dimmer: Full-range dimmer designed to produce 0 to 100% brightness control by means of single slide and:
(a) Fit single-gang standard switch box.
(b) Advanced solid-state circuitry with silicon symmetrical switch.
(c) Two moving parts:
  .1 Single pole switch,
  .2 Long-life potentiometer.
(d) Push to turn ON or OFF without disturbing preselected brightness setting.
(e) Rated: 600W at 120V AC.
(f) Radio/TV interference filter.

Acceptable Manufacturers: Lightolier
Lutron
Prescolite #HT6

16.4.065 Time Clock

Submit product data in accordance with Section 16.2.001.

Electronic Time Clock
(a) Solid state digital timer, keyboard entry, digital LED readout.
(b) 7-day control and programming.
(c) Repeat programming feature.
(d) Astrodial.
(e) Manual override.
(f) Contacts rated 15A, 120V.
(g) Contacts independent of load switches.
(h) 100-hour battery carry over.
(i) CSA 1 enclosure.
(j) 120V, 60Hz.
(k) Manual ON-OFF-REVIEW-SET selector.

Acceptable Manufacturer: Tork
Paragon

16.4.066 Interval Timers

Submit product data in accordance with Section 16.2.001.

Interval Timers:
(a) 6-hour control dial.
(b) Dial graduations without hold.
(c) Contacts rated 20 amps nominal inductive load at 120V, 60Hz, AC.
(d) Spring wound timer.
(e) Flush mounting in single gang box.
(f) Ivory moulded urea case with black numerals on gold dials.
(g) Setting knob shall turn in either direction.

Acceptable Manufacturers: Intermatic, Series FF6H
Paragon
Tork

16.4.067 Time Controls

Submit product data in accordance with Section 16.2.001.

Electronic Programmable Time Clock:
(a) Solid state, programmable, digital timer, keypad entry, digital LCD readout.
(b) 7-individual-day programming capability with skip-a-day feature and 30 set points.
(c) One SPDT, 15A at 120V (resistive/ inductive) rated contact.
(d) Momentary contacts, adjustable from 1 - 59 seconds, assignable to any or all set points.
(e) 10-day battery carryover.
(f) Manual override toggled from keypad or automatically reset at next set point.
(g) Selectable 12 or 24-hour clock format.
(h) DIN enclosure.
(i) Input voltage - 120V, 60Hz.

16.4.068 Surge Suppression

Submit product data in accordance with Section 16.2.001.

Spare Parts

Provide one spare module.

Materials

All materials to be CSA approved.

Parallel across-the-line module design, staged transient voltage surge suppression circuitry.

Diagnostic LED in each module indicating module is active and functioning properly.

IEEE C62.41 Category A & B suppression response.

UL Standard 1449 Transient Voltage Surge Suppressors c/w three modules.

Removable single phase direct plug-in transient voltage surge suppression module design.

EMI/RFI Noise Filtering.
CSA 1 enclosure.

Acceptable Products: Leviton #52120/M3
Approved Equal

16.4.069 Power Generation Diesel

Related Work: Concrete housekeeping pads: to Division 23.

Description of System

Generator set consists of:
(a) Diesel engine;
(b) Alternator;
(c) Alternator control panel & wiring;
(d) Battery charger and battery;
(e) Fuel supply system;
(f) Exhaust system;
(g) Structural steel mounting base c/w vibration isolation and fuel tank;
(h) Block heater;
(i) Metal duct and flexible duct;
(j) Remote generator panel and generator exerciser.

Set designed to operate as emergency standby unattended.

Walk-in enclosure c/w accessories.

16.4.069 Power Generation Diesel (Cont'd)

Shop Drawings

Submit eight (8) copies of shop drawings.

Include:

(a) Engine: make and model, with performance curves;
(b) Alternator: make and model;
(c) Voltage regulator: make, model and type;
(d) Battery: make, type and capacity;
(e) Battery charger: make, type and model;
(f) Alternator control panel: make and type of meters and controls;
(g) Governor type and model;
(h) Cooling air requirements in cubic meters/s;
(i) British standard or DIN rating of engine;
(j) Flow diagrams for:
    .1 Diesel fuel;
    .2 Lubricating oil;
    .3 Cooling air;
(k) Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays and total weight, base fuel tank;
(l) Remote generator panel and generator exerciser.
(m) Dimensions and structural specifications of engine-generator foundation;
(n) Continuous full load output of set at 0.8pf lagging;
(o) Description of set operation including:
    .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency;
    .2 Manual starting;
    .3 Automatic shut-down on:
        (a) Overcranking;
        (b) Overspeed;
        (c) High engine temperature;
        (d) Low lube oil pressure;
        (e) Short circuit;
        (f) Alternator overvoltage;
        (g) Lube oil high temperature;
(p) Walk-in enclosure c/w accessories.

16.4.069 Power Generation Diesel (Cont'd)

Operation and Maintenance Data

Provide data for incorporation into maintenance manual.

Operation and Maintenance Manual to include instructions for particular unit supplied and not general description of units manufactured by supplier and:

(a) Operation and maintenance instructions for engine, alternator, control panel, battery charger, battery, remote generator panel, exerciser, fuel system, exhaust system and accessories, to permit effective operation, maintenance and repair.
(b) Clearly indicate manufacturer's suggested routine maintenance schedule.
(c) Technical data:
    .1 Illustrated parts lists with parts catalogue numbers;
    .2 Schematic diagram of electrical controls;
    .3 Flow diagrams for:
        (a) Fuel system;
        (b) Lubricating oil;
        (c) Cooling system;
(d) Certified copy of factory test results.

Maintenance Materials

Provide maintenance materials in unbroken cartons or strongly packaged. Identify contents.

Include:

(a) 6 fuel filter replacement elements;
(b) 6 lube oil filter replacement elements;
(c) 6 air cleaner filter elements;
(d) 2 sets of fuses for control panel;
(e) Necessary special tools for unit servicing as recommended by the manufacturer.

Field Quality Control

Field test generator set including control, engine, alternator, control panels, transfer switch, remote generator panel, exerciser and accessories.

Test procedure:

(a) Prepare blank forms and check sheet with spaces to record data. At top of first sheet, record:
    .1 Date;
    .2 Generator set serial number;
    .3 Engine, make, model, serial number;
    .4 Alternator, make, model, serial number;
    .5 Voltage regulator, make and model;
    .6 Rating of generator set, kW, kVa, V, A, r/min, Hz;
    .7 Name of test technician.
(b) Mark check sheet and record data on forms in duplicate as test proceeds.

16.4.069 Power Generation Diesel (Cont'd)

(c) Tests:
.1 With 100%-rated load bank provided by generator supplier, operate set for 6 hours, taking readings at 30 minute intervals, and record following:
(a) Time of reading;
(b) Running time;
(c) Ambient temperature in degrees C;
(d) Lube oil pressure in kPa;
(e) Lube oil temperature in degrees C;
(f) Engine coolant temperature in degrees C;
(g) Exhaust stack temperatures in degrees C;
(h) Alternator voltage, phases 1, 2 and 3;
(i) Alternator current, phases 1, 2 and 3;
(j) Power in kW;
(k) Frequency in Hz;
(l) Power factor;
(m) Battery charger current in A;
(n) Battery voltage;
(o) Alternator stator temperature in degrees C.

Continue above tests for and additional 6 hours under normal building load.

After completion of 12-hour run, demonstrate following shut-down devices and alarms.
(a) Overcranking;
(b) Overspeed;
(c) High engine temperature;
(d) Low lube oil pressure;
(e) Short circuit;
(f) Alternator overvoltage;
(g) Low battery voltage, or no battery charge.

Verify:
(a) Automatic starting of set and automatic transfer of load on failure of normal power;
(b) Automatic shut-down of engine on resumption of normal power;
(c) That battery charger reverts to high rate charge after cranking.
(d) Operation of remote generator panel and exerciser.

Verify low oil pressure and high engine temperature shut-downs without subjecting engine to these excesses.

Forward copy of test report to Engineer for review.

Guarantee

Provide a written guarantee, signed and issued in the name of the Owner stating that the generating set is guaranteed against defects in material and workmanship for a period of two years, or 600 operating hours, whichever occurs first, from the date of the Final Certificate of Completion.

Forward a copy of guarantee to Engineer.

16.4.069 Power Generation Diesel (Cont'd)

Engine

Diesel engine: to ISO 30465/1 - 1981.

Engine: standard product of current manufacture, from company regularly engaged in production of such equipment.

Four-cycle, turbo charged, and aftercooled, synchronous speed, 1800 r/min.

Capacity: Rated continuous power in kW at 1800 r/min., after adjustment for power losses in auxiliary equipment necessary for engine operation, to be calculated as follows:

Rated Continuous Output = Generator kW / Generator Eff @ FL

under following site conditions:

(a) 10m above sea level
(b) Ambient temp. 40°C
(c) Relative humidity 60%

Engine overload capability 110% of continuous output for 1 hour within 12 hour period of continuous operation.

Cooling system:

(a) Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side. Thermostatically controlled, with ethylene glycol anti-freeze non-sludging above -46EC.
(b) To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 38EC.
(c) Block heater: 120V AC thermostatically controlled lube oil or liquid coolant heater connected to line side of automatic transfer switch to allow engine to start in room ambient 0EC.
(d) Metal duct and flexible duct from intake louvre to radiator, size as indicated.

Fuel: No. 2 diesel.

Fuel system: solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.

Governor: electronic type.

Lubrication system:

(a) Pressure lubricated by engine driven pump;
(b) Lube oil filter;
(c) Lube oil cooler;
(d) Engine sump drain valve.

16.4.069 Power Generation Diesel (Cont'd)

Starting system:
(a) Positive shift, gear engaging starter 12V DC;
(b) Current limited during engine cranking and short circuit conditions;
(c) Cranking limiter to provide 3 cranking periods of 10 s duration, each separated by 5 s rest;
(d) Lead acid, 12V storage battery with sufficient capacity to crank engine for 3 min. at 0EC without using more than 25% of ampere hour capacity;
(e) Battery charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: ±1% output for ±10% input variation. Automatic boost for 6 hours every 30 d. Equipped with DC voltmeter, DC ammeter and ON-OFF switch.

Shock mounted engine instrument panel with:
(a) Lube oil pressure gauge;
(b) Lube oil temperature gauge;
(c) Coolant temperature gauge;
(d) Running time meter.

Guards to protect personnel from hot and moving parts.

Drip tray.

Materials:
(a) Cylinder head material: cast iron.
(b) Crankshaft material: forge steel.

Alternator

Alternator: to NEMA MG1.

Rating: as indicated on the drawings, 60Hz, at 0.8pf.

Revolving field, brushless, single bearing.

Drip proof.

Amortisseur windings.

Synchronous type.

Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.

Exciter: permanent magnet.

EEMAC Class F insulation on rotor.

Voltage regulator: solid state, silicon controlled rectifiers with phase controlled sensing circuit:
(a) Regulation ± 3% no load to full load.
(b) Steady state regulation ± 1%.

Output at 40°C ambient: 100% full load continuously.

16.4.069 Power Generation Diesel (Cont'd)

Control Panel

Totally enclosed, mounted on generator.

Panel door with formed edges and lockable handle with 2 keys.

Flexible conductors between door and fixed panel.

Instruments:

(a) Digital indicating type 2% accuracy, rectangular scale, flush panel mounting:
  .1 Voltmeter: AC, scale 0 to 250V;
  .2 Ammeter: AC, scale 0 to 600A;
  .3 Frequency meter: scale 55 to 65Hz.

(b) Voltmeter selector switch, rotary, panel mounting, four-position labeled "OFF- Phase A - Phase B - Phase C".

(c) Ammeter selector switch, rotary, maintained contacts, panel mounting, designed to prevent opening of current circuits, four-position labeled "OFF - Phase A - Phase B - Phase C".

(d) Fuses for indicating instruments: miniature, glass, fast acting, fitted at rear of instrument.

(e) Full standard electronic display of engine and alternator monitoring function, including control and monitoring systems so that alarm can be accurately sent to Owner=s monitoring company to call maintenance staff.

(f) One N/O run indicating contact rated 120V AC.

(g) Alternator output breaker:
  .1 Circuit breaker: bolt-on for 40°C ambient, dual thermal-magnetic trip, 800A, 3P, 100% rated;
  .2 Automatic shut-down and alarms:
  .1 Engine overcrank;
  .2 Engine overspeed;
  .3 Engine high temperature;
  .4 Engine - low lube oil pressure;
  .5 Low battery voltage, or no battery voltage continuously monitored even when engine not running. Auto rest alarm;
  .6 Alternator overvoltage, undervoltage;
  .7 Devices: manually reset, momentarily energized, solenoid operated and 2 sets of NC/NO contacts wired to a terminal block for future connection.

16.4.069 Power Generation Diesel (Cont'd)

Panel to annunciate the following:

Lamp Legend	Generator Set Condition Indicated	Light	Audible Alarm
High Battery Voltage	Battery charger too high	Red	No
Low Battery Voltage	Battery voltage too low	Red	No
Normal Battery Voltage	Battery voltage ok	Green	No
Generator Running	Generator has output voltage	Green	No
Normal Utility Power	Utility power supplying the load	Green	No
EPS Supplying Load	Genset supplying the load	Green	No
Pre-Low Oil Pressure	Oil pressure approaching low limit	Yellow	Yes
Low Oil Pressure	Engine has shut down due to low oil pressure	Red	Yes
Pre-High Coolant Temp.	Temperature of coolant approaching high limit	Yellow	Yes
High Coolant Temp.	Genset has shut down due to high coolant temp	Red	Yes
Low Engine Temp.	Engine heater has malfunctioned	Red	Yes
Overspeed	Engine has shut down due to overspeed	Red	Yes
Overcrank	Engine failed to start	Red	Yes
Not in Auto	Engine control switch not in AUTO position	Flashing Red	Yes
Battery Charger Malfunction	Charger is signaling a failure	Red	Yes
Low Fuel	Fuel level below preset minimum	Red	Yes
Fault	Customer preselected condition	Red	Yes

In addition the following items shall be monitored:

(a) High temperature in generator enclosure measured by temperature monitor in enclosure under this Contract.
(b) Generator run time from last start-up.

Controls shall include a relay output card to supply the following alarms, to the City's SCADA system:

(a) Engine Overcrank;
(b) Engine Overspeed;
(c) High Coolant Temperature;
(d) Low Oil Pressure
(e) Diesel Auto; and
(f) Diesel Run

Structural Steel Mounting Base

Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.

16.4.069 Power Generation Diesel (Cont'd)

Assembly fitted with vibration isolators and control console resiliently mounted. Spring-type isolators with adjustable side snubbers.

Exhaust System

Heavy-duty, critical type, horizontally mounted exhaust silencer with condensate drain, plug and flanged couplings, supplied with generating set.

Suitable length of heavy duty flexible exhaust hose with flanged couplings for connection from engine to exhaust system.

Fittings and accessories as required.

Expansion joints: stainless steel,
corrugated to absorb both vertical and horizontal expansion.

Exhaust system from muffler to outside c/w weatherproof cap, insulated thimble, etc.

Fuel System

Copper feed and return lines. Provide flexible termination at engine.

Shut-off cock.

Renewable cartridge filter.

Fill and vent lines from tank to exterior of building fitted with weatherheads.

Fuel level gauge, float switch and remote low level alarm contacts.

Tank drain and end plug.

700-gallon, double-wall, sub-base fuel tank and integral positioned placement pump sized to allow continuous unit operation for 12 h.

Equipment Identification

Provide equipment identification - Control panel:
(a) Lamicoid nameplates with 8mm high letters for controls such as alternator breakers and program selector switch.
(b) Lamicoid nameplates with 5mm high letters for meters, alarms, indicating lights and minor controls.

Cooling Air System

Engine ventilation system:
(a) Recirculating insulated damper assembly with modulating motor.
(b) Cold air insulated inlet damper assembly with modulating motor.
(c) Air discharge and intake gooseneck weatherheads.
(d) Modulating thermostat.
(e) Replaceable air intake filters (provide two spare each type).

All dampers shall be set for quick opening not quick closing.

16.4.069 Power Generation Diesel (Cont'd)

Fabrication

Shop assemble generating unit including:
(a) Sub-base fuel tank;
(b) Engine and radiator;
(c) Alternator;
(d) Control panel;
(e) Battery and charger.

Walk-in Enclosure (for exterior installations)

Walk-in enclosure to be constructed with galvanized steel frame and side panels (4000mm W x 8700mm L x 4403mm H). Layout of enclosure, diesel generator, associated equipment and concrete pad is based on equipment sizes provided by listed equipment suppliers. Other equipment sizes that increase enclosure and pad sizes are the contractor=s responsibility to include in his tender price.

Motorized intake and exhaust insulated louvres controlled by reverse acting thermostat in enclosure spaces.

DC lighting with batteries and charger.

Standby diesel generator c/w structural bolting to floor of enclosure.

Interior insulation for -30°C operation and noise attenuation.

Air discharge hood for additional noise enclosure attenuation.
Dual wall 700-gallon sub-base fuel tank.

Interior wiring for and supply of 120/208V, 3 ¯, 4W lights, heater (5kW) and receptacles and 12-circuit, 100A load center complete with 60A main breaker and required breakers. 15kVA step down transformer and 60A fused disconnect.

Wiring of generator set to building switchgear feeders.

Automatic oil make-up system.

Fire extinguishing system.

Galvanized steel service and entrance doorways complete with galvanized steel frames, triple hinges, dead-bolt locks and double insulation around all sides of doors to prevent wind driven rain from entering.

Exercise clock for generator and
programming transition.

Sleeved openings for incoming/outgoing ducts welded to enclosure to create oil spill reservoir.

16.4.069 Power Generation Diesel (Cont'd)

Copper grounding bus.

Pull box for fire alarm and security system.

Floor, side walls, door and duct sleeves to be raised so that enclosure will contain 700 gal. of fuel in the event of oil spill.

Provide three (3) sets of ear protection headsets.

Acceptable Manufacturers: Caterpillar
Kohler Power Systems
Onan/Cummings

16.4.070 Automatic Load Transfer Equipment

Design Criteria

Automatic isolation bypass load transfer equipment to:
(a) Monitor and synchronize voltage of normal and emergency power supply;
(b) Initiate cranking of standby generator;
(c) Transfer load from normal supply to standby unit when standby unit reaches rated speed and voltage;
(d) Transfer load from standby unit to normal power supply when normal power restored;
(e) Shut down standby unit after adjustable time delay;
(f) Be equipped with bypass isolation;
(g) Be equipped with remote manual transfer capability;
(h) Include contact for SCADA monitoring of emergency power.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Include:
(a) Make, model and type;
(b) Load classification:
  .1 Restricted use: resistance and general load, 0.8 pf or higher;
(c) Single line diagram showing controls and relays;
(d) Description of equipment operation including:
  .1 Automatic starting and transfer to standby unit and back to normal power;
  .2 Test control;
  .3 Manual control;
  .4 Automatic shutdown.

Operation and Maintenance Data

Provide data for incorporation into maintenance manual.

Detailed instructions to permit effective operation, maintenance and repair.

16.4.70 Automatic Load Transfer Equipment (Cont'd)

Technical data:

(a) Schematic diagram of components; controls and relays;
(b) Illustrated parts lists with parts catalogue numbers;
(c) Certified copy of factory test results.

Source Quality Control

Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.

Tests:

(a) Operate equipment both mechanically and electrically to ensure proper performance.
(b) Check Generator Control Panel selector switch, in 4 positions (Test, Auto, Manual, Engine Start) and record results.
(c) Check voltage sensing and time delay relay settings.

Check:

(a) Automatic starting and transfer of load on failure of normal power;
(b) Retransfer of load when normal power supply resumed;
(c) Automatic shutdown.

Forward copy of all test reports to Engineer for review.

Contactor Type Transfer Equipment

Two three-phase contactors in double throw arrangement, mechanically and electrically interlocked, solenoid operated, with CSA 1 gasketted enclosure. (914mm W x 1067mm D x 337mm H, painted steel)

Rated: as indicated on the drawings.

Main contacts: silver surfaced, protected by arc disruption means including separate arcing contacts.

Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

Auxiliary contact: to initiate emergency generator start-up on failure of normal power.

Fault withstand rating: standard.

Bypass isolation: Bypass isolation to allow the transfer switch and other parts of the emergency system to be inspected, tested and maintained without load interruption. During this time, the load can be supplied from either the normal or emergency services.

Controls

Control transformers: dry type with 120V secondary to isolate control circuits from:

16.4.070 Automatic Load Transfer Equipment (Cont'd)

(a) Normal power supply;
(b) Emergency power supply.

Solid-state monitors: continuous duty, industrial type.
(a) Voltage sensing, one per phase, solid-state type adjustable drop-out and pick-up, close differential, 2V minimum, undervoltage and overvoltage protection;
(b) Time delay, normal power to standby, adjustable 0 s to 480 s, no delay on engine start;
(c) Time delay on engine starting to override momentary power outages or dips, adjustable calibrated 0.5 to 6s;
(d) Time delay on engine starting, adjustable from 0 to 5 minutes;
(e) Time delay to override momentary normal source outages to delay all transfer, adjustable from 0.5 to 6s;
(f) Time delay on retransfer from standby to normal power, adjustable from 0 to 30 minutes;
(g) Time delay on engine cool-down period, 5 minutes minimum.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Control panel:
(a) For meters, indicating lights, minor controls, size 3 nameplates.

Acceptable Manufacturer: Ascolectric Ltd.
Onan
Kohler

Fabrication

Shop assemble transfer equipment including:
(a) Mounting base and enclosure.
(b) Transfer switch and operating mechanism.
(c) Control transformers and relays.
(d) Accessories.

16.4.071 Fire Detection & Alarm System

Related Work

Fire pump and controller: Division 15.

Sprinkler systems: Division 15.

Dry chemical: Division 15.

Standpipe and hose systems: Division 15.

Automatic door release Division 15

16.4.071 Fire Detection & Alarm System (Cont'd)

References

CAN/ULC-S524, Installation of Fire Alarm Systems.

ULC-S525, Audible Signal Appliances for Fire Alarm Systems.

CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.

CAN/ULC-S527, Control Units, Fire Alarm.

CAN/ULC-S528, Manual Pull Stations.

CAN/ULC-S529, Smoke Detectors, Fire Alarm.

CAN/ULC-S530, Heat Actuated Fire Detectors, Fire Alarm.

CAN/ULC-S531, Smoke Alarms.

CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.

CAN/ULC-S537, Verification of Fire Alarm Systems.

NBC, National Building Code of Canada.

Description of System

System includes:
(a) Microprocessor-based, site-programmable control panel to carry out fire alarm and protection functions, including receiving alarm signals, initiating alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
(b) Trouble signal devices.
(c) Power supply facilities.
(d) Manual alarm stations.
(e) Automatic alarm initiating devices.
(f) Audible signal devices.
(g) End-of-line devices.
(h) Annunciators.
(i) Visual alarm signal devices.
(j) Ancillary devices.

Requirements of Regulatory Agencies

System:
(a) To the National Building Code.
(b) Subject to Provincial Fire Marshall's approval.

16.4.071 Fire Detection & Alarm System (Cont'd)

Shop Drawings

Submit shop drawings in accordance with Division 7.

Include:
(a) Layout of equipment;
(b) Zoning;
(c) Complete wiring diagram, including schematics of modules.

Operation & Maintenance Data

Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Division 7.

Include:
(a) Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance;
(b) Technical data - illustrated parts lists with parts catalogue numbers;
(c) Copy of approved shop drawings;
(d) List of recommended spare parts for system;
(e) Copy of system verification;
(f) Copy of system certification.

Maintenance Materials

Provide maintenance materials in accordance with Division 7.

Include: Ten (10) spare glass rods for manual pull box stations.

Maintenance

Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Owner.

Training

Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

Materials

Equipment and devices: ULC listed and labeled and supplied by single manufacturer.

Power supply: to CAN/ULC-S524.

Audible signal devices: to ULC-S525.

Visual signal devices: to CAN/ULC-S526.

Control unit: to CAN/ULC-S527.

16.4.071 Fire Detection & Alarm System (Cont'd)

Manual pull stations: to CAN/ULC-S528.

Thermal detectors: to CAN/ULC-S530.

Smoke detectors: to CAN/ULC-S529.

Smoke alarms: to CAN/ULC-S531.

System Operation

Single-stage operation. Operation of any alarm initiating device to:
(a) Cause signal devices to operate throughout building;
(b) Transmit signal to remote station via building auto dialer;
(c) Display zone of alarm device on control panel;
(d) Cause air conditioning and ventilating fans to shut down;
(e) Cause fire and smoke control doors to close automatically if normally held open.

Operation of any supervisory initiating device to:
(a) Cause internal signal to sound at the control panel;
(b) Display zone of initiating device on control panel annunciator;
(c) Display the restoral of any supervisory initiating device.

Capability to program smoke detector status change confirmation on any or all zones in accordance with CAN/ULC-S527, Appendix C.

Control Panel

Class B.

Single-stage operation.

Zoned, non-coded.

Enclosure: CSA Enclosure 1, complete with lockable concealed hinged door, full viewing window, flush lock and two keys.

Supervised programmable modular control panel designed with plug-in modules:
(a) Alarm receiver with trouble and alarm indications, provision for remote supervised annunciation for Class B initiating circuit;
(b) Spare zones: compatible with smoke detectors and open circuit devices;
(c) Space for future modules;
(d) Latching-type supervisory receiver circuits; discrete indication for both off-normal and trouble.

16.4.071 Fire Detection & Alarm System (Cont'd)

Components:

(a) Programmable alarm receiver panel with trouble and alarm indications for Class B initiating circuit;
(b) Audible signal control circuits complete with terminals for wiring and plug-in modules for DC signals up to 2.0A load with trouble indication with Class B connections;
(c) Common control and power units:
    .1 Control panel containing following indications and controls:
    .1 "POWER ON" LED to monitor primary source of power to system;
    .2 "POWER TROUBLE" indication;
    .3 "GROUND TROUBLE" indication;
    .4 "REMOTE ANNUNCIATOR TROUBLE" indication;
    .5 "SYSTEM TROUBLE" indication;
    .6 "SYSTEM TROUBLE" buzzer and silence switch complete with trouble resound feature;
    .7 System reset switch;
    .8 "LED TEST" switch;
    .9 "ALARM SILENCE" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound;
    .10 "SIGNALS SILENCED" indication.
(b) Master power supply panel to provide 24V DC to system from 120V AC, 60Hz input.
(c) Fire Department connections:
    .1 Plug-in module for municipal box;
    .2 Fire Department bypass switch complete with indicator for trouble at panel.
(d) Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and complete with individual bypass switch.
    .1 Contacts: 2.0A, 120V AC, for functions such as release of door holders or initiation of fan shut-down.
    .2 Contact terminal size: capable of accepting 22-12AWG wire.

Power Supply

120V AC, 60Hz input, 24V DC output from rectifier to operate alarm and signal circuits, with standby power of gell cell batteries minimum expected life of four years, sized in accordance with NBC.

Manual Alarm Stations

Manual alarm stations: pull lever, glass rod, wall mounted semi-flush type, non-coded single pole normally open contact for single stage, bilingual signage.

Automatic Alarm Initiating Devices

Heat detectors, fixed temperature, non-restorable, rated 88°C.

Thermal fire detectors, combination fixed temperature and rate-of-rise, non-restorable fixed temperature element, self-restoring rate-of-rise, fixed temperature 57°C, rate-of-rise 8.3°C per minute.

16.4.071 Fire Detection & Alarm System (Cont'd)

Smoke detector - ionization-type:
(a) Twistlock plug-in type with fixed base;
(b) Wire-in base assembly with integral red alarm LED and terminals for remote relay or alarm LED;
(c) Air duct type with sampling tubes with protective duct mount enclosure as indicated.

Audible Signal Devices

Horns: 92dB, semi-recessed mounting, 24V DC complete with integral flashing strobe light.

End-of-line Devices

End-of-line devices to control supervisory current in alarm and signaling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel.

Graphic Display

Provide fire alarm acrylic silk screened graphic display indicating zoning of building in glazed frame adjacent to the fire alarm control panel.

Minimum framed size: 600mm x 600mm.

Visual Alarm Signal Devices

Strobe type: flashing, 24V DC, 4–5 candela.

Designed for surface mounting on interior signaling horns or surface on walls as indicated.

Complete with "FIRE" markings on white lexan lens.

As-Built Riser Diagram

Fire alarm system riser diagram: in glazed frame, minimum size 600mm x 600mm.

Ancillary Devices

Remote relay unit to initiate fan shut-down.

16.4.072 Multiplex Fire Alarm System

Description of System

Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital and multiplexing techniques for data transmission.

System to carry out fire alarm and protection functions; including receiving alarm signals; initiating two-stage alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signaling to monitoring agency.

Zoned, non-coded, two-stage.

Modular in design to allow for future expansion.

System to include:
(a) Central Control Unit in separate enclosure with power supply, standby batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display and program control/signaling,
(b) Power supplies,
(c) Initiating/input circuits,
(d) Output circuits,
(e) Auxiliary circuits,
(f) Wiring,
(g) Manual and automatic initiating devices,
(h) Audible and visual signaling devices,
(i) End-of-line resistors,
(j) Local and remote annunciators,
(k) Historic event recorder.

Requirements of Regulatory Agencies

System:
(a) Subject to Fire Commissioner of Canada (FC) approval.
(b) Subject to FC inspection for final acceptance.

System components: listed by ULC and comply with applicable provisions of National Building Code and meet requirements of local authority having jurisdiction.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Operation & Maintenance Data

Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 16.2.001.

16.4.072 Multiplex Fire Alarm System (Cont'd)

Maintenance

Provide maintenance materials in Materials accordance with Section 16.2.001.

Include:
(a) Ten (10) spare glass rods for manual pull box stations, if applicable.

Provide one year's free maintenance with two inspections by manufacturer during year. Inspection tests to conform to ULC-S536. Submit inspection report to Owner.

Training

Provide minimum of three days of on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

Materials

Equipment and devices: ULC listed and labeled and supplied by single manufacturer.

Power supply: to CAN/ULC-S524.

Audible signal devices: to ULC-S525.

Control unit: to CAN/ULC-S527.

Manual fire alarm stations: to ULC-S528.

Thermal detectors: to ULC-S530.

Smoke alarms: to CAN/ULC-S531.

System Operation: Two-Stage - Signals Only

Actuation of any alarm initiating device on first stage to:
(a) Cause electronic latch to lock in alarm state at central control unit,
(b) Indicate zone of alarm at central control unit and at remote annunciator.
(c) Cause audible devices throughout building to sound at 20 strokes per minute.
(d) Cause audible devices in zone of alarm to sound continuously while other audible devices throughout building sound at 20 strokes per minute.
(e) Transmit signal to fire department via central station.
(f) Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.
(g) Cause fire doors and smoke control doors, if normally held open, to close automatically.

Actuation of any alarm initiating device on second stage to cause audible signaling devices to sound in alarm tone throughout building.

16.4.072 Multiplex Fire Alarm System (Cont'd)

If first-stage alarm is not acknowledged within five (5) minutes, system to automatically go into second stage.

Acknowledging alarm indicated at central control unit.

Possible to silence signals by "alarm silence" switch at central control unit, after 60-second period of operation.

Subsequent alarm, received after previous alarm has been silenced, to reactivate signals.

Actuation of any supervisory device to:
(a) Cause electronic latch to lock in supervisory state at central control unit,
(b) Indicate respective supervisory zone at central control unit and remote annunciator,
(c) Cause audible signal at central control unit to sound,
(d) Activate common supervisory sequence.

Resetting alarm supervisory device to return system indications/functions back to normal.

Trouble on system to:
(a) Indicate circuit in trouble at central control unit.
(b) Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; visual indication to remain until trouble is cleared and system is back to normal.

Trouble on system suppressed during course of alarm.

Trouble condition on any circuit in system not to initiate alarm conditions.

Control Panel

Central Control Unit (CCU):
(a) Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
(b) Minimum capacity of 500 addressable monitoring and 500 addressable control/signal points. Points may be divided between two (2) communications channels in distributed system, each channel operation independently of other. Faults on one communications channel not to affect operation of other channel.
(c) System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.
(d) Integral power supply, battery charger and standby batteries.
(e) Basic life safety software: retained in non-volatile Erasable Programmable Read Only Memory (EPROM). Extra memory chips: easily field installed. Random Access Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions; e.g., zone labels, priorities and changing of system operation software.

16.4.072 Multiplex Fire Alarm System (Cont'd)

(f) Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.
(g) Communications between CCU and remote central station to be supervised (Class A). Should communications fail between CCU and central station, audible and visual trouble to be indicated at central station. Data communications to be binary DC, baseband, time-division multiplex, half-duplex. Each data channel capable of communicating up to distance of 3000 metres.
(h) Support up to four RS-232-C I/O ports. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.
(i) Equipped with software routines to provide Event Initiated Programs (EIP); change in status of one or more monitor points may be programmed to operate any, or all, of system's control points.
(j) Software and hardware to maintain time of day, day of week, day of month, month and year.
(k) 80-character LCD display with scrolling events recorder.

Power Supplies

120V, 60Hz as primary source of power for system.

Voltage regulated, current limited distributed system power.

Primary power failure will activate common trouble sequence.

Interface with battery charger and battery to provide un-interruptible transfer of power to standby source during power failure.

During normal operating conditions, a fault in the battery charging circuit is to activate standby power trouble indicator.

Standby batteries: sealed, maintenance free.

Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

Initiating/ Input Circuits

Receiving circuits for alarm-initiating devices wired in Class A configuration to central control unit.

Alarm receiving circuits compatible with smoke detectors and open contact devices.

Receiving circuits for supervisory, N/O devices wired in Class A configuration to central control unit.

16.4.072 Multiplex Fire Alarm System (Cont'd)

Alarm Output Circuits

Alarm output circuit is connected to signals, wired in Class A configuration to central control unit.

(a) Signal circuits operation to follow system programming, capable of sounding horns continuously at 20spm. Each signal circuit is rated at 2A, 24V DC and is fuse protected from overloading/overcurrent.
(b) Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

Auxiliary Circuits

Auxiliary contacts for control functions.

Actual status indication (positive feedback) from controlled device.

Alarm and supervisory trouble on system to cause operation of programmed auxiliary output circuits.

Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.

Fans are stagger-started upon system reset. Timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system. Timing circuit is controlled by CCU.

Auxiliary circuits are rated at 2A, 24V DC or 120V AC and are fuse protected.

Wiring

Twisted copper conductors shall be rated at 300V.

Wiring to initiating circuits is #18AWG minimum, and is in accordance with manufacturer's requirements.

Wiring to signal circuits is #16AWG minimum and is in accordance with manufacturer's requirements.

Wiring to control circuits is #14AWG minimum and is in accordance with manufacturer's requirements.

Manual Alarm Stations

Addressable manual pull station:

(a) Pull-lever, break-glass rod, semi-flush, wall-mounted type, single action, two-stage (key-operated). Electronics to communicate station's status to CCU over two (2) wires and to supply power to station.
(b) Back box to accommodate pull station and relay.

16.4.072 Multiplex Fire Alarm System (Cont'd)

Automatic Alarm Initiating Devices

Smoke detector: ionization air duct type with sampling tubes with protective housing:
(a) Twistlock type with fixed base.
(b) Wire-in base assembly with integral red alarm LED and terminals for remote relay.

Addressable smoke detector:
(a) Ionization type.
(b) Electronics to communicate detector's status to addressable module/ transponder.
(c) Detector address to be set on detector base in field.

Audible/Visual Signal Devices

Electronic horn/strobe with high intensity horn (90dB) and low intensity strobe (4.7 candela) with "FIRE' markings on white lexan strobe lens.

Overall red lexan cover, complete with recessed back box.

Horns capable of two-stage program annunciation.

Exterior horns without strobes to be weatherproof, complete with recessed weatherproof back box.

Visual Alarm Signal Devices

Strobe type: flashing, white, 24V DC.

Designed for surface mounting on recessed outlet box in ceilings or walls.

Remote Annunciators

LED type, with designation cards to indicate zones.

Display:
(a) Alarms and trouble for alarm initiating circuits.
(b) Common supervisory alarm for supervisory initiating circuits.
(c) Common system trouble.

Trouble buzzer: Acknowledging trouble at main panel to silence trouble buzzers in system.

Supervised, with LED test button and alarm trouble acknowledge button.

Graphic Display

Passive graphic display to be provided indicating building layout and identifying zone locations. Graphic to be silk screened aluminum and installed in glazed frame, size as required.

16.4.072 Multiplex Fire Alarm System (Cont'd)

As-Built Riser Diagram

Fire alarm system riser diagram to be in glazed frame, minimum size 600mm x 600mm.

Ancillary Devices

Remote relay unit to initiate fan shut-down.

16.4.073 Communications Intrusion Alarm

System to consist of empty conduits for an alarm system by Owner.

Conduits: Empty conduits complete with fish rope to Section 16.4.007.

Outlet Boxes: Outlet boxes to Section 16.4.017.

Cabinets, Pull Boxes: Cabinet and pull boxes to Section 16.4.016.

16.4.074 Building Entrance Control System

Description of System

Building entrance control system:
(a) Caller pushes button on building entrance panel to sound tone signal in suite.
(b) Occupant may operate talk-listen switch to converse with caller.
(c) Occupant may operate switch to release building entrance door magnetic lock to admit caller.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Include riser diagram and block diagram of complete system.

Maintenance and Operation Data

Provide data for incorporation into maintenance manual specified in Section 16.2.001.

Include description of system operation.

Include parts list, using component identification numbers standard to electronics industry.

Maintenance Materials

Provide maintenance materials as recommended by the manufacturer.

Building Entrance Panel

16.4.074 Building Entrance Control System (Cont'd)

Control and communication panel at building entrance location as indicated.
(a) Enclosed flush mounting.
(b) Solid aluminum pushbuttons, engraved nameplates behind vandalproof transparent cover, quantity engraving as indicated.
(c) Buzzer.
(d) Door opener, buzzing.
(e) Adjustable volume control.
(f) Solid state controls.
(g) Power supply: input 120V, output 24V.
(h) Amplifier.
(i) Speaker/microphone: 90mm dia. Min.
(j) Panel finish: clear, brushed aluminum.

Acceptable Product: Mirtone Modular AG@ Series
Approved Equal

Door Opener

Magnetic door opener front for controlled building entrance doors, reversible for left of right hand doors. Materials: compatible with door load.

Suite Stations

Suite stations, as indicated:
(a) Enclosed, flush mounted.
(b) High impact plastic material, finish colour beige.
(c) Talk-listen switch.
(d) Tone buzzer.
(e) Speaker/microphone: 90mm dia. min.
(f) Matching backbox for flush mounting.

Acceptable Product: Mirtone IS-401 c/w IB-2A
Approved Equal

Additional Features

Post office lock door operation.

Communications Conductors

Multi-conductor, 22-gauge cable twisted pairs with PVC overall jacket.

16.4.075 Door Bells/Chimes System

Delivery bell: Adaptabell, 150mm diameter, 24V AC vibrating, 92dB at 3m, ULC listed.

Acceptable Products: Edwards #340-6G5; Approved Equal

"RING FOR SERVICE" chime: 24V AC, 81dB at 3m, ULC listed.

Acceptable Products: Edwards #338-G5; Approved Equal

Delivery pushbuttons: weatherproof, low voltage, solid brass finish, surface mounted.

Acceptable Products: Edwards #1786C; Approved Equal

"RING FOR SERVICE" pushbutton: low voltage, solid brass finish, surface mounted.

Acceptable Products: Edwards #600; Approved Equal

Exterior door alarm: low voltage, contact open when door is closed, door contactor recessed mounted.

Acceptable Products: Edwards Series S601; Approved Equal

Class II transformers, 24V, secondary, 120V, 60Hz primary, flush mounting, CSA listed, thermal protected.

Type LVT low voltage wiring.

16.4.076 Intrusion Alarm

Description of System

System to consist of alarm control panel, programming keypad, microwave intrusion detectors, and keypad arming stations.

Care, Operation and Start-Up

Refer to Section 16.2.001 and provide technical personnel to check, adjust, balance and calibrate components.

Program system to Owner’s requirements.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

General

Complete intrusion alarm system made up of components as indicated.

16.4.076 Intrusion Alarm (Cont'd)

Control Panel

Master control panel flush mounted, modular design providing:
(a) Power: Primary 120V, 1 ¯, secondary 16V AC (40 VA).
(b) Standby power: 12V, 2.6 AH gell cell battery c/w charger.
(c) 16-programmable, supervised zones.
(d) Full zone annunciation.
(e) Built-in siren driver.
(f) Alarm memory.
(g) Exit/entry delay.
(h) Built-in auto dialer.
(i) System and dialer test switches.
(j) Alarm shutdown reset.
(k) AC indicator.
(l) Key station volume control.
(m) Tamper switch.
(n) Zone shunting.
(o) Access codes.

Acceptable Products: Silent Knight #4720 c/w accessories indicated.
DSC #PC3000.

Master Programming Keypad

Commercial model programming keypad flush mounted with:
(a) Alpha-numeric LCD display.
(b) Pizoelectric transducer buzzer.
(c) Illuminated keypad.
(d) Status, armed and chime LED=s.

Acceptable Products: Silent Knight #4430.
DSC #LCD500.

Remote Keypad

Commercial model arming and access station flush mounted with:
(a) Status, armed and LED=s.
(b) Numeric keypad.

Acceptable Products: Silent Knight #4200.
DSC #PC1000.

Intrusion Detectors

Detectors surface mounted:
(a) Passive Infrared Detector.
(b) 4 elements.
(c) Walk test light.
(d) 4 coverage patterns.
(e) Alarm relay output.
(f) Operation on 8 to 16V DC.
(g) Mounting bracket.

16.4.076 Intrusion Alarm (Cont'd)

Acceptable Products: Racal - Guardall #DX20:20
Approved Equal

Serial Sensor

Serial sensor surface mounted at each detector:
(a) Two wire connection to zone expander.
(b) Two wire connection to detector.
(c) Five jumper wires for zone selection.
(d) Solid state circuiting.

Acceptable Products: Silent Knight #4101.
DSC

Horn

Horn: high impact plastic, white, 125 dB yelp or steady signal, 8 ohm impedance, 30W power capacity.

Manual switch located in control panel to turn horn circuit off if silent alarm is desired.

Acceptable Products: SSI #SS86 c/w enclosure.
Approved Equal

Wiring

Conductors to be #22 AWG QUAD cable in EMT conduit.

16.4.077 Card Access & Alarm Monitoring System

Description of System

System shall provide computerized control of access points to indicated areas, provide input channels for monitoring of doors and alarm contact closures and provide a printed record of all entries and alarms.

The system shall include the following equipment:
(a) Control panel
(b) Proximity card readers
(c) Proximity coded cards
(d) IBM-compatible PC c/w access control software
(e) Printer
(f) Remote alarm
(g) Flashing alarm
(h) Required cabling.

System Certification

A manufacturer's representative shall inspect all system components as installed to ensure:
(a) Installation and connections as per manufacturer=s recommendations
(b) System operation is as intended by this Section and related drawings.

16.4.077 Card Access & Alarm Monitoring System (Cont'd)

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

Include a training and maintenance video tape on VHS format.

Maintenance Materials

Provide maintenance material in accordance with Section 16.2.001.

Include spare parts as recommended by manufacturer.

Access Control Panel

A microprocessor-based unit in a CSA 1 enclosure suitable for flush mounting in a wall.

The control panel shall be capable of storing all required data in memory and carrying out all decision making.

Control panel capable of supporting the following:
(a) Inputs: 16-alarm input points
(b) Card readers: 2
(c) Outputs: 8 DPDT relay contacts
(d) Door strike outputs: 2
(e) Card numbers: 3800
(f) Transaction memory: 1850
(g) Communication port: 20 ma current loop
(h) Memory capacity: 64K bytes
(i) Supports up to 63 time zones
(j) Battery backup power.

Power: 36VA at 12V AC.

Battery: 8V DC, 5 amp/hour.

Temperature: 2°C – 40°C.

Fully expandable on two-wire loop.

Suitable for interfacing with a PC.

16.4.077 Card Access & Alarm Monitoring System (Cont'd)

Access Control Software

Complete software package suitable for installation on any IBM compatible computer. Software shall have the following features:

(a) Operation can control or modify access cards or keypad codes and times that may be used.
(b) Menu driven.
(c) Help and tutorial information.
(d) Card editing feature.
(e) Access level.
(f) Alarm acknowledge.
(g) Password log ON/OFF.
(h) Transaction logging.

Computer

100% IBM compatible with the following features:

(a) 2 Gb RAM
(b) Intel Core 2, 2.13 GHz processor
(c) DVD ROM
(d) 19" LCD Colour monitor
(e) 7 USB ports (minimum)
(f) Windows XP operating system
(g) MS Office 2007 software

Acceptable Products: ACER 5900 Pro
Approved Equal

Proximity Card Reader

Unidirectional card reader with a read range of 125mm -200mm and suitable for mounting outdoors.

External power supply: 12V.

Current: 130mA.

Temperature: -30ºC – 65ºC.

Proximity cards compatible with reader. Supply 150 coded cards with system.

Acceptable Manufacturers, system & software:

Northern Computers - #N-1000-11X c/w PC-PAK
Approved Equal

16.4.077 Card Access & Alarm Monitoring System (Cont'd)

Remote Alarm

Audio/visual alarm unit with signal silence suitable for mounting in a standard recessed two-gang outlet box.

Brushed stainless steel faceplate with signal silence pushbutton, red LED and alarm buzzer.

Input power: 16V AC.

Remote initiating contact.

Acceptable Products: Edwards #CCS 2236
Approved Equal

Flashing Alarm

High/low intensity flashing strobe. ULC approved. High impact housing and clear lens. 120V AC xenon flash tube with a 1 - 2 flash-per-second rate.

Acceptable Products: Edwards #891E-1011.
Approved Equal

16.4.078 Automatic Telephone Dialer

Description of System

Dual channel automatic telephone dialer for intrusion and fire alarm.

Care, Operation and Start-Up

Refer to Section 16.2.001 and provide technical personnel to check, adjust, balance and calibrate components.

Shop Drawings

Submit shop drawings in accordance with Section 16.2.001.

General

Two-channel digital communicator. Features:

(a) ULC approval for transmitting fire and intrusion alarm and supervisory signals to a central station.
(b) Capability to supervise two telephone lines, seize phone lines and send alarm signal on one or both lines.
(c) Local trouble signal in phone service is interrupted for more than 45 seconds with remote signal transmit both on service loss and restore.
(d) Transmit test signal to central station every 24 hours, time programmable.
(e) Supervision of single open or ground fault, low battery or loss of AC power with local audible trouble and remote signal transmit to control station.
(f) One Class 'A' and one Class 'B' circuit.

16.4.078 Automatic Telephone Dialer (Cont'd)

(g) Compatible with SID standard, 3/1 toneburst, FSK, 4/2 and Radionics BFSK formats.
(h) Transient voltage protection.
(i) Programming in EEPROM memory.
(j) Components:
  .1 16.5V AC, 40VA transformer.
  .2 Battery charger and battery to provide 24-hour standby power.
  .3 Audible trouble with external silence switch.
  .4 End-of-line resistors.
  .5 Flush mounted EEMAC I enclosure with hinged lockable door.

Acceptable Manufacturers: Pyrotronex
Simplex
Edwards

16.4.079 Telephone Raceway System

Complete empty telephone raceway system consists of outlet boxes, coverplates, distribution cabinets, conduits, pull boxes, sleeves and caps, fish wires, service fittings.

Conduits: EMT type, to Section 16.4.007.

Junction boxes, cabinets: to Section 16.4.016.

Outlet boxes, conduit boxes and fittings: to Section 16.4.017.

Fish wire: polypropylene type.

16.4.080 Incoming Telephone Service

Description of System

Incoming telephone service facilities from service pole to main terminal in underground duct.

Coordination with Telephone Authority

Coordinate with telephone authority to ensure availability of service.

Materials

Direct-buried cable ducts: to Section 16107.

Grounding: to Section 16.4.046.

Telephone raceway system: to Section 16741.

16.4.081 Communications Wire Cable Connections

Product Data

Submit product data in accordance with Section 16.2.001.

Reference

CAN/CSA C22.2 No.214, Communications Cables.

CAN/CSA C22.2 No.182.4, Plugs, Receptacles and Connectors for Communications Systems.

CAN/CSA C22.2 No.225, Telecommunications Equipment.

CAN/CSA C22.2 No.233, Cord and Cord Sets for Communications Systems.

IEEE 802.3 (Ethernet), 802.4 (Token Bus), 802.5 (Token Ring), ANSC X3T9.5 (FDDI) Local Area Networks.

Coordination with Telephone Authority or Telecommunications Provider

Coordinate with telephone authority to ensure availability of service at agreed demarcation points in their own wiring system using the shared telecommunications raceway system.

Distribution Cabling

The installer must supply and install all UTP cables, BIX blocks distribution panels mounted on 4750mm relay racks, cross-connect cables, faceplates, connectors and all other related devices for the cable distribution.

All data distribution cables will be unshielded twisted pair (UTP), 24AWG solid annealed copper, FT4 rated, Category 5e data grade, Northern Telecom BDN-Plus. Two data cables are required per work station/outlet.

All voice distribution cables will be unshielded twisted pair (UTP), 24AWG solid annealed copper, FT4 rated, Category 5e data grade, Northern Telecom BDN. One voice cable is required per work station outlet.

Documentation

The contractor is to provide documentation showing the following:

(a) The location and port ID to which each down-drop is connected.

(b) Two (2) copies of a floor plan (typically referred to in the industry as an "As-Built Drawing"). One copy of the floor plan is to be fixed to the cable room wall, and the second copy is to be provided to RSS (Remote Site Support). These plans are to indicate data locations, voice locations and corresponding identification numbers.

16.4.081 Communications Wire Cable Connections (Cont'd)

Voice/Data Outlet Jacks

Northern Telecom Category Quad DVO, complete with faceplate (ivory nylon).

Bottom two RJ45's to one data and one spare. Top two RJ45's to be one voice and one spare.

Provide blank coverplates over outlets not used.

Flush mount required for work station outlet jacks on walls and surface mount downfeed poles.

RJ45 outlets must accommodate 4J11 plugs.

Cross-Connection Equipment

Category 5e BIX 46DI (4-6 position).

Category 5e BIX 1A as required.

Category 5e B+ cross-connect wire.

BIX connecting blocks as required.

16.4.082 Public Address System

Description of System

Main Intercom System incorporating:

(a) Voice paging to remote stations on a selected room, zone, all-call or emergency all-call basis.
(b) Two-way voice communication and signaling between the console and remote stations.
(c) Six call-in priority levels.
(d) Digital annunciation of incoming calls and priority levels, paging zone selection and clock as well as for user programming.
(e) Aural and visual monitoring for all program materials and controls to pre-monitor before distribution.
(f) Full privacy - normal control at each remote classroom station and Control Centre with ability to receive program, time and alarm signals and page calls when in the private position while preventing eavesdropping.
(g) Hands-free conversation at remote classroom stations.
(h) Audio program distribution on an all-call or selected room basis as programmed from the console from microphone, tuner, tape player and auxiliary inputs.
(i) Programmable master clock with 64 events, 8 time zones and 2 schedules.
(j) Review capability for waiting incoming calls.
(k) Non-volatile memory for all programmable functions.
(l) Master power switch and pilot light at Control Centre.
(m) Tuner-Cassette player program source.

16.4.082 Public Address System (Cont'd)

Capacity

As identified in Division 3.0 – Particular Specifications

Care, Operation and Start-Up

Refer to Section 16.2.001.

Manufacturer's factory service engineer to allow for two visits to verify, adjust and balance and to include 4 hours to instruct:
(a) Maintenance personnel in the maintenance of system.
(b) Operating personnel in the use of system.
(c) Manufacturer's factory service engineer to allow for visit to program annunciation and call-in zoning to control console to suit requirements of the school.

Project Data and Start-Up

Submit project data in accordance with Section 16.2.001.

Maintenance Operation and Data

Refer to Section 16.2.001.

Include description of system operation.

Include parts list, using component identification numbers standard to electronics industry.

Materials

Electronic equipment: to CSA C22.2 No. 1.

Conduits: to Section 16.4.007, maximum 40% fill.

Communication conductors:
(a) Type 1: one twisted pair 22 AWG tinned copper, PVC insulated, chrome PVC jacket.
(b) Type 2: 2/c shielded, 2/c unshielded 22 AWG tinned copper, polypropylene insulated, aluminum-polyester shield over red and black conductors, 24 AWG stranded copper drain wire, chrome PVC jacket.
(c) Type 3: pair 22 AWG tinned copper, PVC insulated each pair individually shielded with aluminum-polyester shield and 22 AWG solid tinned copper drain wire, overall chrome PVC jacket.
(d) Type 4: bare copper covered steel conductor, polyester insulation, conductive layer, tinned copper braid shield, black PVC jacket.

16.4.082 Public Address System (Cont'd)

Equipment General

Public address system to operate on 120V nominal 60Hz input voltage.

Duty cycle 24-hour per day.

Modular system design ensuring convenience and minimum cost in making changes and additions.

All components to be solid state, and suitable for cabinet mounting unless otherwise specified.

Maximum operating temperature 65°C.

Central Control Unit

Wall mount kit to accommodate system components, enclosed type, steel construction.

Central control unit to contain, but not necessarily be limited to, the following components:

(a) System microprocessor
(b) Power supply:
  .1 24V DC @ 20A
  .2 5V DC @ 0.6A
(c) Solid state amplifier for distribution of program audio, time signals and paging.
  .1 Power output: 35W
  .2 Frequency response: 60 to 18,000 Hz.
  .3 Line output: 25V.
  .4 Input-output circuitry.
  .5 Battery backup for time clock.

As a standard of quality acceptable manufacturer is: BCE/EDCOM
Dukane

Control Console

Desk top control consoles constructed of white, high impact moulded plastic enclosure with a moisture-proof mylar faceplate providing the following colour coded function keys:

(a) Room select
(b) Push to talk
(c) Hold
(d) Page
(e) Cancel
(f) All rooms
(g) Selected rooms
(h) Microphone
(i) Tuner
(j) Tape
(k) Turntable
(l) Auxiliary

16.4.082 Public Address System (Cont'd)

(m) Display calls
(n) Time function
(o) Program function

Built-in microphone and speaker for push-to-talk intercom conversations.

Telephone handset with retractable cord.

LED display indicating room number and priority. The display shall indicate time in idle mode.

Program distribution on all-call or selected room basis shall be selected by the keyboard.

Programmable functions shall be accomplished by the keyboard.
(a) Room numbers
(b) Room call-in priority levels
(c) 12/24 hour clock
(d) 64-event, 8-zone program clock
(e) Speaker paging zone assignment
(f) Call-in tone characteristics.

Any of the control consoles shall have the ability to be designated as the current console in order to allow all incoming calls from classrooms to be annunciated at a specified console.

Acceptable Products: Dukane MCS250
BCE/EDCOM

Tuner-Cassette Player

Tuner mounted in desktop unit.

Controls:
(a) AM/FM select
(b) ON-OFF-VOLUME
(c) Tuning
(d) Input: 12/24V DC, 65 mA
(e) Output: IV rms
(f) Frequency response:
  .1 FM: 50-15,000 Hz ∀3 dB
  .2 AM: 100-4,500 Hz ∀3 dB
(g) Tuning range:
  .1 FM: 88-108 MHz
  .2 AM: 525-1605 KHz
(h) Absolute sensitivity:
  .1 FM: 20dB UV @ 30dB signal to noise ratio
  .2 AM: 40dB UV @ 30dB signal to noise ratio.

Cassette player mounted in desktop console.

16.4.082 Public Address System (Cont'd)

Controls:
(a) Volume
(b) Fast forward/auto reverse/rewind
(c) Eject
(d) Input: 12/24V DC, 150mA
(e) Output: 1V rms
(f) Frequency response: 100-7,000 Hz,∀3 dB
(g) Signal/noise ratio: below 45 dB
(h) Wow and flutter: below 0.35%
(i) Distortion: below 2%.

Acceptable Products: TOA #RT22 & PAU-02
Approved Equal

Exterior Speakers

Trumpet type wire angle sound reproducers.

Wall mounted, gray baked enamel over corrosion resistant coating.

Weight: 3.9kg.

Line transformer 25V primary with tapped secondary for volume adjustment.

Frequency response: 250 to 14,000 Hz.

Dispersion: 120E to 60E.

Power rating: 30W.

Sound pressure 123dB at 1.2m.

Acceptable Products: Atlas #APC-30T
Dukane #SA411
TOA #TC-301TA

Call-In Switch

Provide privacy feature and annunciator call-in to the central console.

Three-position rocker switch, spring return on CALL.

Designations: PRIV and CALL.

Dimensions: 114mm x 70mm x 56mm.

Stainless steel with black trim.

Surface mounting in Edwards #PP27193 beige backbox.

Weight 70g.

16.4.082 Public Address System (Cont'd)

Acceptable Products: Dukane #9A1770
Bogen #CA-11

Gym Sound System

Cassette player in in-wall locking cabinet:

Controls:
(a) Volume
(b) Fast Forward/Auto Reverse/Rewind
(c) Eject
(d) Input: 120V, 10W
(e) Output: 1V rms
(f) Frequency response: 63-10,000 Hz, ∀3 dB.
(g) Signal/noise ratio: below 45dB.
(h) Wow and flutter: below 0.35%.
(i) Distortion: below 2%.

Acceptable Products: Sony TC-FX150
Approved Equal

Locking cabinet to be tamperproof, c/w2 tilt-out door and key lock assembly. As a standard of quality, manufacturer: Soundolier AWR

Gym & Cafeteria Sound System Speakers

200mm coaxial type sound reproducer.

Ceiling recess type in cafeterias and surface type in gyms, 300mm x 300mm square baffle of baked matte white steel and 384mm x 324mm x 102mm backbox.

Magnet weight: 800g.

Line transformer 25V with tapped secondary for volume adjustment.

Hertz range 30 to 20,000 Hz nominal.

Continuous program power capacity: 40 watts.

Impedance: 8 ohms.

As a standard of quality, acceptable manufacturer is: JBL #8140 c/w backbox indicated.

16.4.083 Television Cable System

Description of System

Incoming television service facilities to share common duct with telephone as indicated.

16.4.083 Television Cable System (Cont'd)

Complete empty television raceway system consists of outlet boxes, coverplates, distribution cabinets, conduits, pull boxes, sleeves and caps and fish wires. Alternately, if acceptable to the Utility, obtain television cables from the Utility and prewire building from floor cabinets to outlets indicated.

Coordination with Cable Television Distributor

Coordinate with cable television distributor to ensure availability of service.

Pay any fees or charges to provide service as part of contract price.

Conduit: EMT type to Section 16.4.007.

Junction boxes and cabinets: to Section 16.4.016.

Outlet boxes, conduit boxes and fittings: to Section 16.4.017.

Fish wire: polypropylene type.

16.4.084 Ceiling Fans

Submit product data in accordance with Division 7.

Ceiling Fans

Ceiling mounted circulation fans to be:
(a) Wooden four-blade type, brown enamel finish, 900mm diameter.
(b) Rated: 60W, 120V, AC, 4200 CFM.
(c) Suitable for infinitely variable speed control.

Acceptable Products: CANARM/PLEASANTAIRE #CP36D.
Approved Equal

Speed Control

Infinitely variable solid-state manual dial speed control to be:
(a) Rated 120V, AC for number of fans indicated.
(b) Suitable for flush mounting in single gang box.

Acceptable Products: CANARM/PLEASANTAIRE #MC-3 (1 fan) or #MC-5 (up to 3 fans).
Approved Equal

16.4.085 Motor Starters to 600V

Shop Drawings & Product Data

Submit shop drawings and product data in accordance with Section 16.2.001.

Indicate:
(a) Mounting method and dimensions,
(b) Starter size and type,
(c) Layout of identified internal and front panel components,

16.4.085 Motor Starters to 600V (Cont'd)

(d) Enclosure types,
(e) Wiring diagram for each type of starter,
(f) Interconnection diagrams.

Operation & Maintenance Data

Provide data for incorporation into maintenance manual specified in Section 16.2.001.

Include operation and maintenance data for each type and style of starter.

Maintenance Materials

Provide maintenance materials in accordance with Section 16.2.001.

Provide listed spare parts for each different size and type of starter:
(a) 2 contacts, stationery
(b) 2 contacts, movable
(c) 1 contact, auxiliary
(d) 1 control transformer
(e) 1 operating coil
(f) 2 fuses
(g) 4 indicating lamps

Materials

Starters: EEMAC E14-1. Half-size starters not acceptable.
Starters to be rated for NEMA (EEMAC) premium motors.

Manual Motor Switches

Single phase manual switch; one, two or three poles as required, mounted in CSA 1 Enclosure with quick-make, quick-break toggle switch.

Rated for 30A at 250V AC, 20A at 600V AC.

Shielded toggle with provision to be padlocked in "ON" or "OFF" positions.

Acceptable Products: Arrow Hart 6810/7810-G
Bryant No. 30102/3
Square D Class 2510, Type K
Approved Equal

Manual Motor Starters

Single phase manual motor starters of size, type rating, and CSA 1 Enclosure type unless indicated otherwise, with components as follows:
(a) Switching mechanism, quick-make and quick-break,
(b) One overload heater, manual reset, trip indicating handle.

Accessories:
(a) Toggle switch: heavy duty, labelled as indicated.
(b) Indicating light: heavy duty type, red colour, unless indicated otherwise.

16.4.085 Motor Starters to 600V (Cont'd)

(c) Locking tab to permit padlocking in "ON" or "OFF" position.

Acceptable Products: Allen-Bradley Bulletin 600
Cutler-Hammer B200-9101
Furnas Class 10
Square D Class 2510 Type F
Westinghouse Type MS
Approved Equal

Full Voltage Magnetic Starters

Combination magnetic starters of size, type, rating and in CSA 1 enclosure type unless indicated otherwise with components as follows:
(a) Contactor solenoid operated, rapid action type.
(b) Motor overload protective device in each phase manually reset from outside enclosure.
(c) Power and control terminals.
(d) Wiring and schematic diagram inside starter enclosure in visible location.
(e) Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

Combination-type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter and provision for:
(a) Locking in "OFF" position with up to three padlocks,
(b) Locking in "ON" position,
(c) Independent locking of enclosure door,
(d) Provision for preventing switching to "ON" position while enclosure door is open, except when located in a motor control centre.
(e) Provision for defeater mechanism to provide access while in "ON" position, for maintenance purposes.

Accessories:
(a) Pushbuttons, selector switches: oil-tight, labeled as indicated.
(b) Indicating lights: oil-tight type and colour as indicated.
(c) 1-N/O and 1-N/C spare auxiliary contact, unless otherwise indicated.
(d) Relays: as indicated.

Acceptable Products: Allen-Bradley Bulletin 513
Cutler-Hammer A40
Furnas Class 18
Square D Class 8539
Westinghouse Class A206
Approved Equal

Control Transformer

Single phase, dry-type, control transformer with primary voltage as indicated and 120V secondary, unless indicated otherwise, complete with secondary fuse, installed in with starter as indicated.

Size control transformer for control circuit load plus 20% spare capacity.

16.4.085 Motor Starters to 600V (Cont'd)

Solid-State Line Monitor

Where indicated, each three-phase magnetic starter to be equipped with a solid-state line monitor to automatically protect the motor against phase unbalance, phase loss, phase reversal, incorrect phase sequence and low line voltage.

Finishes

Apply finishes to enclosure in accordance with Section 16.2.001.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.

Manual starter designation level, white plate, black letters, size 1, engraved as indicated.

Magnetic starter designation level, white plate, black letters, size 5 engraved as indicated.

16.4.086 Motor Starters to 600V (VFD's)

General

Description
This specification is to cover a complete Variable Frequency Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications.

The drive manufacturer shall supply the AC drives, Ethernet adaptor hardware and all necessary controls as herein specified.

Quality Assurance
(a) Referenced Standards:
1. Institute of Electrical and Electronic Engineers (IEEE)
    a) Standard 519, IEEE Guide for Harmonic Content and Control
2. Underwriters laboratories
    a) UL508C
3. National Electrical Manufacturer's Association (NEMA)
    a) ICS 7.0, AC Adjustable Speed Drives

(b) Testing:
All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 40°C (104°F), at full rated load. All testing and manufacturing procedures shall be ISO 9001 certified.

16.4.086 Motor Starters to 600V (VFD's) (Cont'd)

(c) Qualifications:
VFDs and options shall be UL, cUL and CSA listed as a complete assembly.

Shop Drawings & Product Data

Submit shop drawings and product data in accordance with Section 16.2.001

Indicate:
(a) Mounting method and dimensions
(b) Layout of identified internal and front panel components
(c) Enclosure types
(d) Wiring diagram of VFD
(e) Interconnection diagrams

Operation and Maintenance Data

Provide data for incorporation into maintenance manual as specified in Section 16.2.001

Finishes

Apply finishes to enclosure in accordance with Section 16.2.001

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001

Products

Variable Frequency Drives

The Variable Frequency Drives (VFDs) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output-switching device. The drive efficiency shall be 96% or better at full load. Displacement power factor shall be no less than 0.98 at all speeds and loads.

Harmonic Distortion Control

The VFD design shall incorporate mechanisms that lower the harmonic currents caused by the drive as compared to standard six-pulse drives onto the AC power line. Harmonic distortion at the drive is not to exceed 29% without the use of additional components such as line reactors or DC link chokes.

Harmonic calculations shall be supplied upon request based on a single line diagram of the electrical system. This diagram shall include transformer(s) KV, kVA and impedance percentage to accurately predict the harmonic levels at the PCC (Point of Common Coupling), as specified by IEEE519. The calculations shall be made with the point of the common coupling being the utility feeder.

16.4.086 Motor Starters to 600V (VFD's) (Cont'd)

Specifications:

(a) Input voltage and VFD ratings as specified in the Contract Documents, +/- 10%, 3 phase, 48-63 Hz.
(b) Voltage tolerance + or – 10% of specified line voltage.
(c) Output Frequency 0 to 150 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
(d) Environmental operating conditions: 0 to 40°C, 0 to 1000 metres above sea level, less than 95% humidity, non-condensing.
(e) A single enclosure shall be used for each variable frequency drive. A variable frequency drive that is required to be floor mounted shall have a 200mm housekeeping pad or a 200mm plinth.
(f) A dv/dt load filter shall be mounted inside the cabinet at the bottom and, if not integral to the drive, a line reactor shall be mounted at the top.
(g) The VFD shall have a Human Machine Interface (HMI) mounted on the front exterior door.

Features

All VFDs shall have the following standard features:

(a) The VFD shall have an HMI, including digital display, and keypad. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting. An optional keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
(b) The keypad shall include Hand, Auto, Stop selections. When in "Hand", the VFD will be started and the speed will be controlled from the up/down arrows. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Auto" and "Hand" modes.
(c) The VFD shall have, mounted on the front panel, a Hand/Off/Auto selector switch, a red "Run" indication lamp and a red "Mushroom Head" type Emergency Shutdown (ESD) pushbutton switch.
(d) An Advanced Operator Interface (AOP) shall be included for local control, for setting all parameters, and for stepping through the displays and menus. The display shall as a minimum be 4 lines x 30 characters in size. The keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. An optional keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

16.4.086 Motor Starters to 600V (VFD's) (Cont'd)

(e) The following operating information displays shall be standard using an optional VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. All parameters viewed from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable).

- Output Frequency
- Motor Current
- Calculated Motor Power(kW)
- Output Voltage
- Analog Input Values
- Keypad Reference Values
- K Wh meter (resettable)
- Digital input status
- Motor Speed (RPM, %, or Engineering units)
- Calculated Motor Torque
- DC Bus Voltage
- Heatsink Temperature (deg C)
- Analog Output Value
- Elapsed Time Meter (resettable)
- MWh meter
- Digital output status

(f) The VFD's shall include a Quick Start feature that leads the user through the most typical required parameters.

(g) The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

(h) The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

(i) The VFD shall also be capable of DC injection braking that can be employed to stop a free-wheeling motor prior to starting to avoid overvoltage nuisance tripping.

(j) The VFD shall have the ability to be programmed to automatically extend the ramp-down time as required to keep the drive from tripping on over-voltage caused by regeneration of power by the load.

(k) If the input reference (0/4-20mA or 0/2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, replay output and/or over the serial communicated bus.

(l) The customer terminal strip shall be isolated from the line and ground.

(m) The drive shall employ current limit circuits to provide trip free operation:

- The Slow Current Regulation limit circuit shall be adjustable to 150% (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
- The Current Switch-off limit shall be fixed at 180% (minimum, instantaneous) of the VFD's normal duty current rating.

16.4.086 Motor Starters to 600V (VFD's) (Cont'd)

(n) The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute in every 10 minutes.
(o) The VFD shall be capable of sensing a loss of load (broken belt/no water in pump) or high current mechanical sensing failure, and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.

Adjustments

All VFDs to have the following adjustments:

(a) Four (4) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
(b) A custom PID preset to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 100 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, digital inputs, or over the communications bus. A Hibernation mode shall be included in the PID functions. This feature shall allow the motor to be stopped when at minimum speed for a user defined period, for additional energy savings.
(c) VFD PID shall incorporate pre-configured sensor selections that automatically configure the scaling for the selected sensor.
(d) Two (2) programmable analog inputs shall accept a current or voltage sensor level input signal for speed reference or for reference and actual (feedback) signals for the PID controller.
(e) Analog inputs shall include a filter to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 – 20 ma and 0 – 10 Volts. Additionally, the reference must be able to be scaled so that maximum frequency is below 60 Hz. Process variables shall be capable of being inverted.
(f) Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices.
(g) Two (2) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus Voltage, Active Reference, and other data.
(h) Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be full form C relay contacts; open collector outputs are not acceptable.
(i) Fifteen (15) programmable preset speeds.
(j) Two independently adjustable accel and decal ramps. These ramp times shall be adjustable from 1 to 650 seconds.
(k) The VFD shall Ramp or Coast to a stop, as selected by the user.
(l) The displayed operating information shall be user selectable.
(m) Up to 20 parameters shall be user selected for storing in a user grouping for ease of configuration and customization.

16.4.086 Motor Starters to 600V (VFD's) (Cont'd)

Protection Circuits

The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall announce the fault condition of the keypad display:

(a) Overcurrent
(b) Overvoltage
(c) Undervoltage
(d) Overtemperature, Heatsink Temperature
(e) Ground Fault either running or at start
(f) Adaptable Electronic Motor Overload ($I^2 t$). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependent, are unacceptable. The electronic motor overload protection shall be CSA certified for this function.

Speed Command

Speed Command Input shall be via any of the following:

(a) Keypad
(b) Two Analog inputs, each capable of accepting a 0/4-20mA, 0-10V, 2-10V signal, and direct NI 1000 temperature sensor input.
(c) Serial Communications

Communications

(a) The VFD shall have a ETHERNET port as standard.
(b) Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control (Set Point) adjustments and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), relay outputs, digital inputs and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.
(c) Communications shall be provided to communicate with the existing SCADA system PLC which expects Modbus TCP connections.

Acceptable Manufacturers:
ABB
Allen Bradley
Schneider
Siemens
Vacon

16.4.087 Motor Control Centre

Operation & Maintenance Data

Provide data for incorporation into maintenance manual specified in Division 7.

Include data for each type and style of starter.

Supply Characteristics

600V, 60Hz, wye connected, 3-phase, 3 wire.

Motor Control Centre

Compartmentalized vertical sections with common power bus bars.

Floor mounting, free standing, enclosed dead front.

Indoor CSA 1 enclosure.

Accommodating combination starters as indicated.

Front mounting as indicated.

Class I, Type C.

Vertical Section Construction

Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

Each vertical section divided into compartment units, sized to suit installation requirements, as indicated.

Each unit to have complete top and bottom steel plate for isolation between units.

Horizontal wireways, equipped with cable supports across top and bottom, extending full width of motor control centre, isolated from bus bars by steel barriers.

Vertical wireways for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

Incoming cables to enter at bottom.

Provision for outgoing cables to exit via top or bottom.

16.4.087 Motor Control Centre (Cont'd)

Removable lifting means.

Provision for future extension of both ends of motor control centre, including bus bars without need for further drilling, cutting or preparation in field.

Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

Sills

Continuous 100mm channel iron floor sills for mounting bases with 19mm diameter holes for bolts

Bus Bars

Main horizontal and branch vertical, three phase high conductivity tin plates, aluminum bus bars in separate compartment, bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated. Required rating as indicated:

(a) Main horizontal bus bars: 600A.
(b) Branch vertical bus bars: 300A.

Branch vertical busbars for distribution of power to units in vertical sections.

No other cables, wires, equipment in main and branch bus bar compartments.

Brace bus work to withstand effects of short circuit current of 22kA rms symmetrical.

Bus supports: high dielectric strength, low moisture absorption, high impact material, with long creepage surface designed to discourage collection of dust.

Ground Bus

Copper ground bus size 50mm x 3mm, extending entire width of motor control centre, located at bottom.

Motor Starters: Combination magnetic starters and accessories to Section 16.4.085.

Transformers: Transformers 600-208V/120V to Section 16.4.047.

Panelboards: Panelboards to Section 16.4.049.

Starter Unit Compartments

Units EEMAC size 4 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses are energized.

Unit mounting:

(a) Engaged position - unit stabbed into vertical bus.

16.4.087 Motor Control Centre (Cont'd)

(b) Withdrawn position - unit isolated from vertical bus but supported by structure. (Terminal block accessible for electrical testing of starter)
(c) Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
(d) Stab-on connectors, free-floating, silver-plated clips, self-aligning (backed up with steel springs).

External operating handle of circuit switch interlocked with door to prevent door openings with switch in "ON" position. Provision for three (3) padlocks to lock operating handle in "OFF" position and lock door closed.

Provision for defeater mechanism to gain access while in the "ON" position for maintenance purposes.

Hinge unit doors on same side.

Overload relays manually reset from front with door closed.

Pushbuttons and indicating lights mounted on door front.

Devices and components by one manufacturer to facilitate maintenance.

Wiring Identification

Provide wiring identification in accordance with Section 16.2.001.

Equipment Identification

Provide equipment identification in accordance with Section 16.2.001.
(a) Motor control centre main nameplate: Size No.7, engraved "MCC No. ____".
(b) Individual compartment nameplates: Size No.5, engraved as indicated.

Acceptable Manufacturers: Allen Bradley Canada Limited
Furnas Electric Canada Limited
Westinghouse Canada Limited
Approved Equal

16.4.088 Time Controls

Submit project data in accordance with Section 16.2.001.

Electronic Time Clock

Seven-channel, solid-state digital timer, keyboard entry, digital LED readout.

Seven-day control with skip-a-day feature.

Contacts rated 4A tungsten per pole up to 120V.

Contacts independent of load switches.

Four-month battery carryover.

16.4.088 Time Controls (Cont'd)

CSA 1 enclosure.

120V, 60Hz.

Manual ON-OFF-REVIEW-SET selector.

365-day calendar, daylight savings and leap year correction.

Acceptable Products: Intermatic Series
Paragon #EC77/120V
Tork
Approved Equal

16.4.089 Control Devices

Submit shop drawings in accordance with Section 16.2.001.

Include schematic, wiring, inter-connection diagrams.

Materials

Enclosure: CSA Type 1, surface or flush mounting as indicated.

Pushbuttons: Heavy duty, operator flush type with 1-NO and 1-NC contacts rated at 5A AC, labels as indicated. Stop pushbuttons mushroom head, coloured red, labeled "STOP", push in to maintain STOP condition.

(a) Operators to be keyed-type where indicated. Provide six (6) keys for each keyed operator. All operators keyed alike.

Three-position Switches: maintained type; HAND/OFF/AUTO indication provided.

Indicating Lights: Heavy duty, full voltage type; lens colour: as indicated; supply voltage: 120V; lamp voltage: 120V; labels as indicated.

Acceptable Manufacturers: Allen Bradley Canada Ltd., Series 800
Siemens
Square D Company
Westinghouse Canada Ltd.

16.4.090 Programmable Logic Controller

Submit shop drawings in accordance with Section 16.2.001.

Materials

A twenty-point stand-alone PLC with the following integral features:

(a) LED display for each input and output terminal.
(b) Integral power supply set for 120V input.
(c) Isolated input terminals rated for 110V AC.
(d) Output relay terminals rated for 110V AC.
(e) 120V, 60Hz operation.
(f) Integral input/output terminals.
(g) EEPROM memory: 8 Kbytes.

16.4.090 Programmable Logic Controller (Cont'd)

(h) Real time clock feature with date and time.
(i) Arithmetic operation: addition, subtraction, multiplication and division.
(j) Comparison operation.
(k) Internal timers: 32.
(l) Internal counters: 32.
(m) Maximum number of I/O: expandable to 160.
(n) Execution scan time: 3ms/1Kb.
(o) Programming method: ladder logic.

Operational sequence to be field programmable using a hand-held programming terminal.

Operating temperature range: 5°C – 55°C.

Humidity: 30% to 95%.

Power consumption: 42VA.

Surface wall-mount cabinet.

Acceptable Manufacturers: Telemecanique TSX1722028
Omron
Allen-Bradley

16.4.091 Elevator Services

Reference Standards

Elevator services work to CSA B44 & CSA B44S3 except where specified otherwise.

Installation must comply with the Province of New Brunswick Elevator and Lifts Act and requires the Chief Elevator Inspector's "Certificate of Inspection" for final inspection.

Description of System

Elevator power and lighting, supply, switching and protection; lighting systems for machine room, pits, secondary levels, supplementary controls, conduit and wiring for associated equipment.

Materials

Building Wires: to Section 16.4.014.

Conduits: to Section 16.4.007.

Luminaires: to Section 16.4.056.

Disconnect switches, fusible, rating, number of poles, configuration, as indicated for each of following circuits:
(a) Power c/w auxiliary contacts
(b) Lighting
(c) Car convenience outlet

16.4.092 Electric Heating & Cooling Controls

Submit product data in accordance with Section 16.2.001.

Thermostats (Low Voltage)

Low voltage wall thermostat:
(a) For use on 24V circuit at 1.5A capacity.
(b) Heat anticipator adjustable 0.1 to 1.2A.
(c) Temperature setting range: 10°C to 25°C.
(d) Surface mounting sub-base.

Thermostat (Line Voltage)

Line voltage wall thermostat:
(a) For use on 240V circuit at 24A capacity.
(b) Double pole.
(c) Temperature setting range 10°C – 25°C.
(d) Scale markings: OFF-5-10-15-20-25°C.

Acceptable Manufacturers: Honeywell
Barber Coleman

Thermostat Guards: Thermostat guards: clear, plastic housing with ventilation slots.

16.4.093 Programmable Time Controller

Submit project data in accordance with Section 16.2.001.

Microprocessor-based solid-state time switch.

Two circuits for lighting programmable for each day of the week plus holiday on a separate schedule accuracy ±1 minute.

Program entries by electronic keypad.

Manual override of each circuit, without disturbing master program.

Visual indicator to show ON/OFF condition of each circuit.

Output voltage for contactors 120V.

Output power 2.5 amps maximum for all circuits.

CSA 1 surface enclosure.

275-hour backup reserve power to maintain full memory using rechargeable battery c/w charger. Audible or visual indication should memory reset be required.

240-memory positions which can be distributed in any quantity to any circuit at any time on any day without interfering with other entries.

Input 120V, 60Hz.

16.4.093 Programmable Time Controller (Cont'd)

Acceptable Products: Paragon EC72.
Approved Equal

16.4.094 Heating Panels - Radiant

Related Work: Heating and Cooling Controls: Section 16.4.091.

Submit product data in accordance with Section 16.2.001.

Materials

Radiant heating panels to be CSA approved.

Radiant Heating Panels (Type I)

Rating: as indicated in heater schedule.

Size: 305mm x 305mm or 610mm x 1220mm, as indicated.

Panel construction:
(a) 24 ga. satin coat steel back of unit.
(b) High temperature fibreglass insulation.
(c) Dielectric insulation.
(d) Electric heating element.
(e) Dielectric insulation.
(f) 22 ga. paint steel front panel.

Surface or recess mounting as indicated. Use manufacturer supplied frame for surface mounting.

Acceptable Manufacturers: Aztec
Approved Equal

Radiant Heating Panels (Concealed in Ceiling) (Type II)

Rating: as indicated in heating schedule.

Size: 305mm wide, length as indicated.

Panel construction: low temperature nichrome heating wires embedded in 12mm gypsum board panels.

Connectors: CSA approved connectors for direct connection to conductor without a junction box.

Acceptable Manufacturers: Thermaray Inc;
Approved Equal

Controls

Remote control as indicated.

16.4.095 Heating Cables - Floor Warming

Submit product data in accordance with Section 16.2.001.

Floor Warming Heating

Copper alloy conductor with X-link PVC insulation, copper ground braid, PVC protective jacket, sealed cold leads. Length as indicated on plans.

Steel pre-punched strapping to hold cables in place where embedded in concrete.

As a standard of quality, acceptable manufacturer: Pyrotenax #HOST.

Controls: Thermostat: remote bulb type.

As a standard of quality, acceptable manufacturer Pyrotenax #4668W.

16.4.096 Baseboard Convectors - Residential

Related Work: Heating and Cooling Controls: Section 16.4.091.

Submit product data in accordance with Section 16.2.001.

Product data to include:
(a) Suspension of heating element
(b) Physical size
(c) Finish
(d) KW rating
(e) Cabinet thickness
(f) Cabinet surface temperature.

Baseboard Convectors

Heaters: standard wattage density as indicated with connection box both ends. Element through-type fitted with aluminum convector vanes and resistor wire enclosed in mineral insulation in aluminum sheath.

Element locked to cabinet and supported with non-metallic supports to allow for expansion.

Cabinet: steel 1.08mm thick finished in baked enamel two coats in white colour with integral air deflector for diffusion.

Approved wiring channel for interconnection of heaters and components.

Knockouts for 12mm dia. conduit connection.

Controls: Wall mounted thermostats: line voltage type, to Section 16.4.091.

Acceptable Manufacturers: Dimplex Canada
Stelpro Design Canada
Convect-Air

16.4.097 Baseboard Convectors - Commercial

Related Work: Heating and Cooling Controls: Section 16.4.091.

Submit product data in accordance with Section 16.2.001.

Product data to include:
(a) Suspension of heating element
(b) Physical size
(c) Thermostat control if integral
(d) Finish
(e) KW rating
(f) Cabinet thickness
(g) Cabinet surface temperature.

Materials

Heaters: to CSA C22.2 No. 46.

Heaters: wattage density 1.15 watts/mm with connection box at both ends. Element through-type fitted with aluminum convector vanes and resistor wire enclosed in mineral insulation in aluminum sheath.

Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non-metallic supports.

Cabinet: 350mm high x 130mm deep, unless indicated otherwise, length as indicated, front panel 1.6mm thick, finished in baked enamel, two coats beige colour. Integral air diffusion reflector with wireway at bottom and built-in clamps.

Controls: Line voltage wall mounted thermostats: Section 16.4.091.

Acceptable Products: Dimplex Canada, Type AC-3
Convect-Air
Stelpro Design Canada, Type CW375.

16.4.098 Cabinet Convector Heaters

Related Work: Heating and Cooling Controls: Section 16.4.091.

Submit product data in accordance with Section 16.2.001.

Product data to include:
(a) Element replacement data
(b) Mounting methods
(c) Auxiliary controls
(d) Finish
(e) KW rating, voltage, phase
(f) Cabinet material thicknesses.

Cabinet Convectors

Wall mounted cabinet: front inlet/top outlet, 16 gauge front panel sloped steel. Phosphatized and finished with two coats baked enamel in sahara sand colour. Pre-drilled back for securing to wall.

16.4.098 Cabinet Convector Heaters (Cont'd)

Elements: mineral insulated with steel sheath and welded fins, secured and free-floating for expansion.

Controls: Supplied and installed by Division 15 unless indicated otherwise.

Acceptable Products: Dimplex Canada, ASC Series.
Stelpro Design Canada
Convect-Air
Approved Equal

16.4.099 Unit Heaters

Related Work: Heating and Cooling Controls: Section 16.4.091.

Submit product data in accordance with Section 16.2.001.

Product data to include:
(a) Mounting methods
(b) Physical size
(c) Layout and diagrams of unit heaters
(d) KW rating, voltage, phase
(e) Cabinet material thickness
(f) Finish.

Provide data for incorporation into maintenance manual specified in Section 16.2.001.

Unit Heaters

Horizontal blower type where indicated complete with adjustable louvers finished to match cabinet.

Vertical blower type where indicated.

Fan type unit heaters with built-in high-heat limit protection, fan-delay switches and thermostat control as indicated.

Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount. Built-in fan motor thermal overload protection.

Hangers as required.

Elements: mineral insulated stainless steel sheath with continuous helical brazed fins.

Cabinet: steel, 1.52mm thick, fitted with brackets for wall mounting. Phosphatized and finished with two coats baked enamel in beige colour.

Control circuit to have built-in time delay, adjustable 0-3 min. to allow heaters to be staged ON.

Controls: Remote controls as indicated.

16.4.099 Unit Heaters (Cont'd)

Acceptable Manufacturers: Dimplex Canada
Horizontal Type BUH
Vertical Type VUB
Stelpro Design Canada
Convect-Air

16.4.100 Horizontal Unit Heaters

Submit product data in accordance with Section 16.2.001.

Product data to include:
(a) Mounting methods
(b) Physical size
(c) Layout and diagrams of unit heaters
(d) KW rating, voltage, phase
(e) Cabinet material thickness
(f) Finish.

Unit Heaters

Unit heaters: ratings as indicated on the drawings, horizontal blower complete with adjustable louvers finished to match cabinet.

Fan-type unit heaters with built-in high heat limit protection, and main 80A, 2P circuit breaker.

Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.

Ceiling type hangers.

Elements: mineral insulated stainless steel sheath with continuous helical brazed fins.

Cabinet: steel, 1.52mm thick, fitted with brackets for ceiling mounting. Phosphatized and finished with two coats baked enamel in beige colour.

Controls: Integral thermostat, relay, transformer.

Acceptable Manufacturers: Canadian Chromolax Co. Ltd.
Type "EUH05B21T/EDUAR21"
Stelpro Design Canada
Convect-Air

16.4.101 Blower Type Hand/Hair Dryers - Infrared Controls

Submit product data in accordance with Section 16.2.001.

Drawings to include:
(a) Mounting methods
(b) Physical size
(c) Layout and diagrams of all unit heaters used as auxiliary to main heating plant.

16.4.101 Blower Type Hand/Hair Dryers - Infrared Controls (Cont'd)

Submit maintenance data to Section 16.2.001.

Equipment

Heaters: CSA Listed.

Fan type heaters 180 CFM, with built-in high-heat limit protection.

Fan motor 1/8 HP, 3000 RPM, permanently lubricated ball-bearing type with resilient mount. Built-in fan overload protection.

Heater element 2000W Nichrome wire.

Cabinet to consist of one-piece heavy-duty, rib reinforced zinc alloy casting fitted with revolving nozzle, recessed instruction plate. Exposed portions finished with chip-proof, electro-statically applied polyester or epoxy finish. All other metal parts chrome plated.

Unit to be recess mounted at manufacturer=s recommended height for age group served.

Units rated 10.0A, 208V, 1 phase, 60Hz.

Controls: Built-in infrared sensors.

Acceptable Products: Nova, Model IR20-AV085
Stelpro Design Canada

16.4.102 Blower Type Hair Dryers - Manual Control

Submit product data in accordance with Section 16.2.001.

Drawings to include:
(a) Mounting methods
(b) Physical size
(c) Layout and diagrams of all unit heaters used as auxiliary to main heating plant.

Submit maintenance data to Section 16.2.001.

Equipment

Heaters: CSA Listed.

Fan type heaters 180 CFM, with built-in high-heat limit protection.

Fan motor 1/8 HP, 3000 RPM, permanently lubricated ball-bearing type with resilient mount. Built-in fan overload protection.

Heater element 2000W Nichrome wire.

Cabinet to consist of one-piece heavy-duty, rib reinforced zinc alloy casting fitted with revolving nozzle, recessed instruction plate. Exposed portions

16.4.102 Blower Type Hair Dryers - Manual Control (Cont'd)

finished with chip-proof, electro-statically applied polyester or epoxy finish. All other metal parts chrome plated.

Unit to be recess mounted at manufacturer=s recommended height for age group served.

Units rated 10.0A, 208V, 1 phase, 60Hz.

Controls: Built-in three-minute time cycle.

Acceptable Products: Nova, Model MT203-AV085
Approved Equal

16.4.103 Forced Air Console Unit

Related Work

Heating and Cooling Controls: Section 16.4.091.

Product Data

Submit product data in accordance with Section 16.2.001.

Product data to include:
(a) Fan accessibility
(b) Anchoring of cabinet
(c) Physical size
(d) Thermostat, transformer, controls integral
(e) Finish
(f) KW rating, voltage, phase
(g) Cabinet material thickness

Forced Air Console Unit

Elements: stainless steel sheathed with corrosion protected aluminum fins covering full length of element.

Blower motors: two-speed, single phase.

Built-in thermostat with integral relay for wall mounting units. Wall mounted thermostats: to Section 16.4.091 c/w integral relay and control transformer in heater for ceiling mounting.

Fan delay switch.

ON-OFF switch.

Trim for flush T-bar or wall installation as indicated.

Finish: three stage phosphatized treatment followed by two coats baked enamel with final coat beige colour.

Assembly fully wired to one outlet location.

16.4.103 Forced Air Console Unit (Cont'd)

Multiple knockouts for 12 to 19mm dia. conduit.

Acceptable Manufacturers: Dimplex Canada
Canadian Chromalox Co. Ltd., Series CH.
Stelpro Design Canada
Convect-Air

16.4.104 Forced Air Wall Heaters

Related Work

Heating and Cooling Controls: Section 16.4.091.

Product Data

Submit product data in accordance with Section 16.2.001.

Product data to include:
(a) Replacement data for motor element, thermostat and switch
(b) Mounting methods
(c) KW rating, voltage, phase
(d) Cabinet material thicknesses
(e) Physical size
(f) Finish
(g) Thermostat, transformer, controls where integral.

Forced Air Wall Heaters

Forced air wall heaters, commercial type as follows:
(a) Enclosure:
  .1 Steel
  .2 Knockouts for 12mm dia. conduit left, right, bottom and rear
  .3 Grill and frame finished black.
(b) Elements and Fan:
  .1 Mineral insulated, nickel chromium alloy
  .2 Motor: totally enclosed, shaded pole, impedance protected motor.

Built-in tamperproof controls. "ON-OFF-FAN ONLY" selector switch and temperature control knob.

Acceptable Manufacturers: Dimplex Canada
Canadian Chromalox Co. Ltd.
Stelpro Design Canada
Convect-Air

16.4.105 Rotating Beacon

Submit shop drawings in accordance with Section 16.2.001.

Equipment to FAA specification AC150/5345-12 for L-801A.

All moving parts permanently lubricated.

Cast aluminum and vented motor-drive housing.

16.4.105 Rotating Beacon (Cont'd)

Permanently lubricated 60Hz motor.

Four lamps mounted at right angles to each other.

Automatic changeover to standby lamps in case of lamp failure.

Telltale circuit for lamp failure signal.

Rotation at 12.4 RPM to produce a total of 25 flashes per minute, alternately white and green.

1000W quartzline PAR-64 lamps, 4000-HR rated life, 50,000 minimum effective candelas from +2° to 8° vertical.

Lamp housings adjustable from +2E to 10E.

Power requirements 2500W, 120V AC, 60Hz.

Heater to warm gear box lubricant to facilitate cold weather operation.

Mounting base for roof mounting.

Approved Products: ALNACO Style RB-4, Catalogue #80114-0100.
Approved Equal

16.4.106 Electrical Panel Schedules

Not applicable to this Section.

16.5 CONSTRUCTION METHODS

16.5.001 Electrical - Removals

Description of Work

In general, work of this section consists of the complete removal of all existing electrical equipment and materials in the building to be renovated.

Reference Standards

All removal or modification work of electrical construction to be done in accordance with the safety standards outlined in the Canadian Electrical Code.

Protection

Be responsible for any damages to existing structure as a result of the work.

Salvage Material

Materials and equipment identified on the drawing as being reused are to be taken down, stored, reinstalled, etc. as required to allow for new construction.

Contractor must identify any damaged equipment or materials intended for reuse prior to demolition and point out deficiencies to the Engineer at that time.

Disposal

Prior to demolition, Owner will identify any items of electrical equipment which are to be set aside as directed for future use by Owner.

All other materials and equipment removed under work of this section becomes the property of the Contractor for disposal off of property.

Schedule

The Contractor is to note that the Owner intends to carry on business as usual and work activities must be coordinated to maintain electrical services in occupied areas. Provide any required temporary work.

Overtime work and work outside normal work hours as deemed necessary to accomplish this scheduling are the responsibility of the Contractor and must meet the requirements of the Department of Labour. All costs resulting from such overtime must be included in the Contractor's Estimated Total Tender Price.

Fire Protection Services; i.e., fire alarm, emergency and exit lighting, are considered essential services and must be maintained in operation at all times.

16.5.001 Electrical – Removals (Cont'd)

General Removals

Remove all existing electrical services including exposed wire and conduit, except those designated for reuse.

Remove electrical services associated with existing mechanical systems.

Coordinate work of this section with other trades.

Schedule all removal work with the Owner. Do not disrupt operations except as permitted by the Schedule.

Cutting

Cutting required for removals and alterations to be to the approval of the Engineer and performed with appropriate power tools.

Cleaning

Reused existing equipment to be cleaned in accordance with Section 16.2.001.

16.5.002 Trenching for Cables & Ducts

Excavations

Excavate to lines, grades, elevations and dimensions indicated on drawings or as directed.

Cut edges of asphaltic pavement with suitable cutting wheel or jack hammer and saw cut reinforced concrete deck prior to excavation. Cut only to width required to install services.

Remove unsuitable material from trench bottom to extent and depth directed by Engineer.

Where required due to removal of unsuitable material or unauthorized over excavation, bring bottom of excavation to design grade with common backfill material.

Compact trench bottom to density at least equal to density of adjacent surrounding soil.

Excavations require inspection and approval prior to commencement of installation operations.

Bedding Installation

Place sand bed in trenches where cable ducts are direct buried.

Ensure that trench has been excavated to the proper required depth.

Cover bottom of trench with 75mm of sand.

Lay cable ducts in trench in accordance with Section 16.5.003.

16.5.002 Trenching for Cables & Ducts (Cont'd)

Backfilling & Compaction

Do not proceed with final trench backfilling operations until installation of cable ducts is complete and that Engineer has inspected installations.

Use approved common backfill material as indicated or directed.

Place backfill material in uniform layers not exceeding 150mm in thickness up to subgrade elevation or top of trench. Compact each layer before placing succeeding layer.

Compact common backfill materials as follows:

(a) In non-pavement areas to a density at least equal to density of adjacent, undisturbed soil.
(b) In pavement areas and sodded areas to a minimum of 95% density for ASTM D698-78 maximum density.

Dispose of surplus backfill material off property after backfilling operations are complete.

Cable Marker Tape

Install polyethylene marker tape in trenches where cables are installed in cable ducts.

Place marker tape 150mm below final grade; continuous over full length of cable run.

Restoration of Existing Surfaces Affected

The following paragraphs are intended for complete reinstatement of all the existing surfaces disturbed by the excavations of this section.

Where existing grassed areas are encountered during excavations, stock pile reusable materials for replacement after cable or duct installation and backfilling are completed.

Where existing asphaltic pavement is encountered during excavations, remove all asphaltic debris from site and after cable duct installation and backfilling are completed, provide new base coarse and asphaltic pavement to match existing.

Where existing concrete pavement is encountered during excavation, remove all concrete debris from site and after cable duct installation and backfilling are completed, provide new concrete surface to match existing.

Where existing sidewalk is encountered, remove and reinstall after backfilling is complete.

16.5.003 Concrete-Encased Duct Banks

Installation General

Install reinforced concrete encased underground duct banks, including form work.

Build duct bank on undisturbed soil or on well-compacted granular fill not less than 150mm thick, compacted to 95% of maximum proctor dry density.

Open trench completely before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

Wood forms must be provided to prevent frost from lifting uneven sides of excavated trench. Wood forms to consist of 19mm plywood, 75mm higher than top of highest conduit in trench and along both sides of the entire length of the trench. Top of plywood to be held in place with 50 x 100mm wood studs installed every 1,000mm and connecting to the plywood on both sides of the trench. The bottom sides of the plywood forms are to be held in place with 150mm of backfill on the outside of the forms. All form work is to be removed after concrete is set-up.

Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.

Install base spacers at maximum intervals of 1.5m leveled to grades indicated for bottom layer of ducts.

Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 75mm horizontally and vertically. Stagger joints in adjacent layers at least 150mm and make joints watertight. Encase duct bank with 75mm thick concrete cover. Use galvanized steel conduit for sections extending above finished grade level.

Make transpositions, offsets and changes in direction using 5 degree bends sections, do not exceed a total of 20 degrees with duct offset.

Terminate duct runs with a duct coupling set flush with the end of the concrete envelope when dead ending duct bank for future extension.

Cut, ream and taper end of ducts infield to manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.

Allow concrete to attain 50% of its specified strength before backfilling.

Use anchors, ties and trench jacks as required to secure ducts and prevent moving during pouring of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.

Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.

16.5.003 Concrete-Encased Duct Banks (Cont'd)

Immediately after pouring of concrete, pull through each duct a mandrel followed by a stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling in cables.

Install four 3m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to buildings.

Inspections

Advise Engineer so that he may inspect ducts prior to pouring and be present during pour of concrete and clean-out.

16.5.004 Installation of Cables in Trenches & In Ducts

Cable Installation in Ducts

Install cables as indicated in ducts.

Do not pull spliced cables inside ducts.

Install multiple cables in duct simultaneously.

Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

To facilitate matching of colour coded multiconductor control cables, reel off in same direction during installation.

Before pulling cable into ducts and until cables are properly terminated, seal ends of cables with moisture seal tape.

After installation of cables, seal duct ends with duct sealing compound.

Field Quality Control

Perform tests in accordance with Section 16.2.001.

Perform tests using qualified personnel. Provide necessary instruments and equipment.

Check phase rotation and identify each phase conductor of each feeder.

Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is no less than 50 megohms.

Tests:

After installing cable, but before splicing and terminating, perform insulation resistance test with 1000V megger on each phase conductor.

Check insulation resistance after each termination to ensure that cable system is no less than 50 megohms.

16.5.004 Installation of Cables in Trenches & In Ducts (Cont'd)

Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

Remove and replace entire length of cable if cable fails to meet any of the test criteria.

16.5.005 Direct-Buried Underground Cable Ducts

Installation

Install fibreglass duct as indicated and in accordance with manufacturer's instructions.

Clean inside of ducts before laying.

Ensure full, even support every 1.5m throughout duct length.

Slope ducts as indicated with 1 to 400 minimum slope.

During construction, cap ends of ducts to prevent entrance of foreign materials.

Pull through each duct a steel or wooden mandrel not less than 300mm long and of a diameter 6mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling in cables.

In each duct, install pull rope continuous throughout each duct run with 3.0m spare rope at each end.

16.5.006 Pole Lines & Hardware

Preparation of Poles

Where poles require shortening, cut piece from top only.

Roof top of poles with two cuts forming planes at 45E to meet in horizontal ridge.

Cut parallel plane crossarm gains in face of pole for single and double arming, spacing as indicated.

Bore hole in centre of each gain for crossarm bolt as indicated.

Treat roof top, gains, bored holes with preservative before assembly.

Drill crossarms for pins, through bolts, double arm bolts and brace bolts as indicated. Pre-drill treated crossarms to standard spacing.

Fasten wood insulator pins to crossarms with galvanized steel nails.

Install crossarms and braces.

Install secondary racks as indicated.

16.5.006 Pole Lines & Hardware (Cont'd)

Installation

Locate and dig pole hole as indicated. Make holes large enough to allow space for tamping backfill.

Set poles to depth as indicated.

Align poles with crossarms at right angles to pole line on straight runs.

At change in direction of line, set crossarms to bisect angle formed by change.

Set poles to maintain even grade. Allow for contour of terrain and do not exceed grading of 1.5m per pole.

Replace backfill in 150mm layers. Tamp each layer and apply final layer to drain water away from pole.

For rock-mounted poles, install cribs, size to Saint John Energy standards.

For swampy condition, install cribs size to Saint John Energy standards.

Locate and install guy wires and anchors at dead-ends, corner poles and start of branch feeders, as indicated.

Insert anchor at least 1.8m into ground. Backfill and tamp in 150mm layers.

Install primary insulators.

Install number nails on each pole as indicated.

16.5.007 Conduits, Conduit Fastenings & Conduit Fittings

Drawings do not show all conduits. Those shown are in diagrammatic form only.

Installation

Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

Use rigid galvanized steel threaded conduit for all service work unless specified otherwise.

Use electrical metallic tubing (EMT) for feeders and branch circuit work except in poured concrete or underground unless indicated otherwise. When used for feeders, install a separate integral ground wire sized in accordance with the C.E.C.

Use rigid PVC conduit for feeders and branch circuit work under ground floor slab and in poured concrete unless indicated otherwise. Install an integral ground wire. Restrictions for use:

16.5.007 Conduits, Conduit Fastenings & Conduit Fittings (Cont'd)

(a) Do not use in hazardous locations.
(b) Do not use where enclosed in thermal insulation.
(c) Do not use where exposed.
(d) Must terminate at first outlet box in wall (maximum allowable length from floor stub out to first outlet box is 1500mm).

Use electrical non-metallic tubing (ENT) for branch circuit work concealed in concrete floor slab. Use only fittings and cement certified by the manufacturer for use with ENT. Install an integral ground wire. Restrictions for use:
(a) Must be provided with mechanical protection where subject to damage during or after construction.
(b) Do not use in hazardous locations.
(c) Do not use for direct burial.
(d) Do not use where enclosed in thermal insulation.
(e) Do not use where exposed.
(f) Must terminate at first outlet box in wall (maximum allowable length from floor stub out to first outlet box to 1500mm).

Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a pre-wired outlet box, connection to surface or recessed fluorescent fixtures, alternately used armoured cables.

Use liquid-tight flexible metal conduit for connections to motors in damp or wet locations.
Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

Mechanically bend steel conduit over 19mm diameter.

Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

Install fish cord in empty conduits.

Run six 25mm spare conduits up to ceiling space from each flush panel. Terminate these conduits in 152mm x 152mm x 102mm junction boxes in ceiling space.

Where conduits become blocked, remove and replace blocked section.

Dry conduits out before installing wire.

Conduit sizing, where indicated, is based on copper conductors and rigid steel conduit. Where NUAL is used, or where EMT that requires an additional ground wire is used, adjust conduit size to suit.

Surface Conduits

Run parallel or perpendicular to building lines.

Run conduits in flanged portion of structural steel.

Group conduits wherever possible on suspended/surface channels.

16.5.007 Conduits, Conduit Fastenings & Conduit Fittings (Cont'd)

Do not pass conduits through structural members except as indicated.

Do not locate conduits less than 75mm parallel to steam or hot water lines with a minimum of 25mm at crossovers.

Concealed Conduits

Do not install horizontal runs in masonry walls.

Do not install conduits in terrazzo or concrete toppings.

Conduits In Cast-In-Place Concrete

Locate to suit reinforcing steel. Install in centre one-third of slab.

Protect conduits from damage where they stub out of concrete.

Install sleeves where conduits pass through slab or wall.

Where conduits pass through waterproof membrane, provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.

Encase conduits completely in concrete.

Conduits In Cast-In-Place Slabs on Grade

Run conduits 25mm and larger below slab. Provide 50mm of sand over conduits below floor slab.

Conduits Underground

Slope conduits to provide drainage.

16.5.008 Surface Raceways

Install raceways as indicated, before installation of wiring. Install covers for raceways and fittings after installation of wiring.

Install supports, elbows, tees, connectors, fittings, bushings, adapters as required and as indicated.

Keep number of elbows, offsets and connections to minimum.

16.5.009 Underfloor Distribution System

Install underfloor distribution system complete with junction boxes, couplings, supports, adaptors and service fittings in accordance with manufacturer=s recommendations.

Install with cover side down during construction period for protection of finish material.

16.5.009 Underfloor Distribution System (Cont'd)

Seal joints of underfloor distribution system with approved waterproof sealer and adjust separation barrier to bear firmly under lids prior to placing of concrete floors.

Install duct so that inserts are 3mm below finished concrete floor.

Install marker screws on each end of every run, on either side of junction boxes, and on either side of permanent partitions.

Adjust marker screws flush so their heads show in cast-in-place surface of concrete.

Clean underfloor distribution system before installation of conductors and leave system free of moisture.

16.5.010 Cabletroughs

Installation
Install complete cabletrough system as indicated or as required.

Support cabletrough with hanger brackets and threaded rod through concrete ceiling.

Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

Cables in Cabletrough
Install cables individually.

Secure cables in cabletrough with nylon ties.

Identify cables in accordance with Section 16.2.001.

16.5.011 Busways

Not applicable to this Section.

16.5.012 Indoor Service Poles

Not applicable to this Section.

16.5.013 Power Cable & Overhead Conductors 1001 - 15000V

Install primary conductors up pole as per Saint John Energy standard.

16.5.014 Wires & Cables 0 - 1000V

Installation of Building Wires

Install wiring as follows:
(a) In conduit systems in accordance with Section 16.4.007.
(b) In cabletroughs in accordance with Section 16114.

16.5.014 Wires & Cables 0 - 1000V (Cont'd)

(c) In underground ducts in accordance with Section 16.5.004.
(d) In trenches in accordance with Section 16.5.003.
(e) In surface and lighting fixture raceways in accordance with Section 16.4.056.
(f) In wireways and auxiliary gutters in accordance with Section 16.4.056.

Installation of TECK Cable

Install cables as indicated.

Group cables wherever possible on channels.

Install cables in trenches in accordance with Section 16.5.003.

Lay cable in cabletroughs in accordance with Section 16114.

Terminate cables in accordance with Section 16151.

Installation of Armoured Cables

Group cables wherever possible.

Install cables in trenches in accordance with Section 16.5.004.

Lay cable in cabletrough in accordance with Section 16114.

Terminate cable in accordance with Section 16151.

Installation of Control Cables

Install control cables in conduit.

Ground control cable shield.

16.5.015 Communications Conductors

Install armoured cables in ducts as indicated using pulling eyes or wire rope sockets to protect outer sheath.

Install cables in conduits and cabletroughs inside buildings.

Leave 7.0m coils at each end for termination by Owner.

16.5.016 Splitters, Junction, Pull Boxes & Cabinets

Splitter Installation

Install splitters as indicated and mount plumb, true and square to the building lines.

Extend splitters full length of equipment arrangement except where indicated otherwise.

16.5.016 Splitters, Junction, Pull Boxes & Cabinets (Cont'd)

Junction, Pull Boxes & Cabinets Installation

Install pull boxes in inconspicuous but accessible locations.

Mount cabinets with top not higher than 2.0m above finished floor.

Size and install cabinets to C.E.C. requirements.

Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30.0m of conduit run between. pull boxes.

Identification

Provide equipment identification in accordance with Section 16.2.001.

Install Size 2 identification labels indicating system name, voltage and phase.

16.5.017 Outlet Boxes, Conduit Boxes & Fittings

Support boxes independently of connecting conduits.

Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

For flush installations, mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.

Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers not allowed.

16.5.018 Underground Distribution & Splice Boxes

Install below-grade service enclosures and grade level handholds where indicated to manufacturer's instructions.

16.5.019 Wiring Devices

Switches

Install single throw switches with handles in "UP" position when switch closed.

Install switches in gang-type outlet box when more than one switch is required in one location.

Mount toggle switches at height specified in Section 16.2.001 or as indicated.

Receptacles

Install receptacles in gang-type outlet box when more than one receptacle is required in one location.

Mount receptacles at height specified in Section 16.2.001 or as indicated.

16.5.019 Wiring Devices (Cont'd)

Where split receptacles have one portion switched, mount vertically and switch upper portion.

Coverplates

Protect coverplate finish with paper or plastic film until painting and other work is finished.

Install suitable common coverplates where wiring devices are grouped.

Do not use coverplates meant for flush outlet boxes on surface-mounted boxes.

16.5.020 Multi-Outlet Assemblies

Install at 850mm A.F.F. to underside.

Install supports, elbows, tees, connectors and fittings.

Keep number of elbows, offsets and connections to minimum.

Install barriers where required.

Install wiring and wiring devices as indicated.

16.5.021 Terminals & Connectors for Conductors - Communications

Mount connection blocks on plywood backboards in telephone room.

Colour match conductors on terminal strips to telephone authority standard.

Use tool with seating and cutting heads for connecting conductors to terminals.

Harness slack wire.

16.5.022 Wire & Box Connectors 0 - 1000V

Remove insulation carefully from ends of conductors and:
(a) Install mechanical pressure type connectors and tighten. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
(b) Install fixture type connectors and tighten.
(c) Install bushing stud connectors in accordance with EEMAC 1Y-2.

16.5.023 Connectors & Terminations

Install terminations and splices in accordance with manufacturer's instructions.

Bond and ground as required.

16.5.024 Connectors & Terminations - 15KV

Installation

Installation of termination kits of 15KV cables at sectionalizing switchgear in accordance with manufacturer's instructions is to be done.

Install deadbreak junctions in manholes as indicated in accordance with manufacturer=s instructions. Use shields drilled into walls and stainless steel mounting hardware for support.

Install deadbreak connectors on all cables in manholes. Each cable to have a minimum of 4.0 meters of slack cable at termination.

Install one stand-off bushing in parking stand on each deadbreak junction.

Install a copper ground bus below each deadbreak junction for terminating concentric neutrals. Bond all buses together using 2/0 AWG ground wire.

Install loadbreak connectors on cables at all transformer connections. Each cable to have a minimum of 2.5 meters of slack cable at termination. Excess cable to be coiled under pad.

Install insulated protective caps on all unused connection points.

Each cable to be megger tested after terminations installed to verify integrity.

Grounding

Ensure all non-current-carrying parts of metal equipment are bonded to ground.

16.5.025 Fastenings & Supports

Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

Secure equipment to poured concrete with expandable inserts.

Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

Secure surface mounted equipment with clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.

Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

Fasten exposed conduit or cables to building construction or support system using straps:

(a) One-hole steel straps to secure surface conduits and cables 50mm and smaller.
(b) Two-hole steel straps for conduits and cables larger than 50mm.
(c) Beam clamps to secure conduit to exposed steel work.

16.5.025 Fastenings & Supports (Cont'd)

Suspended support system:

(a) Support individual cable or conduit run with 6mm dia. threaded rods and spring clips.
(b) Support two or more cables or conduits on channels supported by 6mm dia. threaded rod hangers where direct fastening to building construction is impractical.

For surface mounting of two or more conduits, use channels at 1.5m oc spacing.

Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

Do not use wire lashing or perforated strap to support or secure raceways or cables.

Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trades and approval of Engineer.

Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer=s installation recommendation.

16.5.026 Wood Products

Installation

Layout and install the work in the location and arrangement shown on the drawings or as indicated by the Engineer.

Pre-drill all anchor holes to prevent splitting of wood.

All field cuts, holes and breaks in the preservative treatment shall be given two coats of Pentox green.

Install identification as indicated.

Install multi-outlet assemblies as indicated.

16.5.027 Uninterruptible Power Systems - Static

Installation

Locate UPS cubicles, battery rack and battery as indicated.

Locate and install remote mode lights and alarm cabinet as indicated.

Assemble and interconnect components to provide complete UPS as specified.

Connect AC mains to main input terminal.

16.5.027 Uninterruptible Power Systems – Static (Cont'd)

Connect UPS output to load.

Start-up UPS and make preliminary tests to ensure satisfactory performance.

Testing

Perform tests in accordance with Section 16.2.001.

Provide:
(a) Competent field personnel to perform test, adjustments and instruction on UPS equipment,
(b) Dummy load adjustable to 150% of system rated output.

Notify Engineer ten (10) working days in advance of test date.

Tests:
(a) Inspection of cubicles, battery rack and battery.
(b) Inspection of electrical connections.
(c) Inspection of installation of remote mode lights and alarms.
(d) Demonstration of system start-up and shut-down.
(e) Run UPS for minimum period of 4 h at full rated load to demonstrate proper operation with AC mains input, emergency generator input, no AC input.
(f) Discharge battery by operating UPS with AC mains open for specified duration of full load. Record readings of temperature of each cell.
(g) Recharge battery automatically with full rated load on UPS for 4 hours and record readings of voltage of each cell.

16.5.028 Unit Substation Structure to 15KV

Installation

Set and secure cubicles and transformers in place, rigid, plumb and square, on channel bases.

Interconnect cubicles and transformer with bus bar connections supplied by manufacturer.

Check factory made connections for mechanical security and electrical continuity.

Run one grounding conductor 3/0 AWG bare copper in 25mm conduit from substation ground bus to electrical room ground bus as indicated.

After finishing work, remove foreign material, including dust, before energizing substation.

Set transformer taps for secondary voltage of 600V at no load.

Check fuse sizes and relay settings against shop drawings to ensure proper working of components and that coordinated sequence of action is established.

16.5.028 Unit Substation Structure to 15KV (Cont'd)

Field Tests

Perform tests in accordance with Section 16.2.001.

Test to include:
(a) Primary and secondary voltage at no load.
(b) Primary and secondary voltages at normal load.
(c) Primary and secondary current in each phase.
(d) kW and kVA.
(e) Transformer ambient temperature.

16.5.029 Outdoor Substation Structure to 15KV

Installation

Set and secure substation structure in place rigid, plumb and square and as indicated.

Field Quality

Perform tests in accordance with Section 16.2.001.

Arrange for pre-service inspection. insulation test.

Check insulation of substation assembly with 1000V megger with feeder cables and connections disconnected.

Conduct high potential tests on substation assembly to Engineer=s written instruction.

Verify phase rotation of each feeder.

Check continuity of each feeder.

16.5.030 Distribution Transformers - Liquid Cooled

Install transformers only after other work in area is completed and in accordance with manufacturer=s instructions.

Use spreader bars on slings when lifting transformers into place.

Set and secure transformers in place, rigid, plumb, square.

Ensure internal connections are mechanically tight.

Make connections.

Connect transformer ground terminal to system ground.

Set taps to produce rated secondary voltage at no-load.

16.5.031 Primary Dry Type Transformers

Installation

Locate, install and ground transformers as indicated and in accordance with manufacturer's instructions.

Set and secure transformers in place, rigid, plumb and square.

Connect primary bushings to high voltage circuit.

Connect secondary bushings to secondary circuit.

Energize transformers and check secondary no-load voltage.

Adjust primary taps as necessary to produce rated secondary voltage at no-load.

Locate and install cooling fans:
(a) Connect thermostat control.
(b) Connect sequence contacts of temperature indicator:
(c) First contact closure: start fan.
(d) Second contact closure: sound alarm.
(e) Third contact closure: trip secondary breaker.

Use torque wrench to adjust internal connections in accordance with manufacturers recommended values.

Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

Tests

Perform tests in accordance with Section 16.2.001.

Energize transformers and apply incremental loads:
(a) 10% for first hour.
(b) 25% for next two hours.
(c) 50% for next three hours.
(d) Full load.
(e) At each load change, check temperatures ambient, enclosure and ventilating air.
(f) Adjust cooling fan controls if required.

16.5.032 Pad Mounted Distribution Transformers

Inspection

Check factory made connections of transformer unit for mechanical security and electrical continuity.

Check transformer insulating liquid for correct quantity and specification according to manufacturer's instruction.

16.5.032 Pad Mounted Distribution Transformers (Cont'd)

Installation

Ensure concrete pad is fully cured before transformer is installed.

Set and secure transformer unit in place, rigid plumb and square.

Make connections as indicated.

Connect transformer unit ground bus to system ground.

Wire one set of contacts on liquid temperature thermometer and liquid level gauge to PLC to alarm unsafe conditions.

Ensure care is taken to prevent contamination of liquid and components when field filling transformers.

Use only metal hose when field-filling transformer with oil: never, under any circumstances, use rubber hose.

Set taps to produce rated secondary voltage at no-load.

16.5.033 Concrete Transformer Pad

Inspection

Check manufactured pad for visible defects in workmanship prior to installation.

Installation

Excavation and installation of backfilling materials for the transformer pad site shall be by the general contractor.

Concrete pad shall be installed on a bed of 300mm of well-tamped gravel with 150mm of well-tamped sand between the ducts and foundation planks installed under the pad base.

A minimum of 150mm of sand shall be installed inside the pad to provide a cable bed and to minimize washouts.

Backfill pad with well-tamped gravel or crushed rock.

Install four ground rods (20mm x 3000mm) 800mm out from the four pad corners and 150mm below grade in undisturbed soil. They shall be interconnected with 2/0 bare copper ground conductor with two leads brought in under the pad as per Saint John Energy standard practice details. Ground rods and ground conductor may be placed inside pads in paved areas with special approval from Saint John Energy.

Install bollards as required and connect to ground loop with 2/0 ground conductor.

16.5.033 Concrete Transformer Pad (Cont'd)

Care to be taken during equipment installation so as not to crack, scratch or chip the pad surface. Minor chips or scratches shall be repaired with epoxy cement and painted to avoid ultraviolet deterioration of the fibreglass.

Cables or pulling lines are not to be attached to the pad during cable installation.

16.5.034 Pad Mounted Sectionalizing Switchgear

Inspection

Check factory made connections, mechanical security and electrical continuity.

Check operation of interrupter switches according to manufacturer=s instructions.

Installation

Ensure concrete pad is fully cured before equipment is installed.

Set and secure equipment unit in place, rigid, plumb and square.

Make connections.

Connect ground bus to system ground.
Verify correct operation of key interlock switches.

16.5.035 Primary Lightning Arresters

Mount arresters adjacent to primary bus of unit substation and connect line terminals to phase conductors. Connect ground terminals to ground bus.

16.5.036 Primary Switchgear Assembly to 15KV

Installation

Set and secure switchgear assembly in place on channel base, rigid, plumb and square as indicated.

Make field connections in accordance with manufacturer=s recommendations.

Connect ground bus to system ground, as indicated.

Render entire assembly rodent and insect proof by means of plates, screens, and grouting.

Ensure fixed housing into which interrupter moving carriage enters, is plumb.

Check factory-made connections for mechanical security and electrical continuity.

Check fuse sizes against shop drawings.

16.5.036 Primary Switchgear Assembly to 15KV (Cont'd)

Field Quality Control

Perform tests in accordance with Section 16.2.001.

Operate load interrupter closing and tripping mechanisms, to verify correct functioning.

Check insulation of switchgear assembly with 1000V megger. If values not satisfactory, clean, dry and heat switchgear and repeat tests until readings acceptable to Engineer.

Check phase rotation of each feeder.

Place primary switchgear in service and check ammeter readings to ensure proper functioning of instruments and satisfactory phase balance of loads.

16.5.037 Fuse Cutouts & Fuses - Outdoor

Mount fuse cutouts on crossarms and connect to primary and transformers feeder as indicated.

Mount fuse cutouts on substation structure as indicated.

16.5.038 Load Interrupters

Install load interrupter switches c/w switchgear cubicle.

16.5.039 Grounding - Primary

Grounding Installation

Install continuous grounding system including electrodes, conductors, connectors, accessories as indicated and to requirements of local authority having jurisdiction.

Ground fences to grounding system independent of station ground.

Install connectors to manufacturer=s instructions.

Protect exposed grounding conductors from mechanical injury.

Make buried connections and connections to electrodes, structural steel work, using copper welding by thermite process.

Use mechanical connectors for grounding connections to equipment provided with lugs.

Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG mhd bare copper cable for taps on risers from main ground bus to equipment.

Use tinned copper conductors for aluminum structures.

16.5.039 Grounding – Primary (Cont'd)

Electrodes Installation

Install ground rod electrodes. Make grounding connections to station equipment.

Install ground rod electrodes at transformer and switchgear locations.

Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.

Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

Equipment Grounding

Install grounding connections as indicated to typical station equipment including: neutral and gradient control mats. Non-current-carrying parts of: transformers, current transformers, frames of gang operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Outdoor lighting. Substation fences.

Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

Connect metallic piping inside station to main ground bus at several locations, including each service location within the station.

Neutral Grounding

Connect transformer neutral and distribution neutral together using 1000V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.

Interconnect electrodes and neutrals at each grounding installation.

Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

Pole-Mounted Transformer Grounding

Drive ground rods at base of each existing pole on which transformers are mounted and interconnect transformer, system neutral, lightning arresters and ground rods. Use butt ground on all new poles with and without transformers as indicated.

16.5.039 Grounding – Primary (Cont'd)

Cable Sheath Grounding

Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulation sleeves in cables.

Use No. 6 AWG flexible copper wire, soldered, not clamped, to cable sheath.

Connect bonded cables to ground with No. 2/0 AWG copper conductor.

Tests

Perform tests in accordance with Section 16.2.001.

Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction.

Perform tests before energizing electrical system.

16.5.040 Overhead Service

Install service mast and weatherhead.

Install meter socket, CT cabinet and conduit.

Install service drop conductors allowing adequate conductor length for connection to service equipment.

Allow adequate conductor length for connection to supply by power supply authority.

Allow adequate conductor length for drip loops.

Make grounding connections in accordance with Section 16.4.046.

16.5.041 Underground Service

Fit up service pole as indicated.

Install primary ducts as indicated.

Install transformer pad as indicated.

Install secondary ducts and conduit as indicated.

Install cables in underground ducts and conduit as indicated.

Allow adequate conductor length for connection to supply by power supply authority. Provide suitable bus to cable lugs so Utility can properly terminate secondary cables at transformer.

Allow adequate conductor length for connection to service equipment.

16.5.041 Underground Service (Cont'd)

Make grounding connections in accordance with Section 16.4.046 and utility service entrance standards.

16.5.042 Capacitors for Power Factor Correction

Install and connect capacitor.

Perform tests in accordance with Section 16.2.001.

16.5.043 Service Equipment

Install service equipment as indicated.

Connect to incoming service as indicated.

Connect to outgoing load circuits as indicated.

Make grounding connections in accordance with Section 16.4.046 and Utility Services Entrance Standards.

Make provision for power supply authority=s metering to meet their requirements.

16.5.044 Service Entrance Board

Locate service entrance board as indicated and fasten to wall.

Connect main secondary service to line terminal of main breaker.

Connect load terminals of distribution breakers to feeders as indicated.

Connect ground bus to service ground.

Check factory-made connections for mechanical security and electrical continuity.

Run one grounding conductor 3/0 AWG bare copper in 25mm conduit from ground bus to building steel.

Check trip unit settings against coordination study to ensure proper working and protection of components.

16.5.045 Disconnect Switches - Fused & Non-Fused - Up to 1000V

Install disconnect switches, complete with fuses, as indicated.

16.5.046 Grounding - Secondary

Installation General

Install complete permanent, continuous system and circuit, equipment, grounding systems including electrodes, conductors, connectors, accessories as indicated to conform to requirements of Engineer and local authority having jurisdiction over installation.

16.5.046 Grounding – Secondary (Cont'd)

Install connectors to manufacturer's instructions.

Protect exposed grounding conductors from mechanical injury.

Make buried connections and connections to conductive water main, electrodes, using copper welding by thermit process.

Use mechanical connectors for grounding connections to equipment provided with lugs.

Soldered joints not permitted.

Install an integral bonding wire in all flexible conduit connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.

Install separate ground conductor to outdoor lighting standards.

Connect building structural steel to ground by welding copper to steel.

Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

Bond single conductor, metallic armoured cables to cabinet at supply end and load end.

Electrodes

Make ground connections to continuously conductive underground water pipe on street side of water meter.

Install water meter shunt.

Install rod electrodes and make grounding connections as indicated.

Bond separate, multiple electrodes together.

Use Size 3/0 AWG copper conductors for connections to electrodes.

System & Circuit Grounding

Install system and circuit grounding connections to neutral of secondary 600V and 208V system.

Equipment Grounding

Install grounding connections to typical equipment included in, but not necessarily limited to, following list: service equipment, transformers, duct systems, frames of motors, starters, control panels, building steel work, distribution panels, outdoor lighting.

16.5.046 Grounding – Secondary (Cont'd)

Communications

Install grounding connections for telephone system as follows:
(a) Telephone: make telephone grounding system in accordance with telephone company's requirements: one No.6AWG in 12mm conduit to telephone backboard with 3.0m coil left for telephone company use.

Field Quality Control

Perform tests in accordance with Section 16.2.001.

Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

Perform tests before energizing electrical system.

16.5.047 Dry-Type Transformers Up to 600V Primary

Mount dry-type transformers up to 75KVA as indicated.

Mount dry-type transformers above 75KVA on floor.

Ensure adequate clearance around transformer for ventilation.

Install transformers in level upright position.

Remove shipping supports only after transformer is installed and just before putting into service.

Loosen isolation pad bolts until no compression is visible.

Make primary and secondary connections indicated on wiring diagram.

Energize transformers immediately after installation is completed, where practicable.

16.5.048 Loadcentres - Breaker Type

Locate loadcentres as indicated and mount securely, plumb, true and square, to adjoining surfaces.

Install surface mounted loadcentres on plywood backboards.

Mount loadcentres to height given in Section 16.2.001 or as indicated.

Connect loads to circuits as indicated.

Control neutral conductors to common neutral bus with respective neutral identified.

16.5.049 Panelboards - Breaker Type

Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

Mount panelboards to height given in Section 16.2.001 or as indicated.

Connect loads to circuits as indicated.

Connect neutral conductors to common neutral bus with respective neutral identified.

16.5.050 Panelboards - Switch & Fuse Type

Locate panelboards as indicated and mount securely, plumb, and square to adjoining surfaces.

Connect loads to circuits as indicated.

Connect neutral conductors to common neutral bus with respective neutral identified.

16.5.051 Air Circuit Breakers

Install air circuit breakers as indicated.

Install suitable cable lugs on load stabs and install load cables with substation hot.

Install circuit breakers without de-energizing unit substation.

Adjust breaker trip settings as indicated and verify operation using appropriate test set.

Wire out shunt trip through 120V power source and verify shunt trip operation.

16.5.052 Moulded Case Circuit Breakers

Install circuit breakers as indicated.

16.5.053 Fuses

Install fuses in mounting devices immediately before energizing circuit.

Ensure correct fuses fitted to physically-matched mounting devices.

Ensure correct fuses fitted to assigned electrical current.

Install fuse cabinet c/w spare fuses.

16.5.054 Contactors

Install contactors and connect auxiliary control devices as indicated.

16.5.055 Ground Fault Circuit Interrupters - Class "A"

Do not ground neutral on load side of ground fault device.

Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

Perform tests in accordance with Section 16.2.001.

Demonstrate simulated ground fault tests.

16.5.056 Lighting Equipment

Locate and install luminaires as indicated.

Connect luminaires to lighting circuits.

For luminaires mounted in suspended ceilings, support luminaires from ceiling grid in accordance with local inspection requirements.

Support fluorescent luminaires mounted in continuous rows one every 1.5m.

Align luminaires mounted in continuous rows to form straight uninterrupted line.

Align luminaires mounted individually parallel or perpendicular to building grid lines.

16.5.057 Exit Lights

Install exit lights and test as indicated, to requirements of NBC-1990 and as indicated.

Connect fixtures to exit light circuits as indicated.

Connect to remote 12V DC emergency lighting units.

Ensure exit light circuit breaker is locked in the “ON” position.

Provide wire guards in gymnasium.

16.5.058 Floodlighting - Exterior

Install floodlights in accordance with manufacturer=s instructions and as indicated.

Aim energized floodlights as indicated during darkness and in presence of Architect/Engineer.

Lock floodlights in final aiming position after Engineer’s approval.

16.5.059 Unit Equipment for Emergency Lighting

Mount 2500mm from finished floor or at ceiling level when less than 2500mm.

Install unit equipment and remote mounted fixtures as indicated.

Direct heads as indicated.

Test each unit for 30 minutes on emergency.

Provide wire guard in gymnasium.

Connect exit lights to unit equipment as indicated.

16.5.060 Lighting - Central Emergency System

Identify conductors for polarity and voltage.

Direct light heads as directed by Engineer.

Install with conductors sized to maintain current flow with maximum 5% voltage drop.

Perform tests in accordance with Section 16.2.001.

Submit test record to Engineer.

16.5.061 Street Lighting Poles & Luminaires

Install concrete foundation to standards set out in Division 3.

Erect poles on foundation, true and plumb, as indicated.

Install luminaires on poles, connect to pole wiring and install lamps.

Support wiring at top of pole with suitable wire grip.

Install fuse fitting and fuse in pole handhold.

Connect pole wiring to underground light circuit in handhold at pole base.

Perform tests in accordance with Section 16.2.001.

16.5.062 Lighting Control Equipment - Low Voltage

Locate transformer and relays in relay panel in accordance with manufacturer's recommendations and as indicated.

Locate switchgear indicated. Use two #18 LVT in EMT for wiring to switches, except use two #16 LVT in EMT for switches marked "Y" and "Z".

Perform tests in accordance with Section 16.2.001.

Actuate control units in presence of Engineer to demonstrate lighting circuits are controlled as designated.

16.5.063 Lighting Control Equipment - Photoelectric

Install photoelectric controls as indicated.

16.5.064 Lighting Control Equipment - Dimming - Incandescent

Installation

Install wall box dimmer and commercial dimmers as indicated.

Connect lamp circuits to dimmer as indicated.

Field Quality Control

Perform tests in accordance with Section 16.2.001.

Demonstrate that dimming systems are installed as indicated.

Demonstrate that dimming systems operate as intended and that there are no problems in starting lamps, nor in keeping them lit at any setting of dimming intensity control.

Demonstrate that no radio or TV interference is carried by system.

16.5.065 Time Clock

Install time clock as indicated.

120V control to be a separate circuit from loads.

Program to Owner’s requirements per manufacturer=s instructions.

Demonstrate operation to Engineer and Owner.

16.5.066 Interval Timers

Install interval timers as indicated.

16.5.067 Time Controls

Installation

Install time switch controls as indicated.

Program unit for the sequence of operation.

Demonstrate the complete sequence of operation.

Instruct the Owner in the operation and programming of the system.

16.5.067 Time Controls (Cont'd)

Field Quality Control

Perform test in accordance with Section 16.2.001.

Check out complete system for operational sequencing.

Submit to Engineer one copy of test results.

16.5.068 Surge Suppression

Install surge suppressor surface on wall beside Panel 'DB' and connect into panel feeders.

Connect to panel with 4 #3 AWG wire plus ground in EMT. Keep leads as short as possible.

Demonstrate operation to Owner.

16.5.069 Power Generation Diesel

Installation

Locate generating unit and walk-in enclosure and install as indicated.

Install fuel supply system as required.

Install ventilating air duct system as required.

Install wiring for motorized dampers from engine control circuit as required.

Install grounding as required.

Complete wiring and interconnections as required.

Start generating set and test to ensure correct performance of components.

Care, Operation & Start-Up

Provide services of factory service technician to supervise start-up of installation, check, adjust, balance and calibrate components.

Instruct Engineer and operating personnel in the operation, care and maintenance of equipment.

Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

16.5.069 Power Generation Diesel (Cont'd)

Testing

Perform tests as detailed in 16622.1.5.

Notify Engineer ten working days in advance of test date.

Provide fuel for testing and leave full tanks on acceptance. Remove fuel from existing generator tank and re-install in new generator tank.

Demonstrate:
(a) Unit start, transfer to load, retransfer to normal power, unit shut-down, on "Automatic" control.
(b) Unit start and shut-down on "Manual" control.
(c) Unit start and transfer on "Test" control.
(d) Unit start on "Engine Start" control.
(e) Operation of automatic alarms and shut-down devices.

Run unit on load for minimum period of 12 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.

At end of test run, check battery voltage to demonstrate charger has returned battery to fully charged state.

16.5.070 Automatic Load Transfer Equipment

Installation

Locate, install and connect transfer equipment as indicated.

Check relays, solid state monitors and adjust as required.

Tests

Provide factory trained field service technician to verify installation and witness start-up and commissioning of emergency power system.

Perform tests in accordance with Section 16.2.001.

Energize transfer equipment from normal power supply.

Set Generator Control Panel selector switch in "Test" position to ensure proper standby start, running, transfer and re-transfer. Return selector switch to "Auto" position to ensure standby shuts down.

Set Generator Control Panel selector switch "Manual" position and check to ensure proper performance.

Set Generator Control Panel selector switch in "Engine Start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

16.5.070 Automatic Load Transfer Equipment (Cont'd)

Set Generator Control Panel selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min., then should transfer back to normal power supply and standby should shut down.

Repeat, at 1 hour intervals, 8 times, complete test with selector switch in each position, for each test.

16.5.071 Fire Detection & Alarm System

Installation

Install systems in accordance with CAN/ULC-S524.

Install main control panel and connect to power supply.

Locate and install manual alarm stations and connect to alarm circuit wiring.

Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1m of air outlets. Maintain at least 600mm radius clear space on ceiling, below and around detectors. Locate duct-type detectors in straight portions of ducts.

Connect alarm circuits to main control panel.

Locate and install horns and visual signal devices and connect to signaling circuits.

Connect signaling circuits to main control panel.

Install end-of-line devices at end of alarm and signaling circuits.

Install remote annunciator panels and connect to annunciator circuit wiring.

Locate and install door releasing devices.

Locate and install remote relay units to control fan shut-down.

Sprinkler system: wire alarm and supervisory switches and connect to control panel.

Connect fire suppression systems to control panel.

Annunciation:

(a) Include system configuration and programming for annunciation of the building to the monitoring station as required.

16.5.071 Fire Detection & Alarm System (Cont'd)

Field Quality Control

Perform tests in accordance with Section 16.2.001 - Electrical General Requirements, and CAN/ULC-S537.

Fire alarm system:

(a) Test each device and alarm circuit to ensure manual stations, detectors and sprinkler system transmit alarm to control panel and actuate general alarm and ancillary devices.
(b) Check annunciator panels to ensure zones are shown correctly.
(c) Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of system.
(d) Class B circuits:
    .1 Test each conductor on all circuits for capability of providing alarm signal on line side of signal open-circuit fault condition imposed at electrically-most-remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    .2 Test each conductor on all circuits for capability of providing alarm signal during ground fault condition imposed at electrically-most-remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

Inspections

The manufacturer to make an inspection of all equipment components, devices and connections. Inspection to comprise an examination of such equipment for the following:

(a) That the type of equipment installed is that designated by this specification;
(b) That the wiring, installation and connections to equipment components show that the installer observed all applicable codes and standards;
(c) That the supervisory wiring of equipment is functioning as specified;
(d) That equipment supplied is installed in accordance with the manufacturer's recommendation and that all devices have been tested to verify their operation.

The manufacturer to supply to the contractor technical assistance with respect to changes necessary to conform to Paragraphs (a), (b), (c) and (d) above. During the period of inspection, the electrical contractor is to make available to the manufacturer, electricians as required.

On completion of the inspection and when all of the above conditions have been complied with, the manufacturer to issue to the engineer:

(a) A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.
(b) A certificate of verification confirming that the inspection has been completed in accordance with CAN/ULC-S537 and showing the conditions upon which such inspection and certification have been rendered.
(c) Final test and acceptance of the system shall be witnessed by representatives of three parties; the owner, the contractor and the manufacturer.

16.5.071 Fire Detection & Alarm System (Cont'd)

All costs involved in this inspection (from the manufacturer and the electrical contractor) to be included in the tender price.

Warranty

Provide a written guarantee, signed and issued in the name of the owner, stating that the fire alarm system is guaranteed against defects in material, workmanship and performance for a period of two (2) years from the date of the Final Certificate of Completion; CAN/ULC-S537.

16.5.072 Multiplex Fire Alarm System

Installation

Install systems in accordance with CAN/ULC-S524.

Install central control unit and connect to AC power supply.

Locate and install alarm devices and connect to alarm circuit wiring. Do not mount detectors within 1 metre of air outlets. Maintain at least 600mm radius clear space on ceiling, below and around detectors. Locate duct detectors on straight portions of ducts.

Connect alarm circuits to main control panel.

Install audio/visual devices and connect to signaling circuits.

Connect signaling circuits to main control panel.

Install remote annunciator and connect to annunciator circuit wiring.

Install remote relay units to control fan shutdown.

Sprinkler system: wire alarm and supervisory switches and connect to control panel.

Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.

Identify circuits and other related wiring at central control unit, annunciators and terminal boxes.

Field Quality Control

Perform tests in accordance with Section 16.2.001 and CAN/ULC-S537.

Fire alarm system:

(a) Test each alarm and signaling device to ensure proper operation.
(b) Check annunciator panels to ensure zones are shown correctly.
(c) Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of trouble signals.

Provide final PROM progress reburn, incorporating program changes made during construction.

16.5.073 Communications Intrusion Alarm

Install complete empty alarm conduit system as indicated.

16.5.074 Building Entrance Control System

Install system in accordance with manufacturer=s instructions.

Perform tests in accordance with Section 16.2.001.

Perform intelligibility tests.

16.5.075 Door Bells/Chimes System

Attach components to wall where indicated with screws and expanded shields or toggle bolts.

Install wiring as indicated.

Remove packing material and construction dirt around plunger.

Test system for operation and sound level.

16.5.076 Intrusion Alarm

Installation

Install complete intrusion alarm system as indicated.

Program system to Owner's requirements.

All system components tested by manufacturer in presence of Engineer to ensure correct operation of system.

On completion of tests, provide certificate listing all components tested.

Run 2/C #22 ga. twisted pair in 12mm conduit from telephone terminal to Intrusion Alarm control panel.

Detectors mounted surface to wall 300mm above T-bar ceiling unless indicated otherwise.

Demonstration

Instruct and demonstrate complete operation to Owner.

Provide simplified operating instructions and plan/chart indicating detector location in plasticized covers.

16.5.077 Card Access & Alarm Monitoring System

Installation

Flush mount control panel, card access stations, remote alarm panel and flashing alarm as indicated.

Connect card access stations to access control panel.

Connect laboratory freezer and refrigerator alarms to panel as indicated.

Connect remote alarm contacts to output contacts of alarm panel to indicate an audio/visual alarm when laboratory alarms are activated.

Connect flashing alarm to single pole switch mounted adjacent to specimen fridge.

Connect door strikes to doors where card access system is installed.

Install software on computer.

Interface control panel to computer and printer.

Cabling

Follow manufacturer's recommended procedure for the installation of all device cabling.

Testing

Do testing in accordance with manufacturer=s recommended procedure.

Provide Certification of Acceptance indicating that the system is operating as intended, and in accordance with manufacturer=s tolerances.

Training

Instruct Engineer and operating personnel in the operation, care and maintenance of equipment.

Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

Include an instructional training video tape.

16.5.078 Automatic Telephone Dialer

Install two line automatic dialer on existing telephone entrance backboard c/w 120V from breaker and 2#14 RW90 in 20mm EMT. Contractor is to pay for all initial fees associated with the installation of telephone lines.

Connect input to fire alarm and intrusion alarm panel.

Connect output to telephone system.

16.5.078 Automatic Telephone Dialer (Cont'd)

Program unit to dial up numbers as per Owner's instructions.

Test system in presence of Engineer and Owner to ensure correct operation. Contractor is to coordinate with Owners representative and local fire and police department officials for exact wording on the automatic dialer. Contractor is to provide necessary training to above.

16.5.079 Telephone Raceway System

Install empty raceway system, including fish wire, cabinets, outlet boxes, pull boxes, coverplates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.

Install bushings on ends of all conduit runs.

16.5.080 Incoming Telephone Service

Install telephone service facilities.

Install 19mm thick plywood backboard in telephone room as indicated.

Install grounding facilities.

16.5.081 Communications Wire Cable Connections

Installation

Install building telecommunications terminating and cross-connecting systems in telecommunications closet equipment room in accordance with Engineer's drawings and manufacturer's instructions.

Install telephone and data service facilities.

Install connection to equipment racks in telecommunications closets and equipment rooms.

Install multiple connector system and cross-connection facilities in telecommunications closet.

Install jumpers to cross-connection facilities, telephone facilities and equipment outlets to commission voice or data service. Exact jumpering to be determined on site.

All cross-connect cable must use the highest quality parts, and be Category 6 rated.

Installation of Telecommunications Wires

Use tool with seating and cutting heads for connecting conductors to terminals.

Harness slack wire in cabinets, terminals and cross-connecting terminating systems.

16.5.081 Communications Wire Cable Connections (Cont'd)

Installation of Outlet Jacks

At each work station/outlet, the cables are to be terminated on a Northern Telecom Quad Category 6, 8-position RJ45, non-keyed modular BIX data/voice outlet (DVO), ISDN pinout, flush mounted on walls.

Voice & Data Cable Drops

Flush-mounted wall jacks:
(a) Provide two voice and one data cable drops as indicated to each telephone outlet box shown on plans.
(b) Make connections to outlets.

Telecommunications Closet Connection

Voice:
(a) Make cross-connect to demarcation point for each voice cable connection.
(b) Coordinate with local telephone authority to ensure telephone service is available upon completion of project.

Labeling

For each voice and data connection, label outlet jack and BIX field.

Label outlet jack with decal. Cross-connect fields may be labeled with marker.

Exact type of labeling to be determined on site.

Both ends of each cable are to be labeled with the terminating outlet identifier number.

An additional five voice and five data cables shall be left coiled in the ceiling of the general office area, secured to the ceiling tile suspension eyelets, to facilitate future relocations. The extra length of each cable coiled in ceiling shall be 10 metres.

All cables are to be routed as indicated.

Where cables leave zone conduit, they are to be tie wrapped to the ceiling suspension eyelets at regular intervals to prevent them from laying across the ceiling tiles.

Field Quality Control

Acceptance testing:
(a) All wires must be tested for continuity in accordance with Northern Telecom's IBDN Document #IBDN-TEST-9104.
(b) Certification is to be from the jack to the BIX 46DI and will include a cable length test, a cable dB loss test, a cable cross-talk test, a cable noise detection test and a cable DC loop resistance test.
(c) Any defects are to be corrected and the circuit re-certified.

16.5.081 Communications Wire Cable Connections (Cont'd)

Local and national codes: Installation must conform to the Canadian Electrical Code,
the National Building Code and other applicable regulatory requirements.

Provide instruments, meters, equipment and personnel required to conduct tests during, and at conclusion of, project.

Submit test results for Engineer's review.

Standard of Quality

As a "standard of quality", acceptable manufacturer's catalogue designations are included in portion of this specification. These catalogue designations and descriptions are not necessarily listed in order of preference and all manufacturers meeting this "standard of quality" may not be listed.

This installation is to be considered as an "end-to-end", Category 6 installation. Thus, all equipment, unless specified otherwise, is to be Category 6 rated. Installers must be approved prior to tender closing.

16.5.082 Public Address System

Installation

Locate, install and connect all Public Address system components as indicated.

Ensure all intercom system functions as expected. Remove and replace any defective components.

Tests

Test complete system, including intelligibility tests, under actual working conditions, in presence of, and to satisfaction of Engineer.

16.5.083 Television Cable System

From floor cabinets to television outlets, install empty 12mm raceway system, including fish wire, outlet boxes, pull boxes, coverplates, conduit sleeves and caps, miscellaneous and positioning material to constitute complete system. Alternately subject to cable television distributor approval, install cables directly without a raceway system, during construction.

16.5.084 Ceiling Fans

Install support for fan in ceiling as recommended by manufacturer.

Install ceiling fan and speed control as indicated.

Perform tests in accordance with Section 16.2.001.

Test at all speeds.

16.5.085 Motor Starters to 600V

Installation

Install starters, connect power and control as indicated.

Ensure correct fuses and overload devices elements installed.

Tests

Perform tests in accordance with Section 16.2.001 and manufacturer's instructions.

Operate switches, contactors to verify correct functioning.

Perform starting and stopping sequences of contactors and relays.

Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

16.5.086 Motor Starters to 600V (VFD's)

Installation

(a) Installation shall be the responsibility of the electrical contractor. The electrical contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
(b) The electrical contractor shall complete all power and control wiring. The electrical contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

Start-Up

Certified factory start-up shall be provided for each drive by factory-authorized service centre. A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer.

Product Support

Factory trained application engineering and service personnel that are thoroughly familiar with the drive products offered will be locally available at both the specifying and installation locations.

Warranty

Warranty shall be 24 months from the date of shipment (with certified start-up).

16.5.087 Motor Control Centre

Installation

Installation of concrete pad, anchor devices, channel base sills, setting templates: to standards set out in Division 23.

Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

Make field power and control connections as indicated.

Ensure correct overload heater elements are installed.

Tests

Perform tests in accordance with Section 16.2.001.

Ensure moving and working parts are lubricated where required.

Operate starters in sequence to prove satisfactory performance of Motor Control Centre during 8-hour period.

16.5.088 Time Controls

Install time switch controls as indicated.

16.5.089 Control Devices

Installation

Install pushbutton stations, control devices as indicated and interconnect as indicated.

Field Quality Control

Perform tests in accordance with Section 16.2.001.

Check out complete system for operational sequencing.

Submit to Engineer one copy of test results.

16.5.090 Programmable Logic Controller

Install programmable logic controller where indicated.

Connect designated terminals, wired per manufacturer=s instructions.

Install typewritten terminal designation nameplate cards adjacent to the terminal LED’s.

Connect to 120V power supply through a surge suppression device.
Wire input and output devices to the terminals.
Program unit for the sequence of operation.

16.5.090 Programmable Logic Controller (Cont'd)

Demonstrate the complete sequence of operation to the Consultant.

Instruct the Owner in the operation and programming of the system.

16.5.091 Elevator Services

Review installation requirements with Elevator Inspector prior to rough-in.

Install conductors, conduits, make connections as indicated, for:
(a) Power
(b) Lighting
(c) Emergency voice communication

Interface between work in Division 16 and work in Division 14 at supply terminals of elevator controller in machine room. Leave sufficient length of wire to make connections to controller.

Install disconnects in machine room as indicated.

Install conduit system for telephone as indicated.

Install lights, switches, receptacles for machine room, pit, as indicated.

Do not install any equipment in elevator hoistway, except equipment associated with elevator services.

Demonstrate to Engineer that services operate and coordinate with elevator as intended.

16.5.092 Electric Heating & Cooling Controls

Install and wire control devices as indicated.

On outside wall, mount thermostats on bracket or insulated pad 25mm from exterior wall.

Install guards on thermostats as indicated.

16.5.093 Programmable Time Controller

Install programmable time controller as indicated.

Connect input and loads as indicated.

Program unit as directed by Engineer.

Demonstrate complete operation and programming procedures to Engineer and Owner.

16.5.094 Heating Panels - Radiant

Install radiant panels as indicated and in accordance with manufacturer=s instructions.

Connect to power and thermostat circuits as indicated.

Perform both resistance and power tests prior to covering panels.

Install securely in place fibreglass or rigid insulation minimum R value of 7 on two of Type II panels.

Cover electrical connectors on Type II panels with sleeve provided and fill with silicone.

Provide both resistance and power test prior to covering connections. Leave panel energized for 2-hours minimum to ensure proper operation.

16.5.095 Heating Cables - Floor Warming

Installation

Install heating cable as indicated and in accordance with manufacturer=s instructions.

Secure cable straps to concrete with 25mm nails. Strapping located 1m intervals.

Secure cable to anchoring devices and confine cable within 50mm minimum from edge of slab.

Do not penetrate waterproofing membrane.

Protect heating cables with 13mm plywood sheets and removed progressively when concrete topping is poured.

Place remote sensing bulb in conduit in between heating cables 50mm deep in concrete.

Do not cross expansion joints with cable.

Do not alter heating cable length.

Ensure cables do not bunch or cross.

Do not energize cable for 28 days after concrete topping.

Ground cable and mesh to building grounding system.

Fasten floor warming cable to underside of slab on 400mm centres.

Tests

Perform tests in accordance with Section 16.2.001.

16.5.095 Heating Cables - Floor Warming (Cont'd)

Use 500V megger to test cables for continuity and insulation value and record readings before, during and after installation.

Where resistance of 50 megohms or less is measured, stop work and advise Engineer.

16.5.096 Baseboard Convectors - Residential

Install baseboard heaters and controls as indicated.

Make power and control connections as indicated.

Perform tests in accordance with Section 16.2.001.

Ensure that heaters and controls operate correctly.

16.5.097 Baseboard Convectors - Commercial

Installation

Install baseboard convector heaters as indicated.

When wireway is used, remove knockouts and insert insulating bushing between each unit.

Install grounding wire to maintain ground integrity between heating and auxiliary sections.

Make power and control connections.

Perform tests in accordance with Section 16.2.001.

Ensure that heaters and controls operate correctly.

16.5.098 Cabinet Convector Heaters

Install cabinet convectors as indicated.

Make power and control connection.

Perform tests in accordance with Section 16.2.001.

16.5.099 Unit Heaters

Installation

Suspend from ceiling as indicated.

Make power and control connections as indicated.

Tests

Perform tests in accordance with Section 16.2.001.

16.5.099 Unit Heaters (Cont'd)

Test cut-out protection when air movement is obstructed.

Test fan delay switch to assure dissipation of heat after element shut-down.

Test unit cut-off when fan motor overload protection has operated.

Ensure that heaters and controls operate correctly.

16.5.100 Horizontal Unit Heaters

Installation

Mount on ceiling as indicated.

Make power connection.

Tests

Perform tests in accordance with Section 16.2.001.

Test cut-out protection when air movement is obstructed.

Test unit cut-off when fan motor overload protection has operated.

Ensure that heaters and controls operate correctly.

16.5.101 Blower Type Hand/Hair Dryers - Infrared Controls

Mount on wall 1420mm A.F.

Perform operation tests.

16.5.102 Blower Type Hair Dryers - Manual Control

Mount on wall as indicated.

Perform operation tests. Verify time cycle.

16.5.103 Forced Air Console Unit

Installation

Mount units as indicated.

Make power and control connections.

Tests

Perform tests in accordance with Section 16.2.001.

16.5.104 Forced Air Wall Heaters

Installation

Install heaters as indicated with bottom of heater 300mm A.F. in accordance with manufacturer=s instructions.

Make power and control connections.

Tests

Perform tests in accordance with Section 16.2.001.

16.5.105 Rotating Beacon

Install rotating beacon where indicated in accordance with manufacturer's instructions.

Make power and control connections.

Test for proper operation, adjust lamp housings as directed by Engineer.

16.5.106 Electrical Panel Schedules

As indicated.

16.6 METHOD OF PAYMENT

16.6.01 Measurement for Payment

Measurement for payment shall be on a lump-sum basis.

16.6.02 Basis of Payment

Payment shall be made at the Contract Price, as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specification.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 17

TRAFFIC SIGNALS AND SIGNS

City of Saint John

TABLE OF CONTENTS

DIVISION 17 – TRAFFIC SIGNALS AND SIGNS

City of Saint John

TABLE OF CONTENTS

DIVISION 17 – TRAFFIC SIGNALS AND SIGNS

City of Saint John

TABLE OF CONTENTS

DIVISION 17 – TRAFFIC SIGNALS AND SIGNS

TRAFFIC SIGNALS AND SIGNS

17.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, material, plant and equipment necessary for the installation and commissioning of traffic signals, pedestrian crossing signal systems, other supplemental systems (such as Accessible Pedestrian Signals), traffic signs, posts and associated sign accessories and hardware as per the Drawings and Specifications.

17.2 DEFINITIONS

"**CEC"** shall mean the latest edition of the Canadian Electrical Code.

"**IMSA**" shall mean the International Municipal Signal Association.

"**CSA"** shall mean the Canadian Standards Association.

"**ITE**" shall mean the Institute of Transportation Engineers.

"**MUTCDC**" shall mean the latest edition of the Manual of Uniform Traffic Control Devices for Canada as published by the Transportation Association of Canada.

"NCTIP" shall mean the National Center for Transportation and Industrial Productivity.

"**NEMA**" shall mean the National Electrical Manufacturer's Association.

"**TAC**" shall mean the Transportation Association of Canada.

17.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Excavation, Trenching and Backfill Requirements ..... Div. 13

(d) Electrical Systems ..... Div. 16

(e) Restoration ..... Div. 21

(f) Portland Cement Concrete ..... Div. 23

(g) Landscaping ..... Div. 26

(h) Standard Drawings

17.4 MATERIALS

17.4.01 General

All material shall be supplied by the Contractor, unless otherwise specified.

Unless otherwise specified in the Contract or by the Engineer, all traffic signal equipment for installation shall be new, fabricated and supplied by recognized equipment manufacturers to meet the requirements of the City. All materials, components or custom equipment shall be CSA approved, where applicable, and comply with the requirements of the Electrical Safety Authority with respect to their application.

All materials shall be stored in accordance with manufacturers' instructions to prevent damage, soiling or finish spoilage. New poles shall be stacked to prevent bending or warping and shall be protected against any condition that may cause chipping or pitting in the finish.

Upon request of the Engineer the Contractor shall submit the manufacturer's name and specifications for traffic sign materials prior to incorporating the material into the Work.

Upon request of the Engineer the Contractor shall submit for all galvanized metals the manufacturer's certification that the materials supplied meet the specified requirements prior to incorporating the material into the Work.

The manufacturer is required to place their name and date of fabrication on the back of the traffic sign.

17.4.02 Concrete Bases

Cast-in-place concrete bases shall be in accordance with Division 23, "Portland Cement Concrete" to sizes and dimensions shown on the Standard Drawings.

Concrete shall meet the requirements of CSA A23.1 exposure class C-1.

All reinforcing steel shall be new billet steel conforming to current CAN/CSA G30.18, "Billet Steel Bars for Concrete Reinforcement", Grade 400. Reinforcing steel shall be in the form of deformed round bars. Welding or splicing shorter bars as a substitute for supplying bars of the specified lengths shall not be permitted.

Galvanized anchor bolts and hardware (washers and nuts) are to be included with the concrete bases as determined by the pole or controller manufacturer. Minimum diameter of anchor bolts and the anchor bolt circles in accordance with Standard Drawings. Anchor bolts shall have the following material properties: CSA G40.21, Grade 300W steel.

Other materials are detailed on the Standard Drawings.

Should existing soils conditions for the concrete bases differ than the assumed soils indicated in the Contract, the Contractor shall immediately advise the Engineer. The suitability of the concrete base designs shall be reviewed and

17.4.02 Concrete Bases (Cont'd)

confirmed by a Professional Engineer registered or licensed to practice engineering in the Province of New Brunswick.

17.4.03 Screw Bases

Screw Base: A.B. Chance Model # T112-0699 or approved equivalent.

Screw bases shall also include appropriate galvanized hardware (bolts, nuts and washers).

17.4.04 Underground Ducts & Conduits

Underground ducts and conduits shall be in accordance with Division 16, "Electrical Systems".

Underground ducts (or concrete encased ducts if specified) shall be PVC type DB2, size as indicated on the Drawings. Minimum duct diameter for detector loop home runs shall be 25mm and minimum duct diameter for traffic controller to pole runs shall be 50mm.

Fish line shall be nylon or polypropylene material with a minimum test strength of 400 N.

17.4.05 Grounding and Bonding

Grounding and bonding shall be in accordance with Division 16, "Electrical Systems". Ground plates shall be used for traffic signal grounding as indicated on the Standard Drawings. Ground plates shall be installed with each traffic cabinet base, pole base and service entrance. All poles shall be bonded back to traffic cabinet ground.

Ground Plates: Thomas & Betts Model # 1016BTB or approved equivalent.

17.4.06 Pull Boxes

Underground pull box enclosures shall be Synertech polymer composite boxes manufactured by Oldcastle Precast, complete with a polymer concrete support ring and cover. Covers shall have electrical identification and shall be secured with stainless steel hexagonal head bolts. For single runs of underground duct, the Synertech Catalog No. S1118HBB0A01 pull box shall be used. For multiple runs of underground duct the Synertech Catalog No. S1730B18FA pull box shall be used.

Stone bedding material shall be supplied in accordance with Division 13, "Excavation, Trenching and Backfill Requirements".

Backfill material shall be selected materials from the excavation, subject to the approval of the Engineer.

Above ground junction boxes shall be in accordance with Division 16, "Electrical Systems".

17.4.06 Pull Boxes (Cont'd)

The pull boxes shall be of the type and size as shown in the Contract.

17.4.07 Power Point

For non-metered services such as traffic controllers, flashing beacons, etc., the aerial power point shall consist of a 32mm diameter PVC mast and weatherhead on a wood pole, 3#10 RW90 (red, black and white) in the PVC duct underground to a 30A, 2P EEMAC 3R fused disconnect at 15A mounted 1.5 meters above ground on the traffic controller, 1#6 green ground in 16mm PVC to 100mm above ground and then 1#6 green ground extending to a copper ground plate located adjacent to the controller foundation 1 meter below grade, and then 4#10 RW90 in 32mm PVC to the traffic controller line connection point. Where the Saint John Energy power source is directly from a ground mounted transformer or underground wiring, a red, black and white wire sized #10 RW90 shall be routed in 32mm PVC conduit to a 30A, 2P EEMAC 3R rated fused disconnect with 15A fuses, mounted 1.5 meters above ground on the traffic controller, 1#6 green ground in 16mm PVC to 100mm above ground and then 1#6 green ground extending to a copper ground plate located adjacent to the controller foundation 1 meter below grade, and then 4#10 RW90 in 32mm PVC to the traffic controller line connection point. All fused disconnects shall use a 20K Interrupting Capacity double pole breaker. The service disconnect shall be a Square D (model Q0403L100RB) or approved equivalent.

For metered service, the aerial power point shall consist of a 32mm diameter PVC mast and weatherhead on a wood pole, 3#10 RW90 (red, black and white) in the 32mm PVC duct underground to a 30A, 2P EEMAC 3R fused disconnect fused at 15A and a 60A, 2P, 120/240V, 1Ø, 3W, 3R rated utility meter socket to Saint John Energy requirements mounted 1.5 meters above ground on the traffic controller, 1#6 green ground in 16mm PVC to 100mm above ground and then 1#6 green ground extending to a copper ground plate located adjacent to the controller foundation 1 meter below grade, and then 4#10 RW90 in 32mm PVC to the traffic controller line connection point. Where the Saint John Energy power source is directly from a ground mounted transformer or underground wiring, a red, black and white wire sized #10 RW90 shall be routed in 32mm PVC conduit to a 30A, 2P EEMAC 3R rated fused disconnect with 15A fuses and a 60A, 2P, 120/240V, 1 phase, 3W, 3R rated utility meter socket to Saint John Energy requirements, mounted 1.5 meters above ground on the traffic controller, 1#6 green ground in 16mm PVC to 100mm above ground and then 1#6 green ground extending to a copper ground plate located adjacent to the controller foundation 1 meter below grade and then 4#10 RW90 in 32mm PVC to the traffic controller line connection point. All fused disconnects shall use a 20K Interrupting Capacity double pole breaker.

17.4.08 Electrical

All electrical works shall be in accordance with Division 16, "Electrical Systems" and to the Canadian Electrical Code, latest edition.

17.4.09 Traffic Signal Cable

The traffic signal cable shall be in accordance with International Municipal Signal Association (IMSA) Specification No. 19-1. Traffic signal cable shall include a 10 AWG solid green wire for grounding.

Traffic signal cable to wire the signalized intersection: 26 conductor 14 AWG (neutral 14 AWG), stranded copper conductors, PVC outer jacket, polyethylene insulated and conductors arranged symmetrically in layers as per IMSA specifications. One layer of spirally wound, lapped, mylar tape applied under outer jacket. Cable outside diameter not to exceed 25.4mm. Conductors shall be rated 600 volts AC. Colour coding to be as per City standards (or as directed by the Engineer):

- Red: Solid, with (1) white tracer, red with (2) white tracers, red with (3) white tracers.
- Orange: Solid, with (1) white tracer, orange with (2) white tracers, orange with (3) white tracers.
- Blue: Solid, with (1) white tracer, blue with (2) white tracers, blue with (3) white tracers.
- Black: Solid, with (1) white tracer, black with (2) white tracers, black with (3) white tracers.
- Yellow: Solid, with (1) white tracer, yellow with (2) white tracers, yellow with (3) white tracers.
- Brown: Solid, with (1) white tracer, brown with (2) white tracers, brown with (3) white tracers.
- White: Solid

Traffic signal cable for use as riser cables for all traffic signal heads: 7 conductor 14 AWG (neutral 14 AWG), stranded copper conductors, PVC outer jacket, polyethylene insulated and conductors arranged symmetrically in layers as per IMSA specifications. One layer of spirally wound, lapped, mylar tape applied under outer jacket. Conductors rated 600 volts AC. Colour coding to be as per City standards (or as directed by the Engineer):

- Red: Solid
- Orange: Solid
- Brown: Solid
- Black: Solid
- Yellow: Solid
- Blue: Solid
- White: Solid

Tracers to be permanently marked or embedded into insulation and not printed.

Cable for Accessible Pedestrian Systems (APS) using a Central Control Unit shall be twisted, stranded and shielded communication cable in accordance with IMSA Specification 50-2.

17.4.10 Wire Markers

Wire markers shall be white in colour and shall be a minimum of 50.8mm x 19mm. Tags shall be supplied with a cable tie wrap to connect to the wire. Tags shall be designed to be permanently labelled with a black indelible pen.

Wire Markers: Panduit Model #MP200-C.

17.4.11 Fibre-Optic Cable

Single Mode (SM) Cabled Fibre

The SM fibre shall consist of a glass core surrounded by a glass cladding surrounded by a polymer coating. If tight buffering of the SM fibre is used, the buffering material may be considered to be the polymer coating. The SM fibre core shall have a diameter of between 8.3 to 9 µm inclusive with a tolerance of ± 1.3 µm. The SM fibre cladding shall have an outer diameter of 125 µm with a tolerance of ± 3 µm. The core eccentricity shall be less than or equal to 1.0 µm.

The SM fibre shall be coated with a protective polymer to preserve the strength of the fibre. The coating shall be removable by mechanical or chemical means. The coating shall retain its colour when subject to the manufacturer's recommended fibre cleaning and splicing preparation methods.

The SM fibre shall have attenuation and bandwidth specified at two wavelength windows. The first wavelength window shall be at and around 1310 nm. The second wavelength window shall be at and around 1550 nm. The mean optical attenuation at 1310 nm shall not be greater than 0.4 dB/km with a standard deviation not greater than 0.05 dB/km. The maximum attenuation of any continuous length of SM fibre at 1310 nm shall not exceed 0.45 dB/km.

The mean optical attenuation at 1550 nm shall not be greater than 0.3 dB/km with a standard deviation not greater than 0.06 dB/km. The maximum attenuation of any continuous length of SM fibre shall not exceed 0.36 dB/km.

The fibre attenuation shall not vary more than 0.2 dB/km over the specified cable operational temperature range. The single mode (SM) fibres shall have a step refractive index profile.

The fibre optical bandwidth at 1310 nm or 1550 nm shall be equal to or greater than 1000 MHzkm.

The zero dispersion wavelength shall be at a wavelength of 1310 ± 10 nm. The maximum dispersion at 1550 nm shall not exceed 18 ps/nmkm. The maximum dispersion in the wavelength range of 1285 to 1330 nm shall not exceed 3.2 ps/nmkm.

Multimode (MM) Cabled Fibres

The MM fibre shall consist of a glass core surrounded by a glass cladding surrounded by a polymer coating. If tight buffering of the MM fibre is used, the buffering material may be considered to be the polymer coating. The MM fibre

17.4.11 Fibre-Optic Cable (Cont'd)

core shall have a diameter of 62.5 µm with a tolerance of ± 3 µm. The MM fibre cladding shall have an outer diameter of 125 µm with a tolerance of ± 3 µm. The MM fibre core shall have a theoretical numerical aperture of 0.275. The core eccentricity shall not exceed 7.5%. The typical eccentricity shall be not greater than 2%. The core non-circularity shall be less than 2%.

The MM fibre shall be coated with a protective polymer to preserve the strength of the fibre. The coating shall be removable by mechanical or chemical means. The coating shall retain its colour when subjected to the manufacturer's recommended fibre cleaning and splicing preparation methods.

The polymer coating shall have an outer diameter of at least 230 µm.

The mean optical attenuation for cables at 850 nm shall be not greater than 3.2 dB/km with a standard deviation not greater than 0.3 dB/km. The maximum attenuation of any fibre shall not exceed 3.5 dB/km.

The mean optical attenuation for cables at 1310 nm shall not be greater than 1.0 dB/km with a standard deviation not greater than 0.2 dB/km. The maximum attenuation of any fibre shall not exceed 1.5 dB/km.

The fibre attenuation shall not vary more than ± 0.2 dB/km over the specified cable operational temperature range. MM fibres shall have a graded refractive index profile.

The MM fibre shall have attenuation and bandwidth specified at two wavelength windows. The short wavelength window shall be at and around 850 nm. The long wavelength window shall be at and around 1310 nm. The fibre optical bandwidth at 850 nm shall be equal to or greater than 200 MHzkm. The fibre optical bandwidth at 1310 nm shall be equal to or greater than 500 MHzkm.

Connectors

Connectors shall all be ST style unless otherwise specified in the Contract. Connectors shall have a ceramic ferrule with a nickel plated nut and body.

The connector mean loss shall not be greater than 0.5 dB with a standard deviation of not greater than 0.2 dB. The connector loss shall not vary more than 0.2 dB over the operating temperature range.

The connectors shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.

Index matching fluids or gels shall not be used.

The connector loss shall not vary more than 0.2 dB after 1000 repeated matings. The connector shall withstand an axial load of 135 N.

17.4.11 Fibre-Optic Cable (Cont'd)

The connectors shall be compatible with the optical fibre surrounding jacket and shall be installed on one end of the optical fibre in accordance with the manufacturer's recommended materials, equipment and practices. The connector shall be suitable for the intended environment and shall have an operating temperature range of -30 to +60 ^{o}C

Connectors shall be protected by a suitably installed waterproof protection cap.

17.4.12 Prefabricated Detector Loops

Prefabricated Loop/Lead-In Assembly: Reno A&E Model PLH or approved equivalent.

The loop/lead-in assembly shall be designed for applications in which the loop/lead-in assembly will be overlaid with hot asphalt or embedded in concrete.

The wires in the assembly shall be of a length of at least 30 metres to reach either the pull box or the controller without any joints whatsoever. The loop leads (home-run) must not be spliced.

17.4.13 Wireless Detector

The wireless vehicle detection system shall detect the presence and movement of vehicles with magneto-resistive sensors mounted in the asphalt. The sensors shall continuously transmit detection data via low power radio communications to access points that collect and forward data the traffic controllers.

Wireless Detector: Sensys Networks VDS240 wireless vehicle detection system.

Access Point: Sensys AP240-S.

Repeater: Sensys RP240-BH-LL.

Contact Closure Card: Sensys Contact Closure Card CC240, and Expansion Contact Closure Card EX240 (if required).

17.4.14 Microwave Vehicle Motion Detector

The microwave motion sensor shall identify a vehicle moving in its detection pattern and then trigger the operation of a traffic controller. By utilizing microwave technology, the device shall provide accurate and consistent vehicle detection that is not affected by temperature, humidity, color or background variations.

Motion Detector: MS Sedco TC26-B or approved equivalent.

17.4.15 Ultrasonic Vehicle Presence Sensor

The microwave motion sensor shall detect the continuous presence of an object within its detection pattern, stationary or in motion.

Presence Detector: MS Sedco TC30-B or approved equivalent.

17.4.16 Transformer Bases

Transformer bases shall be 432mm tall aluminum alloy, complete with access door fastened with a stainless steel screw. Galvanized hardware (nuts, bolts, washers) and rubber washers shall be included. Bolt circles to match poles and bases.

Traffic Pole Adapter plate for the TB2-17 transformer base shall be 302mm x 320mm with a bolt circle of 267mm for a 25.4mm round bolt hole (bolt hole shall be round, not slotted). Centre-to-centre dimension of 181mm with a centre hole diameter of 127mm. Plate must be at least 4.75mm thick.

Model TB1-17 and TB2-17 or approved equivalent.

17.4.17 Aluminum Poles

Shop Drawings shall be prepared for the fabrication of aluminum poles. The Shop Drawings shall be submitted to the Engineer for approval prior to commencement of fabrication of the aluminum poles. The Shop Drawings shall be stamped and signed by a Professional Engineer registered or licensed to practice engineering in the Province of New Brunswick. The Manufacturer shall design the poles in accordance with CAN/CSA-S6 to ensure they are adequate to support all of the individual traffic signal, sign and wind loadings that will be applied to that particular pole.

As a minimum, the Shop Drawings shall include the following information:

- Detailed dimensions.
- Plans, elevations, sections, and details to show pole structural details.
- Equipment layout.
- Anchor bolt locations.
- Detailed bill of materials.

The pole shaft shall be of one section fabricated from aluminum alloy seamless tubing free from longitudinal welds. Aluminum used in the production of pole shafts shall be according to ASTM B221, alloy 6063-T6. Typical traffic pole lengths shall be 1.52 metres (5 feet), 2.44 metres (8 feet), 3.05 metres (10 feet), 3.66 metres (12 feet), 4.57 metres (15 feet) or 5.79 metres (19 feet), unless otherwise specified in the Contract. Typical combination street lighting pole length shall be 9.144 metres (30 feet), unless otherwise specified in the Contract.

Poles shall be supplied with a hand-hole (complete with an aluminum cover), semi-flush (100 mm x 150 mm). Centre of hand-hole shall be 500mm from bottom of pole base. Poles shall come complete with an internal ground bar and fasteners.

All welding shall be according to CSA W47.2.

17.4.17 <u>Aluminum Poles</u> (Cont'd)

Aluminum poles shall be heat treated after fabrication to T6. After fabrication is complete, all welds, cut edges, projections and sharp edges shall be ground to present a smooth surface prior to finishing and the pole shall be thoroughly cleaned. Poles shall be finished by a rotating polishing process.

The pole shall be supplied with a one-piece square, cast aluminum anchor base (shoe base) continuously welded to the bottom. The anchor base shall be provided with four oblong holes integral within the casting to receive the anchor bolts in the specified bolt circle diameter. Aluminum used in the production of base castings shall be according to ASTM B108, alloy A 356.0-T6. The base shall telescope the butt end of the shaft and be secured with one continuous weld on the inside of the base at the end of the shaft, and another continuous weld on the outside at the top of the base. The two welds shall be not less than 50mm apart and shall be made in such a manner as to ensure that the welded connection shall develop full strength of the adjacent shaft section to resist any bending action. After fabrication, the underside of the cast anchor base shall be true, distortion free and perpendicular to the centreline of the pole shaft.

Anchor bolts are to be included with each pole and size to be determined by the Manufacturer. Anchor bolt circle to dimensions shown on the Standard Drawings.

Each pole shall be supplied with four (4) aluminum toe caps to be used for bolt covers. The toe caps shall be the type that is attached to the shoe base with a single screw. Bolt covers that fit directly onto the bolt or nut will not be acceptable. Colour of anchor bolt cover to match poles.

A removable aluminum top cap shall be supplied with the shaft. The cap shall be secured rigidly to the shaft by a hexagonal head stainless steel set screw.

All poles shall be CSA certified. Each pole shall have an identification marker located not more than (1) metre above the base, showing the manufacturer's name or trade mark, the length of the pole, the wall thickness and the date of manufacture. The marking shall be on corrosion-resistant plate securely attached to the pole.

Pedestrian Push Button Pole (1.52 metre length): Metal Pole-Lite (# FTAL-1.5MH) or approved equivalent. The shaft shall be round in cross-section with taper from bottom to top (125mm at the base to 100mm at the top). Minimum wall thickness of the pole shall be 3.96mm.

Traffic Pole (2.44 metre length): Metal Pole-Lite (# TP-645-8-188) or approved equivalent. The shaft shall be round in cross-section with taper from bottom to top (150mm at the base to 114mm at the top). Minimum wall thickness of the pole shall be 4.57mm.

Traffic Pole (3.05 metre length): Metal Pole-Lite (#TP-645-10-188) or approved equivalent. The shaft shall be round in cross-section with taper from bottom to top (150mm at the base to 114mm at the top). Minimum wall thickness of the pole shall be 4.57mm.

17.4.17 Aluminum Poles (Cont'd)

Traffic Pole (3.66 metre length): Metal Pole-Lite (#TP-645-12-188) or approved equivalent. The shaft shall be round in cross-section with taper from bottom to top (150mm at the base to 114mm at the top). Minimum wall thickness of the pole shall be 4.57mm.

Traffic Pole (4.57 metre length): Metal Pole-Lite (# FC-107-15-250) or approved equivalent. The shaft shall be round in cross-section with taper from bottom to top (250mm at the base to 178mm at the top). Minimum wall thickness of the pole shall be 6.35mm.

Traffic Pole (5.79 metre length): Metal Pole-Lite (# FC-108-19-250) or approved equivalent. The shaft shall be round in cross-section with taper from bottom to top (250mm at the base to 200mm at the top). Minimum wall thickness of the pole shall be 6.35mm.

17.4.18 Aluminum Single Member Arms

Single member (mast) arm length as specified in the Contract.

Single member arms shall be manufactured by tapering and bending aluminum tube to the required dimensions. The end of the arm shall be provided with a 50mm IPS (iron pipe size) tenon, 100mm long, for mounting of a hanger. The tenon shall be horizontal when the arm is mounted on a vertical surface. After fabrication, arms shall be thermally treated to T6 specifications.

Single member arms shall be finished by a rotating polishing process.

Single member arms shall be supplied complete with galvanized steel pole plates.

All single member arms shall be compatible and supplied with the aluminum poles as shown on the Drawings and shall be CSA certified.

17.4.19 Aluminum Truss Arms

Aluminum poles and truss arms shall be used for special crosswalk installations or for longer span lengths in a signalized intersection. Truss arm length as specified in the Contract. The truss arms shall be Metal Pole-Lite # MA-15, MA-20, MA-25, MA-30, or approved equivalent.

Truss arms shall be aluminium and shall be heat treated after fabrication to T6 specifications. The extreme end of the the arm shall be provided with a 50mm IPS (iron pipe size) tenon, 100mm long, for mounting of a hanger. The tenon shall be horizontal when the arm is mounted on a vertical surface.

Truss arms shall be finished by a rotating polishing process.

The truss arm brackets shall be fabricated such that they can be mounted to the tapered shaft of the aluminum pole. When the brackets are mounted securely to the pole the entire surface of the inside of the attachment plates shall be in contact with the pole shaft.

17.4.19 Aluminum Truss Arms (Cont'd)

The truss arm brackets shall be able to support an aluminium truss arm, a traffic signal hangar assembly and a special crosswalk overhead sign complete with lighting and flashing amber beacons or as otherwise specified.

Each bracket shall be fabricated in such a way that the wiring necessary to illuminate the special crosswalk sign, down light and flashing beacons can be run through the truss arm and directly into the pole shaft.

The brackets shall be mounted to the poles by using backing plates as opposed to U-bolts.

All truss arms shall be compatible with the supplied aluminum poles as shown on the Drawings and shall be CSA certified.

17.4.20 Steel Poles and Single Member Arms

Galvanized steel traffic poles, combination street lighting poles and single member arms shall be custom designed by the manufacturer for each location as shown on the Drawings. Manufacturer shall design the poles and single member arms in accordance with CAN/CSA-S6 to ensure they are adequate to support all of the individual traffic signal and sign loadings that will be applied to that particular pole. All steel used in the production of poles shall conform to CSA G40.20/G40.21.

When steel traffic or combination street lighting poles are utilized, the concrete bases for each pole shall be custom designed for each location by a Professional Engineer registered or licensed to practice engineering in the Province of New Brunswick.

Shop Drawings shall be prepared for the fabrication of steel poles and for the concrete bases. The Shop Drawings shall be submitted to the Engineer for approval prior to commencement of fabrication of the steel poles. The Shop Drawings shall be stamped and signed by a Professional Engineer registered or licensed to practice engineering in the Province of New Brunswick.

The pole shaft shall be round in cross section and shall taper uniformly from bottom to top. Pole shafts shall have one longitudinal automatically electrically welded joint from top to bottom. All welds shall be ground smooth.

All welding shall conform to CSA W59 and the sections shall be joined by a weld before galvanizing. All structural steel, steel hardware and cast ferrous components shall be hot dip galvanized in accordance with CAN/CSA G164. Pole shafts shall be one piece with no circumferential welded splices.

Each pole shall have identification marking located approximately 610mm above the bottom of the hand-hole showing the manufacturer's name or trade mark, length of the pole and year of manufacture. This marking shall be securely attached to the surface of the pole.

The poles shall be supplied with a one-piece fabricated rolled steel base. In all cases the base shall telescope the butt end of the shaft and be secured with one continuous weld on the inside of the base at the end of the shaft and

17.4.20 Steel Poles and Single Member Arms (Cont'd)

another continuous weld on the outside at the top of the base. All welding at the base shall be made in such a manner as to ensure that the welded connection shall develop the full strength of the adjacent shaft section to resist any bending action.

The underside of the plate base shall be true, free from distortion and perpendicular to the centerline of the pole shaft after fabrication.

A waterproof, removable aluminum or galvanized steel top cap shall be furnished with the pole. The cap shall blend with the general pole design to present a neat overall appearance. The cap shall be rigidly secured to the shaft by one or more hexagonal head stainless steel set screws.

The shaft shall be reinforced with a steel hand-hole (dimensions of 100mm x 250mm) frame of such strength and cross section that the strength of the shaft is not reduced. The ground lug plate with a ground screw shall be provided above the centre of the hand-hole.

Anchor bolts are to be included with each pole and size to be determined by the manufacturer.

Cast aluminum anchor bolts covers with one stainless steel screw per cover for attachment of cover to anchor base shall be supplied for all exposed anchor bolts and exposed bolting systems. Colour of anchor bolt cover to match poles.

Each arm is to be provided with a cast end cap secured in place with one or more hexagonal head stainless steel set screws.

All steel poles and single member arms shall be CSA certified.

17.4.21 Wood Poles

All wood poles shall be 12.5 metre minimum height, Class 4, unless otherwise shown.

The Contractor shall supply and install back guys for wood poles, as shown on the Drawings and in accordance with utility requirements. Where it is impractical to install the normal back guy, a sidewalk strut type back guy shall be provided. All back guys shall be installed prior to the installation of aerial spans, cables, signal heads and luminaires.

17.4.22 Aerial Span Wire

Aerial span wire shall be stranded galvanized hard drawn steel 9.53mm diameter seven strand Grade 180 conforming to CAN/CSA-G12.

The Contractor shall supply all associated mounting hardware. Hardware and fittings for aerial cable installations shall conform to CSA C83.

17.4.23 Traffic Signal Hanger Assemblies

Traffic signal rubber cushioned single member arm hangers: Fortran model HAN555 or approved equivalent.

17.4.24 Signal Mounting Hardware

1-Way: Astro-Brac stellar series, tenon mount (Astro-Brac #AB-0137 or approved equivalent). Length as required to accommodate a three or four-section head.

2-Way: Astro-Brac full assembly, tenon mount (Astro-Brac #AB-0639 or approved equivalent). Length as required to accommodate a three or four-section head.

2-Way: Astro-Brac articulated serrated tenon mount w/ internal wiring capability (Astro-Brac #AB-0640 or approved equivalent). Length as required to accommodate a three or four-section head.

Aluminum Span Wire Hanger Assembly: Pelco #SE-3019 or approved equivalent.

Cast Iron 3-Way Span Wire Hanger Assembly (Upper and Lower Arm): Pelco #SE-3156 or approved equivalent.

Cast Iron 4-Way Span Wire Hanger Assembly (Upper and Lower Arm): Pelco #SE-3158 or approved equivalent.

Aluminum 3-Way Span Wire Hanger Assembly (Upper and Lower Arm): Fortran #HAN503 or approved equivalent.

Aluminum 4-Way Span Wire Hanger Assembly (Upper and Lower Arm): Fortran #HAN504 or approved equivalent.

Back to Back Plumbizer Tenon Tee Adaptor: Fortran # PBB555 or approved equivalent.

Elbow Mounting Kit: Pelco SP5419-PNC with 406mm tube arms or approved equivalent.

Aluminum 1-Way Post Top Mounting Kit: Fortran BRK931 or approved equivalent.

Pole Plate: Pelco SE-4071-M3 or approved equivalent.

Stainless steel strapping and buckles: BAND-IT band (19mm wide) or approved equivalent.

17.4.25 Traffic Signal Heads

Three-section vertical housing shall be ultraviolet, heat stabilized black polycarbonate: Siemens #SG103A1C12BBB or approved equivalent.

17.4.25 Traffic Signal Heads (Cont'd)

Four-section vertical housing shall be ultraviolet, heat stabilized black polycarbonate: Siemens #SG104A1C12BBB or approved equivalent. The bottom section shall incorporate a bi-model head.

The housings shall have weather and dust tight gasketed doors. The doors shall be properly hinged and shall provide a suitable latching device.

Stainless steel reinforcing plate(s) shall be provided on the traffic signal housing of the top signal head and, in the case of a four-section head only, on the top and bottom of the top signal head.

Traffic signal heads shall have galvanized steel safety chains for emergency support of suspended signals complete with galvanized steel attachment shackles (2/0 straight link coil chain with working load of 236 kg).

All hinges, latching mechanisms, screws, retainer clips and washers shall be stainless steel. Screws used for visor attachment and LED module retainer clips shall have Robertson type screw heads.

Lenses shall be 300mm diameter and shall be convex prismatic of the UV stabilized polycarbonate type. The lens shall fit into a specially designed, slotted, extruded and bonded full-circle silicone lens gasket designed to fit the housing door in such a manner so as to exclude moisture, dust and road film. The lens and gasket shall be secured to the door with four aluminum lens clips and stainless steel screws.

Each lens shall be provided with a removable polycarbonate cutaway visor. The visor shall be molded polycarbonate with minimum thickness of 2mm. Each visor shall be securely attached to the door by stainless steel screws. Snap fit visors are not acceptable. Colour of visor is to be flat black to match the head housing.

All LED traffic signal modules shall conform to the latest version of the ITE "Vehicle Traffic Control Signal Heads (VTCSH) - Light Emitting Diode (LED)Circular Signal Supplement and Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement". Modules shall be of the colour and orientation specified in the Contract:

- All LED modules must be operationally compatible with traffic controller assemblies, conflict monitors, flashers, and load switches meeting the NEMA Standards publications TS1 and TS2. No further circuit modifications shall be required for system operation.
- All traffic signal modules shall be LED type providing a high efficiency and long-life LED source. LED modules shall provide a high efficiency, be ultra-bright type rated and shall be rated for a minimum service period of 72 months of continuous operation from -40^{o}C to +74^{o}C.
- All arrow modules shall be omni-directional, suitable for installation in any direction. Bi-modal arrows shall comply with both "green" and "amber" ITE specification requirements.
- All LED modules shall be CSA or equivalent approved. The appropriate certification stickers shall be attached to each LED module.

17.4.26 Traffic Signal Backboards

Flexible “poly” backboards shall be fabricated from high density polyethylene with a minimum thickness of 3mm and the colour shall be impregnated throughout. All backboards shall be one piece and shall project a minimum 115 mm width beyond the traffic signal head housing. The backboards shall be predrilled to match the mounting holes of the traffic signal heads. The backboards shall also have built-in adjustments to accommodate plumizer installations. Backboards shall be yellow on both sides and conform to US Federal Standard Colour No. 595-33538 (Yellow).

Backboards shall only be used when specifically identified in the Contract.

17.4.27 Pedestrian Signal Heads

The pedestrian head assemblies shall conform to the latest version of the ITE “Standards on Pedestrian Traffic Control Signal Indicators: Light Emitting Diode (LED) Signal Modules” and Transportation Association of Canada Guidelines.

The signal heads shall use the international symbols (Canadian design - lunar white walking pedestrian and orange Portland hand, outlines only). The “walking pedestrian” and “Portland hand” symbols and colours shall be in accordance with the Manual of Uniform Traffic Control Devices for Canada.

LED traffic signal modules shall be overlay type with countdown (407mm x 480mm): DURALIGHT JXM-400VIECAD or approved equivalent.

The UV stabilized polycarbonate pedestrian signal housing and visors shall be black in colour. The LED housing shall be a one-piece injection-molded section with hinge lugs, screw slots and openings at each end.

17.4.28 Pedestrian Push Button

Pedestrian Push Button: Polara Bull Dog BDL3-Y or approved equivalent.

Aluminum Push Button Housing Cup: Polara APBC-Y or approved equivalent.

Pedestrian pushbutton sign: MUTCDC ID-21 (130mm x 200 mm). Install on aluminum pole, right and left version (ID-21R and ID-21L) as appropriate so that the pedestrian arrow is pointing parallel with and toward the crosswalk direction.

17.4.29 Audible Pedestrian System

Audible Pedestrian System: Polara EZ Communicator Navigator 2-Wire Push Button Station (EN2 PBS), yellow colour, complete with a Central Control Unit (CCU2EN).

Audible Pedestrian System (for mid-block installations only): Polara EZ Communicator Navigator 4-Wire Push Button Station (EN4 PBS), yellow colour, complete with a Ped Head Control Unit (PHCU4W).

Remote programming of the audible pedestrian system shall be compatible with the Polara EZ Communicator Navigator Configurator (ECONFIG).

17.4.29 Audible Pedestrian System (Cont'd)

When specified, a Polara Communicator Sound Baffle (ENAV-SBEZ) shall be installed.

Systems shall be equipped with a 127mm x 197mm pedestrian information sign (TACEL Option D – International Sign or approved equivalent).

Sounds: As per latest recommendation by the Canadian National Institute for the Blind and Transportation Association of Canada Guidelines.

17.4.30 Decorative Traffic Light Poles

Decorative Poles: Aluminous Lighting Products catalogue no: DTAP19-AB (colour – textured black).

The manufacturer shall design the poles in accordance with CAN/CSA-S6 to ensure they are adequate to support all of the individual traffic signals, signs, luminaries, banner arms, ladder rests and wind loadings that will be applied to that particular pole.

Pole shall have a 100 mm x 175 mm hand-hole with flush cover and ground. GFI duplex receptacle to be installed 90^{o} left of hand-hole at a height of 4.93 metres from the ground.

Clear opening of bottom of pole shall accept up to four (4) 50mm diameter PVC ducts for electrical wiring.

Finials shall be cast aluminum. Style to fit pole. The height of the finial shall be approximately 114mm and the diameter shall be such that fits the top of the pole. Colour of finials shall be black to match the colour of the pole.

All exposed parts and finials shall receive an electrostatically applied coat textured semi-gloss finish with a four part corrosion inhibiting chemical treatment process.

The poles shall be supplied with a base plate. The base plate shall accept a bolt circle from 330.2mm diameter to 406.4mm diameter and the four (4) openings in the plate to accept the bolts shall be of size 28.575mm diameter to 66.675mm diameter to accommodate the variable bolt circles and a bolt size of 25.4mm diameter.

The poles shall be supplied with a base plate cover that covers the bolts and concrete pole base.

17.4.31 Decorative Traffic Light Arms

Decorative 3.0 metre long Arms: Aluminous Lighting Products catalogue no: ATR10SMA--56 (colour – textured black).

Decorative 5.5 metre long Arms: Aluminous Lighting Products catalogue No: ATR18SMA-56 (colour – textured black).

17.4.31 Decorative Traffic Light Arms (Cont'd)

Traffic light arms shall be designed such that the end (of the arm) is at a height to allow the bottom of the vertical traffic signal head to be at the required 5.03 metre height above the road surface.

All exposed parts shall receive an electrostatically applied coat textured semi-gloss finish with a four part corrosion inhibiting chemical treatment process.

Traffic light arms shall attach to the traffic light pole with pole plates. The pole plate is to be supplied with the arm.

17.4.32 Traffic Controller Cabinet – M Type

The sturdy weatherproof base mounted controller cabinet shall be supplied in a state ready for field installation to meet or exceed NEMA Standards. The controller cabinet shall consist of a NEMA Standard, Type M base mounted unit (with police door compartment).

The cabinet enclosure shall be provided with a two-position doorstop rail with a stop wheel to enable the main cabinet door to be securely held open at increments of 90º and 120º.

The entire perimeter of each door opening on the cabinet shall have a 17mm flange to act as a rain gutter when any of the cabinet doors are open.

An internal ground base flanged lip of 70mm width shall be incorporated around the entire inside bottom edge perimeter. This flange must allow the enclosure to sit flat against the concrete traffic controller base that it will be mounted upon.

Cabinet enclosure must meet the following requirements:

- Be constructed of 3.2mm thick, Type 5052-H32, sheet aluminum, all welded construction. All welds shall be continuous in all seams;
- Incorporate a 25mm slope towards the rear of the top of the cabinet, to prevent rain accumulation;
- Have a smooth exterior, with rounded corners and be neat in design and appearance;
- The interior and exterior of the enclosure, main door, police door and shelves shall be thoroughly cleaned and degreased, primed with zinc chromatic based rust inhibiting primer coat and finished with 2 mils (tolerance +10%, -0%) of baked enamel powder paint, colour "Munsell Grey" (ASA 61 or ASA 70) or approved equivalent.
- Provide a one-piece 3.175mm thick hard rubber neoprene gasket to be installed between the concrete traffic controller base and the bottom of the cabinet.
- Exterior surface of the cabinet shall be free of any labels and writings;
- All doors shall close and secure tightly with a closed cell neoprene gasket, providing a weatherproof seal.

Overall dimensions of the M type cabinet unit enclosure shall be 1380mm (H) x 760mm (W) X 430mm (D).

17.4.32 Traffic Controller Cabinet – M Type (Cont'd)

There shall be an aluminum base-plate (2.5mm thickness) included in the base of the main enclosure. All points within the base-plate where there is a possibility of cable contact shall have plastic shields and grommets appropriately in place to prevent wear and damage to cabling.

The main enclosure door shall incorporate the following:

- Vent openings allowing air to enter the cabinet. These vents must be backed with an easily removable metal non-corrosive, vermin / insect proof, washable, permanent filter screening or approved equivalent.
- A lock mechanism with a three point latching mechanism with nylon rollers at top and bottom and an outside door handle of stainless steel with a 12.7mm shank and a Corbin dead bolt solid brass pin tumbler type lock, Corbin #1R6380.
- Provisions for padlocking the door shut shall be supplied.

The police door compartment shall be located in the centre of the door approximately 135mm from the top of the door. Dimensions of police door compartment shall be 150mm (H) x 340mm (W) X 55mm (D). The weather tight police door compartment shall incorporate:

- An inside mounted stainless steel piano hinge with 2.5mm diameter hinge pin. The hinge pin shall not be accessible from the outside of the cabinet.
- A lock mechanism with a Corbin #035759 solid brass treasury type lock supplied with two brass skeleton keys.

Each eight phase NEMA traffic controller cabinet shall be complete with the following:

- "D" Connector Assembly Adaptor (Tacel Cabinet to Intelight Controller)
- Filter, EZE Clean (25cm x 50cm x 2.5cm)
- NEMA TS1 Loadbay Assembly c/w 30 AMP Power Supply (12 Position, 8 Phase – Tall)
- "D" Connector Assembly (to be included as part of the Loadbay Assembly)
- Humidisorb W/X-Corrode (HXC-10x10-75-1)
- EDI SSM-12LEC-Can c/w RS232
- NEMA EDI 810 Flasher Unit
- NEMA EDI 510 Loadswitch
- NEMA 430 Flash Transfer Relay (120V)
- Power Bar, 6 Outlet with Surge Protection
- EDCO SHA-1210 Filtering Surge Protector
- Standard Police Panel Assembly c/w PB Cord
- Fan/Heater Assembly c/w Adjustable 2 Thermo 250W Tubular Heaters
- Detector Test Panel Assembly c/w GFI & Momentary Test Switches
- Detector Rack Assembly (16 Channels – 8 Channel Vehicles, 4 Channel Pedestrian, 4 Channel Pre-emption)
- Door Switch (normally closed – 8411K8)
- Document Pouch (355mm x 415mm minimum; black back & clear front)

17.4.32 Traffic Controller Cabinet – M Type (Cont'd)

When prefabricated detector loops are specified, the following shall be included with the traffic controller cabinet:

- EDI LM-222 2-Channel Detector Card
- Lightning Arrestor Assembly, 8 Loops

When wireless detection is specified, the following shall be included with the traffic controller cabinet:

- Sensys Master Card (CC-240) for TS1/TS2/170/2070 Traffic Controllers
- Sensys Extension Card for TS1/TS2/170/2070 Traffic Controllers
- AccessBox (CC-ACC) for Contact Closure Master Card

When communication option (copper or telephone land line) is specified, the following shall be included with the traffic controller cabinet:

- EDCO PC-642C-200 Telephone Line Surge Arrestor
- EDCO Socket for PC-642A-XXX

When communication option (fibre optic cable) is specified, the following shall be included with the traffic controller cabinet:

- RuggedComm Fibre to Ethernet Convertor (Multi-Mode)

When pedestrian push buttons are specified, the following shall be included with the traffic controller cabinet:

- EDI 242 DC Isolator Card (DLDC242)

When audible pedestrian system push buttons (Polara EZ Communicator Navigator 2-Wire Push Button Station) are specified, the following shall be included with the traffic controller cabinet:

- Polara Navigator Central Control Unit (CCU) c/w USB, Ethernet Port & Hardware Kit (PXCCU1)

The traffic controller cabinet shall include a sealable clear weatherproof "Document Pouch" with the minimum dimensions of 355mm x 415mm. The pouch will be clear on one side with a black back and a zipper or snap enclosure at one end. The pouch shall be mounted on the inside of the door below the police door compartment to store diagrams and manuals. The zipper or snap enclosure side of the pouch shall be on the top and shall not interfere with any switches when mounted.

All traffic controller assemblies shall be in compliance with the current NEMA, NTCIP and Advanced Transportation Controller (ATC) 5.2b Standards, shop tested prior to delivery and come with a minimum two year warranty on all parts and labour.

The traffic controller supplier shall program all signal phasing and timings based upon information provided by the Engineer. In addition, the traffic cabinet manufacturer shall have a technician on site to check all field wiring connections and put the traffic controller into operation during the signal start-up.

The supplier and/or manufacturer shall provide non-emergency telephone technical support during the warranty period at no additional cost, as required

17.4.32 Traffic Controller Cabinet – M Type (Cont'd)

by the City, during normal business hours. When problems cannot be resolved using telephone support, the manufacturer shall provide on-site support within five business days at no additional cost, unless the cause of the problem is determined to be non-manufacturer related.

The manufacturer shall provide the City with an up-to-date electronic copy (PDF on USB Drive) of both the cabinet wiring diagram and cabinet layout drawing. It shall also include all the necessary information to repair and maintain the traffic controller. In addition, one printed copy of each document shall be supplied in the Document Pouch with each cabinet. They shall be written in English and use terminology that is common to traffic engineering or electronic engineering.

The manufacturer shall provide operation and maintenance training at the City's facility for two (2), eight (8) hour days. It shall be comprehensive and cover all aspects of controller operation, configuration and troubleshooting. Training shall include both theoretical and "hands on" training. The manufacturer shall provide training manuals for each participant (minimum 5) in addition to all other documentation. At the City's discretion, the City may opt out of the operation and maintenance training, if similar training for traffic controller assembly has been previously provided.

Quality Certification

Traffic controller cabinets are to be provided only from manufacturer(s) that have a certified ISO 9001 Quality Management System in place. Each supplier shall provide a copy of their intended manufacturer(s) ISO 9001 certification with their shop drawing submission.

Traffic controller cabinets and their related modules must be CSA approved. Each cabinet must display the certification sticker in a prominent place within the traffic controller cabinet.

17.4.33 Traffic Controller Cabinet – G Type

To be used for pole-mounted installations only.

Specifications shall be the same as for M Type (Section 17.4.32) with the following exceptions:

- Overall dimensions of the G type cabinet unit enclosure shall be 1260 mm (H) x 640 mm (W) X 400 mm (D).
- Shall be specifically designed for pole mounted installation by means of pole plates and stainless steel strapping.
- Bottom of cabinet shall be enclosed

17.4.34 Traffic Controller

Each eight phase NEMA TS1 traffic controller cabinet shall be complete with the following:

- One (1) NEMA TS2 Type 2 Traffic Controller: Intelight X1L TS2-2 Advanced Transportation Controller (ATC) complete with:
    - NEMA TS2 & ATC 5.2b Standards Compliancy (Current)
    - NCTIP – ASC Standards Compliancy (Current)
    - MaxTime Intersection Traffic Controller Software (Current)
    - Open Architecture Embedded Multi-Processing Operating System
    - Master and/or Slave Capability
    - Intelight Traffic Responsive Closed Loop System Software

Note that unique situations may dictate the need for a different model as shown in the Drawings and/or Specifications.

Each traffic controller shall have an up-to-date "Traffic Controller System Software" Technical Reference Manual electronically available for access from the traffic controller. This manual shall be extracted via a Wi-Fi enabled device with a web browser or a laptop computer via an Ethernet cable. In addition, one printed copy of this manual shall be supplied with each traffic controller. They shall be written in English and use terminology that is common to traffic engineering or electronic engineering. They shall include all information necessary to install, program and operate the traffic controller. It shall also include a description of all the features on all the displays.

The manufacturer shall provide the City with software / firmware revisions and upgrades for a period continuing until two (2) years after delivery. Software / firmware shall be upgradeable via a USB flash drive or from a laptop over Wi-Fi or Ethernet cable.

Quality Certification

Traffic controllers are to be provided only from manufacturer(s) that have a certified ISO 9001 Quality Management System in place. Each supplier shall provide a copy of their intended manufacturer(s) ISO 9001 certification with their shop drawing submission.

Traffic controllers and their related modules must be CSA approved. Each cabinet must display the certification sticker in a prominent place within the traffic controller cabinet.

17.4.35 Pedestrian Signal Controller

The controller shall be housed in an aluminum weather-proof cabinet finished in grey measuring approximately 205mm x 261mm x 400mm, complete with stainless steel pole mounting hardware.

The pedestrian signal controller shall operate two (2) distinct phases - (1) attributed to vehicular traffic controlled by green, amber and red adjustable intervals and (2) attributed to pedestrian traffic and consisting of adjustable walk and pedestrian clear intervals. The pedestrian movement shall be actuated by a push button system. Conflict monitoring shall comprise the surveillance of each phase via the green and/or walk display.

17.4.35 Pedestrian Signal Controller (Cont'd)

The cabinet must be able to accept two NEMA load switches and one NEMA solid state two pole flasher.

Pedestrian Signal Controller & Cabinet: Electromega MCA-250 Controller and CAB-200 cabinet or approved equivalent. Controller and cabinet to be pole mounted.

Power point for pedestrian signal controller in accordance with Section 17.4.07, "Power Point". Grounding and bonding in accordance with Section 17.4.05, "Grounding and Bonding".

17.4.36 Special Crosswalk

RA-5 Crosswalk Sign shall be an illuminated face walking man symbol 600mm × 750mm. The walking man symbol shall be white inside a black border complete with dual or quad 300mm amber LED traffic signal heads attached to each side of sign, if specified.

Sign housing shall be welded extruded aluminum, finished with yellow polyurethane paint. Type NEMA 4X.

The sign lens shall be Lexan 5 mm thick with MUTCDC Standard Crosswalk Symbol (RA-5R and RA-5L). Lenses shall be replaceable slide in, slide out type. Face illumination shall be a 175 watt metal halide lamp. Down light illumination shall be a 250 watt metal halide lamp

RA-5 Crosswalk Sign: Electromega Model RA5 970-1270 or approved equivalent.

Complete sign assembly to be CSA certified.

If RA-5 Crosswalk Sign is to be mounted to a single member arm, the top of sign fixture to be reinforced with minimum 7mm aluminum plate to absorb strain of the hanger. Hanger as per Section 17.4.23, "Traffic Signal Hangar Assemblies". Supply safety chains and eye bolts on top to prevent signs from turning in high winds.

If RA-5 Crosswalk Sign is to be mounted using an aerial span wire, the top of sign fixture to be reinforced with minimum 7 mm aluminum plate. Hanger to be double span wire suspension hangers (Fortran HAN501 or approved equivalent) with wire entrance port c/w wire clamp and protector. Bottom suspension wire to be clamped with suitable clamping device capable of supporting total weight of signs in the event of primary messenger failure.

RA-5 Controller & Cabinet: Electromega RA-5 Controller and CAB-200 cabinet or approved equivalent. Controller and cabinet to be pole mounted. Flashing beacons to operate at 50-60 flashes per minute; the ON period should be approximately equal to the OFF period. Controller shall be capable of altering the duration of activation after each call.

17.4.36 Special Crosswalk (Cont'd)

Pedestrian sign: MUTCDC RA-4. Install on aluminum pole, right and left version (RA-4R and RA-4L) as appropriate so that the pedestrian symbol on each sign is walking towards the centre of the road.

17.4.37 Flashing Beacon

Flashing beacon single section signal housings shall be ultraviolet, heat stabilized black polycarbonate: The housings shall have weather and dust tight gasketed doors and shall have a terminal block in the housing for connections. The doors shall be properly hinged and shall provide a suitable latching device.

All hinges, latching mechanisms, screws, retainer clips and washers shall be stainless steel. Screws used for visor attachment and LED module retainer clips shall have Robertson type screw heads.

Flashing beacon lenses and visor(s) in accordance with Section 17.4.25, "Traffic Signal Heads".

Red or Amber signal LED modules in accordance with Section 17.4.25, "Traffic Signal Heads".

Flashing mechanisms shall be mounted on poles in enclosures with the accompanying conduit, conduit fittings and wiring systems. Flashing mechanisms shall be of electronic or electronic type complete with weather proof enclosure. Flash rate shall conform to the MUTCDC requirements. Flasher unit shall be selected based on application specified.

Flasher Controller Cabinet: TACEL FP101 cabinet or approved equivalent.

Power point for flashing beacon in accordance with Section 17.4.07, "Power Point". Grounding and bonding in accordance with Section 17.4.05, "Grounding and Bonding".

Solar 24-hour flashing beacon: Carmanah R247 or approved equivalent. Red or amber signal modules as per the Drawings and Specifications.

17.4.38 Anti-Seize Lubricant

Anti-Seize lubricant shall be used whenever stainless steel metal contacts aluminum metal in order to prevent seizing, galling and pitting of all metal parts exposed to extreme temperatures or corrosive atmospheres. Anti-seize lubricant to be used shall be Permatex® Anti-Seize Lubricant or approved equivalent.

17.4.39 Aluminum Sign Backing

All sign backing shall be cut from Alcan sign sheet or equivalent, providing the minimum thickness requirement listed herein.

The heat treatment, the mechanical and physical properties and the chemical composition of the aluminum sheeting shall conform to those properties of Alcan alloy and Temper No. 5052-H32.

17.4.39 Aluminum Sign Backing (Cont'd)

Backing material shall be washed, degreased, and acid etched, complete with fastening holes.

All backings shall be free of defects which would detract from the overall surface appearance of the sign.

All corners shall be rounded, except for Stop signs.

17.4.40 Reflective Sign Sheeting

Upon request of the Engineer, the Contractor shall provide in writing a "Certificate of Conformance" from the reflective material manufacturer stating their reflective sheeting being supplied meets the requirements specified for each type of sheeting.

Sheeting type shall be High Intensity for each sign.

Where it can be shown that the reflective sheeting supplied and used on the traffic sign is consistent with the sheeting manufacturer's recommendations and field performance requirements have not been met, the Contractor shall replace the sign at the Contractor's expense.

All reflective sheeting shall conform to the Canadian General Standards Board specification 62-GP-11M and the American Society for Testing Materials specification D4956 entitled Standard Specification for Retroreflective Sheeting for Traffic Control as defined in section A1.6.7 of the MUTCDC.

Reference numbers are drawn from the MUTCDC or the New Brunswick Department of Transportation and Infrastructure Sign Manual.

Unless otherwise specified by the Engineer, the sign message must conform to the MUTCDC or the New Brunswick Department of Transportation and Infrastructure Sign Manual.

17.4.41 Sign Message Application

The message on the sign can be Screen Printed Ink or Electrocut Film.

Screen Printing Inks shall be as recommended by the reflective sheeting manufacturer. These inks shall be fast dry (4 hours air dry) and shall not require a protective clear coat to achieve durability commensurate with the durability of the base reflective sheeting.

Electrocut Films shall be a highly durable, transparent, acrylic, pressure sensitive colored film, designed to be applied to retroreflective film and with performance life warrantied for the same period of time as the reflective sheeting to which it is applied.

17.4.42 Application of the Sign Facing

The sign shall be manufactured by applying the sheeting material onto aluminum sign by Pressure Sensitive Material or by Heat Activated Material.

17.4.43 Traffic Sign Posts and Hardware

Square sign post kit shall be 3660 mm x 50 mm x 50 mm galvanized 14 Gauge Tele-spar posts complete with 760 mm long square Tele-spar receiver and angle bolt.

Tele-spar posts shall have pre-punched holes.

All steel bolts, nuts, U-bolts, lock washers and washers shall be galvanized steel meeting ASTM A153.

Street name signs to be attached to Tele-spar posts with SU-34C post cap and SU-40C cross mounting bracket.

17.4.44 Traffic Sign Banding and Brackets

Where directed by the Engineer, street signs are to be attached to traffic light poles with 12.5 mm (1/2") Stainless Steel banding utilizing Band-It Brand mounting brackets. Stainless Steel banding to be secured to pole with Stainless Steel Ear-Lokt Buckles.

17.5 CONSTRUCTION METHODS

17.5.01 General

The Contractor shall carry out the Work as shown in the Drawings and Specifications and/or as specifically directed by the Engineer.

All electrical Work shall be in accordance with the Canadian Electrical Code and an electrical contractor holding a valid electrical contractor's license issued by the Province of New Brunswick shall perform all electrical Work, with the exception of traffic signal work as outlined in Section 17.2.01, "Traffic Signal General Provisions".

The Contractor shall regularly test all installed equipment and permit inspection by the Engineer during the progress of the work.

Buried, concealed or sealed components shall be inspected prior to the covering activity.

Coordinate all activities with the City, local utilities and authorities.

The installation of all equipment shall follow manufacturer's recommendations.

Traffic Signal General Provisions

Unless otherwise specified on the Drawings and Specifications, the Contractor shall supply and install all materials to complete the specified system, including commissioning, and turn over to the City the completed system in operational order. Minor items or accessories not specified, but obviously required for such systems, shall be provided as if specified and in conformance with modern practice and workmanship.

17.5.01 General (Cont'd)

Field work on traffic signal systems shall be performed by or directly supervised by an IMSA Traffic Signal Technician with a minimum Level II Construction or Field Certification.

In addition, traffic signal work within the controller cabinet and involving the controller cabinet wiring and equipment shall be performed by or directly supervised by an IMSA Traffic Signal Technician with a minimum Level II Field or Bench Certification.

Traffic Signal Codes, Bylaws Ordinances and Regulations

All work covered by this section shall be governed and performed in accordance with applicable Federal, Provincial, City of Saint John, Saint John Energy and NB Power Codes, Bylaws, Ordinances and Regulations, as well as the latest CSA standards pertaining to the Work.

Electrical equipment shall be certified in accordance with New Brunswick Regulation 84-165 under the Electrical Installation and Inspection Act.

In the event of conflict between regulations, the strictest regulation shall apply.

Field Quality Control

All field quality control requirements shall be in accordance with Division 7, "Construction of Municipal Services" and Division 16, "Electrical Systems".

Site Visit

Contractor to visit the site and familiarize himself with the job and all conditions which may affect his costs. Ignorance of existing conditions will not be considered as basis for extra claims.

Shop Drawings, Product Data & Samples

Submit shop drawings, product data and samples in accordance with Division 7, "Construction of Municipal Services".

Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

Where applicable, include wiring, single line and schematic diagrams.

Include wiring drawings or diagrams showing interconnection with work of other sections.

Coordination

This work shall be coordinated with the other work required by the different trades so as to minimize the disturbance, alteration or damage to the adjacent or adjoining facilities. Coordination shall be by the Contractor unless otherwise indicated by the Engineer.

17.5.01 General (Cont'd)

Except as provided for in the Drawings and Specifications, or as may be approved by the Engineer, adjacent or adjoining facilities shall not be disturbed, altered or damaged in any way.

Where the Contractor specifically requests, and the Engineer approves the disturbance, alteration or removal and subsequent replacement of an adjacent or adjoining structure or other facility not provided for in the Contract, all work and costs resulting from the disturbance, alteration or removal and subsequent replacement shall be at the Contractor's expense and no separate payment will be made thereof.

Layout of Equipment

When initial field layout is completed, the Contractor and the Engineer shall meet on site to review the design and locate components in the field. If major modifications to the design are required, new design drawings outlining all modifications shall be prepared by the Engineer. The Engineer shall review and approve all modifications prior to construction. All vehicle detection equipment, ducts, pull boxes, concrete bases and traffic sign locations shall be given final approval in writing by the Engineer, prior to installation.

The Engineer shall be afforded the opportunity during construction to inspect the Works at any time. At a bare minimum, formal documented inspections by the Engineer shall occur at key milestone intervals of the construction. Requests for Engineer inspection shall be provided to the Engineer with 1 working day (no weekends) minimum advance notice. Key milestone intervals are as follows:

- Upon completion of installation of underground works and prior to backfilling or placement of concrete;
- Upon completion of installation of aboveground works and prior to energizing the system and testing.

As-Built Drawings

At completion of the project and prior to Final Completion, the Contractor, at their own expense, shall neatly transfer all electrical addendums, change orders, site instructions and other changes marked in red on blueprint record drawings. These "Redline" drawings shall be submitted to the Engineer for incorporation into As-Built drawings.

Installation, Operation & Maintenance Manuals

Provide installation, operation and maintenance data for electrical work for incorporation into an installation, operation and maintenance manual as specified in Division 7.

17.5.01 General (Cont'd)

Include the following operations and maintenance data:

- Details with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.
- Wiring and schematic diagrams and performance curves.
- Names and addresses of local suppliers for all items included in maintenance manual.

The manual shall document in detail the installation and operation of the equipment on an item by item basis with clearly detailed illustrations including layout of controls, displays, and all other information required to correctly operate a fully functional unit. The model number(s), all options provided, and the correct settings and configuration shall be clearly shown. All modifications to equipment must be documented. The manual shall contain a troubleshooting guide to enable the City, or others, to carry out maintenance operations down to the modular block level.

The final operation and maintenance manual submission shall be provided to the Engineer prior to issuance of Substantial Completion.

Traffic Sign General Provisions

Submit shop drawings, product data and samples in accordance with Division 7, "Construction of Municipal Services".

The Work shall be carried out in such a manner so as to avoid damage to the roadside sign, post, pole and the adjacent and surrounding roadway.

The repair of any damage resulting from this Work shall be carried out by the Contractor at the Contractor's expense.

Direct contact with the sign faces shall be avoided at all times.

Traffic signs shall be immediately installed following installation of the sign post and/or pole. After installation, the signs shall be clean.

17.5.02 Excavation and Backfilling

All excavation, bedding, backfill, and compaction requirements shall be as per Division 13, "Excavation, Trenching and Backfill Requirements".

17.5.03 Concrete Bases

Construction of all traffic signal and controller bases shall be in accordance with the details shown on the Standard Drawings.

Concrete bases shall be constructed with a horizontal location to be within 100mm of the location specified. Concrete bases shall not have a diameter variation greater than 20mm in the cross sectional dimension.

Anchor bolt assemblies of the size and type indicated in the Contract shall be accurately positioned in the footings. The anchor bolt assembly shall be orientated in order that future pole brackets and signal heads will be right angles to the roadway being served. The template shall be firmly positioned and fixed in a level position before concrete is placed to ensure anchor bolts are plumb. The template shall remain in place until the pole is to be erected.

Concrete shall be placed in accordance with the requirements of Division 23, “Portland Cement Concrete”.

Reinforcing steel shall be placed in accordance with CSA A23.1 and Concrete Reinforcing Steel Institute (CRSI), “Placing Reinforcing Steel Recommended Practices”.

- Immediately before placing, reinforcing steel shall be free of oil, dirt, mill scale, loose or excessive rust or other coatings that would reduce bond to concrete.
    - Reinforcing steel shall be maintained in this clean condition until embedded in concrete.
    - Bar supports shall be made of plastic.
- Reinforcement shall be accurately positioned, secured and supported, using bar supports and side form spacers, to ensure proper concrete cover and spacing within allowable tolerances before and during placement of concrete.

Bases shall have the top surface finished level, smooth and within the following tolerances:

- ± 3mm of a level line when measured across the base;
    - Areas in excess of the 3mm tolerance may be removed by abrasive means, provided the minimum cover requirements specified in the Contract are met.
        - It will not be acceptable to achieve this repair by placing grout or concrete over base concrete that has hardened.
        - If the concrete surface, upon removal areas in excess of the 3mm permissible tolerance, is not to the Engineer’s satisfaction, the Contractor shall, as directed by the Engineer, entirely remove designated portions or all of the concrete, and replace with new concrete.
- ± 10mm of the elevation provided by the Engineer.

17.5.04 Underground Ducts

All underground ducts and concrete encased ducts (when specified) shall be installed in accordance with Division 16, “Electrical Systems” and below.

17.5.04 Underground Ducts (Cont'd)

The location, number and size of ducts shall be as indicated on Drawings or as directed by the Engineer. Each pole shall have its own duct installed directly from the traffic control cabinet as shown on the Drawings. Where possible, ducts shall share a common trench. Additional spare ducts shall be installed for possible future use as shown on the Drawings.

On new construction, the Work under this Item shall be completed before granular subbase placement.

Construction of the trench and the installation of the ducts shall be in accordance with the Standard Drawings. The bottom of the excavated trenches shall be undisturbed insitu soil and shall have a uniform grade, free of sharp rocks. If over excavation is carried out, the Contractor shall, at his own expense, repair the area of over excavation and shall fill this area with an approved backfill material placed in accordance with Division 13, "Excavation, Trenching and Backfill Requirements".

The Contractor shall install the ducts in the prepared trench such that the ducts are free of sharp bends, kinks and breaks.

Install concrete encased ducts at locations indicated on the Contract.

Ducts shall be inspected and approved by the Engineer prior to backfilling. Backfill shall be placed in such a manner so as to not damage the installed ducts.

Trenches shall be completely backfilled and finished level with the surrounding adjacent surface in accordance with Division 13, "Excavation, Trenching and Backfill Requirements".

Underground service marker tape shall be installed in accordance with Division 16, "Electrical Systems".

After the backfilling is complete (and prior to concrete or asphalt placement), a mandrel with a diameter of at least 90% of the diameter of the installed ducts shall be passed through the length of the duct system in the presence of the Engineer. The Contractor shall be responsible, to clear and/or replace any ducts that do not pass the mandrel test.

Immediately after the mandrel inspection and approval, the Contractor shall securely block the open ends of the ducts with a watertight plug.

In each duct, an additional 1.5 m length of fish line (beyond what was installed) shall be left coiled, tied and accessible at the end of each underground duct. Fasten fish line to end of conduit with duct tape.

17.5.05 Electrical and Grounding

All electrical installation works and grounding shall be in accordance with Division 16, "Electrical Systems".

17.5.06 Pull Boxes

The installation of pull boxes shall follow manufacturer's recommendations. Locations shall be shown on the Drawings.

In general, splicing of wires shall not be permitted. However, under special circumstances and only with the Engineer's pre-approval, wire splices inside pull boxes shall only be made with a CSA approved direct buried splice kit.

The Work shall be carried out in a manner so as to avoid damage to the adjacent and surrounding infrastructure. The Contractor shall be responsible, at his own expense, to repair any such damage resulting from the Work.

Pull boxes shall be installed above the water table on a 400mm thick foundation layer of stone bedding material.

- The foundation layer shall be constructed such that the area is maintained free-draining and the area of the pull box installation shall be provided with positive drainage to ensure that water cannot pond or saturate the foundation zone.

Tops of pull boxes shall be placed flush with the surrounding grade.

17.5.07 Prefabricated Detector Loops

The approximate location of each loop is shown on the Drawings. Final locations shall be determined by the Engineer.

To install prefabricated detector loops in gravel, if necessary, dig a shallow trench in which to place the prefabricated detector loop. The orientation and dimensions of the trench should match the configuration of the loop and lead-in when installed. If a trench has been dug, place the prefabricated detector loop in the trench. If no trench has been dug, place the prefabricated detector loop in the proper position and orientation in the desired location. Use corner brackets to hold the loop in place. Cover the loop with a sand material (minimum 25mm cover over entire loop conduit). Route the lead-in cable to the traffic controller or specified termination point.

To install prefabricated detector loops inlaid in asphalt (when specified only), using an asphalt saw, cut a 9.375mm wide slot to accept the lead-in cable and the sides of the loop. Ensure that slots are clean with no sharp corners which could damage the loop. Remove chips and moisture using compressed air. Place the prefabricated detector loop in the proper position and orientation on the asphalt base lift. Route the lead-in cable to the traffic controller or specified termination point. Use fiberglass backed mastic tape cut into 50mm x 100mm strips to hold the loop and lead-in cable in place. Apply the surface course of asphalt. Note that when placing the surface course of asphalt, make certain that the loop cable does not get pulled into the augers on the paving machine.

Conduct loop continuity test at loop lead-in cable termination ends. Obtain a resistance of 5 ohms or less. Provide test results to Engineer.

17.5.08 Detectors

Installation of wireless detectors, motion detectors and presence sensors shall follow manufacturer's recommendations.

17.5.09 Transformer Bases

Anchorage templates shall be removed prior to installation of the transformer bases. All studs, bolts and nuts shall be cleaned and coated with white lithium based grease prior to the installation of the transformer base onto the anchor bolt assembly. Install a one-piece closed cell neoprene gasket, adhesive on one side, 3mm thick, between the concrete base and the bottom of the transformer base.

The access door of the transformer base must be oriented away from the traffic, to allow IMSA technicians to see the intersection while servicing the base.

Install transformer base directly to concrete base and secure to the anchor bolts according to the manufacturer's recommendations. Level transformer bases with shims only. Do not use leveling nuts. Mount the transformer base to the concrete base so that the tabs project a minimum of ½ the anchor bolt diameter beyond the galvanized nut. Galvanized nuts shall be tightened and torqued an equal amount in accordance with the manufacturer's recommendations. Do not use bolt or nut covers. Provide a plywood cap on all bases that do not have a pole.

17.5.10 Pole Erection

Poles shall be installed with the hand-hole facing away from traffic and on the same side as the hand hole on the transformer base. However, if the hand-hole on the pole conflicts with the location of the pedestrian button, the pole shall be positioned such that this conflict no longer exists.

Where feasible, pole locations shall follow TAC "Guidelines for Understanding, Use and Implementation of Accessible Pedestrian Signals" in order to facilitate access to the pedestrian controls.

Poles shall be handled using suitable non-abrasive slings at the pole pick up points specified by the pole manufacturer.

For poles installed directly to concrete bases, anchorage templates shall be removed prior to installation of the poles. All studs, bolts and nuts shall be cleaned and coated with white lithium based grease prior to the installation of the pole onto the anchor bolt assembly. Poles shall be secured to the anchor bolt assembly by setting all nuts to an initial torque of 75 Nm. Poles shall then be set in plumb vertical alignment by adjustment of combinations of pole shims and holding nuts. Final tightening of nuts shall follow manufacturer's recommendations.

For installation of poles on transformer bases, remove plywood cap, if necessary prior to installation. Poles shall be secured to the transformer base in accordance with the manufacturer's recommendations. Final tightening of nuts shall follow manufacturer's recommendations.

17.5.10 Pole Erection (Cont'd)

Excavation for installation of wood poles shall be done by vacuum excavation, augering or other suitable means to obtain a hole large enough to accommodate wood pole and backfill. Backfill shall be native material placed and compacted in conformance with Division 13, "Excavation, Trenching and Backfill Requirements". Where poles are installed in the vicinity of existing overhead utilities, a minimum offset (as per Utility requirements) shall be maintained or where it is impractical to achieve this offset, the installation of the pole shall be coordinated with the appropriate Utility.

Ensure poles are installed and secured to a vertical alignment which meets Engineer's approval.

Install cast aluminum anchor bolts covers with stainless steel screw on all exposed anchor bolts and exposed bolting systems. Place anti-seize lubricant on threads of anchor bolts or bolts before installing anchor bolt cover.

Poles shall be cleaned after erection.

17.5.11 Traffic Signal Pole Apertures

Where drilling of apertures is required, the apertures shall be accurately aligned to suit pole attachments and equipment. Apertures in poles shall be de-burred to remove any sharp points or burrs remaining around the hole drilled by the Contractor. The hole diameter to be drilled in the apertures will be limited to the maximum hole required for the wiring times 1.5.

Apertures in galvanized steel poles shall be coated with grey zinc rich paint and allowed to dry. The apertures shall be located clear of the vertical seam and overlapping sections of sectional steel poles.

Wiring apertures in poles shall be provided with rubber grommets.

Temporary unused pole apertures shall be plugged with rubber, neoprene or plastic plugs. Permanent unused pole apertures shall be welded shut.

17.5.12 Single Member Arms

The Contractor shall set the attachment point of the single member arm on the pole to obtain the required clearance from finished grade to the signal head once pole is plumbed and secured. Traffic and pedestrian signal head mounting heights in accordance with Section 17.5.17, "Traffic and Pedestrian Signal Heads".

Single member arms shall be installed perpendicular to the through lanes of traffic being served.

17.5.13 Aerial Span Wire

Aerial span wire to be spanned between poles using thimble eyebolts that are to be bolted through wood poles and steel tape banded to steel poles.

17.5.13 Aerial Span Wire (Cont'd)

Span wire shall be tensioned to obtain the sag and safety clearance from other utilities or above ground facilities at any ambient temperature.

The Contractor shall install all equipment and fittings, hardware, pull boxes and accessories necessary for the mounting of equipment on aerial span wire cable systems. All compression nuts, locknuts and fitting hardware shall be securely tightened to prevent shifting of equipment by wind.

Whenever aerial cable crosses under high voltage lines, the Contractor shall arrange, with Saint John Energy or NB Power (as applicable), for the neutral conductor to be raised to clear the top span by a minimum distance as per Utility requirements. If they are unable to achieve this separation, the Contractor shall arrange with the Utility to protect the neutral with a flexible line insulator protection. The minimum distance as per the Utility working clearance from high voltage conductors shall be maintained.

The Contractor shall ensure no portion of the overhead span installation will be lower than 5.03 metres over the travelled portion of the roadway.

17.5.14 Traffic Signal Hangers

The traffic signal hangers shall be slip-fitted onto the tenon of the single member/truss arm, adjusted to vertical and secured in position. Ensure that signal is plumb to the road and parallel to the pole. Installation shall follow manufacturer's recommendations. Upon completion of signal head adjustments, the piercing set screws shall be tightened to bite into the single member arm tenon.

17.5.15 Signal Mounting Hardware

Installation shall follow manufacturer's recommendations.

17.5.16 Double Tube Arm Brackets

Double tube arm brackets shall be assembled on signal heads prior to pole mounting. The tube arms shall be installed in parallel alignment and all locknuts securely tightened. Pole plates shall be mounted on the side of the pole such that the signal heads meets the required clearance height from finished grade. Pole plates shall be secured with 10mm x 100mm lag bolts or stainless steel strapping which shall not overlap or secure any other equipment on the pole.

When two pedestrian heads are mounted on the same pole, the heads shall be installed so as to allow each head door to swing fully open. This may require that longer tube arms be installed on one or both heads.

17.5.17 Traffic and Pedestrian Signal Heads

Mounting heights of traffic and pedestrian signal heads shall be as shown on the Drawings. Site specific conditions, such as the required traffic pole height or elevation differences between traffic pole locations within a proposed signalized intersection must be considered by the Engineer, which may result

17.5.17 Traffic and Pedestrian Signal Heads (Cont'd)

in a variation from standard layouts described in this Section. Drawings shall also clearly indicate the clearance height for the signals and brackets.

Signal heads shall be installed facing the direction of approaching traffic.

Signal heads shall be securely attached using the specified signal mounting hardware in Section 17.4.24, "Signal Mounting Hardware". Modules of the size and type indicated shall be installed with positive electrical contact in the signal heads. Confirm final traffic and pedestrian signal head aiming on site with Engineer.

Traffic signal heads shall be vertically oriented. Traffic signal heads mounted on a single member arm shall be installed at a minimum of 5.0 metres and at a maximum of 5.5 metres above ground level (measured from the pavement surface to the bottom of the traffic signal head). When a three section traffic signal head is utilized over traffic lanes, the mounting height above the pavement shall allow room for an extra traffic signal head to be installed in the future.

Secondary pole mounted traffic signal heads shall be affixed to the pole using a tube arm assembly and installed equidistant between the top of the pedestrian signal head and bottom of lowest bracket for mast arms.

When there are two brackets attached to a single pole there shall be a 150mm space provided between the brackets, unless directed otherwise by the Engineer.

Pedestrian signal heads shall be installed at 2.60 metres above ground level (measured from the ground surface to the bottom tube arm of the pedestrian head bracket).

All traffic and pedestrian signal heads shall be covered until all tests have been completed and the signal heads are put into operation. Pedestrian signal heads shall be turned to face the pole prior to operation. Covers shall remain in place for up to a maximum of 30 days before the signals are put into operation, unless otherwise approved by the Engineer.

All dimensions for installation shall be verified by the Engineer and adjusted by the Contractor, as required. Traffic and pedestrian signal heads shall be adjusted for maximum visibility and focusing prior to final tightening or sealing of hardware. Unused openings in signal heads shall be plugged with bird plugs. No gasket is required for the bottom of the signal head. Rubber gasket to be installed for the top of the signal head.

17.5.18 Pedestrian Push Buttons and Audible Pedestrian Systems

Pedestrian and audible pedestrian system push buttons shall be installed on the poles at a height of 1.10 metres (± 0.025 metres) above ground level (measured from the sidewalk surface to the centre of the actual pedestrian push button). The push buttons and signs should align parallel to the crosswalk that the push button controls and shall be installed on the sidewalk/crosswalk side of the pole so that it is visible by pedestrians using the sidewalk. The location of the push button and sign should be confirmed by the Engineer before the pole is drilled and tapped.

Securely attach push buttons to the pole according to the manufacturer's recommendations.

Tune and adjust audible signal as per manufacturer's recommendations.

Completely cover pushbutton signs with burlap sacking from time they are installed until system start-up.

17.5.19 Installation of Special Crosswalk Overhead Sign

Installation of RA-5 sign shall follow manufacturer's recommendations. Test the RA-5 flashing beacon and fixture light after installation.

17.5.20 Pole Mounted Conduit Systems

Where traffic signal equipment is to be installed on concrete or wood poles, the Contractor shall install pole mounted conduit systems including junction boxes and all necessary fittings and hardware in accordance with Division 16, "Electrical Systems". Fittings, accessories and hardware shall meet the general configuration requirements shown in the Contract.

17.5.21 Wiring

Before pulling cables through the underground ducts or conduit, the underground ducts or conduit shall be blown out with compressed air from both ends and then swabbed out to remove all stones, dirt, water and other foreign material from the underground ducts or conduit.

No cables shall be drawn into any underground ducts or conduit until all work of any nature that may cause damage to the cables or its insulation has been completed. During pulling, the cables shall be fed carefully into the underground ducts or conduit to prevent stretching, twisting, kinking or looping.

Cable shall be pulled through ducts using any necessary cable lubricant, mechanical aids and pulling cables or ropes as required. The pulling tension shall not exceed the safe tension recommended by the cable manufacturer.

Wiring to conform to requirements of the Canadian Electrical Code.

Wire from the traffic controller to each traffic pole base in accordance with the Drawings. No splicing will be allowed between the traffic controller and each traffic pole base or between traffic pole bases. A minimum length of 900mm of

17.5.21 Wiring (Cont'd)

cable shall be left in pole hand-holes, transformer bases or traffic cabinet bases.

Wire each traffic and pedestrian signal head separately from base of pole. Wiring shall be run through the poles, single member arms, signal hangars and the upper arm of double arm brackets. No splicing will be allowed between the traffic and pedestrian signal heads and the hand-holes or transformer bases. A minimum length of 900mm of cable shall be left in pole hand-holes or transformer bases.

Use Sta-Kon wire connectors of appropriate size on all wire to screw end terminations.

All connections shall be sealed in accordance with IMSA and manufacturer recommendations.

Use weatherproof wire-nut wire connectors from Ideal Industries on all twisted connections complete with non-hardening, silicone-based sealant. Orient wire-nuts so opening is facing down and store bundle high up in transformer base to minimize water damage to wire-nut connections.

Provide drip loops where cable enters the pole from the bracket and on all external cable.

When wiring to signal heads, replace terminal strips with wire-nut wire connectors.

Neatly arrange, bundle and cable tie wrap wiring in the traffic controller, pull/junction boxes, hand-holes, transformer bases and service panels to satisfaction of the Engineer.

Make final connections. Test the wiring and provide written results to Engineer. Obtain approval from Engineer for finished work.

17.5.22 Installation of Fibre-Optic Cables

Cable shall be transported to site using cable reel trailers.

Cable shall be installed in ducts in the field in accordance with the Drawings. Prior to the installation the Contractor shall verify the length of fibre-optic cable slack required for the installation. The Contractor shall be responsible for ensuring the cable length is sufficient to allow for connection between the communication equipment and the splice enclosures including provision for slack, vertical runs, cable necessary for splicing, wastage and cable to allow for the removal of the splice enclosure for future splicing.

Care shall be taken at all times to avoid scraping, denting, or otherwise damaging the cable before, during or after installation. Damaged cable shall be replaced by the Contractor at the Contractor's expense.

The Contractor shall not exceed the manufacturer's recommended safe pulling tension and minimum bending radius at any time. A manufacturer recommended

17.5.22 Installation of Fibre-Optic Cables (Cont'd)

lubricant shall be applied to the cable to reduce friction between the cable and the ducts. Cable shall be installed in accordance with manufacturer's recommendations.

Sufficient slack shall be pulled to allow cable cutting and connection to communications equipment.

The Contractor shall install optical attenuators as required, in order to ensure operation within the operating window of the proposed equipment, while maintaining a 3 dB margin at high and low ends. The Contractor shall record locations where attenuators are installed.

The cable shall be securely fastened in place within pull/junction boxes, concrete bases and cabinets. For vertical conduit runs, the cable installation shall include installation of strain relief mechanism.

Twisted pairs shall be terminated at the termination block in each controller base. All connections shall be clearly identified.

Where trunk cable terminations are left "dead ended", 25 metres of cable shall be left coiled.

All coiled cables shall be securely fastened in place with a minimum of four galvanized steel conduit straps.

The Contractor shall label the interface fibres in the interconnect centre. The labelling scheme selected shall clearly identify the fibre number and connecting device. The labelling scheme is to be approved by the Engineer.

Following installation of the cable in the ducts, all duct entrances at concrete bases and cabinets shall be sealed with duct sealing compound to prevent the ingress of moisture, foreign materials and rodents.

17.5.23 Mounting of Traffic Controller Cabinet

Concrete base mounted controller cabinets shall be installed complete with hardware and accessories and shall be located and oriented as specified in the Contract. The Contractor shall install the traffic controller cabinet such that the person operating the controls will be facing the intersection. The cabinet shall be mounted to the traffic controller cabinet base as per the manufacturer's recommendations.

A gasket shall be attached squarely and symmetrically on the bottom channel of the cabinet prior to installation with holes for mounting bolts drilled when necessary.

17.5.24 Installation of Pole Mounted Traffic Controller Cabinet

Pole mounted controller cabinets shall be installed complete with mounting brackets, hardware, 19mm stainless steel BAND-IT strapping, and pole mounted conduits and fittings. Pole mounted controller cabinets shall be located and oriented as specified in the Contract.

17.5.25 Installation of Traffic Controller

Before any wiring installation begins, the Contractor must obtain all the necessary permits and coordinate the work with Saint John Energy.

Before the wiring of the traffic controller, the Contractor must test all traffic signal cable circuits for continuity and for the absence of short circuits using an ohmmeter. Any defect in the cable circuits must be corrected before the work proceeds.

When using stranded cable, all connections to terminal boards or screw type equipment terminals shall be made with insulated fork tongue compression connectors only,

All wiring to bulkhead connectors on equipment housings shall be made with MS bayonet type connectors in conformance with the manufacturer's recommendations.

Traffic signal cables shall be connected to the terminal board address as assigned on the Shop Drawings. The controller output circuit assigned shall match the proper traffic signal cable circuit. The traffic signal cable neutral(s) shall be securely connected to the AC-terminal in the cabinet.

Unused conductors shall be terminated with insulated wing nut vibration proof spring connectors, leaving sufficient cable to reach terminal boards.

Incoming cables shall be identified as follows:

- Extra-low voltage cable shall be identified with wire markers having the same number as the traffic phase served.
- Traffic signal cable shall be identified with wire markers placed over the outer multi conductor cable, naming the corner of the intersection that the cable is routed towards such as "northeast", "southwest", etc.
- Interconnection cable shall be identified similar to traffic signal cable, naming the direction that the cable is routed towards such as "north", "south", etc.

Test to confirm operation.

Upon completion of wiring and connections, all incoming cables shall be bundled and held in place with nylon cable ties.

The controller cabinet shall be kept locked except when access is required to carry out the work of the Contract. Upon completion of the Work, the traffic controller cabinet keys shall be surrendered to the Engineer.

Flash-out and check all signal and pedestrian heads at the terminal block in controller cabinet prior to system start-up.

17.5.26 Installation of Pedestrian Signal / Special Crosswalk Controller Cabinets

Install pedestrian signal and pedestrian RA-5 controller cabinets in accordance with manufacturer's recommendations. Install pedestrian signal and pedestrian RA-5 controllers in accordance with manufacturer's recommendations

Fasten cabinets to a pole, using 19mm stainless steel BAND-IT strapping.

17.5.27 Installation of Flashing Beacons

Flasher beacons for post top mounting shall be aligned facing the direction of approaching traffic.

Flasher beacons for pole front or side mounting shall be aligned facing the direction of approaching traffic and mounted on double arm brackets or single member arms and signal hangers as specified in the Drawings and Specifications.

Flashing beacons (single or in multiple clusters) for aerial mounting shall be arranged on the aerial span wire to give the required visibility and clearances for each direction of approaching traffic to be controlled. Mounting hardware shall be securely tightened. The Contractor shall ensure no portion of the installation will be lower than 5.03 metres over the travelled portion of the roadway.

Flasher mechanisms shall be mounted in enclosures with the accompanying conduit, conduit fittings and wiring systems.

17.5.28 Removal and Disposal of Damaged or Obsolete Equipment

All concrete, steel reinforcement, brick masonry, timber, cable, conduit, traffic signal equipment, lighting equipment and incidental materials not requiring salvage shall become the property of the Contractor and shall be removed from the right-of-way. The City shall have the first right to salvage equipment.

Mercury vapour, metal halide and fluorescent lamps, and electrical components containing PCB materials shall be disposed of at approved sites in accordance with the Environmental Protection Act and regulations made thereunder.

Disassemble and handle with care all traffic signal equipment to be returned to the City. Removal work shall be timed so that outdoor storage, or storage in non-ventilated or humid areas is not required.

If requested by the Engineer, remove and deliver traffic signal equipment to:

City of Saint John
Millidgeville Facility
100 Boars Head Road
Saint John, NB.

City Staff at this facility shall be notified prior to delivery. Removal and delivery of traffic signal equipment shall be considered incidental to the work.

17.5.29 Testing

Tests on electrical wiring and material shall, unless otherwise specified, conform to the Canadian Electrical Code Part 1 and shall include insulation value readings and resistance to ground readings.

Testing shall be performed by an IMSA certified technician only and shall be done in the presence of the Engineer, City traffic technicians, local Utilities and authorities, as requested.

The Contractor shall provide all necessary instruments, equipment and personnel required to satisfactorily carry out prescribed tests at his own expense.

The following tests shall be performed as directed by the City:

- All conduits and duct systems shall be proven free of stones, dirt, water or other debris by pulling a test mandrel with a diameter of at least 90% of the diameter of the installed conduit or ducts through each individual conduit or duct.
- All circuits shall be proven continuous and free of short circuits or ground faults.
- All circuits shall be proven free of unspecified grounds and the resistance to ground all circuits shall be no less than fifty (50) mega ohms.
- Each optical link (fibre link terminated with optical connectors) shall be tested. Attenuation and continuity shall be demonstrated at wavelength of equipment which is to use the link being measured.
- Calibration between the light source and power meter shall be performed at the beginning of each day of testing.
- All circuits shall be proven to be operable. Each control or switching device shall be operated no less than ten (10) times and each circuit no less than eight (8) hours.
- The resistance to ground for the power service facility ground, the controller ground, and the intersection system ground shall be proven to not exceed 25 ohms. The Contractor shall perform the necessary test and record and document the values for the Engineer.
- The Contractor shall measure the incoming voltage at the power service facility and shall record the value on an appropriate form.

In addition to the above tests, the Contractor shall, where directed by the City, perform any tests called for where performance of the electrical system indicates a deficiency.

Where any tests indicate faulty workmanship or unacceptable electrical measurements, the Contractor shall repair or replace the faulty equipment at his own expense, and to the satisfaction of the City.

The Contractor shall be in charge of all testing and shall assume full responsibility for any damage which may occur to the equipment installed as a result of such testing.

The work of testing shall not be submitted for payment but considered part of the Contractor’s tender pricing and shall be considered incidental to the work.

17.5.30 Adjustment of Equipment

All equipment shall be installed in a neat and orderly manner. Adjustments to equipment, required to ensure that the entire electrical installation and all its equipment, material and components are in satisfactory physical condition and perform the intended function and operations improve the appearance of the installation, shall be carried out at the Contractor's expense.

Any adjustments required to make the system operate in the manner intended by the Engineer shall be made by the Contractor. The Contractor shall make adjustments during nighttime conditions to any equipment, if so required, to provide optimum performance. All such adjustments shall be carried out at the Contractor's expense.

17.5.31 Commissioning

Traffic signal startup shall be carried out as follows:

- Upon completion of the installation, prior to start-up, the Contractor shall advise the Engineer to carry out their final inspection. After the final inspection is completed a written list of deficiencies will be sent to the Contractor.
- All deficiencies noted during the final inspection shall be corrected to the satisfaction of the Engineer prior to signal start-up.
- After the deficiencies are corrected (prior to the signal start-up) the Contractor shall put the signal into flash for a period of seven (7) days, unless otherwise directed by the Engineer.
- The Contractor shall provide the Engineer with the proposed signal start-up date and time. Upon approval from the Engineer, the Contractor shall advise the Engineer and the controller manufacturer a minimum of 72 hours in advance of the approved start-up date and time.
- At the Engineer's discretion, the controller manufacturer's representative shall inspect all field wiring connections and controller operation on site prior to signal start-up.
- In the presence of the Engineer, the controller manufacturer (at the Engineer's discretion) and the City, the Contractor shall put the traffic signals into full operation.
- The Contractor shall supply all the necessary traffic control personnel required during the signal start-up. A minimum of two (2) qualified traffic control persons are required.
- The signal start-up shall be done during non-peak traffic periods.

17.5.32 Cleanup

The Contractor shall restore the Work Area to its original condition. This may include shaping, concreting (curb and/or sidewalk), topsoiling, sodding and/or hydroseeding to the satisfaction of the Engineer. Any areas where Work has been performed shall be restored to original condition, or better.

Existing equipment designated as being removed shall be returned to the City or disposed off-site as noted in the Contract.

17.5.32 Cleanup (Cont'd)

The interior of enclosures, pole hand-holes, transformer bases and wiring areas shall be cleaned of dust, dirt and loose materials, vacuum-cleaned and all water and moisture removed.

All fastening screw holes provided in enclosures shall have a fastening screw installed.

Touch-up all painted areas damaged during installation.

Any spots where the galvanizing is damaged due to drilling, tapping, reaming, welding, or surface damage during transportation and erection, shall be refinished with cold galvanizing compound in accordance manufacturer's recommendations.

17.5.33 Locating and Positioning Traffic Signs

Unless otherwise approved by the Engineer, signs shall be mounted at a height of 2.1 metres to 3.0 metres, measured from the surface of the ground to the bottom of the sign as per the Standard Drawings.

Each sign shall be located according to the plans or as directed by the Engineer. Contractor to confirm location with the Engineer prior to installation.

Installed signs will be inspected at night for maximum effect. If any sign is ineffective at night, the sign shall be replaced at the Contractor's expense.

Signs and posts that are not installed vertically or correctly, to the discretion of the Engineer, shall be reinstalled by the Contractor at the Contractor's expense.

17.5.34 Installation of Traffic Signs and Posts

Tele-spar receivers shall be installed at locations shown on the plans or as directed by the Engineer. Contractor to confirm location with the Engineer prior to installation of receivers.

Receivers to be installed as per the Standard Drawings.

Signs shall be attached using 11 mm diameter stainless steel bolts, nuts and flat washers.

17.5.35 Existing Traffic Signs and Posts

Where indicated on the Contract Drawings, existing traffic signs, posts and bases shall be removed by the Contractor. Existing street name signs and any specified traffic signs identified for re-use shall be stored by the Contractor for reinstallation. Signs for re-use shall be stored by the Contractor in a secure location, and any damaged, lost, or stolen signs shall be replaced by the

17.5.35 Existing Traffic Signs and Posts (Cont'd)

Contractor at the Contractor's expense. The Contractor shall deliver all remaining signs, posts and bases to the City of Saint John, at an approved City site as specified by the Engineer.

Cost to remove and deliver traffic signs, posts and bases to be considered incidental to the works. The Engineer shall be provided one (1) day notice prior to delivery.

Street name signs and specified traffic signs stored by the Contractor shall be reinstalled on new posts with new hardware.

17.6 METHOD OF PAYMENT

17.6.01 Measurement for Payment

All Inclusive Price Method

Measurement for payment for traffic signal installations shall be on a lump-sum basis per intersection as shown on the Drawings, where individual quantities are not provided in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

Payment shall include all labour, materials, equipment, accessories, appurtenances, testing, adjustments, delivery of salvaged components, commissioning and all other incidental items required to do the Work.

Individual Item Method

Payment for individual traffic signal items shall be made under a unit price basis for the number of specified tender items supplied and installed in accordance with this Item. Payment shall include all labour, materials, equipment, accessories, appurtenances, testing, adjustments, commissioning and all other incidental items required to do the Work.

Payment for Tele-spar receivers and posts shall be paid based on the number of post and receiver kits installed, including all necessary hardware.

Payment for new traffic signs shall be paid based on the number of new signs installed, including all necessary hardware.

Reinstallation of re-used street signs on new posts, including new hardware, shall not be measured for separate payment but shall be considered incidental to the installation of new metal Tele-spar posts and receivers.

17.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 18

EXPANDED ASPHALT STABILIZATION

City of Saint John

TABLE OF CONTENTS

DIVISION 18 – EXPANDED ASPHALT STABILIZATION

EXPANDED ASPHALT STABILIZATION

18.1 SCOPE OF WORK

The Work included in this Division consists of supplying all labour, materials, and equipment necessary for the pulverization and stabilization of the existing asphalt pavement and underlying granular base as per the Drawings and Specifications.

18.2 DEFINITIONS

"**CORRECTIVE AGGREGATE**" shall mean virgin aggregate added to the pulverized existing pavement and granular base material to bring the gradation of the mix into the specified grading limits.

"**EXPANDED ASPHALT**" shall mean the heated asphalt cement expanded from its normal volume through the addition of water.

"**HALF-LIFE**" shall mean the length of time in seconds required for the expanded asphalt to subside from its maximum expansion volume to half of its maximum expansion volume.

"**STABILIZATION**" shall mean the mechanical, chemical, or bituminous treatment designed to increase or maintain the stability of a material or otherwise to improve its engineering properties.

"**UNSTABILIZED MATERIAL**" shall mean the mixture of the pulverized existing pavement, granular base, and corrective aggregate if required.

18.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract .....Div. 6

(b) Construction of Municipal Services .....Div. 7

(c) Excavation, Trenching and Backfill Requirements.....Div. 13

(d) Roadway Construction .....Div. 24

(e) Asphalt Concrete .....Div. 27

(f) Standard Drawings

18.4 MATERIALS

18.4.01 Corrective Aggregate

Corrective aggregate shall conform to the City of Saint John General Specification for Granular Base Materials.

18.4.02 Asphalt Cement

The Contractor shall select a performance graded asphalt cement with suitable expansion characteristics. Asphalt cement shall conform to the requirements of the latest edition of New Brunswick Department of Transportation and Infrastructure Standard Specifications. The delivery, handling and storage of asphalt cement shall conform to New Brunswick Department of Transportation and Infrastructure requirements.

18.4.03 Water

All water used shall be clean and free of deleterious substances.

18.4.04 Mix Design

The total asphalt cement content of the design mix includes existing aged binder and new expanded asphalt cement. The percent by mass of new asphalt cement added to the unstabilized material shall be determined by mix design.

The water content of the expanded asphalt shall be established to provide maximum expansion ratio and maximum half-life. The rate of water injection into the expanded asphalt shall be selected to provide a minimum half-life of 10 seconds. The half-life and expansion ratio of the expanded asphalt shall be determined at a minimum of five (5) different water contents. A minimum of two (2) trials shall be completed at each water content and the average values obtained shall be used in the final analysis.

The combined mineral constituents shall produce a mixture conforming to the gradation requirements in Table 18.1. Corrective aggregates shall be incorporated into the mix if required by the mix design.

Table 18.1: Grading Requirements of Pulverized Mixture

Sieve Size (mm)	Percent Passing (%)
50	100
37.5	95-100
26.5	95-100
19	62-100
13.2	52-86
9.5	45-75
4.75	30-55
2.36	23-45
1.18	18-38
0.6	15-32
0.3	11-26
0.15	8-22
0.075	5-20

18.4.04 Mix Design (Cont'd)

For mix design purposes, the Contractor shall obtain representative samples of the material that will be produced during the in-place processing operation. Those samples shall be used to establish the design rate(s) of expanded asphalt as a percentage by mass of the unstabilized material. The mix designs shall be carried out in accordance with the Wirtgen Mix Design Manual.

The mix design(s) shall identify total asphalt cement content, aggregate gradation, compacted bulk density, target dry density, dry tensile strength, wet tensile strength, and the tensile strength ratio. The percent by mass of new asphalt cement added to the unstabilized material shall be a minimum of 2.8%. The mix design(s) shall include information on the type, manufacturer and supplier of the asphalt cement, and a copy of all calculations performed to determine the design rate(s) of expanded asphalt. The area for which each mix design is to be used shall be identified. The mix design(s) shall also list the type, source, gradation, and quantity of any corrective aggregate, if required, to be used in the mix.

The mix design(s) shall be submitted by the Contractor to the Engineer at least seven (7) working days prior to the start of work. Separate mix designs shall be submitted when the percent by mass of new asphalt cement added to the unstabilized material is adjusted by 0.2% or greater. Field modifications to an accepted mix design shall not be allowed. All mix design changes must be submitted to and approved by the Engineer prior to the field operations changing. All costs associated with the development of revised mix designs shall be at the Contractor's expense.

18.5 CONSTRUCTION METHODS

18.5.01 Equipment

General

The Contractor shall supply all tools, machinery and equipment required for the execution of all phases of the work. The Contractor shall maintain the equipment in first-class working condition. Equipment to be operated by a skilled and experienced operator at all times.

Pulverizer-Stabilizer

The pulverizer-stabilizer shall be capable of pulverizing and reclaiming the existing pavement and underlying granular base material to the depths specified in the contract specifications, incorporating corrective aggregate into the mix if required, adding expanded asphalt in a controlled manner, and producing a uniform mix.

The pulverizer-stabilizer shall be fitted with an automatic sensor to accurately maintain a preset depth of cut and have a minimum 2.0 m wide cutting drum.

18.5.01 Equipment (Cont'd)

Pulverizer-Stabilizer (Cont'd)

The pulverizer-stabilizer shall have an expanded asphalt injection system capable of injecting and blending expanded asphalt uniformly throughout the unstabilized material.

In order to mix the unstabilized material with the expanded asphalt, the pulverizer-stabilizer shall include the following features:

(a) A system to control and regulate the application of expanded asphalt in relation to travel speed and mass of material.

(b) A system to monitor and control all aspects of mixing process (% of asphalt cement rate of application, % of water for optimum compaction).

(c) A heating system to maintain operating temperature.

(d) A system of nozzles that provides uniform application of the expanded asphalt across the full width of treatment. The application system shall be adjustable for varying widths of treatment.

Aggregate Delivery Vehicle

The aggregate delivery vehicle shall have a system for controlled application of the corrective aggregates to be incorporated into the mix.

18.5.02 Construction

General

In-place full depth reclamation including pulverization, mixing, shaping and compacting shall be completed across the full pavement width prior to closing down operations each day. The existing shoulders shall be shaped and compacted to match the adjacent lane prior to closing down operations each day.

The build-up of excess material on the shoulders shall not be permitted. If excess material accumulates on the shoulder, it shall be removed at the Contractor's expense.

The expanded asphalt mix shall be allowed to cure for two (2) days and all defective areas, including ravelling and rutting, have been repaired to the satisfaction of the Engineer prior to the placement of any wearing surface.

Traffic, including construction traffic, shall be kept off the freshly placed expanded asphalt mix until such time as it is able to carry traffic without damage.

18.5.02 Construction (Cont'd)

Full Depth Pulverizing and Stabilizing

The Contractor shall reclaim and stabilize to the limits detailed in the contract documents. Corrective aggregate, if required, shall be added to the roadway prior to stabilizing. The unstabilized material shall be stabilized to the depth specified in the Contract documents.

The overlap between successive passes of the pulverizer-stabilizer shall be a minimum of 100 mm.

Unstabilized material exceeding 50 mm in size shall be removed from the surface of the work.

In areas that are inaccessible to the pulverizer-stabilizer equipment, remove existing pavement to allow for installation of new asphalt as directed by the Engineer, placed flush with the adjacent expanded asphalt mix surface.

If the depth of existing asphalt is thicker than anticipated, the Contractor shall be responsible for any additional equipment, work, or materials that may be necessary.

Placing, Grading and Compacting

The surface of the expanded asphalt mix shall be uniform in texture and free of surface defects.

The expanded asphalt mix shall be spread to the profile and cross-section as specified in the contract documents. The compacted surface of the expanded asphalt mix shall be smooth and true to the specified crown and grade.

Compaction of the expanded asphalt mix shall be carried out to 97% of the target dry density established by the mix design. The Contractor shall inform the Engineer of the target dry density. The field moisture content shall be determined by relevant ASTM testing practices.

Inspection and Testing

The Contractor shall be responsible for all quality control sampling and testing to ensure compliance with the requirements of this specification.

(a) Asphalt Cement

Quality control test results or manufacturer's quality control documentation showing conformance of the asphalt cement with the requirements of this specification shall be submitted to the Engineer at least seven (7) working days prior to commencement of work.

18.5.02 Construction (Cont'd)

Inspection and Testing (Cont'd)

(b) Corrective Aggregate

Aggregate physical property testing shall be conducted by a laboratory certified by the Canadian Council of Independent Laboratories as Type D for the applicable test method(s).

Quality control test results showing conformance of the aggregate to the requirements of this specification shall be submitted to the Engineer at least seven (7) working days prior to commencement of work.

(c) Expanded Asphalt Mix

The Contractor shall be responsible for all quality control sampling and testing to ensure that the expanded asphalt mix meets the requirements of this specification. Samples shall be taken at a minimum frequency of two (2) per day of production.

Quality control test results showing the conformance of the expanded asphalt mix with this specification shall be submitted to the Engineer within seven (7) working days of sampling.

(d) Thickness

The Contractor shall be responsible for all quality control testing to ensure that the expanded asphalt mix meets the thickness requirement of this specification. These test results shall be submitted to the Engineer within three (3) working days of testing.

(e) Compaction

The Contractor shall be responsible for all quality control testing to ensure the expanded asphalt mix meets the compaction requirement of this specification. These test results shall be submitted to the Engineer within three (3) working days of testing.

Acceptance Criteria

Quality assurance testing may be carried out by the Owner for the purpose of ensuring that material placed in the work conforms to the requirements of this specification.

Quality assurance samples are to be obtained by the Contractor in the presence of the Engineer, labeled and delivered to the Owner’s designated lab within two (2) working days of sampling. The Contractor is responsible for transporting these samples in a manner to avoid damage to the samples.

18.5.02 Construction (Cont'd)

Acceptance Criteria (Cont'd)

The mean total asphalt cement content for the expanded asphalt mix shall not be less than the established mix design. Individual test results shall not be more than 0.6% or less than 0.4% by mass of the established mix design.

Testing for dry tensile strength, wet tensile strength and tensile strength ratio of the expanded asphalt mix shall be in accordance with ASTM D4867M and shall meet the requirements of Table 18.2.

Table 18.2: Expanded Asphalt Mix Strength Requirements

Property	Minimum Requirement
Dry Tensile Strength (kPa)	**300**
Wet Tensile Strength (kPa)	**150**
Tensile Strength Ratio (%)	**50**

Thickness requirements are met for the expanded asphalt mix when at least 90% of all thickness measurements are equal to or greater than the specified thickness and no individual thickness measurement shall be less than the specified thickness minus 30 mm.

Compaction requirements are met for the expanded asphalt mix when the mean compaction is greater than or equal to 97% of the target dry density and no individual compaction measurement is less than 95% of the target dry density.

Defective Work

Unacceptable expanded asphalt mix, including any area damaged or contaminated by traffic or by natural or added water, shall be reprocessed and additional expanded asphalt added, if required, at the Contractor's expense.

With the exception of repairs for surface tolerance, the minimum width of repair shall be the full width of the pulverizer-stabilizer equipment. The minimum length shall be sufficient for the repair to be carried out. All repairs shall be made using the same equipment as was used during initial production and placement.

18.6 METHOD OF PAYMENT

18.6.01 Measurement for Payment

Measurement for payment for expanded asphalt stabilization shall include all cost of labour, materials, and equipment to complete the work in accordance with the specifications. The unit price shall also include for all necessary means for controlling traffic and flagging.

Measurement for payment shall be based on the square metre (m^2) of area stabilized at the specified depth.

18.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 19

CRACK SEALING ASPHALT PAVEMENTS

City of Saint John

TABLE OF CONTENTS

DIVISION 19 – CRACK SEALING ASPHALT PAVEMENTS

CRACK SEALING ASPHALT PAVEMENTS

19.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, material and equipment necessary for cleaning, drying and sealing existing cracks up to 25 mm in width in hot mix asphalt pavements with hot poured rubberized asphalt sealant compound.

19.2 DEFINITIONS

"CRACK SEALING" is a localized treatment method used to prevent water and debris from entering a crack, which might include routing (if necessary to perform crack sealing in warmer weather when the cracks are essentially closed) to clean the entire crack and to create a reservoir to hold the sealant. Cracks that are sealed are typically less than 25 mm wide.

"CRACK FILLING" differs from crack sealing, mainly in the preparation given to the crack prior to treatment and in the type of sealant used. Crack filling is most often reserved for more worn pavements with wider, more random cracking. Cracks are typically wider than 25 mm.

19.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Roadway Construction ..... Div. 24

(d) Asphalt Concrete ..... Div. 27

(e) Standard Drawings

19.4 MATERIALS

19.4.01 General

The Contractor shall supply all materials necessary for all Work. The materials necessary to complete the Work are:

(a) Hot applied joint sealant used to seal cracks. (An acceptable product is Beram 3060 LM). The crack sealing material shall be hot poured rubberized asphalt compound formulated to meet the latest ASTM D 6690 Type IV for crack sealing. The workers of the crack sealing crew shall become familiar with the Material Safety Data Sheet (MSDS) provided by the supplier. All materials handled and stored shall be in accordance with the MSDS. The Contractor shall ensure all materials are stored and sheltered from rain and sun.

(b) Lime, Portland cement or other approved material used to protect sealed cracks.

19.4.02 Submissions

The City shall be provided with the following data at least five (5) working days prior to placement of sealant:

(a) Batch numbers;

(b) Test results;

(c) Application recommendations;

(d) Recommended heating time and temperature;

(e) Allowable storage time and temperature after initial heating;

(f) Allowable reheating criteria; and

(g) Application temperature range.

19.4.03 Sampling and Testing

The Contractor shall retain copies of the supplier's quality control (QC) testing results (minimum requirement of cone penetration and flow) and undertake quality control as follows:

(a) The Contractor shall supply material samples (a sample of the sealant puck, approximately 4 litres in volume, from one (1) or more batches of sealant) to the Engineer for quality assurance (QA) testing purposes when requested;

(b) At least once each hour, the temperature of the sealant shall be checked by the Contractor. If the Contractor finds that the temperature of the sealant is not within the manufacturer's recommended range, then the Contractor shall remove all of the sealant that has been placed since the last acceptable temperature measurement. Any sealant that is rejected shall be replaced with acceptable material;

(c) During the process of placing, the Engineer may require the Contractor to take samples of the sealant directly from the heating kettle. A minimum of three (3) 4-litre samples shall be taken from the heating kettle spigot at points when approximately ¼, ½, and ¾ of the proposed volume has been placed on the Contract. All samples shall be placed in a properly labelled triple tight metal container; and

(d) If routing is performed, the routing operation shall be periodically checked for cleanliness using duct tape. One (1) metre of the adhesive surface of the tape shall be pressed into the rout and immediately removed. Little if any debris, dust or millings should remain after cleaning.

19.5 CONSTRUCTION METHODS

19.5.01 Equipment

Router

All routing equipment shall consist of mechanical routers capable of continually creating well-defined right angled routs and keeping the rout centreline within 8 mm of the centre of the crack and providing a rout width of 20 mm to 25 mm and a shape factor (width/depth) of 1:1. The routing equipment shall be sufficiently portable and flexible to accurately follow random cracks without undue spalling of the crack edge.

When the Contractor cannot demonstrate to the satisfaction of the Engineer that a router is capable of maintaining the specified dimensions and shape of the rout, the Contractor shall then adjust or replace as many cutters in the router's cutting head as necessary until the dimensions and shape of the rout again meets the specification requirements.

Heating Kettle

The heating kettle for joint sealant compound shall be a double boiler oil heat transfer type (indirect heating) with built in mechanically-operated agitator and equipped with thermometers to measure the temperature of both heat transfer oil and the sealing compound. The heating kettle shall be equipped with a spigot.

The heating kettle shall have automatic thermometric controls that will prevent overheating of the sealant and heat transfer oil. A calibrated thermometer capable of +/- 5°C from 100°C to 400°C will be located so that the workers may safely and frequently check and record the sealant temperature.

A sealant applicator wand will be attached to a heated hose and attached to a heated sealant chamber. Temperature controls will be capable of maintaining the temperature of the sealant within manufacturer's tolerances.

Hot Compressed Air Lance

The indirect flame hot compressed air lance shall have a discharge air temperature of approximately 500°C ± 100°C and an air velocity greater than 1,000 m/s. The lance shall be used whenever there is a chance of moisture being present. If the pavement/cracks are dry (several low humidity days), the lance may be used in compressed dry, oil-free air mode only to remove debris from the crack.

19.5.02 Sealant Preparation

At the beginning of each day, the melting kettle shall be empty and only new material added to the kettle for melting. The sealing compound shall be heated and melted in the melting kettle according to the manufacturer's recommendations. The kettle should be charged by adding a few units of sealing compound at a time. When the compound has reached a fluid condition, additional material can be added until the kettle is full. Care shall be taken to exclude foreign matter from the kettle.

The sealant shall be subjected to continuous and positive agitation during melting. The temperature achieved to melt the sealant will be in accordance with the manufacturer's recommendation. Sealant which is heated in excess of the maximum specified temperature shall be properly discarded.

When the pouring temperature has been reached, the sealant shall be maintained at this temperature until it is placed in the crack, and in no cases shall the sealant be held at fluid temperatures for more than three (3) hours. Overheated, burned or underheated sealant shall not be used. If applied, it shall be removed and replaced at the Contractor's expense.

Preparation of Transverse, Longitudinal and Random Crack Sealing (Unrouted)

Prepare transverse, longitudinal and random cracks of width from 3 mm – 25 mm and not having severe branching, cupping or spalling by cleaning with a high pressure air or hot air lance.

High pressure air shall be used for cleaning to rid cracks of debris and/or moisture. The hot air lance will be subsequently used to clean the cracks. All cracks shall be dry (exhibiting no evidence of moisture) prior to sealing.

All dust, dirt and debris shall be removed from the pavement surface by the Contractor. This shall be considered as incidental to the work. The Contractor shall dispose of unsuitable and surplus material off-site.

Care shall be taken with the use of the hot air lance to ensure that the pavement is not oxidized (burnt) by the lance.

Sealant shall be placed in overband configuration as described in the sealant application below.

Preparation of Cracks (Routed)

Unless otherwise specified in the Particular Specifications, routing of cracks will not be required.

If routing is specified due to the time of year or weather conditions that result in cracks being closed, crack sealing of transverse cracks will include routing to a predefined geometry, cleaning and sealing with hot applied sealant. All transverse cracks greater than 3 mm wide and less than 25 mm wide located on the driving lanes shall be routed. "V" or "U" - shaped grooves are not acceptable. The routing of all transverse and skewed cracks shall be terminated within 25 mm of the pavement edge.

19.5.02 Sealant Preparation (Cont'd)

Preparation of Cracks (Routed) (Cont'd)

Two (2) or more cracks shall not be joined by routing through uncracked pavement or routed in areas where a crack does not exist. If a crack is missed as a result of not accurately following the crack, both the rout and the crack shall be sealed.

Occasional cracks greater than 25 mm wide will not be routed, and will be filled in accordance with the Overband Method described in Sealant Application below.

Following routing, the pavement surface and the routed crack shall be cleaned with high pressure air and heated with a hot air lance. The Contractor shall ensure that no debris or moisture enters the routed crack before sealing. All routed cracks shall be sealed within four (4) hours of routing.

All dust, dirt and debris shall be removed from the pavement surface by the Contractor. This shall be considered as incidental to the work. The Contractor shall dispose of unsuitable and surplus material off-site.

Immediately prior to sealing, the rout shall be completely cleaned and dried using dry, oil-free compressed air to expose the freshly routed surface.

When pavement temperatures are less than 10°C, the hot air lance shall be used to warm the routed crack surface and remove any moisture. Care shall be taken with the use of the hot air lance to ensure that the pavement is not oxidized (burnt) by the lance. Sealant shall be placed in cracks treated with the hot air lance within 2 minutes of preparation with the lance when temperatures are below 10°C.

Sealant Application:

Unrouted or Routed Cracks (Overband Method)

The sealant shall be placed into the unrouted or routed crack, and spread over the crack with a squeegee or with the wand. The sealant centered over the crack shall be shaped with a squeegee or wand as thin as possible into an overband approximately 50 mm wide.

Limitations

Crack sealing shall be carried out only when the pavement surface temperatures are 5ºC and rising and the pavement surfaces are dry.

All crack sealing work will be limited to the following types of cracks:

(a) Longitudinal cracks: 3 mm – 25 mm in width

(b) Random cracks: 3 mm – 25 mm in width

(c) Transverse cracks: 3 mm – 25 mm in width

19.5.02 Sealant Preparation (Cont'd)

Limitations (Cont'd)

All alligator cracks, edge cracks located within 450 mm of the edge of asphalt or curb and all cracks exhibiting severe branching shall not be sealed.

Crack sealing shall be scheduled for completion during the months when pavement cracks are at or near their maximum width (early spring/late fall). Crack sealing shall not be carried out during extended periods of high temperatures.

Deficiencies and Repairs

Where a routed crack is found to be more than 10% outside the specified rout dimension, geometry, or location, it shall be considered unacceptable and corrected by additional routing. Where the sealant subsides in a sealed crack by more than 3 mm below the adjacent pavement surface, except where the pavement will be immediately overlaid, the surface of the sealant shall be cleaned and topped up.

Where the sealant contains imbedded foreign matter other than dusting material; contains entrapped air bubbles; has debonded or pulled away from the crack; or, has been excessively heated; the sealant shall be removed, the routed crack rerouted and resealed at the Contractor's expense.

Acceptance Criteria

Following the application of the crack sealant and before the area is open to traffic, all treated areas will be thoroughly checked by the Contractor for adhesion failure, damage to the sealant, missed cracks, foreign matter in the sealant or other problems. All areas not meeting the acceptance criteria shall be prepared and resealed until satisfactory at the Contractor's expense.

Maintenance of Traffic

The Contractor shall carry out the work in such a manner as to not prevent the passage of traffic on City streets. All signs and barricades shall be supplied in proper working condition and maintained by the Contractor at the Contractor's expense. Should proper execution of the work require traffic restrictions, the scheduling and layout of the traffic restriction or closure(s) shall be provided in writing to the Engineer for review and approval at least five (5) working days prior to implementation.

Protection of Work

Where traffic is to be maintained during crack sealing, the surface of the sealant shall be dusted with Portland cement or lime prior to allowing traffic on the sealed areas. Any damage resulting from improper protection of the work shall be replaced by the Contractor at the Contractor's expense. Treated areas shall be protected from vehicle traffic for either thirty (30) minutes after the sealant has been poured or in accordance with the manufacturer's specifications, whichever is longer.

19.6 METHOD OF PAYMENT

19.6.01 Measurement for Payment

Payment shall be made on the basis of the linear metres (m) of cracks acceptably sealed. The unit prices shall include all preparatory, incidental and related work, labour, materials and equipment required to complete the accepted works.

19.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 20

RANDOM RIPRAP

City of Saint John

TABLE OF CONTENTS

DIVISION 20 – RANDOM RIPRAP

RANDOM RIPRAP

20.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, material and equipment for the supply and placement of sound, durable quarried or field rock in accordance with the Drawings and Specifications.

20.2 DEFINITIONS

Not applicable to this Division.

20.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Roadway Construction ..... Div. 24

(d) Standard Drawings

20.4 MATERIALS

Random riprap shall be hard, sound, durable quarried rock or field rock, free from splits, seams, or defects. Slate, shale or rock with thin foliations will not be acceptable.

The Contractor shall notify the Engineer in writing of the source of random riprap, and materials shall be supplied by the Contractor after being approved by the Engineer. Materials for random riprap shall be in accordance with NBDTI Item 608; including LA Abrasion, soundness and a density of not less than 2.6 t/m^3.

Random riprap material shall be well-graded and shall meet the size requirements given in Table 20.1.

20.4 MATERIALS (Cont'd)

Table 20.1: Riprap Size Requirements

Range in Riprap Size (mm)	NBDTI Designation
120 – 220	R – A
70 – 220	R – 5
120 – 380	R – 25
150 – 480	R – 50
190 – 600	R – 100
260 – 820	R – 250
330 – 1000	R – 500
420 – 1300	R – 1000
530 – 1600	R – 2000

20.5 CONSTRUCTION METHODS

Before placing random riprap, grades and slopes of underlying material shall be prepared by removing debris, snow and other unsuitable material and by shaping the area as shown on the Drawings or as directed by the Engineer.

Where geotextile fabric is to be used prior to installation of random riprap, the Contractor shall take care in placing random riprap to prevent damage to the geotextile fabric.

Random riprap shall be placed until specified dimensions as shown on the Drawings are attained, or as directed by the Engineer, and in such a manner that underlying slopes shall not be disturbed. Smaller rocks shall be distributed uniformly throughout the construction area.

Where noted on the Drawings or directed by the Engineer, rocks used as random riprap shall be individually placed by a machine approved by the Engineer.

Random riprap shall be placed so that the larger rocks are uniformly distributed and that the smaller rock fragments fill the spaces between the larger rocks in a manner which results in a compact uniform layer. Rearranging of individual rocks by mechanical equipment or other means may be necessary to obtain satisfactory placement of materials.

Random riprap material shall be weighed unless otherwise directed by the Engineer.

20.6 METHOD OF PAYMENT

20.6.01 Measurement for Payment

Measurement for payment for supply and placement of random riprap material shall be the number of tonnes (t) of material acceptably supplied and placed.

Clearing and grubbing in random riprap locations will be measured and paid as per Division 24, “Roadway Construction”.

Removal of debris, snow, ice and other unsuitable material and shaping the construction area prior to placing random riprap material will not be measured for payment but shall be considered as incidental to the Works.

20.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 21

RESTORATION

City of Saint John

TABLE OF CONTENTS

DIVISION 21 – RESTORATION

RESTORATION

21.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, materials, plant and equipment necessary to restore all surfaces disturbed by the Contractor after construction as per the Drawings and Specifications.

21.2 DEFINITIONS

Not applicable to this Division.

21.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Water Systems ..... Div. 10

(d) Sewer Systems ..... Div. 11

(e) Manholes, Catch Basins and Valve Chambers ..... Div. 12

(f) Excavation, Trenching and Backfill Requirements ..... Div. 13

(g) Random Riprap ..... Div. 20

(h) Portland Cement Concrete ..... Div. 23

(i) Roadway Construction ..... Div. 24

(j) Chain Link Fencing ..... Div. 25

(k) Landscaping ..... Div. 26

(l) Asphalt Concrete ..... Div. 27

(m) Gabions ..... Div. 29

(n) Standard Drawings

21.4 MATERIALS

Not applicable to this Division.

21.5 CONSTRUCTION METHODS

All surfaces disturbed by the Contractor shall be restored to a condition equal to or better than the original, unless specified otherwise by the Engineer. The surface of the excavation shall be graded neatly and evenly in accordance with the Drawings cross-sections and profiles or as directed by the Engineer. Existing drains, ditches, natural watercourses, culverts and ditch structures shall be restored to their original grades and condition.

21.5.01 Asphalt Concrete Reinstatement

All excavations in paved areas shall be backfilled up to 150 mm below the asphalt lower course with pit run gravel subbase material compacted to 95% Standard Proctor Density ASTM D698, latest edition. The 150 mm of backfill material below the asphalt lower course shall be granular base material compacted to 95% Standard Proctor Density ASTM D698, latest edition.

All utility cuts in asphalt surfaces shall be prepared and reinstated in accordance with the Standard Drawing, 'Utility Restoration Asphalt Concrete "T" Patch' and in accordance with Division 27, "Asphalt Concrete".

Permanent asphalt concrete reinstatement shall not be completed until instructions are issued by the Engineer, and such instructions shall not be construed to guarantee the acceptance of the paving work so reinstated. Permanent pavement reinstatement shall be hot-mix, hot-laid asphalt concrete in accordance with Division 27, "Asphalt Concrete", not less than 75 mm of asphalt lower course and 40 mm of asphalt upper course, or as specified by the Engineer.

Damage to, or settlement of asphalt pavement, caused by inadequate compaction of trenches, as determined by the Engineer, shall be repaired to the extent required and deemed necessary by the Engineer. This remediation shall be at the expense of the Contractor for the duration of the Maintenance Period.

21.5.02 Curbs

Concrete curbs damaged or removed during construction shall be replaced in accordance with Division 23, "Portland Cement Concrete". The dimensions of the new curb shall match those of the existing curb.

Asphalt concrete curbs damaged or removed during construction shall be replaced in accordance with Division 27, "Asphalt Concrete". The dimensions of the new curb shall match those of the existing curb.

21.5.03 Asphalt Concrete Sidewalk

Asphalt concrete sidewalk shall be restored in accordance with Division 27, "Asphalt Concrete".

21.5.04 Concrete Sidewalk

Concrete sidewalk shall be restored in accordance with Division 23, "Portland Cement Concrete".

21.5.05 Grassed Areas

All hydroseeding, topsoil, and sod shall be restored in accordance with Division 26, “Landscaping”.

21.5.06 Driveways

All granular driveways shall be restored with the same material and depth as existing.

Asphalt aprons shall match the width of the existing driveway. Asphalt aprons shall be 50mm thick asphalt (Superpave 9.5 or as directed by the Engineer) and shall extend 1.2m behind the curb, sidewalk or edge of street, unless directed by the Engineer. Commercial driveway asphalt (Superpave 12.5 or as directed by the Engineer) thickness shall match existing.

21.5.07 Site Clearance

All excess materials, equipment and plant shall be removed from the work area continuously as the work progresses.

At completion of the Works all equipment, surplus materials, plant and temporary facilities shall be removed, and the Site shall be left absolutely clean and to the satisfaction of the Engineer.

21.5.08 Maintenance of Pavement Cuts

The Contractor shall be responsible for maintaining all pavement cuts until reinstatement is completed.

Pavement cuts shall be brought to and maintained at finish grade with crushed granular base material if the pavement cuts are not to be reinstated immediately. If the Contractor does not, or refuses to, maintain trenches to the satisfaction of the Engineer, or if in accordance with Section 6.12, “Contractor’s Representative”, the City is unable to contact the Contractor, the Engineer may arrange to have the work completed and the cost charged to the Contractor.

Prior to paving, the Contractor shall remove all excess granular material to underside of pavement base elevation, plus re-cut any damaged pavement edges. Restoration on streets for utility cuts and excavations containing structural geogrid shall be performed in accordance with the respective Standard Drawings.

If asphalt concrete is not available, the Contractor shall maintain the cut with cold mix asphalt concrete equal to QPR 2000, until permanent paving is completed.

21.6 METHOD OF PAYMENT

21.6.01 Measurement for Payment

Measurement for payment for all restoration work, including granular material, asphalt concrete, structural geogrid and landscaping shall be in accordance with the corresponding Divisions in these Specifications.

21.6 METHOD OF PAYMENT (Cont'd)

21.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 22

CULVERTS

City of Saint John

TABLE OF CONTENTS

DIVISION 22 – CULVERTS

CULVERTS

22.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, material, and equipment for the construction of culverts as per the Drawings and Specifications.

22.2 DEFINITIONS

"**CULVERT**" shall mean a storm water crossing under a driveway, road, railway line or other location as may be necessary to direct water from one location to the other.

22.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Sewer Systems ..... Div. 11

(d) Excavation, Trenching and Backfill Requirements ..... Div. 13

(e) Random Riprap ..... Div. 20

(f) Gabions ..... Div. 29

(g) Standard Drawings

22.4 MATERIALS

22.4.01 Corrugated Steel Pipe

Corrugated steel pipe (CSP) shall be round, minimum 16 gauge, Type II aluminized and meet the requirements of the latest editions of CSA Standard G401, AASHTO Standard M36 and CSPI Specifications No. 501.

For connecting corrugated steel pipe, an aluminized annular corrugated coupler shall be used having the same specification as corrugated steel pipe, as specified by the manufacturer.

The use of CSP shall be as approved by the Engineer.

22.4.02 Concrete Pipe

Concrete pipe shall be reinforced concrete to the latest edition of ASTM C76 Standard Class III 65D minimum or as specified, bell and spigot type, with approved o-ring gasket.

22.4.03 High Density Polyethylene Pipe

High Density Polyethylene (HDPE) may be used for driveway culverts only. HDPE pipe shall conform to CSA B182.8. Minimum pipe stiffness to be 320kPa at 5% deflection. Pipe shall be double-walled with a smooth interior surface and corrugated exterior surface. For connecting double-wall pipe, a split coupling, which covers at least two corrugations of each pipe end, shall be used as specified by the manufacturer.

Acceptable Products: Solflo Max by Soleno SPD Inc.
Hi-Q by Hancor

22.4.04 Headwalls

Headwalls shall be constructed as shown on the Drawings.

Random riprap headwalls shall be constructed as specified by the Engineer.

Granite headwalls shall be constructed with granite stone cut into different lengths and shall be installed with two (2) layers of headers and one (1) layer of stringers. At least 10° slope to the vertical should be given to the face of headwall.

Pre-cast concrete headwalls shall be constructed of reinforced concrete and shall be designed and stamped by the manufacturer's Engineer.

Gabion headwalls shall be constructed of PVC coated, galvanized steel wire gabions as manufactured by Maccaferri Canada Ltd., or approved equivalent. Each gabion headwall shall be designed by an Engineer.

22.4.05 Backfill Material

The backfill material shall be as specified in Division 13, "Excavation, Trenching and Backfill Requirements".

22.4.06 Culvert Dimensions

Maximum length of driveway culverts shall be 7.3 m unless otherwise directed by the Engineer. Pipe diameter shall be minimum 450 mm unless otherwise directed by the Engineer. Minimum cover of material over the pipe shall be 300 mm unless otherwise directed by the Engineer.

For cross culverts, pipe diameter shall be a minimum of 450mm unless otherwise directed by the Engineer. Minimum cover of material over the pipe shall be as per manufacturer's specifications.

22.4.07 Culvert Inlet and Outlet Grates

Culverts 25 m and longer shall be equipped with inlet and outlet grates for pipe sizes larger than 300mm, up to and including 1050 mm, unless otherwise directed by the Engineer. Refer to the respective Standard Drawing(s).

22.5 CONSTRUCTION METHODS

All excavation, bedding, backfill, and compaction requirements shall be as per Division 13, “Excavation, Trenching and Backfill Requirements”.

Each pipe shall be inspected for defects, by the Contractor, prior to placement and any defective material shall be removed from the Site. The accepted pipe shall then be placed in the trench and jointed as per the manufacturer's specifications.

The headwall structure shall be constructed on both ends, as shown on the Drawings. For engineered structures, construction methods shall be as approved by the Engineer, or as recommended by the manufacturer.

22.6 METHOD OF PAYMENT

22.6.01 Measurement for Payment

Measurement for payment for pipe shall be per metre (m) of pipe, supplied and installed, which shall include the cost of all material, couplers, gaskets, common excavation, dewatering, compacting, pipe laying, bedding and backfilling to grade.

Measurement for payment for rock excavation shall be in accordance with Division 13, “Excavation, Trenching and Backfill Requirements”.

Measurement for payment for each headwall shall be on a Unit Price basis, for supply and installation.

22.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 23

PORTLAND CEMENT CONCRETE

City of Saint John

TABLE OF CONTENTS

DIVISION 23 – PORTLAND CEMENT CONCRETE

PORTLAND CEMENT CONCRETE

23.1 SCOPE OF WORK

The Work included in this Division consists of supply and placing of Portland cement concrete for the construction of concrete sidewalks, curbs, and any other structure to the lines and grades as per the Drawings and Specifications.

23.2 DEFINITIONS

Not Applicable to this Division.

23.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Water Systems ..... Div. 10

(d) Sewer Systems ..... Div. 11

(e) Manholes, Catch Basins and Valve Chambers ..... Div. 12

(f) Excavation, Trenching and Backfill Requirements ..... Div. 13

(g) Roadway Construction ..... Div. 24

(h) Chain Link Fencing ..... Div. 25

(i) Standard Drawings

23.4 MATERIALS

23.4.01 General

All materials shall be supplied by the Contractor.

Portland cement shall conform to the latest revision of CSA-A23.1 titled Concrete Materials and Methods of Concrete. Requirements for materials and methods given in these Specifications may be superseded by the latest revision to CSA-A23.1 in which case the latest CSA Standard governs. Unless specified otherwise, Portland cement shall be Normal, Type 10. Mix design shall be submitted to the Engineer by the Contractor at least two (2) weeks prior to commencement of work.

23.4.01 General (Cont'd)

The ready mixed concrete supplier shall be certified in accordance with the requirements published by the Atlantic Concrete Association (ACA).

A copy of the current certification of conformance and plant membership shall be submitted by the Contractor to the Engineer prior to the start of concrete delivery.

The ready mixed concrete supplier shall submit a copy of certification of conformance with CSA A23.1 with respect to the requirements for materials and methods in the proportioning, mixing, transport and inspection of cast-in-place Portland cement concrete (PCC) prior to start of concrete delivery.

Water is not to be added to the concrete other than at the batching plant without permission of the Engineer.

Maximum time limit from batching to placing shall not exceed 120 minutes.

Concrete shall be re-tested for conformance to air content when more than 90 minutes have elapsed since batching.

Concrete mix designs shall be adjusted so that aggregates which are known or suspected to be reactive with alkali in Portland cement, shall not be used.

Unless otherwise stated, no admixture, except for an air entrainment agent, shall be used in the concrete mixture.

23.4.02 Exposure Classes

The exposure classes for Portland cement concrete shall be as defined in Table 23.1.

Table 23.1: Definitions of C, F, and N Exposure Classes

Classes	Definition
C-1	Structurally reinforced concrete exposed to chlorides with or without freezing and thawing conditions. Examples: Bridge decks, parking decks and ramps, portions of marine structures located within the tidal and splash zones, and salt water pools.
C-2	Non-structurally reinforced (ie: plain) concrete exposed to chlorides and freezing and thawing. Examples: Garage floors, porches, steps, pavements, sidewalks, curbs, and gutters.
C-3	Continuously submerged concrete exposed to chlorides but not to freezing and thawing. Examples: Underwater portions of marine structures.
C-4	Non-structurally reinforced concrete exposed to chlorides but not to freezing and thawing. Examples: Underground parking slabs on grade.
F-1	Concrete exposed to freezing and thawing in a saturated condition but not to chlorides. Examples: Pool decks, patios, tennis courts, freshwater pools, and freshwater control structures.
F-2	Concrete in an unsaturated condition exposed to freezing and thawing but not to chlorides. Examples: Exterior walls and columns.
N	Concrete not exposed to chlorides nor to freezing and thawing. Examples: Footings and interior slabs, walls and columns.

23.4.03 Requirements for Exposure Classes

The requirements for Portland cement concrete exposure classes shall be as per Table 23.2.

Table 23.2: Requirements for C, F, and N Exposure Classes

Classes	Maximum Water to Cementing Materials Ratio by Mass (w/c)	Minimum 28 day Compressive Strength (MPa)	Air Content Category (A/C)
C-1	0.40	35	*
C-2	0.45	32	1
C-3	0.50	30	2
C-4	0.55	25	2
F-1	0.50	30	1**
F-2	0.55	25	2**
N	For structural design	For structural design	—

23.4.03 Exposure Classes (Cont'd)

* Use Category 1 for concrete exposed to freezing and thawing.
Use Category 2 for concrete not exposed to freezing and thawing.

** Interior ice rink slabs and freezer slabs with a steel trowelled finish have been found to perform satisfactorily without entrained air.

23.4.04 Air Content

The air content requirements shall be as per Table 23.3.

Table 23.3: Requirements for the Air Contents Categories

Air Content Category (A/C)	Range in Air Content* for Concrete with Indicated Nominal Maximum Sizes of Coarse Aggregate, (%)		
	10 mm	14 - 20 mm	28 - 40 mm
1	6 - 9	5 - 8	4 - 7
2	5 - 8	4 - 7	3 - 6

* At the point of discharge from the delivery equipment, unless otherwise specified.

23.4.05 Slump Tolerances

Tolerances in slump shall be within the following applicable ranges, unless otherwise stated:

(a) When the specified slump is less than, or equal to 40 mm, the allowable variation shall be +/- 10 mm;

(b) When the specified slump is greater than 40 mm and less than or equal to 80 mm, the allowable variation shall be +/- 20 mm;

(c) When the specified slump is greater than 80 mm and less than or equal to 180 mm, the allowable variation shall be +/- 30 mm;

(d) When the specified slump is greater than 180 mm, the allowable variation shall be +/- 40 mm.

23.4.06 Concrete Curb

Concrete curb in this Division shall also include concrete curb and gutter, and concrete gutter.

Portland cement concrete used in this work shall be proportioned to meet the specifications in Table 23.4.

Table 23.4: Portland Cement Concrete Curb Mix Requirements

Minimum Cement Content	380 kg/m^3 for a slipform curbing machine 400 kg/m^3 for metal forms
Nominal Maximum Size of Coarse Aggregate	20 mm
Maximum Sand Content by Weight of Total Aggregate	40%
Maximum Water/Cement Ratio By Mass (w/c)	0.45
Air Content (a/c)	5% - 8%
Minimum Compressive Strength at 28 Days	32 MPa
Slump (Slipform curbing machine)	40 mm

23.4.07 Concrete Sidewalk

Portland cement concrete used in this work shall be proportioned to meet the specifications in Table 23.5.

Table 23.5: Portland Cement Concrete Sidewalk Mix Requirements

Minimum Cement Content	400 kg/m^3 for metal forms
Nominal Maximum Size of Coarse Aggregate	20 mm
Maximum Sand Content by Weight of Total Aggregate	40%
Maximum Water/Cement Ratio By Mass (w/c)	0.45
Air Content (a/c)	5% - 8%
Minimum Compressive Strength at 28 Days	32 MPa
Slump	80 mm

23.4.08 Welded Wire Fabric

Welded wire fabric shall be used for the reinforcement of concrete sidewalk in non-residential driveways or as directed by the Engineer.

The welded wire fabric shall be the standard style and the size of the mesh shall be 152 mm x 152 mm. The gauge number shall be 6. The metric designation is 152 x 152 MW18.7 x MW18.7 and the equivalent Imperial style is 6x6 6/6.

The wire used in the manufacture of the welded wire fabric shall conform to the latest edition of CSA Standard G30.3-M, Cold-Drawn Steel for Concrete Reinforcement.

23.5 CONSTRUCTION METHODS

23.5.01 Concrete Curb

Concrete curb shall be constructed to the line and grades shown on the Drawings or laid out in the field and in accordance with the typical cross-sections shown on the Standard Drawings. Construction methods shall conform to the requirements of CSA-A23.1, latest editions.

All asphalt pavements (road and/or sidewalks) shall be neatly cut straight before excavation with an asphalt saw.

The curb height shall be 160 mm ± 10 mm above finished asphalt elevation, or as shown on the Drawings.

Catch basin and manhole adjustments shall be in accordance with Division 12, “Manholes, Catch Basins, and Valve Chambers”.

Existing granite curbs from excavation shall be delivered by the Contractor to an approved City site as specified by the Engineer. Care shall be exercised to avoid breaking of the granite curb.

Concrete which arrives at the Site at a temperature of less than 10°C or more than 35°C shall not be placed and shall be rejected. There shall be no payment for rejected concrete.

The placing of concrete shall not be started until the granular base and the forms have been inspected and approved by the Engineer. Existing curb shall be saw cut square and neat before placing new curb against it.

The granular base shall be prepared and compacted with crushed granular material in accordance with Division 13, “Excavation, Trenching and Backfill Requirements” and Division 24, “Roadway Construction” and with the corresponding Drawings. Minimum thickness of granular base shall be 150 mm.

23.5.01 Concrete Curb (Cont'd)

Equipment and forms shall be free from hardened concrete and foreign matter, and shall be cleaned at frequent intervals.

Concrete shall be placed while still plastic and workable. Use of any partially hardened concrete will not be permitted.

Under adverse weather conditions, arrangements acceptable to the Engineer shall be made to prevent damage to fresh concrete.

The Contractor shall protect the curb and keep it in alignment and first class condition until the completion of the Contract. Any curb which is damaged at any time before the Final Acceptance of the Works shall be removed and replaced with new curb at the Contractor's expense.

Driveways and Access Ramps

Concrete curb, and sidewalk shall be depressed at driveway entrances, pedestrian crosswalks or other locations as directed by the Engineer.

Height of depressed section of curb at driveway entrances shall be 20 mm maximum above the existing asphalt elevation or final asphalt elevation, unless otherwise directed by the Engineer.

Height of depressed section of curb at access ramps shall be flush with the existing asphalt elevation or final asphalt elevation, unless otherwise directed by the Engineer (refer to the Standard Drawing).

Control joints shall be placed at the bottom of the transition at each side and at the centre of the driveway entrance.

Concrete thickness at access ramps shall be 100 mm.

The width of the depressed curb and sidewalk shall be as shown on the respective Standard Drawing(s).

Access ramps may be constructed monolithically with the curb or curb and gutter.

The Contractor shall be responsible for providing access to all driveway entrances after the concrete has attained sufficient strength by filling in excavated areas with gravel over the usable portion of the driveway entrances until asphalt reinstatement is completed either by the City or the Contractor, depending on the Contract requirements.

23.5.01 Concrete Curb (Cont'd)

Method of Forming

All forms shall be set true to line and grade and held rigidly in position. Forms shall be either of metal or of acceptable planed and matched lumber, and of such construction that there will be no interference to inspection of grade and alignment and that a smooth surface will be provided.

Forms may be used for curb or curb and gutter construction where length of section does not exceed 20 m, or as directed by the Engineer.

Formwork shall be thoroughly coated with a commercial quality form coating, which will permit the ready release of the forms. Form coating shall not discolour the concrete.

The forms shall be left in place at least twenty-four (24) hours or until the concrete has set sufficiently so that, in the opinion of the Engineer, they can be removed without damage to the curb.

Slipforming

The Slipforming process shall be utilized for curb, or curb and gutter construction where the length of section exceeds 20 m, or as directed by the Engineer.

Slipforming equipment must be approved by the Engineer before curbing begins.

Control (saw cut) joints shall be at 3 m intervals. Saw cut joints shall be 6 mm wide and 25 mm deep.

23.5.02 Concrete Sidewalk

Concrete sidewalk shall be constructed to the line and grades shown on the Drawings or laid out in the field and in accordance with the typical cross-sections shown on the Standard Drawings. Construction methods shall conform to the requirements of CSA-A23.1, latest edition.

Excavation for sidewalk, including the removal of existing sidewalk, (asphalt or concrete) shall be to the depth and width shown on the Drawings or on the Standard Drawings.

All soft, yielding and otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted to a minimum 95% maximum dry density in accordance with ASTM D698, latest edition, and extend a minimum of 0.3 m outside the form lines.

Granular Base for sidewalk shall be crushed gravel to the required grades and shall be placed and compacted in accordance with Divisions 13, "Excavation, Trenching and Backfill Requirements" and Division 24, "Roadway Construction" of the Specifications. Minimum thickness of granular base shall be as per the Standard Drawings.

23.5.02 Concrete Sidewalk (Cont'd)

Water shall be applied to the granular base immediately prior to placing concrete so as to thoroughly moisten the aggregate base surface without the pooling of water. Water to be supplied by the Contractor shall be considered incidental to the Work.

Existing manholes in the sidewalk shall be adjusted according to Division 12, "Manholes, Catch Basins, and Valve Chambers".

Sidewalks, unless specified otherwise, shall be 1.5 m wide and a minimum of 100 mm thick; 150 mm thick under driveways. Welded wire fabric shall be used in concrete sidewalks at non-residential locations.

Concrete which arrives on the Site at a temperature of less than 10°C or more than 35°C shall not be placed and shall be rejected. There shall be no payment for rejected concrete.

The placing of concrete shall not be started until the granular base has been reviewed by the Engineer.

Equipment and forms shall be free from hardened concrete and foreign matter and shall be cleaned at frequent intervals.

Concrete shall be placed while still plastic and workable. Using any partially hardened concrete will not be permitted.

The forms shall be so arranged as to give a finished surface slope of 2%. The direction of the slope will depend on local conditions, but in general it shall be toward the curb.

After the concrete has set sufficiently, the spaces in front and back of the sidewalks shall be refilled with suitable material approved by the Engineer to the required elevation. The fill material shall be thoroughly compacted in layers.

Under adverse weather conditions, arrangements acceptable to the Engineer shall be made to protect fresh concrete.

The Contractor shall protect the sidewalk until completion of the Contract. Any sidewalk which is damaged at any time before the Final Acceptance of the Works shall be removed and replaced with new sidewalk at the Contractor's expense.

Joints

Expansion (isolation) joints shall be located at 6 m intervals and shall consist of asphalt impregnated fibreboard or Deck-O-Foam Expansion Joint Filler. Where specified by the Engineer, expansion joints that include Deck-O-Foam Expansion Joint Filler shall be finished with self leveling polyurethane sealant at the discretion of the Engineer.

Acceptable Products: Polyurethane Sealant:
SikaFlex 2C 2L
Sonolastic SL 2

23.5.02 Concrete Sidewalk (Cont'd)

Joints (cont'd)

Control joints saw cut at intervals shown on the Standard Drawings, unless otherwise directed by the Engineer. The depth of the control joints shall be a minimum of one quarter (¼) of the depth of the cross-sectional thickness and the width of the joints shall be a maximum width of 6 mm.

All joints shall be saw cut before uncontrolled shrinkage takes place between 4 hours and 24 hours following placement of concrete and the timing shall be the responsibility of the Contractor.

Saw cutting shall be done using handheld circular concrete saws in small concrete sidewalk areas of standard width, and walk behind power saws shall be utilized for longitudinal cuts or large concrete areas, or as directed by the Engineer.

When sidewalks are placed next to Portland cement concrete curbs, the joints shall be located in the same transverse plane as the saw cut joints in the curb.

Construction of joints required at irregularities shall be considered incidental to placement of concrete.

Structures

Where catch basins, manholes or other structures are located in the sidewalk, they shall be treated as isolated structures. A full depth construction joint shall be placed at a spacing of no less than 150 mm and no greater than 300 mm at either side of a structure.

The frame of the structure shall be properly positioned with respect to line and grade before concrete has been poured. Sloping around the frame shall be required for catch basins and manholes.

Any service boxes, manholes or valve chambers located in the sidewalk shall be raised by the Contractor to the final grade of the new sidewalk before concrete is placed.

Any service boxes, manholes or valve chambers not raised and consequently buried with concrete shall be raised by the Contractor at no additional cost to the City.

Tolerance

Concrete surfaces shall be finished to within 3 mm over 3 m from line, level or grade as measured with a straightedge placed on the concrete surface.

Method of Forming

The forms shall be of metal, wood or other suitable material that is straight and free from warps, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent the leakage of concrete. Flexible or rigid forms of proper curvature may be used for curves that have a radius of 30 m or less.

The front and back forms shall extend for the full depth of the concrete. All of the forms shall be braced and staked so that the forms remain in both horizontal and

23.5.02 Concrete Sidewalk (Cont'd)

Method of Forming (Cont'd)

vertical alignment until their removal. Forms shall be cleaned and coated with an approved form release agent before concrete is placed against them. The concrete shall be deposited into the forms without segregation and then it shall be vibrated, tamped and spaded for thorough consolidation. Front and back forms shall be removed without damage to the concrete after it has set.

Slipforming

Sidewalk slipform equipment shall be reviewed by the Engineer prior to sidewalk construction.

23.5.03 Curing and Protection

General

Curb and sidewalk shall be protected from all elements, including vandalism until completion of the Contract. Curb and sidewalk damaged before Final Acceptance of the Work shall be removed and replaced by the Contractor at no additional cost to the City.

The replacement of full sections only (ie: from joint to joint) shall be required and construction joints shall be provided at each end of the replaced section.

Curing shall begin immediately following the placing and finishing operations and shall provide the temperatures and moisture conditions for the period of time necessary for concrete to develop its strength, durability, and other properties in accordance with CSA A23.1, latest edition.

White pigmented curing compounds shall meet the requirements of ASTM Standard C309 "Liquid Membrane-Forming Compounds for Curing Concrete," latest edition.

The permissible concrete temperatures at placing shall be as per Table 23.6.

Table 23.6: Permissible Concrete Temperatures at Placing

Thickness of Section (m)	Temperatures	
	Minimum (°C)	Maximum (°C)
< 0.3	10	35
0.3 - 1	10	30
1 - 2	5	25
> 2	5	20

23.5.03 Curing and Protection (Cont'd)

General (Cont'd)

Aggregates shall not be heated above 80°C. Frozen lumps of aggregate shall be excluded from the mix. Portions of stockpiles and storage bins in use shall be protected by tarpaulins, or other suitable means, against accumulation of ice and snow.

Equipment required for heating materials shall be approved by the Engineer.

Heated water over 40°C shall not be brought in direct contact with the cement, but shall be added into the mixer before, with, or after the aggregates. The mixer shall be turned over a few times to distribute the heat before the cement is added. The prescribed mixing time shall then start.

Chloride compounds or other materials to lower the freezing point of concrete shall not be permitted.

Placing

Concrete shall not be placed against frozen surfaces. Formwork, any existing concrete at a construction joint, and reinforcing steel shall be free of ice and snow. Formwork and reinforcing steel shall be preheated to a temperature of not less than 5°C and so maintained.

Concrete shall not be placed on a frozen base.

Water shall not be added to the surface of concrete during finishing procedures.

Concrete placing shall be delayed until the ground thaws and warms up sufficiently to ensure that it will not freeze again during the curing period.

Freshly deposited concrete shall be protected from freezing, abnormally high temperatures or temperature differentials, premature drying, and moisture loss for the period of time necessary to develop the desired properties of the concrete in accordance with CSA A23.1, latest edition.

Finishing

Before the set has been completed, the plastic concrete shall be worked to a smooth finish prior to texturing by using a wooden or magnesium float. Steel trowels shall not be used. The finished surface, (ie: the exposed faces) of concrete curb, curb and gutter and sidewalk will be broom finished. Power trowels shall not be used unless authorized by the Engineer.

Water sprinkling applied to the concrete surface to aid in the finishing operation shall not be permitted during concrete finishing. The Engineer shall, upon discovery, reject any parts which have been sprinkled and notice will be given in writing to the Contractor. Upon receipt of such notice, the Contractor shall replace the affected parts, all in accordance with the Specifications. All such replacement shall be done at the expense of the Contractor.

23.5.03 Curing and Protection (Cont'd)

Finishing (Cont'd)

If concrete curb, or curb and gutter is placed by using forms, the face forms will be removed from the front of the curb, or curb and gutter, before setting is complete and the prescribed broom finish will be applied to exposed vertical face and top of curb and gutter and the edges of concrete shall be rounded with an acceptable edging tool.

Top surfaces of sidewalks shall be floated by using a wooden float. A 50 mm wide strip shall be finished smooth along the edges of each slab. The edges shall be rounded with an approved edging tool to a radius of 6 mm. The remainder of the exposed surface shall be broom finished to a texture similar to that applied to concrete curb, and curb and gutter.

Basic Curing Period

Concrete surfaces shall be cured for either three (3) days at a minimum temperature of 10°C or for the time necessary to attain 40% of the specified twenty-eight (28) day compressive strength of the concrete.

Additional Curing for Durability

Curing of exposed surfaces shall commence as soon as the concrete has hardened sufficiently to prevent surface damage. Curing of concrete surfaces shall be achieved using one (1) or more of the following methods:

(a) Ponding or continuous sprinkling;

(b) Absorptive mat or fabric kept continuously wet;

(c) Damp sand, earth, or similar moist materials;

(d) Curing compounds whose type, method, and rate of application shall be approved by the Engineer;

(e) Waterproof paper or plastic film;

(f) Vapor mist bath;

(g) Forms in contact with concrete surface; or

(h) Other moisture retaining methods as approved by the Engineer.

23.5.04 Curing and Protection in Extreme Temperatures

Hot-Weather Curing

When the air temperature is at or above 27°C, curing during the basic curing period shall be accomplished by water spray or by using saturated absorptive fabric, in order to achieve cooling by evaporation. Mass concrete shall be water cured for the basic curing period when the air temperature is at or above 20°C, in order to minimize the temperature rise of the concrete.

Cold-Weather Curing

During freezing weather, water curing of concrete shall be terminated twelve (12) hours before the end of the protection period.

Protection

All freshly placed and consolidated concrete shall be suitably protected during the curing period against damage from adverse weather conditions.

Hot-Weather Protection

When the air temperature is at or above 27°C during the placing period (as forecast by the nearest official meteorological office), facilities shall be provided for the protection of the concrete in place from the effects of hot and/or drying weather conditions.

Cold-Weather Protection

When the air temperature is at or below 5°C within twenty-four (24) hours of placing (as forecast by the nearest official meteorological office), all materials and equipment needed for adequate protection and curing shall be on hand and ready for use before concrete placement is started.

Placing

All snow and ice shall be removed before concrete is deposited on any surface. Calcium chloride or other de-icing salts shall not be used as a de-icing agent in the forms. Concrete shall not be placed on or against any surface that will lower the temperature of the concrete in place below the minimum value shown in Table 23.6, except when non-chloride, non-corrosive accelerators are used.

Some non-chloride, non-corrosive accelerators conforming to the latest edition of ASTM Standard C494, Type C and E, have been found to accelerate setting and strength gain at ambient temperatures of 5°C and below. When adequate information pertaining to past performance records is available, concrete containing non-chloride, non-corrosive accelerators can be placed at ambient temperatures as low as -5°C. Test panels/placements and compressive strength cylinders should be made to verify that the setting time and early strength gain characteristics of the proposed mix design are satisfactory. Cement characteristics and initial concrete temperature will have a significant impact on early strength gain.

23.5.05 Protection Requirements and Methods

General

During cold weather, adequate protection of the concrete shall be provided for the duration of the required curing period. Protection shall be provided by means of heated enclosures, coverings, insulation, or a suitable combination of these methods.

Enclosures shall be constructed to withstand wind and snow loads and shall be reasonably airtight. The enclosure shall provide sufficient space between the concrete and the enclosure to permit free circulation of warmed air. Heat shall be supplied to the enclosure by live steam, forced hot air, or stationary heaters of various types. At the time of placing and during curing, concrete surfaces shall be protected by formwork or an impermeable membrane from direct exposure to combustion gases or drying from heaters.

The type of protective cover and the amount of insulation required to cure concrete properly in cold weather shall be determined on the basis of the expected air temperature and wind velocity (wind chill factor), the size and shape of the concrete structure, and the amount of cementing material in the concrete mix.

Cooling after Protection

To avoid cracking of the concrete due to a sudden temperature change near the end of curing period, the protection shall not be completely removed until the concrete has cooled to an acceptable temperature differential. For high-performance concrete, the maximum temperature differential for all structural components shall be 20°C.

23.5.06 Timing of Portland Cement Concrete Work

Portland cement concrete operations shall not continue after October 15 unless approved by the Engineer.

23.5.07 Quality Control

The Contractor shall conduct such quality control (QC) procedures, including sampling and testing as necessary to ensure that all Portland cement concrete to be used in the work conforms to the requirements of the Specifications. All testing shall be conducted in accordance with the latest revision of CSA-A23.1 / A23.2 Methods of Test and Standard Practices for Concrete. The Contractor shall determine the type and amount (schedule/frequencies) of QC sampling and testing required to ensure that the Portland cement concrete meets the requirements of the Specifications. As a minimum, on projects that involve more than three (3) loads of concrete daily, a complete test consisting of a slump, air test and compressive strength test shall be made on each of the first two (2) loads and then on every third load of concrete. On smaller projects, involving two (2) to three (3) loads of concrete in total, one (1) complete test shall be made. Air tests shall be made on samples taken from the first portion of the concrete and prior to placement. Test samples for compressive strength shall consist of three (3) concrete cylinders with compressive strength testing completed at 7 and 28 day intervals.

23.5.07 Quality Control (Cont'd)

The Contractor shall engage and pay for a qualified consulting engineering firm to perform the sampling and testing. The concrete testing laboratories utilized by the consulting engineering firm shall be certified in accordance with CSA Standard A283 "Qualification Code for Concrete Testing Laboratories". The field and laboratory test results shall be recorded on a form titled "Concrete Testing Summary". A typical form is contained in the Sample Forms section of the General Specifications. The Contractor shall submit the test results to the Engineer as soon as the tests are completed. All quality control testing costs shall be deemed to be included and distributed among the Contract Unit Prices.

The Contractor shall be responsible for the interpretation of the QC test results and the determination of any action to be taken to ensure that all materials and work conform to the requirements of the Contract.

23.5.08 Quality Assurance

Quality assurance inspection and testing will be carried out by the City's designated inspectors or Consultants on all materials used and all work performed. Inspectors will have the full authority to reject defective material and workmanship and to suspend the carrying out of any work that is being improperly done, subject to the final decision of the Engineer. The Contractor remains, however, fully responsible for the quality of the materials and workmanship, even though the Inspector is present.

23.6 METHOD OF PAYMENT

23.6.01 Measurement for Payment

Manhole adjustments in sidewalks shall be measured and paid for under the provisions of Division 12, "Manholes, Catch Basins, and Valve Chambers".

Saw cutting and construction of joints in concrete shall be considered incidental to the placement of concrete.

Costs for the removal and delivery of recovered granite curb sections shall be considered incidental to the Work

Measurement and payment of concrete curb and concrete sidewalk shall be classified as to the following:

Concrete Curb

Method A: Including Excavation and Backfill

In areas where construction is limited to the replacement of existing curb or placement of new curb, measurement for payment shall be made per metre (m) of curb which shall include all labour, material and equipment necessary to complete the work including cutting of asphalt, all excavation (excluding rock), backfilling, compaction, curing and protection of the concrete. Rock excavation shall be measured and paid in accordance with Division 13, "Excavation, Trenching and Backfill Requirements".

23.6.01 Measurement for Payment (Cont'd)

Concrete Curb

Method B: Excluding Excavation and Backfill

Measurement for payment for installation of curb on new construction or on street reconstruction shall be made per metre (m) of curb which includes all labour, material and equipment necessary to complete the work including curing and protection of the concrete.

Method B: Excluding Excavation and Backfill

Excavation and backfill shall be measured for payment in accordance with Division 13, "Excavation, Trenching and Backfill Requirements".

Concrete Sidewalk

Method A: Including Excavation and Backfill

In areas where construction is limited to the replacement of existing sidewalk or placement of new sidewalk, measurement for payment shall be made per metre (m) of sidewalk for 1.5 m wide sidewalk and per square metre (m^2) for variable width sidewalk. Measurement for payment shall include all labour, material and equipment necessary to complete the work including cutting of asphalt, all excavation (excluding rock), backfilling, compaction, curing and protection of the concrete. Rock excavation will be measured and paid as per Division 13, "Excavation, Trenching and Backfill Requirements".

The length of concrete sidewalk at driveway locations, including the transition sections, to be measured for payment shall be the number of metres (m) of depressed sidewalk acceptably placed.

The area of variable width of concrete sidewalk at driveway locations, including the transition sections to be measured for payment, shall be the square metres (m^2) of depressed sidewalk acceptably placed.

Method B: Excluding Excavation and Backfill

Payment for installation of sidewalk on new construction or on street reconstruction shall be made per metre (m) of sidewalk for 1.5 metre wide sidewalk and per square metre (m^2) for variable width sidewalk. Measurement for payment shall include all labour, material and equipment necessary to complete the work including curing and protection of the concrete.

The length of concrete sidewalk at driveway locations including the transition sections to be measured for payment shall be the number of metres (m) of depressed sidewalk acceptably placed.

23.6.01 Measurement for Payment (Cont'd)

Concrete Sidewalk (Cont'd)

Method B: Excluding Excavation and Backfill (Cont'd)

The area of variable width of concrete sidewalk at driveway locations, including the transition sections to be measured for payment shall be the square metre (m^2) of depressed sidewalk acceptably placed.

Excavation and backfill will be measured for payment in accordance with Division 13, "Excavation, Trenching and Backfill Requirements".

Measurement for payment for welded wire fabric shall be the number of square metres (m^2) acceptably placed.

23.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 24

ROADWAY CONSTRUCTION

City of Saint John

TABLE OF CONTENTS

DIVISION 24 – ROADWAY CONSTRUCTION

ROADWAY CONSTRUCTION

24.1 SCOPE OF WORK

The Work included in this Division consists of the requirements for all excavation, granular backfill, compaction and related work for the construction of roadways or other surfaces as per the Drawings and Specifications.

24.2 DEFINITIONS

COMMON EXCAVATION

Refer to Division 13, Section 13.2.01.

ROCK EXCAVATION

Refer to Division 13, Section 13.2.02.

CLEARING

Clearing shall consist of the removal and disposal of all trees, shrubs, logs, and any other vegetation to within 300 mm of ground surface, from the area designated to be cleared.

GRUBBING

Grubbing shall consist of the removal and disposal of all stumps, roots, logs and any other debris or vegetation, from the area designated to be grubbed.

24.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Excavation, Trenching and Backfill Requirements ..... Div. 13

(d) Restoration ..... Div. 21

(e) Asphalt Concrete ..... Div. 27

(f) Chip Seal ..... Div. 28

(g) Standard Drawings

24.4 MATERIALS

24.4.01 Rock and Gravel Aggregates

Rock and gravel aggregates shall be in accordance with Division 13, "Excavation, Trenching and Backfill Requirements.

24.4.02 Calcium Chloride

Calcium chloride shall be in the form of loose, dry flakes, and shall meet the requirements of ASTM D98, latest edition.

Calcium chloride shall be delivered to the Site in bags or containers which clearly identify the manufacturer, the net weight, and the percentage of calcium chloride ($CaCl_{2)}$ guaranteed by the manufacturer.

24.4.03 Geotextile Fabric

Geotextile fabric shall be installed in accordance with manufacturer's recommendations. Geotextiles for drainage applications shall be non-woven fabrics. Woven fabric shall be used for stabilization and separation under granular roadbase material when specified.

The geotextile shall conform to the following minimum requirements in Table 24.1:

Table 24.1: Geotextile Minimum Requirements

Property	Unit	ASTM	Non-Woven	Woven
Mullen Burst Strength	kPa	D3786	1100	1500
Tearing Strength (Trapezoid Method)	N	D4533	160	200
Grab Tensile Strength (Both Directions)	N	D4632	400	400
Elongation at Break	%	D4632	50	25 max.
Apparent Opening Size	µm	D4751	50-250	840 max.
UV Degradation	% Ret.	D4355	-	70 min.
Permittivity	Sec^{-1}	D4491	1.75 - 3.50	0.01 min.

24.4.03 Geotextile Fabric (Cont'd)

Property values above the heavy lines in Table 24.1 are Minimum Average Roll Values (MARV). A specification based upon minimum roll average ensures that over 95% of the fabric in a lot will meet or exceed minimum requirements. The minimum roll average is the average minus approximately two standard deviations.

Seven (7) days prior to commencement of work, the Contractor shall submit to the Engineer for approval, a mill certificate for the geotextile to be supplied and the manufacturer's recommended procedures for installation and instructions for handling of the selected geotextile.

24.4.04 Soil Reinforcement (Structural Geogrid)

Tensar Geogrid BR-1 (BX1100 or BX1200), Maccaferri (EB20 or EB30), or approved equal, shall be placed as recommended by the manufacturer.

The Contractor shall submit the name of the supplier to the Engineer seven (7) days prior to commencement of work and shall provide supplier representatives for a pre-construction meeting with the Engineer, to ensure that preparations and installation procedures are in accordance with the manufacturer's recommendations.

The Contractor shall submit to the Engineer seven (7) days prior to commencement of work, a mill certificate for the geogrid to be supplied.

24.5 CONSTRUCTION METHODS

24.5.01 Materials Testing

All materials that are to be incorporated in the Works shall be subject to tests carried out by the Engineer to determine material suitability for the portions of the Works in which the materials are to be placed. Such tests may consist of chemical or physical analysis to determine the organic content, mechanical properties, bearing capacity, density, stability or any other properties pertinent to the satisfactory completion of the Works as proposed. Materials not meeting the requirements shall be disposed of off Site, at the Contractor's expense.

The Contractor shall be responsible for quality control testing for the compaction stage of the Work to ensure that the density conforms with the requirements of the Specifications. The Contractor shall coordinate and pay for the testing as outlined in Section 13.5.13, "Backfilling", Table 13.8. The Contractor shall engage a qualified consulting engineering firm to perform the testing and shall submit the results as soon as tests are completed. All quality control testing costs shall be deemed to be included in and distributed among the Contract Unit Prices. At the Engineer's discretion, the Engineer may request the Contractor to proof roll the sub-grade, subbase or granular base to carry out a visual deflection and yielding test with a fully loaded tandem truck. This item shall be considered incidental to the Works.

Only materials approved by the Engineer shall be used in the Works. Any material of a quality or nature not suitable for its intended use will be rejected.

24.5.01 Materials Testing (Cont'd)

Materials will be considered unsuitable even if particle sizes are within the limits of the grading sizes herein provided, if particle shapes or any other characteristics preclude satisfactory compaction or fail to provide a roadway suitable for traffic.

24.5.02 General

The Contractor shall perform all the excavation as shown on the Drawings, including the right-of-way in the construction of the roadway, side intersections, side entrances, road ditches, off-take ditches, detours, all outlets to structures, and the hauling and placing of the excavated materials.

If an excavated area becomes wet after the area is excavated, the wet area shall be removed and replaced with suitable material, at the Contractor's expense.

The Contractor shall perform all excavation operations in accordance with all New Brunswick Department of the Environment and Local Government Regulations. This includes, but is not limited to, all erosion and sediment control requirements for excavation operations.

The Contractor shall perform all excavation operations in such a manner as to avoid the saturation by flooding of embankment materials and roadway foundation materials, either by providing effective surface drainage during all stages of the work, or in the case of sub-excavation and stripping operations, where provision for surface drainage is not feasible, by placing the backfill materials as soon as practical following the excavation work.

All ice and snow shall be removed from any portion of the Works either prior to or during any stage of ditching, excavating, borrowing and any other grading operation.

24.5.03 Clearing and Grubbing

The Contractor shall perform all clearing and grubbing operations to the limits shown on the Drawings. For easements, the area to be cleared and grubbed will generally be the width of the easement, as specified by the Engineer. Clearing and grubbing shall be performed with the aid of root rakes or other equipment that will minimize the removal of suitable topsoil. All material shall become the property of the Contractor and be removed from and disposed of off Site, unless noted otherwise in Division 3.

Under no circumstances shall material resulting from the grubbing operation be disposed of under fill or embankments, nor shall excavation be combined with the grubbing operation.

Upon completion of clearing and grubbing operations, the Site shall be left in such a condition that grading operations and installation of services can be undertaken immediately.

The Contractor shall be responsible for disposing of all waste material at an approved location.

24.5.04 Over Excavation

Should the Contractor excavate beyond the limits and grades indicated, the Contractor shall be required to backfill such excavations with suitable materials and compact it in 150 mm layers or less, at no additional cost to the City.

24.5.05 Unsuitable Material

All frozen and unsuitable materials shall be removed to below sub grade and such unsuitable materials shall be replaced with acceptable material and compacted in place.

24.5.06 Cuts and Embankment Fills

All earth cuts shall be finished to true section as excavation progresses. Ditches in roadway cuts shall be constructed as soon as possible to provide drainage in the cut to prevent softening of the sub-grade.

Where sub-drainage is required in bases of roadway cuts the work must be completed at the time the ditches are being constructed.

The roadway foundations under embankments of 1.2 m or less in height shall be stripped of all unsuitable materials.

All sub-grade surfaces shall, on completion, be compacted and shaped to the specified grade and cross-section. The finished surface shall not deviate more than 30 mm from the specified grade and cross-section, and shall be compacted to a minimum of 95% of the maximum dry density, in accordance with ASTM D698, latest edition, in maximum 300 mm lifts. The surfaces shall be maintained to these grade and cross-section tolerances, and to a density of not less than that specified until the Contract or that portion thereof is accepted by the Engineer or, if the Contract includes the construction of the granular base course, until the surfaces are covered with granular base course.

24.5.07 Rock Excavation

Rock excavation, as defined in Division 13, shall include the required excavation of all materials classified as ‘Rock Excavation’ whenever encountered in this work.

Rock excavated from roadway cuts may be placed in roadway embankments upon approval of the Engineer. All rock excavated from other sites for the construction of the roadway such as drains, ditches, and channel changes may, if required and feasible, be placed in roadway embankments upon approval of the Engineer.

Overburden material may be incorporated into roadway embankments, deposited and trimmed on the right-of-way, upon approval of the Engineer, or placed in disposal areas.

Frozen overburden materials shall not be incorporated into embankments. The Contractor shall, therefore, schedule the overburden excavation operations so as to complete the stripping of those rock cuts prior to the overburden materials freezing during winter months.

24.5.07 Rock Excavation (Cont'd)

The side slopes shall be excavated to the slope lines shown on the Drawings with no rock projecting within the true slopes. The slopes must be carefully scaled down during or immediately after the excavation so that the rock obtained may be incorporated within the embankment. All rock boulders, and fragments, either on or outside the excavated area, liable to slide, or roll down the slope shall be removed to the satisfaction of the Engineer. With the exception of excavation of rock in roadway cuts, no shattering of rock below grade will be required.

Excavation below grade in rock cuts shall be brought to grade with spalls or approved granular material.

For rock excavation, the Contractor shall notify the Engineer if, during excavation, material which appears to conform to the classification for rock excavation is encountered. Material shall be stripped or exposed to such an extent that, in the opinion of the Engineer, elevations can be taken to calculate rock quantities. If the Contractor fails to give notice, the Engineer will not approve any quantity of excavated material as rock excavation before the Engineer sees it in its original state prior to its excavation.

24.5.08 Drilling and Blasting

This Section shall be read in conjunction with Section 13.5.09, "Explosives and Blasting".

Protective measures shall be used where blasting may damage adjoining property or public utilities. Under Division 6, Section 6.7.04, "Loss or Damage", the Contractor shall be responsible for all damages.

Where rock is encountered in the excavation of roadway cuts, it shall be shattered a minimum of 300 mm below rock grade for the full width of the cut, including the grade of the ditch bottoms. In order to obtain uniform shattering, drilling shall be carried out to a plane parallel to and at a minimum of 600 mm below the rock grade so as to eliminate undrained water pockets. The Contractor shall accurately control the depth of drilling to produce a uniform depth of shatter as herein specified. Overblast shall be corrected by removing overblast rock and backfilling with approved granular material, unless otherwise directed by the Engineer, all at no additional cost to the City.

All costs of rock excavation such as those of explosives, supplies, equipment, labour and any other costs shall be included in the price per cubic metre (m^3) for "Rock Excavation", as bid in the tender.

All operations shall be so conducted as to effect drainage to ditches and not leave undrained pockets in the foundation of the road bed and in the cuts.

24.5.09 Earth Embankment Construction

Earth embankment shall be built to the lines, grades and cross-section specified and only approved materials shall be used.

24.5.09 Earth Embankment Construction (Cont'd)

Embankment materials shall be deposited and spread in uniform layers of the depth specified and for the full width of the embankment. Each layer shall be shaped to the line and cross-section and thoroughly compacted before the succeeding layer is placed. In case of side hill or sloping sections, the lower portion shall be constructed as above, until a full width surface of the specified cross-section is obtained and the embankment shall be completed thereafter with full width layers.

In no case will the Contractor be permitted to construct a core through the embankment and complete the embankment by side dumping.

Materials being placed in embankments shall not contain frozen lumps, weeds, sod, roots, logs, stumps or any other foreign matter.

All earth embankment roadway surfaces shall, on completion, be compacted and shaped to the specified grade and cross-section. The finished surfaces shall not deviate more than 30 mm from the specified grade and cross-section and shall be compacted to a minimum of 95% of the maximum dry density, in accordance with ASTM D698, latest edition. The surfaces shall be maintained to these grade and cross-section tolerances and to a density of not less than that specified until the Contract or that portion thereof is accepted by the Engineer or, if the Contract includes the construction of the granular base course, until the surfaces are covered with granular base course.

Earth shoulders will be considered an integral part of the embankment and as such their construction shall conform to all conditions and requirements as set forth in this Specification. Earth shoulders shall not, during any stage of construction, be built to a grade higher than that of the adjacent granular base course and an efficient embankment surface run-off shall be maintained at all times.

24.5.10 Compaction of Sub-Grade

Compaction of the sub-grade (below the limits of granular materials) shall be compacted to a minimum of 95% of the maximum dry density in accordance with ASTM D698, latest edition.

If the degree of compaction shall be found unsatisfactory the embankment shall be scarified to the depth of the layer and re-compacted entirely at the Contractor's expense.

24.5.11 Placing and Spreading Granular Materials

The Contractor shall exercise due care at all times to prevent the granular base course materials from becoming contaminated by clay or other types of deleterious materials. Any such contamination shall be removed at the Contractor's expense.

Granular Base

All such base course materials shall be placed on the subbase, shaped to proper grade and cross section, in layers each to a thickness not greater than 150 mm.

24.5.11 Placing and Spreading Granular Materials (Cont'd)

Granular Base (Cont'd)

The materials shall be spread by using conventional spreading equipment, approved by the Engineer, which shall be adjustable to place material at required width and thickness.

Granular Subbase

The requirements for placing and spreading subbase materials shall be the same as for base materials. However, in the case of sub-excavations or other conditions, an increased thickness shall be used if specified and/or approved by the Engineer.

The thickness of each granular layer shall be as shown on the Standard Drawings, or as specified in Division 3.

24.5.12 Grading and Compacting Granular Materials

After each layer has been spread, it shall be graded to a smooth surface conforming to the required cross-section and grade. Where granular material is placed in more than one (1) location, a blade grader for each location shall be required for the smoothing operation.

All materials shall be compacted at a moisture content suitable for obtaining the required density. When the material moisture content is considered to be too low, water shall be applied by means of an approved distributor. When the material moisture content is considered too high, dry materials shall be incorporated with the wet material and thoroughly mixed, or the wet materials shall be dried by blading, discing or other approved methods.

Each layer of material shall be shaped to the specified line and cross-section and compacted to a minimum of 95% of the maximum dry density in accordance with ASTM D698, latest edition.

24.5.13 Geotextile Fabric

Geotextile fabric shall not be placed until the Site has been prepared by the Contractor and approved by the Engineer.

Geotextile shall not be placed on brush, limbs, stumps, ice or other material that may tear or puncture the fabric.

Geotextile fabric shall be placed such that the surface is free of stress, folds, wrinkles and creases.

No equipment shall be permitted to travel on uncovered fabric. For roadbed construction, at least 300 mm of fill material shall be kept between equipment and fabric.

Damaged areas shall be repaired by the Contractor, at the Contractor's expense, with a patch of the same fabric extending a minimum of one (1) metre (m) beyond the damaged area.

24.5.14 Soil Reinforcement (Structural Geogrid)

Geogrid shall not be placed until the Site has been prepared by the Contractor and approved by the Engineer.

Geogrid shall be oriented such that the roll length runs longitudinally and parallel to the traffic direction.

Geogrid shall be tensioned by hand and secured at roll ends to the sub-grade surface and the ends shall be secured with approved fasteners as recommended by the manufacturer.

Geogrid shall be overlapped as shown on the Drawings, or as recommended by the manufacturer. Geogrid shall be cut to shapes as required by the manufacturer.

Damaged areas shall be repaired by the Contractor, at the Contractor's expense, with a patch of the same material extending a minimum of one (1) metre (m) beyond the damaged area, or as required by the manufacturer.

No equipment shall be permitted to travel on uncovered geogrid. At least 150 mm of fill material shall be kept between the equipment and the geogrid, at all times.

24.5.15 Application of Calcium Chloride

In accordance with New Brunswick Department of Environment and Local Government requirements, proper dust control measures shall be undertaken at all times during construction using water only. Use of calcium chloride shall be restricted to off hours and weekends. Before application of calcium chloride, the surface may require dampening by thorough sprinkling with an approved sprinkler or other approved methods. When calcium chloride is used, it shall be a 77% - 80% flaked calcium chloride dehydrate product applied using an approved spreader and at a rate acceptable to the Engineer.

Water used during dust control operations shall be considered incidental to the Work.

24.5.16 Weigh Scales

If requested, the Contractor shall provide proof for the current year that the weigh scales meet the requirements of the Weights and Measures Act, Statute of Canada.

The City reserves the right to periodically carry out random spot checks of truck tare and gross vehicle weights. The truck or trucks will be required to be weighed at another Government inspected scale within the greater Saint John area. No payment will be made for this requirement; it shall be considered incidental to the work.

If it is determined that the gross vehicle weight as indicated on the weight slip is incorrect, the Contractor's or supplier's scale shall be immediately closed until such time as it is again certified according to the requirements of the

24.5.16 Weigh Scales (Cont'd)

Weights and Measures Act, Statute of Canada. An appropriate adjustment to all weights accepted prior to the time of closure will be made.

The City reserves the right to place an inspector at the scale site or sites during times when materials are being weighed for use on City Contracts. The cost of this Inspector will be paid for by the City.

24.6 METHOD OF PAYMENT

24.6.01 Measurement for Payment

Clearing and grubbing shall be paid on a square metre (m^2) basis, including all material, equipment, and labour necessary to complete the work.

Geotextile fabric shall be paid on a square metre (m^2) basis including all material, equipment and labour necessary to acceptably install the material according to the Contract Drawings and Specifications.

Geogrid soil reinforcement shall be paid on a square meter (m^2) basis including all material, equipment and labour necessary to acceptably install the material according to the Contract Drawings and Specifications.

Overlap joints, patches and seams shall be measured as a single layer of geotextile or geogrid material.

Common and rock excavation shall be paid on a cubic metre (m^3) basis, including all material, equipment, and labour necessary to acceptably shape and compact the material according to the Contract Drawings and Specifications.

Over excavation, beyond the limits and/or grades specified, shall not be considered for payment.

Granular base and subbase materials shall be paid on a cubic metre (m^3) basis, including all material, equipment and labour necessary to acceptably supply, place, grade and compact the material, according to the Contract Drawings and Specifications.

Additional common excavation and supply and placement of granular materials required due to soft subgrade conditions that existed at the start of construction, shall be paid according to the Schedule of Quantities and Unit Prices, upon authorization of the Engineer.

Application of calcium chloride shall be paid on a 40 kg bag basis, including all material, equipment, labour and water necessary to complete the work.

24.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 25

CHAIN LINK FENCING

City of Saint John

TABLE OF CONTENTS

DIVISION 25 – CHAIN LINK FENCING

CHAIN LINK FENCING

25.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, materials and equipment necessary for the supply and installation of chain link fencing and gates as per the Drawings and Specifications.

25.2 DEFINITIONS

Not applicable to this Division.

25.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Restoration ..... Div. 21

(d) Standard Drawings

25.4 MATERIALS

Chain link fencing and appurtenances shall meet the latest requirements of CAN/CGSB 138.1 and 138.2. Gates and fittings shall meet latest requirements of CAN/CGSB 138.4. All hot dip galvanization methods shall be in accordance with CSA G164, latest edition.

25.4.01 Fence Fabric

Fence Fabric shall be chain link hot dipped galvanized, constructed of 3.5 mm steel wire, Type 1, Class A, Style 2, Grade 2, woven in a 50 mm mesh. The top selvedge of the fabric shall have a twisted and barbed finish and the bottom selvedge shall have a knuckled finish. The galvanized fabric shall have a minimum of 490 g/m^2 of zinc.

25.4.02 Line Posts

Line posts shall be 60 mm outside diameter (OD), 4 mm wall thickness, schedule 40, scale free, hot dipped galvanized tubular steel pipe, with a minimum mass of 5.45 kg/m. Posts shall be complete with galvanized metal caps.

25.4.03 Terminal and Gate Posts

Terminal and gate posts shall be 89 mm OD, 5.5 mm wall thickness, Schedule 40, scale free, hot dipped galvanized tubular steel pipe, with a minimum mass of 11.28 kg/m, supplied with stretching bands and bars for attaching the fabric to the posts, and bands for attaching the braces. Posts shall be complete with galvanized metal caps.

25.4.04 Top Rails

Top rails shall be 43 mm OD, 3.6 mm wall thickness, Schedule 40, scale free, hot dipped galvanized tubular steel pipe, with a minimum mass of 3.38 kg/m. Rail shall be connected at the joints with sleeves that allow for contraction and expansion. Stretcher bands must be steel bands (3 m x 19 mm) or aluminum bands (5 m x 19 mm). Stretcher bars must be 3 m x 19 mm.

25.4.05 Braces

Gate, corner, and end posts shall be braced by a centre rail of the same material as the top rail, between the gate, corner, or end post and the next post.

25.4.06 Fittings

Fittings shall be hot dipped galvanized steel, or aluminum alloy.

25.4.07 Tension Wire

Tension wire for the bottom shall be 5 mm electro-galvanized wire.

25.4.08 Gates

Gate frames shall be 43 mm OD, 3.6 mm wall thickness, Schedule 40, scale free, hot dipped galvanized tubular steel pipe, electrically welded at the joints, complete with galvanized malleable iron hinges, latch and latch catch. Double gates shall have a center rest with drop bolt for closed position and a chain hold for open position. Gate latches to be suitable for padlock which can be attached and operated from either side of gate. Hinges shall permit gate to swing back against fence - 180° if required. Gates over 4.5 m^2 in area shall have diagonal bracing, 33 mm OD, Schedule 40, scale free, hot dipped galvanized tubular steel pipe, electrically welded at the joints. Pipe and fabric to be galvanized to the same standard as fence fabric and line posts.

25.4.09 Fence Height

Fence height shall be as defined in the Contract Specifications or as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

25.4.10 Barbed Wire

Barbed wire shall be 3 mm, 4 point, 150 mm barbed galvanized line wire with a minimum of 244 g/m^2 of zinc. Spacing of barbed wire, 3 strands required, shall be 100 mm apart for fence overhead and 75 mm apart for gates and gate posts. Barbed wire shall be supported by a galvanized stretcher bar angled towards the outside of the fence. Barbed wire shall only be used where specified.

25.4.11 Concrete Footings

Concrete footings shall be exposure class F-2, and in accordance with Division 23, “Portland Cement Concrete”. Diameter of concrete footing shall be 300 mm, unless specified otherwise.

25.5 CONSTRUCTION METHODS

Prior to the construction of the chain link or barbed fence, the Contractor shall remove any debris and correct minor ground undulations (greater than 0.3 m vertical in a 3 m length) which would interfere with the proper construction of the fence in its required location.

All fence grades shall be subject to the approval of the Engineer.

All posts installed in soil shall be vertically embedded in concrete by placing in a concrete form tube which forms the boundary of the augured excavation hole. Form tubes are not required if the excavation is in rock. Terminal and gate posts shall be set into footings a depth of 1.2 m. Line posts shall be set into footings a depth of 0.80 m.

Unless specified otherwise, soil from the auger holes shall be removed at no additional cost. Soil may be spread over the area adjacent to the fence line if authorized by the Engineer.

If posts are placed in solid rock, the footings shall be constructed as indicated on the respective Standard Drawing.

Spacing of posts shall be 3.0 m. If an obstruction or major ground elevation difference prevents placing a post at 3 m from an adjacent post, the post may be placed not less than 2.4 m from the next post and in no case more than 3 m.

A corner post shall be installed wherever the fence line changes direction by more than 10°, and a straining post at changes in elevation of more than 30°.

Top rails, braces and appurtenances shall be installed in accordance with the manufacturer's recommended procedures.

Terminal posts shall be braced by a centre rail of the same material and size as the top rail, between the gate, corner or end post and the adjacent post.

The fence fabric shall be installed on the outside of the line posts and top rail, continuous between terminal posts and stretched tightly and uniformly but not to such a degree that the diamond pattern is distorted.

25.5 CONSTRUCTION METHODS (Cont'd)

Lengths of fabric shall only be joined by splicing, using the manufacturer's approved splicing wire system such that a continuous diamond mesh pattern results. Splicing by overlap will not be permitted.

At all end, corner and gate posts the fabric shall be broken and secured to the posts by a steel stretching bar and stretching bar bands as indicated in the manufacturer's recommended procedures.

The bottom tension wire shall be strung tight on the outside of the line posts at the diamond pattern, fastened to the fabric by a twisted wire or enclosed in a fabric knuckle.

Unless specified otherwise, the bottom of the fence fabric shall be 75 mm to 125 mm above final grade elevation.

25.6 METHOD OF PAYMENT

25.6.01 Measurement for Payment

Payment shall be made per metre (m) of fence which includes the supply of all necessary materials, labour, and equipment for the supply and installation of all fencing, including, grading (cuts or fills), foundation excavation, and concrete footings whether in rock or common material.

Payment for gates shall be made under a unit price basis which includes the supply of all necessary materials, labour and equipment for the supply and installation of gates, including grading (cuts or fills), foundation excavation, and concrete footings whether in rock or common material.

25.6.02 Basis of Payment

Payment shall be made at the Contract Unit Price as contained in the Schedule of Quantities and Unit Price, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 26

LANDSCAPING

City of Saint John

TABLE OF CONTENTS

DIVISION 26 – LANDSCAPING

LANDSCAPING

26.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, material and equipment necessary to carry out the work required for landscaping as per the Drawings and Specifications.

26.2 DEFINITIONS

Not applicable to this Division.

26.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Excavation, Trenching and Backfill Requirements ..... Div. 13

(d) Restoration ..... Div. 21

(e) Standard Drawings

26.4 MATERIALS

The following list of materials must be approved by the Engineer before construction begins:

26.4.01 Water Supply

Water shall be clean, fresh and free from harmful substances.

26.4.02 Pit Run Gravel Subbase

Pit run gravel subbase will be supplied, hauled and graded by the Contractor, as directed by the Engineer. The pit run gravel subbase shall conform to the size and gradation outlined in Division 13, “Excavation, Trenching and Backfill Requirements”.

26.4.03 Lime and Fertilizer

Lime shall be ground agricultural limestone containing a minimum 85% of total carbonates and graded as in Table 26.1.

Table 26.1: Limestone

Sieve Size (mm)	Percent Passing (%)
1.0	90
0.125	50

Lime shall be applied at the rate of 48 kg per 100 m^2 and cultivated into the full depth of topsoil prior to any fertilizer application.

Twenty percent (20%) superphosphate shall be evenly spread over the whole of the approved topsoil area at a rate of 9.7 kg per 100 m^2. This application shall be thoroughly incorporated into the topsoil.

A 50:50 mixture by weight of 1:2:2 ratio fertilizer and activated sludge shall be supplied directly to the sod at a rate of 9.7 kg per 100 m^2. This application shall occur two (2) weeks after the evidence of growth and shall only be permitted between April 1 and September 30.

26.4.04 Topsoil

Topsoil shall be free from rock, roots or other foreign matter, with a minimum of 4% organic matter. Topsoil to be approved and depth to which topsoil is to be stripped to be specified before carrying to the Site.

Sample tests may be ordered to determine pH, NPK and organic matter levels. Sufficient lime shall be added to bring topsoil to a pH range of 5.9 - 7.0. Topsoil shall meet the sieve analysis in Table 26.2.

Table 26.2: Topsoil

Sieve Size (mm)	Percent Passing (%)
25	100
12.5	97 - 100
0.150	40 - 60

26.4.05 Peat Moss

Peat Moss shall be of good quality and all particles shall pass a 12.5 mm sieve.

26.4.06 Trees and Shrubs

All trees and shrubs shall be of Standard No. 1 quality, true to name and type, and to be of type and size as specified.

Trees and shrubs shall have normal, well-developed branches and vigorous root systems.

All trees and shrubs shall be subject to inspection, and any lacking compactness or suffering from damage or disease will not be acceptable.

Substitutions will not be permitted without permission; adjustment to nearest type or size may then be allowed with adjustment of contract price.

Unless otherwise specified all trees and shrubs shall be nursery grown.

Source of all trees and shrubs shall be indicated by the Contractor.

26.4.07 Nursery Sod

Nursery sod used is to have a uniform size and thickness (40 mm minimum), contain not more than 10% undesirable grasses or weeds, and be free from stones, foreign roots or other matter.

The Contractor shall be responsible to furnish all material and shall replace, at the Contractor's expense, all such material found defective or damaged in handling after delivery by the supplier. This shall include the furnishing of all material and labour required for the replacement of installed material discovered defective prior to the Final Acceptance of the Works.

26.4.08 Hydroseed

Composition of the hydroseed mixture to be, by mass, as per Table 26.3.

Table 26.3: Hydroseed Composition

Type 1	Type 2
30% Perennial Rye Grass	45% Creeping Red Fescue
40% Kentucky Bluegrass	20% Hard Fescue
15% Red Fescue	10% Canada Bluegrass
15% Chewing Fescue	10% Alsike or White Clover
—	10% Annual Ryegrass
—	5% Colonial Bentgrass

Type 1 hydroseed shall be used for restoration of existing grassed areas, such as medians, traffic islands, and adjacent to sidewalks and/or curbs.

26.4.08 Hydroseed (Cont'd)

Type 2 hydroseed shall be used for restoration of foreslopes, backslopes, ditches and other areas not previously maintained; each species to meet or exceed the Canadian Grade Standards for Common No. 1 seed.

Fertilizer to be 15-25-15 (N-P-K) mix for seeding done May to September and 10-20-20 (N-P-K) thereafter. Binder may be in liquid, flake or powder form.

Seed and fertilizer that have been subjected to moisture shall not be used.

Water to be free of any impurities which would inhibit germination of the seed.

Hydraulic mulch for hydroseeding shall consist of shredded wood fibers or shredded newsprint colored green with an environmentally acceptable dye, or shredded straw or hay mixed with raw cotton fibres and/or shredded newsprint. When applied, the mixture shall be capable of forming an absorptive mat, which will allow moisture to percolate into the underlying soil.

26.5 CONSTRUCTION METHODS

26.5.01 Nursery Sod

Prior to commencement of placing nursery sod, the Contractor shall obtain the approval of the Engineer in writing, in regard to final grade elevations as well as depth of topsoil (100 mm minimum).

Nursery sod shall be closely laid with staggered joints, fine topsoil to be brushed into joints, the surface rolled or tamped to an even grade at the required level. Nursery sod shall be “cut in”; not layered over existing or adjacent sod. Nursery sod or slopes where it may be prone to slippage shall be pegged such that it is secure. The Engineer shall reject any or all nursery sod at point of delivery which is considered unsatisfactory.

Immediately following the nursery sod laying, water shall be thoroughly applied to ensure moisture penetration of 100 mm to 125 mm through the nursery sod, soil and sub-soil. After the soil has dried out to a point where the structure will not be damaged, the nursery sod shall be rolled with a medium roller and tamped to provide a uniform surface.

26.5.02 Hydroseeding

Hydroseeding during rainfall, windy conditions, freezing temperatures, or over frozen soil is not acceptable. Any stones greater than 75 mm in the least dimension shall be removed and disposed of off Site.

Application rates for hydroseed mixture to be within +/-15% of the application rates listed in Table 26.4.

Table 26.4: Application Rates

Item	Rate
Seed	125 kg/ha
Fertilizer	375 kg/ha
Hydraulic Mulch	1350 kg/ha
Binder	As per manufacturer's specifications

26.5.03 Tree and Shrub Planting

Trees and shrubs are to be planted as and where specified by the Drawings. All stock is to be nursery grown No. 1 stock. All shrubs are to be planted in prepared bed areas. Each shrub shall be fertilized with 500 g of bone meal. All pruning and trimming as required by good horticultural practice is to be carried out on both trees and shrubs.

Pits for the trees are to be a minimum of 600 mm deep and 1200 mm in diameter. The pit shall be wider if necessary to accommodate the root spread. The topsoil used for backfill shall be mixed with a minimum of 0.1 m^3 peat moss and 1 kg of bone meal. A top dressing of 500 g of 10-6-4 fertilizer is to be made after the tree has been planted. All trees are to be staked with painted metal T Bars or stakes, two (2) per tree. All trees and shrubs are to be guaranteed for a minimum of one (1) full growing season.

All plant materials shall be dug and handled with reasonable care to prevent injury.

Roots of bare rootstock are to be protected by wet moss, straw, etc.

Balled and burlapped plants are to be moved with a compact natural ball of sufficient size to contain all fibrous roots and firmly tied in burlap. The root ball will at no time to be allowed to dry out.

Only plants for the day's planting are to be brought to the Site, and to be protected from the elements by tarpaulins or other suitable cover.

Mulch shall be supplied and placed around trees and shrubs as directed by the Engineer.

26.5.04 Maintenance

Grass areas shall be watered twice (2) a week for the first (1) month, and once (1) a week thereafter, until the end of the Maintenance Period. Grass shall be mowed during the Maintenance Period but must not be mowed closer than 65 mm.

The Contractor shall, if required during the Maintenance Period, apply suitable weed killer as necessary and also in the fall and spring, apply a layer of milorganite at a rate of 1.5 kg per 10 m^2.

Trees and shrubs shall be watered twice (2) a week for the first two (2) months after planting and thereafter when necessary, until material has been accepted as maintaining satisfactory growth.

Soil of shrub beds and around all shrubs and trees to a diameter of 450 mm shall be kept free of weeds during the maintenance period.

The Contractor shall replace, at the Contractor's expense, during the Maintenance Period, all unsatisfactory nursery sods, trees and shrubs to the satisfaction of the Engineer.

26.6 METHOD OF PAYMENT

26.6.01 Measurement for Payment

Measurement for payment for topsoil shall be on a cubic metre (m^3) basis which shall include all labour, materials and equipment necessary for the full completion of the work, including grading and fertilizing.

Measurement for payment for sodding shall be on a square metre (m^2) basis which shall include all labour, materials, and equipment necessary for the full completion of the work.

Measurement for payment for hydroseeding shall be on a square metre (m^2) basis which shall include all labour, materials, and equipment necessary for the full completion of the work.

Measurement for payment for trees and shrubs shall be made on a unit price basis which shall include all labour, materials and equipment necessary for the full completion of the work including excavation, fertilizing, topsoil and mulching.

There shall be no separate payment for repairs to seeded or sodded areas during the maintenance period whether the cause is due to lack of growth or as a result of erosion.

26.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 27

ASPHALT CONCRETE

City of Saint John

TABLE OF CONTENTS

DIVISION 27 – ASPHALT CONCRETE

City of Saint John

TABLE OF CONTENTS

DIVISION 27 – ASPHALT CONCRETE

Section **Page**

ASPHALT CONCRETE

27.1 SCOPE OF WORK

The Work included in this Division 27 Specification (Specification) consists of site preparation and supplying, transporting, placing and compacting Superpave hot-mix asphalt (HMA) concrete for roadways, curbs and sidewalks in accordance with the Contract Documents and in conformity with the lines, grades, courses, types, thicknesses, and cross sections given in the Contract Documents and/or shown on the Plans, or as established by the Engineer. The City will accept the Work in accordance with the Quality Assurance requirements of this Specification.

REFERENCES

The following Superpave asphalt technology specifications and practices for engineering, materials, mix designs, testing, inspection, and construction, are referred to in this Specification.

New Brunswick Department of Transportation and Infrastructure Standard Specifications (Current)
Item 260 Asphalt Concrete

AASHTO Standards (Current)
M 17 Mineral Filler for Bituminous Paving Mixtures
M 332 Performance Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test
M 323 Superpave Volumetric Mix Design
R 35 Superpave Volumetric Design for Hot-Mix Asphalt (HMA)
T 283 Resistance of Compacted Asphalt Mixture to Moisture-Induced Damage
T 312 Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

Asphalt Institute Publication (Current)
MS-22 Construction of Hot Mix Asphalt Pavements

Transportation Research Board Publication (Current)
NCHRP Report 452, Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method: Technician's Manual. National Cooperative Highway Research Program, Transportation Research Board, Washington, DC.

27.2 DEFINITIONS

For the purpose of this Specification, the following definitions apply:

"AMRL" means the AASHTO Materials Reference Laboratory.

"ATTRIBUTE" means one of the following: Designated Large Sieve (DLS), 4.75 mm sieve, 600 µm sieve, 75 µm sieve, asphalt cement content, air voids, or compaction.

"DESIGN ESALs" means design equivalent (80 kN) single-axle loads.

"DESIGNATED LARGE SIEVE (DLS)" means the sieve size specifically designated for each mix type for gradation testing.

27.2 DEFINITIONS (Cont'd)

"FAT SPOT" means an area of pavement substantially blacker than the surrounding pavement.

"HOT-MIX ASPHALT (HMA)" means hot-mixed, hot-laid Superpave asphalt concrete.

"HOT-MIX ASPHALT MISCELLANEOUS" means HMA that is required in areas that cannot be placed by a machine and requires manual placement, such as slug work, but does not include the manual work required to be carried out concurrently with machine paving operations, as specified in the Contract Documents.

"HOT-MIX ASPHALT PADDING" means an HMA layer used for correcting crossfall and profile deficiencies in the existing pavement before placing the levelling, lower, or upper (surface) course, as specified in the Contract Documents.

"HOT-MIX ASPHALT PATCHING" means an HMA surface course placed over localized areas of distressed pavement, generally for the purpose of improving strength, rideability, or safety, as specified in the Contract Documents.

"JOB-MIX FORMULA (JMF)" means the percentage passing on each designated sieve of the total mass of aggregate and the amount of asphalt binder (cement) as a percentage by mass of the mix that are based on specified mix design procedures that, when mixed, result in an HMA that is according to this Specification.

"JOINT" means a vertical contact between an HMA pavement course and any HMA pavement or any rigid object that exists at the time the HMA is laid.

"LEVELLING COURSE" means an HMA course of variable thickness used to eliminate transverse and longitudinal irregularities on an existing surface prior to placing an HMA lower or upper course, as specified in the Contract Documents.

"LOT" means a specific quantity of material or a specific amount of construction, normally from a single source, and produced by the same process.

"LOWER COURSE" means a hot-mix asphalt (HMA) course between an upper (surface) course and either a granular base course or stabilized base course, an existing pavement, or another HMA lower course.

"MIX PROPERTIES" means the percent passing the DLS, 4.75 mm sieve, 600 µm sieve, and 75 µm sieve; the asphalt binder (cement) content; and the air voids.

"PAVING IN ECHELON" means two or more pavers are used to pave multiple adjacent lanes simultaneously, within 60 m of each other.

"PERFORMANCE GRADED ASPHALT CEMENT (PGAC)" means an asphalt binder (cement) that is an asphalt-based cement produced from petroleum residue, either with or without the addition of non-particulate modifiers, according to AASHTO M 332.

"QUALITY ASSURANCE (QA)" means a system or series of activities carried out by the Engineer to ensure that materials received from the Contractor meet the specified requirements.

27.2 DEFINITIONS (Cont'd)

"QUALITY CONTROL (QC)" means a system or series of activities carried out by the Contractor to ensure that materials supplied by the Contractor, and work completed by the Contractor, meet the specified requirements.

"RANDOM SAMPLE" means a sample from a location chosen by the Engineer based on random numbers such that any portion of a lot or sublot has an equal probability of being selected.

"RANGE" means the numerical difference between the maximum and minimum test results within a lot.

"RECLAIMED ASPHALT PAVEMENT (RAP)" means the processed HMA material that is recovered by partial or full depth removal.

"REFEREE TESTING" means testing by an independent laboratory selected by the Engineer and acceptable to the Contractor, the results of which are used for resolving differences between QC and QA testing.

"SCREED" means the unit of the paver that strikes off and imparts initial compaction to the HMA.

"SEGREGATION" means a condition of the asphalt concrete pavement characterized by areas with comparatively coarser or finer texture than that of the surrounding pavement.

"SUBLOT" means approximately equal divisions or portions of a lot.

"SUPERPAVE" means an acronym for Superior Performing Asphalt Pavements. It is an alternative system to the Marshall method for specifying material components and asphalt mix designs using the Superpave gyratory compactor.

"UPPER COURSE" means an HMA surface (wearing) course of any flexible or composite pavement.

"VERTICAL SURFACE" means all edges of concrete curbs, catch basins and other appurtenances, longitudinal joints, and transverse joints for application of tack coat.

27.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Manholes, Catch Basins and Valve Chambers ..... Div. 12

(d) Excavation, Trenching and Backfilling Procedures ..... Div. 13

(e) Restoration ..... Div. 21

(f) Roadway Construction ..... Div. 24

(g) Standard Drawings

27.4 MATERIALS

27.4.01 General

This Division refers to those portions of the Work that involve the supply and placement of Superpave hot-mix asphalt (HMA) concrete paving. This must be referenced to, and interpreted simultaneously with, all other Divisions related to the Work of this Division.

The Superpave HMA types, based on nominal maximum aggregate size, are: Superpave 19 mm (Superpave 19) – lower course; Superpave 12.5 mm (Superpave 12.5) – lower or upper course; Superpave 9.5 mm (Superpave 9.5) – upper course, curbs, and sidewalks; and Superpave 4.75 mm (Superpave 4.75) – fine mix.

The Superpave HMA mix designs are based on the current AASHTO Designation: R 35 Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA): materials selection to meet the environmental and traffic requirements applicable to the asphalt concrete paving; design of aggregate structure; design performance-graded asphalt binder (cement) content selection; and evaluation of moisture susceptibility. This mix design procedure uses aggregate and mix properties to develop a Superpave HMA job-mix formula (JMF) based on the volumetric properties of the HMA in terms of air voids (AV), voids in mineral aggregate (VMA), and voids filled with asphalt cement (VFA).

The Superpave HMA types (Superpave 19, 12.5, 9.5 and/or 4.75) for the Project are given in the Contract Documents along with the design ESALs, performance-graded (PG) asphalt binder (cement) grade and any special requirements for each of the Superpave HMA types for the Project. Selection of the Superpave HMA types, design ESALs, PG asphalt binder grades, and special requirements for the Project's flexible pavement design, environmental conditions, and traffic requirements are covered by the current AASHTO Designation: M 323 Standard Specification for Superpave Volumetric Mix Design. The overall Superpave asphalt technology engineering, materials, mix designs, testing, and the inspection for the Project must be in accordance with the requirements of AASHTO M 325 and R 35.

Superpave HMA production, transport, placement, and compaction processes and requirements guidance is given in the Asphalt Institute MS-22.

27.4.02 Submissions

Materials Certification

At least five (5) working days prior to commencing any asphalt paving work, the Contractor shall, in writing, submit to the Engineer:

a) Producer or supplier test data and certification that the performance graded (PG) asphalt binder(s) for the Superpave HMA mix(es) meets the requirements of this Specification; and

b) Producer or supplier test data and certification that the coarse aggregate(s), fine aggregate(s), and mineral filler (if any) for the Superpave HMA mix(es) meet the requirements of this Specification.

27.4.02 Submissions (Cont'd)

Superpave HMA Mix Design(s)

At least five (5) working days prior to commencing any asphalt paving work, the Contractor shall submit to the Engineer, in writing, for approval, Superpave mix design(s) and asphalt plant trial batch mix test(s) results, from a qualified asphalt testing laboratory(ies), meeting the requirements of this Specification. This submission, as a minimum for each Superpave HMA mix type design (AASHTO R 35) shall include:

a) Project number and description, design ESALs, Superpave mix design number, laboratory name, responsible technician or engineer, and Report date;

b) information on the design aggregate structure including the source(s) of aggregates, kind of aggregates, required quality characteristics, and gradations;

c) information on the design asphalt binder (cement) content including the source of asphalt binder, and the performance grade; and

d) information about the Superpave HMA including the percent of asphalt binder in the mix; the relative density; the number of initial, design, and maximum gyrations; the voids in mineral aggregate (VMA), the voids filled with asphalt (VFA), the effective binder volume (V_{bc}), the absorbed binder volume (V_{ba}), the air voids (V_a), and dust-to-binder ratio; and the tensile strength ratio (TSR) including details (source, type, and addition rate) of any required antistripping additive.

Approval of a Superpave HMA mix design(s) by the Engineer shall not alleviate the Contractor from full responsibility for the quality and applicability of the mix design(s) throughout the Work.

All costs associated with the completion of the mix design(s) shall be deemed to be included in the unit prices for hot-mixed, hot-laid asphalt concrete in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

Quality Control Plan (QCP)

At least five (5) working days prior to commencing any work, the Contractor shall provide the Engineer, in writing, for approval, a Contractor Quality Control Plan (QCP) for the Work that includes, as a minimum:

(a) Elements of the materials and methods which affect the quality of the Superpave hot-mix asphalt (HMA). These elements include (Asphalt Institute MS-22):

.1 aggregate sources, types, gradations, transportation, stockpiling, moisture contents, handling, and quality (supplier quality control);

.2 asphalt binder sources, types, grades, transportation, storage, incorporation, and quality (supplier quality control), including mixing and compaction temperatures, and handling requirements for polymer modified asphalt cements, when applicable;

27.4.02 Submissions (Cont'd)

Quality Control Plan (QCP) (Cont'd)

.3 asphalt mix (HMA) designs (Job-Mix Formula, JMF), including mix design laboratory and technician qualifications, and reporting;

.4 antistripping additive source, type, amount and handling, when applicable;

.5 asphalt mix production, including: overall process control for proper storage and handling of component materials; accurate proportioning and feeding of the aggregate; effective drying and heating of the aggregate to the proper temperature; proper dust and filler control; proper proportioning, addition and mixing of asphalt binder; and proper storage, handling, and weighing of the asphalt mix;

.6 asphalt mix transportation, including truck box cleanliness (only non-petroleum release agents used) and tarpaulins;

.7 asphalt mix placement, including segregation avoidance, thickness, texture, joints, and smoothness;

.8 asphalt mix compaction, including rollers selection and roller patterns; and

.9 procedures for the disposal of surplus materials, spilt materials and materials removed from the existing pavement.

(b) Truck Scales:

.1 provide certification for the current year that the truck (weigh) scales being used for the Work meet the requirements of the Weights and Measures Act, Statute of Canada;

.2 verification, every ten (10) working days, of the tare weights of any trucks being used for transporting asphalt mix; and

.3 provide the location of an independent certified truck (weigh) scale, within the Greater Saint John area, that can be used for random spot checks of truck tare and gross vehicle weights, when instructed by the Engineer.

The Engineer reserves the right to place a City Inspector at the truck scale site(s) when materials are being weighed for the Work. The City will be responsible for the cost of the City Inspector.

If it is determined that the gross vehicle weight is incorrect, as indicated on the weigh slip, the use of the truck (weigh) scale shall be stopped immediately until such time as it is again certified according to the requirements of the Weights and Measures Act, Statute of Canada. The Engineer will make an appropriate adjustment to all weights accepted prior to the time the use of the truck scale was stopped.

27.4.02 Submissions (Cont'd)

Quality Control Plan (QCP) (Cont'd)

(c) Processes to assure the quality of Superpave materials and work meet all Specification requirements. These quality control processes include (Asphalt Institute MS-22):

.1 types of inspection and testing required;

.2 frequency of inspection, sampling, and testing required;

.3 inspection and testing equipment requirements and calibration procedures;

.4 qualification requirements for laboratories and inspection and testing staff;

.5 documentation and retention of inspection records and test results;

.6 procedures for reporting inspection records and test results to the Engineer;

.7 procedures for dealing with non-conformities in materials and work; and

.8 supplementary quality control plans and procedures for any subcontractors and materials suppliers.

(d) Applicable Material Safety Data Sheets (MSDS).

(e) Hot-Mix Plant(s) and Process Control:

.1 location, type, model, nominal hourly capacity, manufacturer's rated capacity of drier or drum in tonnes per hour (t/hr) of dried aggregate for various percentages of moisture in the combined aggregate feed and process control procedures for the hot-mix plant(s).

A moisture content determination must be completed by the Contractor each morning and afternoon for each aggregate and reclaimed asphalt pavement (RAP), if any, being used in a drum mixing plant, with these moisture contents reported to the Engineer no later than by the next working day.

While the Engineer will make the results of quality assurance (QA) testing available to the Contractor, the Contractor shall be responsible for the necessary process control testing during the hot-mix production, placement and compaction, and any necessary adjustments, to produce uniform, acceptable hot mix meeting all the requirements of this Specification.

(f) Traffic Control Plan for the Work.

27.4.02 Submissions (Cont'd)

Quality Control Plan (QCP) (Cont'd)

(g) Adjustment of Structures:

.1 how frames and covers will be adjusted to meet the requirements of the Work.

This information will be reviewed jointly by the Contractor and the Engineer so that they are all familiar with the methods to be used in the Work.

In some cases, the appropriate utility must be notified before the necessary adjustment(s).

(h) Grade and Slope Control of Paver(s):

.1 the number of pavers, type of grade and transverse slope control and all pertinent information with respect to setting grades and controlling the pavers to follow these grades.

This information will be reviewed jointly by the Contractor and the Engineer so that they are all familiar with the methods to be used in the Work.

(i) General:

Approval of the Quality Control Plan by the Engineer shall not alleviate the Contractor from full responsibility for the implementation, use, interpretation and applicability of the Quality Control Plan throughout the Work.

All costs associated with the development, implementation, use, and interpretation of the Quality Control Plan, including random spot checks of truck tare and gross vehicle weights, when instructed by the Engineer, shall be deemed to be included in the unit prices for hot-mixed, hot-laid asphalt concrete in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

27.4.03 Performance-Graded Asphalt Binder

Performance-graded (PG) asphalt binder(s) (cement) shall meet the requirements of AASHTO M 332. Laboratories completing asphalt binder testing shall have participated in the current AMRL Interlaboratory Program for Asphalt Binders, or equivalent program acceptable to the Engineer.

Unless otherwise specified in the Contract Documents, the performance-graded (PG) asphalt binder shall be PG 58S-28.

27.4.04 Reclaimed Asphalt Pavement

Reclaimed asphalt pavement (RAP) shall meet the processing, quality, and use requirements of NCHRP Report 452 and Table 27.1, with a maximum RAP incorporation limit of 25 percent in lower course Superpave HMA and 15 percent in upper course Superpave HMA.

27.4.05 Aggregates

Aggregates for use in Superpave HMA shall be from proven aggregate sources meeting the requirements of this specification. Regardless of compliance with the specified physical requirements, coarse and fine aggregates may be accepted or rejected by the Engineer on the basis of documented past field performance.

Coarse Aggregate

a) The coarse aggregate shall be prepared by crushing rock or gravel and shall consist of hard, sound, durable particles, free from adherent coatings, shale, clay, loam, schist and other soft or disintegrating pieces, or other deleterious substances.

b) Coarse aggregate is the portion retained on the 4.75mm sieve when tested in accordance with ASTM C136.

Table 27.1 Physical Requirements for Coarse Asphalt Aggregate

Test Method	Design ESAL's (Million)		
	<3.0	3.0 to < 10.0	> 10.0
Freeze/Thaw % (max), MTO LS-614	16.0	14.0	12.0
Micro-Deval %(max), MTO LS - 618	16.0	15.0	15.0
Petrographic No.(max), MTO LS - 609	200	180	180
Flat & Elongated Particle, (max @ 4:1 ratio) ASTM D4791	20.0	15.0	15.0
Crushed Particles, (min), ASTM D5821			
one crushed face	95	95	100
two crushed face	80	80	100
Aggregate absorption % (max), ASTM C 127	1.50	1.50	1.50

Fine Aggregate

a) The fine aggregate shall be prepared by crushing rock or gravel or screening a manufactured sand and shall consist of hard, sound, durable particles, free from adherent coatings, shale, clay, loam, schist and other soft or disintegrating pieces, or other deleterious substances.

b) Fine aggregate is the portion passing the 4.75mm sieve when tested in accordance with ASTM D136 and C117.

27.4.05 Aggregates (Cont'd)

Table 27.2 Physical Requirements for Fine Asphalt Aggregate

Test Method	Design ESAL's (Million)		
	<3.0	3.0 to < 10.0	> 10.0
Micro-Deval %(max), MTO LS - 619	20.0	17.0	17.0
Sand Equivalent (min), ASTM D2419	45	50	50
Uncompacted Void Content (min), ASTM D1252	45	45	45
Aggregate absorption % (max), ASTM C 128	2.00	2.00	2.00

Note: 1. The allowable Micro-Deval surface Fine Aggregate shall be Max % Loss=19.0, if the Micro-Deval on Coarse Aggregate is ≤12.0, provided that the Coarse Aggregate is from the same source.

27.4.06 Blending Sand

a) Blending sand shall be used to obtain acceptable physical HMA properties. The source shall be approved by the Engineer before the material is incorporated into the HMA.

b) The maximum mass of blending sand to be used in the total asphalt mix shall not exceed 10 percent of the total mass.

c) Blending sand shall have 100 percent passing the 9.5mm sieve prior to the introduction into the asphalt plant.

27.4.07 Mineral Filler

Mineral filler, if any, shall meet the requirements of AASHTO M 17.

Table 27.3: Asphalt Binder Selection Guidelines for Reclaimed Asphalt Pavement (RAP) Mixtures[1,2,3]

Recommended New Asphalt Binder Grade[4]	RAP Percentage[5]
No change in asphalt binder selection	<15
Select new asphalt binder one grade softer than normal (select a PG 52S-34 if a PG 58S-28 would normally be used, for example)	15-25

Notes: 1. Table 27.3 is adapted from AASHTO M 323.
2. The recommended use of RAP is covered in detail in NCHRP Report 452.
3. Asphalt binder is an asphalt-based cement that is produced from petroleum residue either with or without the addition of non-particulate organic modifiers (SBS, for instance – polymer modified asphalt binder).
4. Performance-graded asphalt binder (cement) meeting the requirements of AASHTO M 332.
5. Reclaimed asphalt pavement (RAP) is removed and/or processed pavement materials containing asphalt binder and aggregates.

27.4.07 Mineral Filler (Cont'd)

Table 27.4: Superpave HMA Aggregate Gradation Control Points[1,2]

Sieve Size	Nominal Maximum Aggregate Size[3] — Control Points (Percent Passing)							
	19.0 mm		12.5 mm		9.5 mm		4.75 mm	
	Min	Max	Min	Max	Min	Max	Min	Max
50.0 mm	—	—	—	—	—	—	—	—
37.5 mm	—	—	—	—	—	—	—	—
25.0 mm	100[4]	—	—	—	—	—	—	—
19.0 mm	90	100	100[4]	—	—	—	—	—
12.5 mm	—	90	90	100	100[4]	—	100[4]	
9.5 mm	—	—	—	90	90	100	95	100
4.75 mm	—	—	—	—	—	90	90	100
2.36 mm	23	49	28	58	32	67	—	—
1.18 mm	—	—	—	—	—	—	30	60
0.075 mm	2	6	2	6	2	6	6	8

Notes:
1. Table 27.4 is adapted from AASHTO M 323.
2. The combined aggregate shall conform to these gradation control point requirements.
3. The nominal maximum aggregate size is one size larger than the first sieve that retains more than ten percent aggregate.
4. The maximum aggregate size is one size larger than the nominal maximum aggregate size.

Table 27.5: Gradation Classification[1,2]

Primary Control Sieve (PCS) Control Point for Mixture Nominal Maximum Aggregate Size (Percent Passing)			
Nominal Maximum Aggregate Size	19.0 mm	12.25 mm	9.5 mm
Primary Control Sieve (PCS)	4.75 mm	2.36 mm	2.36 mm
PCS Control Point (Percent Passing)	47	39	47

Notes:
1. Table 27.5 is adapted from AASHTO M 323.
2. The combined aggregate gradation shall be classified as coarse-graded when it passes below the primary control sieve (PCS). All other gradations shall be classified as fine-graded.

27.4.08 Superpave HMA Mix

The AASHTO M 323 Superpave HMA mix design(s) shall meet the requirements of Table 27.6 and Table 27.7. The HMA mix design shall be completed within the same calendar year as the work is to be completed unless otherwise approved by the Engineer.

27.4.08 Superpave HMA Mix (Cont'd)

Table 27.6: Superpave Gyratory Compaction Effort[1]

Design ESALs[2] (million)	Compaction Parameters			Typical Roadway Applications
	$N_{initial}$	N_{design}	N_{max}	
<0.3[3]	6	50	75	Applications include roadways with very light traffic volumes such as local roads, country roads, and city streets where truck traffic is prohibited or at a very minimal level. Traffic on these roadways would be considered local in nature, not regional, intrastate, or interstate. Special purpose roadways serving recreational sites or areas may also be applicable to this level.
0.3 to <3	7	75	115	Applications include many collector roads or access streets. Medium-trafficked city streets and the majority of county roadways may be applicable to this level.
3 to <30[4]	8	100	160	Applications include many two-lane, multi-lane, divided, and partially or completely controlled access roadways. Among these are medium to highly trafficked city streets and many provincial routes.
≥30	9	125	205	Applications include major highways, both rural and urban in nature. Special applications such as truck-weighing stations or truck-climbing lanes on two-lane roadways may also be applicable to this level.

Notes:
1. Table 27.6 is adapted from AASHTO R 35.
2. The anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, the design ESALs are determined for 20 years.
3. When specified by the Engineer and the top of the design layer is ≥100 mm from the pavement surface and the estimated design traffic level is ≥0.3 million ESALs, decrease the estimated design traffic level by one, unless the mixture will be exposed to significant mainline construction traffic prior to being overlaid. If less than 25 percent of a construction lift is within 100 mm of the surface, the lift may be considered to be below 100 mm for mixture design purposes.
4. When the estimated design traffic level is between 3 and <10 million ESALs, the Engineer may specify $N_{initial}$ at 7, N_{design} at 75, and N_{max} at 115.

27.4.08 Superpave HMA Mix (Cont'd)

Table 27.7: Superpave HMA Design Requirements[1,7]

Design ESALs[2] (Million)	Required Relative Density, Percent of Theoretical Maximum Specific Gravity			Voids in the Mineral Aggregate (VMA), Percent Minimum[6]				Voids Filled with Asphalt (VFA) Range	Dust-to Binder Ratio
				Nominal Maximum Aggregate Size, mm					
	$N_{initial}$	N_{design}	N_{max}	19.0	12.5	9.5	4.75	Percent	Range[3,5]
<0.3	≤91.5	96.0	≤98.0	13.0	14.0	15.0	16.0	70-80	0.6-1.2
0.3 to <3	≤90.5	96.0	≤98.0	13.0	14.0	15.0	16.0	65-78	0.6-1.2
3 to <10	≤89.0	96.0	≤98.0	13.0	14.0	15.0	16.0	65-75[4]	0.6-1.2
10 to <30	≤89.0	96.0	≤98.0	13.0	14.0	15.0	16.0	65-75[4]	0.6-1.2
≥30	≤89.0	96.9	≤98.0	13.0	14.0	15.0	16.0	65-75[4]	0.6-1.2

Notes:
1. Table 27.7 is adapted from AASHTO M 323.
2. The anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, the design ESALs are determined for 20 years.
3. For 4.75 mm nominal maximum size mixes (Superpave 4.75), the dust-to-binder ratio shall be 0.9 to 2.0.
4. For design traffic levels >3 million ESALs, 9.5 mm nominal maximum size mixes (Superpave 9.5) the specified VFA range shall be 73 to 76 percent, and for 4.75 mm nominal maximum size mixes (Superpave 4.75) shall be 75 to 78 percent.
5. If the aggregate gradation passes beneath the PCS control point specified in Table 27.5, the dust-to-binder ratio range may be increased from 0.6-1.2 to 0.8-1.6 at the agency's discretion.
6. Mixes with VMA exceeding the minimum value by more than 2 percent may be prone to flushing and rutting. Unless satisfactory experience with high VMA mixes is available, mixes with VMA greater than 2 percent above the minimum should be avoided.
7. The Superpave HMA design, when compacted according to AASHTO T 312 at 7.0 ± 0.5 percent air voids, and tested in accordance with AASHTO T 283, shall have a minimum tensile strength ratio of 0.80.

27.4.09 Superpave HMA Job Mix Formula (JMF)

The Contractor shall submit a Job Mix Formula (JMF) to the Engineer representative prior to HMA production. The JMF submission shall include the following:

(a) The JMF shall include the Asphalt Mix Design parameters including aggregate types, the combined aggregate percent by mass passing for each sieve size, asphalt content by percent of mass, air voids, VMA and VFA.

(b) The asphalt cement grade, supplier and temperature-viscosity chart.

27.4.09 Superpave HMA Job Mix Formula (JMF) (Cont'd)

(c) Target gradations for the DLS (see Table 27.14, Note 1), 4.75 mm, 600 µm and 75 µm sieve sizes. The JMF gradation targets shall be within the limits as provided in Table 27.4.

(d) Target for the asphalt cement content.

The JMF targets shall not deviate from the HMA mix design by more than the following:

± 3% for material passing 4.75 mm sieve size
± 0.8% for material passing 75 µm sieve size
± 0.3% for asphalt cement content

A maximum five (5) JMF adjustments per mix type will be accepted. Additional JMF adjustments will require a new HMA mix design.

27.4.10 Tack Coat Material

Tack coat shall consist of RS-1 or CRS-1 Grade emulsified asphalt and shall conform to the provisions of ASTM D977 or D2397, respectively.

Non-tracking emulsified asphalt shall be diluted with 40% water and shall meet the requirements of Table 27.8. Dilution of the emulsified asphalt shall be permitted at the terminal only.

Table 27.8: Non-Tracking Emulsified Asphalt Requirements (Prior to Dilution)

Test Type	Specification Range	
	Minimum	Maximum
Test on Emulsion		
SF Viscosity, 25°C, SFs	20	
Sieve Test, 850 µm, %		0.1
Dist. Residue, 260°C	55	
Oil Portion of Dist., %		trace
Particle Charge	(-) or (+)	
Test on Residue		
Penetration, 25°C, dmm	20	55
Ash Content, %		1.0

27.5 CONSTRUCTION METHODS

27.5.01 Equipment

General

All equipment for the production, transportation, placement and compaction of Superpave HMA shall be designed and operated to produce HMA and asphalt concrete pavement meeting all of the requirements of this Specification. The equipment shall be of adequate rated capacity and shall be kept in good working order. The Engineer shall be provided safe access to all equipment in order to check for compliance with this Specification.

Hot-Mix Asphalt Plant

The HMA plant(s) and its (their) component shall conform to AASHTO M 156. The HMA plant(s) shall include an efficient dust collecting system to prevent the loss of fine material. The material collected may be returned to the mix at a uniform rate and/or be discarded.

Paving Equipment

Asphalt pavers shall be self-propelled and capable of laying a consistent satisfactory mat that is true to the crossfall, profile, cross-section, and alignment specified in the Contract Documents. Pavers shall be equipped with hoppers and distributing augers capable of placing the HMA evenly in front of the screeds. Screeds shall be capable of being heated and being adjustable as to level and crown. Pavers shall be capable of simultaneously placing the shoulder pavement and roadway pavement whether the shoulder pavement is at the same or different crossfall from the roadway pavement.

In all cases, pavers shall be equipped with automatic longitudinal and transverse grade and slope controls capable of being operated from either side of the paver. The longitudinal grade control shall be adjustable for mat thickness in small increments, without the necessity of stopping the paver. The paver shall be equipped to operate from either a 12 m ski or floating beam, a 3 m ski, or a joint matching shoe. Where the ski is a flexible unit, it shall be equipped with a spring-tensioned wire extending between brackets fitted on and slightly above each end of the ski. The sensing grid shall ride on the wire, not on the ski.

Plows or other edge ramping devices that are attached to or towed by the screed portion of the paver shall not be permitted.

A 3 m straight edge shall be provided on each paver. This straight edge shall be made of metal with a level recessed in its upper surface parallel to the lower edge.

Rollers

(a) Classification of Rollers

Rollers shall be classified into categories as follows:

Class S Self-propelled steel-drum, tandem, or three-wheel rollers according to Table 27.9.

27.5.01 Equipment (Cont'd)

Rollers (Cont'd)

Table 27.9: Requirements for Class S Rollers

Roller	Minimum Mass (t)	Minimum Mass Per mm Total Roll Width (kg)
S 1	7	3.5
S 2	9	4.5

Class R Self-propelled pneumatic-tired rollers according to Table 27.10.

Table 27.10: Requirements for Class R Rollers

Roller	Minimum Mass (t)	Minimum Mass Per Tire (kg)
R 1	8	900
R 2	18	2,500
R 3	25	3,600

Class V Self-propelled vibratory rollers specifically designed for HMA compaction having either dual vibratory rolls or a combination of vibratory roll and pneumatic tires with a contact area equal to or greater than 70% of the roll width according to Table 27.11.

Table 27.11: Requirements for Class V Rollers

Roller	Minimum Roll Diameter m	Minimum Roll Width m	Minimum Static Mass Per mm Total Roll/Tire Width kg
V 1	1.00	1.40	2.0
V 2	1.20	1.60	2.6
V 3	1.40	1.90	2.9

(b) Requirements for Rollers

All rollers shall be capable of reversing without backlash.

The Engineer shall be provided with the mass of the rollers. The Engineer may require the weighing of the rollers in his presence.

27.5.01 Equipment (Cont'd)

Rollers (Cont'd)

The rolls or drums shall be kept moist with water or non-petroleum based release agents to prevent adhesion of HMA to them. Excess water or release agents shall not be permitted.

(c) Steel-Drum Rollers

The drums of tandem steel-drum rollers shall not be less than 1.20 m in width.

(d) Pneumatic-Tired Rollers

Pneumatic-tired rollers shall be constructed such that the wheels on either the front or back oscillate either independently or in pairs. The wheels shall be mounted with smooth rubber tires. Tire inflation pressure shall be a minimum of 350 kPa when the tires are cold. All tires shall have equal pressure. Skirts or windbreaks shall be provided at all times to protect all tires from the cooling effects of atmospheric conditions. Each roller shall be equipped with a suitable tire pressure gauge for checking tire inflation pressure.

(e) Vibratory Rollers

Vibratory rollers shall be according to the following requirements:

i. Frequency of vibrations of the vibratory roller shall be 2,200 vibrations per minute or greater;

ii. Rollers shall be equipped with provision for automatic shutoff vibrations before coming to a stop; and

iii. Vibration levels that could cause damage to services and other structures shall be avoided.

27.5.02 Quality Control

Quality control (QC) procedures shall be conducted by the Contractor to ensure the HMA meets the requirements of the Contract Documents and this Specification. The Contractor shall be responsible for the interpretation of the QC test results and the determination of any actions to be taken to ensure that all materials and work are according to the requirements of the Contract Documents and this Specification.

A qualified asphalt testing laboratory (Quality Control Laboratory) with AMRL, CCIL or equivalent qualifications acceptable to the Engineer shall be used. Testing of the samples in the Quality Control Laboratory shall be conducted by technicians qualified to perform the QC tests. All test result Reports shall be reviewed, signed and submitted to the Engineer by the Contractor, within one (1) working day of taking the sample(s) for testing.

27.5.03 Preparation of Foundation and Existing Pavement

Granular Grade

Prior to placing any course of Superpave HMA on a granular grade, a Class S roller of minimum mass of 7 t, or an equivalent Class V roller with a drum width of at least 1.2 m, shall be used to finish roll the granular grade ahead of the asphalt paver to ensure a compacted, smooth, and float-free surface.

The Contractor shall check grades, cross falls, surface tolerances, and compaction of the granular grade, and shall correct any deficiencies. All costs associated with the preparation of the granular grade will be deemed to be included in the unit prices for hot-mix, hot-laid asphalt concrete in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

HMA placement shall not be carried out if the roadbed is frozen. The granular grade shall be free of standing water at the time of HMA placement.

Frames and Appurtenances

The Contractor shall check and adjust all frames and appurtenances to grade, including longitudinal and transverse slopes. All costs associated with the adjustment of frames and appurtenances will be deemed to be included in the unit prices for structure adjustments in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

Existing Pavement

Prior to placing any HMA, all HMA and concrete surfaces shall be clean of all loose, broken, and foreign materials. Milled surfaces shall be swept with a power broom. The Contractor shall carry out such cleaning, brooming and flushing, as necessary. All costs associated with cleaning, brooming and flushing shall be considered incidental to the Work.

The surface of a pavement upon which HMA is to be placed shall be dry at the time of HMA placement. An HMA course shall not be placed on a previously laid course until a minimum of 4 hours have elapsed, following final compaction of the previous course, and the temperature of the previous course is 60°C or less, and the paving equipment does not damage the previously laid course.

27.5.04 Application of Tack Coat

Tack coat shall be used to treat the entire cold-milled asphalt concrete surface, or any other surface specified by the Engineer, prior to placing HMA.

Tack coat shall be used at all joints, curb lines, aprons, around street hardware, and catch basin frames, or any other vertical face(s) that the new asphalt concrete will terminate against, unless directed otherwise by the Engineer.

Immediately before the application of tack coat, and prior to delivery of any HMA to the paving location, the Contractor shall carry out power or hand brooming when deemed necessary by the Engineer.

27.5.04 Application of Tack Coat (Cont'd)

The tack coat shall be applied in a uniform manner without streaking by means of a pressure distributor at a minimum diluted rate of 0.4 ℓ/m², or as directed by the Engineer. Tack coat shall not be applied during inclement (wet) weather. Care shall be taken during the application of tack coat to prevent the defacing of adjacent buildings, walls or signs. The tack coat shall be allowed to properly cure (break), with any traffic diverted until the tack coat has cured and the traffic will not cause any tracking.

27.5.05 Transportation of Hot-Mix Asphalt

The Superpave HMA shall be transported from the asphalt plant to the work in leak-proof truck boxes that have been previously cleaned of all foreign materials. If required, truck boxes shall be lightly coated with a uniform application of a non-petroleum based release agent. Truck boxes must be drained after each application and before loading. No release agents shall be used that can adversely affect the quality or performance of the HMA. Release agents shall be used according to their proprietary requirements.

Delivery of HMA to the site shall be scheduled such that placing and compacting of the HMA is completed by one-half hour after sunset.

Night paving shall only be as approved in writing by the Engineer. Approval of the Engineer for night paving shall not alleviate the Contractor from the responsibility of meeting all of the conditions of this Specification.

Each truck shall use a canvas tarpaulin of sufficient size to completely cover the load at all times.

27.5.06 Sampling

Asphalt Binder

When required by the Engineer, the Contractor shall take a sample of the PG asphalt binder (cement) in the presence of the Engineer for QA purposes. Typically a minimum of one sample will be randomly chosen for QA testing for each asphalt binder used on the Contract.

Hot-Mix Asphalt

The Contractor is responsible for obtaining QC HMA samples, and QA HMA plate samples at stratified random locations selected by the Engineer. For QC samples, the Contractor may determine the method of sampling. QA samples shall be taken in the presence of the Engineer and be placed in an appropriate container.

The minimum frequency for sampling and testing is the responsibility of the Contractor, but shall be no less than the requirements specified in Table 27.12. All samples shall be labelled with the location, date, time of sampling, and HMA type, using the labels provided by the Engineer for this purpose.

Cores

Cores of the HMA shall be extracted by the Contractor for the Engineer at stratified random sampling locations as determined by the Engineer.

27.5.06 Sampling (Cont'd)

Cores (Cont'd)

For 4.75 mm, 9.5 mm and 12.5 mm mixes, 100 mm diameter cores of the HMA shall be extracted and for 19.0 mm mixes, 150 mm diameter cores shall be extracted. Random numbers shall be generated to determine distance from section start and offset from centerline with no core taken closer than 0.3 m from curbs, structures or joints. Cores shall be taken no later than the next Business Day on which a lane closure is possible. The frequency of cores shall be a minimum of three cores per lift per street or one core per 300 tonnes of each HMA type, whichever is greater. The Engineer may reduce the frequency of core extractions to a minimum of one core per 500 tonnes of each HMA type if testing results indicate the compactive effort is consistently meeting this Specification.

Delivery

All HMA samples and cores for the Engineer shall be delivered by the Contractor, within 4 hours of sampling, to a Quality Assurance Laboratory designated by the Engineer.

Repair of Sampling Locations

HMA and compaction requirements for filling all sample holes shall be the same as the adjacent undisturbed pavement. All sample holes shall be cleaned, dried, and filled and then compacted using a mechanical, self-powered gas, electric, or air powered compactor immediately after sampling.

All costs associated with the sampling, delivery and repair of sampling locations for QA samples shall be deemed to be included in the unit prices for hot-mixed, hot-laid asphalt concrete in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

Table 27.12: Sampling and Testing Frequency of Hot-Mix Asphalt

Quantity Per Day Per HMA Type	Minimum Frequency of Sampling and Testing (Note 1)	Minimum Superpave Sampling Size kg
≤ 300 tonnes	One sample	25
>300 and ≤1200 tonnes	One sample per 300 tonnes or part thereof	
>1200 tonnes	One sample per 400 tonnes minimum of 3 (Note 1)	

Notes: 1. The Engineer may reduce the testing frequency for HMA that is consistently being produced to meet Specification requirements.

27.5.07 Placing Hot-Mix Asphalt

General

Prior to compaction, obvious defects in the HMA material placed shall be corrected. Irregularities in the alignment and grade along the outside edges shall be corrected.

A through lane paving course shall be completed prior to the placement of adjacent side roads, speed change lanes, and other paved areas. For all courses, each adjacent lane shall be completed to approximately the same location at the end of each day's paving.

At the end of each completed portion and prior to opening the lanes to traffic, the completed sections of HMA course shall be ramped transversely to the existing pavement for a minimum distance of 1.5 m. If at the end of a day's production two adjacent lanes are not completed to the same location, the longitudinal edges must be ramped down in a safe manner to the adjacent existing pavement. In all cases, the ramps shall not form part of the permanent asphalt pavement and shall be removed prior to continuing paving operations.

The temperature of the HMA immediately after spreading and prior to initial rolling shall not be less than 120°C.

Lower Course

Lower courses shall not be placed unless the air temperature at the surface of the road is a minimum of 2°C and rising.

Lower course paving operations shall not continue after October 31st, unless approved in writing by the Engineer.

Upper Course

Upper (surface) courses shall not be placed unless the air temperature at the surface of the road is at least 7°C and rising.

When single course pavement is laid on granular grade the minimum air temperature at the surface of the granular grade shall be at least 2°C and rising.

Upper coarse paving operations shall not continue after October 15th, unless approved in writing by the Engineer.

27.5.08 Use of Paving Equipment

Leveling, lower, and upper courses shall be laid by means of mechanical self-propelled asphalt pavers.

Pavers working in echelon shall maintain a distance of less than 60 m between them.

The longitudinal alignment of the paver shall be controlled by the use of a string line placed at each outer edge of the pavement. The paver is to be directed at

27.5.08 Use of Paving Equipment (Cont'd)

all times by the string line and not by the edge of the preceding course, except for the trailing paver when paving in echelon.

The automatic screed controls and all compaction aids on the paver shall be operational while the HMA is being placed, except that the automatic controls shall not be used when placing Superpave 9.5, Superpave 4.75, or a single course of HMA on granular grade.

Single pavers or the lead paver when paving in echelon shall be controlled for longitudinal grade by a 12 m ski or floating beam.

The pavers shall operate continuously at a uniform speed necessary to match the output of the HMA plant. However, in no case shall the speed of an asphalt paver exceed 18 m/min.

If the HMA for upper course paving comes from more than one asphalt plant, the HMA from each plant shall be placed by a separate asphalt paver.

27.5.09 Widenings and Irregular Sections

When it is necessary to hand-spread the HMA in sections adjacent to machine-laid areas, such hand-spreading shall be carried out concurrently with machine-laying operations.

Widenings

The HMA shall be placed in widenings such that the top of the compacted HMA is flush with the top of the existing pavement. When stepped joints are specified in the Contract Documents, the layers placed in the widening shall be placed to the top of each step in separate operations. HMA shall be placed in the widening using equipment specially designed for this purpose.

Irregular Sections

In turn-outs, driveways, and other irregular sections where it is impractical to use machine methods to spread and finish the lower, levelling, or upper courses, the Contractor shall use other spreading equipment or shall spread the HMA by hand.

27.5.10 Hot-Mix Asphalt Padding

When and where specified in the Contract Documents, HMA padding shall be carried out to correct geometric deficiencies on the surface of the existing pavement. All costs associated with HMA padding will be deemed to be included in the unit prices for HMA padding in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

27.5.11 Hot-Mix Asphalt Patching

Prior to HMA patching, any temporary patching material shall be removed from the locations designated for such removal in the Contract Documents. The

27.5.11 Hot-Mix Asphalt Patching (Cont'd)

resulting areas shall be filled and compacted with HMA, as specified in the Contract Documents. The HMA patching material shall be machine laid to the required thickness, grade, and crossfall. Transverse and longitudinal joints between the existing pavement and the patch shall be perpendicular butt joints formed by a milling process or keyed in, as specified in the Contract Documents. All costs associated with HMA patching will be deemed to be included in the unit prices for HMA patching in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

27.5.12 Longitudinal and Transverse Joints

General

All joints shall be made to ensure a full face bond and a smooth riding surface. Longitudinal and transverse butt or stepped joints between the new HMA pavement and the existing pavement shall be constructed by trimming the existing pavement edge to a straight clean vertical surface of at least 40 mm. All dirt or other foreign material and all loose material shall be removed from all vertical surfaces. When matching a compacted joint, the depth of the uncompacted mat shall be set to allow for compaction. The paver screed shall overlap the adjoining mat by no more than 50 mm.

Tack Coating of Joints

Vertical surfaces at which joints are made shall be tack coated with a thin, uniform and continuous coating of tack coat, except for longitudinal joints between lanes paved in echelon. All costs associated with the application of tack coat will be deemed to be included in the unit prices for hot-mix, hot-laid asphalt in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

Longitudinal Joints

Longitudinal joints shall be properly set up, with the back of a rake or lute, at the proper height and grade prior to rolling. For multiple lifts of HMA, the width of subsequent courses shall be staggered to an offset of 150 to 300 mm so that longitudinal joints do not coincide. This shall also apply to the joint between through lanes and speed change lanes and other similar longitudinal joints. The longitudinal joints in the upper course shall correspond to the demarcation between the driving lanes, speed change lanes, and tapers. During upper course paving, excess material shall not be cast on to the surface of the freshly laid mat. When resurfacing against a rigid object, a butt joint shall be constructed by milling the existing pavement to provide an exposed vertical surface of at least 25 mm at the face of the rigid object. The milling shall be feathered out to zero over a minimum length of 1.25 m from and parallel to the exposed face of the rigid object providing a minimum of 40 mm of resurfacing material over the area of removal.

Transverse Joints

The paver shall not move more than 15 m from any transverse joint until that joint has been rolled and checked with a straight edge. If the joint is not satisfactory, it shall be corrected immediately before the paver is allowed to proceed. Joints between HMA pavement laid under this Contract and existing

27.5.12 Longitudinal and Transverse Joints (Cont'd)

Transverse Joints (Cont'd)

HMA courses not laid under this Contract shall be constructed as follows:

a) Where a lower course is placed flush against an existing HMA pavement and a butt joint is to be made, the existing pavement shall be trimmed back to form a straight vertical surface.

b) Where an upper course is placed flush against an existing HMA pavement, a stepped joint shall be prepared by removing the existing surface course to its full depth for minimum length of 0.5 m and the remaining face shall be trimmed to form a straight vertical surface.

c) Where a lower course and upper course are not placed flush against an existing HMA pavement, the lower course shall be feathered out and the upper course shall be butt jointed by removing the existing upper course to a minimum depth of 40 mm and for a longitudinal distance not less than 3 m.

27.5.13 Compaction

Rolling

(a) Static Rolling

Compaction shall be accomplished using the minimum combination number of rollers specified in Table 27.13. The Contractor shall determine the correct sequence of rollers used for compacting in order to achieve compaction requirements. The operating speed of steel drum rollers shall not exceed 5 km/h and shall be operated in a manner to avoid undue displacement of the mix. Rollers shall operate with the drive wheel forward in the direction of paving. Rolling procedures shall be as follows:

Breakdown Rolling

The mix shall be uniformly compacted as soon after placing as it can support the roller without checking or undue displacement. Rolling shall start longitudinally at the lower edge and proceed towards the higher edge of the course, overlapping on successive passes. Alternate passes of the roller shall be staggered.

Intermediate Rolling

The intermediate roller shall follow the breakdown roller as closely as possible. Passes shall overlap previous passes. The roller shall be operated to prevent pick-up of the HMA on the tires.

Finish Rolling

Finish rolling shall start longitudinally at the higher edge and proceed towards the lower edge.

27.5.13 Compaction (Cont'd)

Rolling (Cont'd)

(b) Vibratory Rolling

For all HMA being compacted on bridge decks, vibratory rollers shall be operated in static mode.

Compaction of Irregular Sections and Inaccessible Areas

At all places not accessible to rollers, the mix shall be properly compacted by mechanical, self-powered gas, electric, or air powered equipment, to meet the density requirements of this Specification.

Table 27.13: Maximum Production Rates Per Paver for Combinations of Rollers

Maximum Production (t/h)	Minimum Roller Combinations
120	S2 + R1 +S1
	V1 + R1
135	V2 + R1
	V1 + R2
150	S2 + 2 x R1 + S1
	S2 + R2 + S1
	V2 + R2
200	V3 + R2
220	V3 + R3

27.5.14 Tolerances

After final compaction, each course shall be smooth and true to the established crown and grade. HMA lower and upper courses shall be free from deviations exceeding 6 mm and 3 mm, respectively, as measured in any direction with a 3 m straight edge. These tolerances shall also apply to all frames and appurtenances (street hardware). All frames and appurtenances shall be adjusted to final grade so that, when tested with a 3 m straight edge placed anywhere and in any direction on the surface, there shall not be a vertical gap between the bottom of the straight edge and the surface of the asphalt concrete pavement, frame or appurtenance exceeding 3 mm.

27.5.15 Surface Appearance

Each course after final compaction shall be of uniform texture and shall be free of defects such as segregation, fat spots, oil spills, and roller marks, etc. Defective areas shall be removed and replaced with HMA of the same type and compacted to the satisfaction of the Engineer, at the Contractor's cost.

27.5.16 Placing Asphalt Concrete Curb

Asphalt concrete curb(s) shall be as shown in the Contract Documents, unless otherwise directed by the Engineer.

The hot-mix asphalt for asphalt concrete curb(s) shall be Superpave 9.5, unless otherwise specified in the Contract Documents.

The curbing machine used for placing the asphalt concrete curb shall be an automatic curber capable of producing a smooth, well-compacted finished curb by extrusion under the pressure method through a worm or screw gear into the curb mold. The curber shall have a sufficiently large hopper to ensure a steady flow of HMA to the extrusion screw. The curber shall have a uniform weight distribution to ensure sufficient compaction to produce maximum density. Side forms should be used where the pavement grade is not smooth in order that the finished asphalt concrete curb will have a smooth and true line and grade. The density of the placed asphalt concrete curb shall not be less than 90% of the maximum theoretical density of the HMA. On grades greater than 3% the asphalt concrete curb shall be laid uphill. No expansion joints are required for the asphalt concrete curb.

The surface on which the asphalt concrete curb is to be placed should be thoroughly cleaned and dried before placing the asphalt concrete curb. Tack coat shall be applied at 0.55 ℓ/m² to 0.82 ℓ/m², and allowed to properly cure (set), before placing the asphalt concrete curb. For proper support on pavement edges, the back of the curb should be at least 0.4 m from the pavement edge, unless otherwise instructed by the Engineer. Asphalt concrete curb shall not be placed on a surface cooler than 5°C or during inclement (wet) weather.

All costs associated with placing asphalt concrete curb will be deemed to be included in the unit prices for asphalt concrete curb in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

27.5.17 Placing Asphalt Concrete Sidewalk

Asphalt concrete sidewalk(s) shall be as shown in the Contract Documents, unless otherwise directed by the Engineer.

The hot-mix asphalt for asphalt concrete sidewalk(s) shall be Superpave 9.5, unless otherwise specified in the Contract Documents.

The granular base for the asphalt concrete sidewalk shall be prepared in accordance with the Sections on granular materials in Divisions 13 and 24. The minimum thickness of the granular base shall be 150 mm. The sidewalk shall be sloped at a 2% grade, and the direction of this slope will depend on local conditions, but in general shall be towards the street.

The asphalt concrete sidewalk shall have a compacted thickness of 50 mm, and shall be laid with a small asphalt paver (finishing machine) capable of producing an asphalt concrete sidewalk meeting the requirements of this Specification. Where the asphalt concrete sidewalk is abutted by an asphalt concrete curb, all contact surfaces of the curb shall be painted with a thin, uniform coat of tack coat.

27.5.17 Placing Asphalt Concrete Sidewalk (Cont'd)

If no suitable small asphalt paver is available in the City, the Contractor may, upon approval of the Engineer, lay the asphalt concrete sidewalk by hand. In this case, and when there is no curb for support, forms shall be employed. These sidewalk forms shall be staked so that the forms are held firmly in line and grade. The upper edge of the forms shall be level with the finished grade of the asphalt concrete sidewalk.

All costs associated with placing asphalt concrete sidewalk will be deemed to be included in the unit prices for asphalt concrete sidewalk in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

27.5.18 Shoulders

Upon completion of upper (surface) course asphalt concrete pavement, the Contractor shall place shoulder material to blend the new asphalt concrete pavement surface to the existing adjacent grade in accordance with Division 24. All driveways shall be made accessible within twenty-four (24) hours of placing the upper course asphalt concrete pavement. All shouldering shall be completed in five (5) working days of placing the upper course asphalt concrete pavement. If shouldering and/or driveway access are not provided within these specified time periods, the City reserves the right to have this work completed by others at the Contractor's cost.

The granular materials for shoulder construction shall be placed by means of a shoulder spreader. Where obstacles on the shoulder prevent the efficient use of the spreader, the shoulder material may be placed adjacent to the obstacle(s) by end dumping and hand spreading. Before commencing any shoulder construction, all debris and deleterious material shall be removed. Regardless of the method of placing, and the width of shoulder, all shoulder construction material shall be placed directly on to the shoulder without segregation and compacted to meet the requirements of Division 24. Any spillage and materials dragged on to the pavement surface shall be removed and the area thoroughly cleaned, without damage to the asphalt pavement surface.

All costs associated with shouldering will be deemed to be included in the unit prices for shouldering in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

27.5.19 Milling of Existing Asphalt Concrete

When and where indicated in the Contract Documents, existing asphalt concrete shall be milled off for the area(s) and depth(s) indicated.

The Contractor shall notify the Engineer a minimum of three (3) working days in advance of beginning the milling operations.

The Contractor shall take care in full depth removal to not contaminate the reclaimed asphalt pavement (RAP) with underlying aggregate material. The Contractor shall provide, in partial depth removal, equipment with automatic controls for longitudinal grade and transverse slope. The milled surface shall be uniform and free of ridges.

27.5.19 Milling of Existing Asphalt Concrete (Cont'd)

All loose materials remaining after cold milling shall be swept by the Contractor to a granular shoulder, or picked up from paved shoulders or gutters, before reopening to traffic. This shall be considered incidental to the work.

If a transverse vertical joint is milled in the existing pavement to allow for transition between new and old pavement, the Contractor shall promptly construct a temporary smooth ramp with HMA to a slope of 25:1. This shall be considered incidental to the work.

The reclaimed asphalt pavement (RAP) shall become the property of the Contractor.

The Contractor shall remove all asphalt concrete from the faces of curbs and/or gutters, around street hardware, catch basins, and any other structures abutting the work in such a manner that the curbs, gutters, street hardware, catch basins, and other structures are not damaged and the area, after removal, matches the grade of the adjacent milled area. This shall be considered incidental to the work.

Unless otherwise specified, a transverse key joint shall be cold milled at each end of an overlaid section or where new asphalt concrete pavement terminates against an existing pavement.

The HMA resurfacing shall be completed within ten (10) working days of completing the cold milling. The Contractor shall maintain the site free of potholes, and in a condition providing for the safe flow of traffic from the time of cold milling until the time of HMA resurfacing.

Should the Contractor not complete the HMA resurfacing within the required time after completion of the cold milling, the City may have the work completed by others at the Contractor's cost.

All costs associated with milling existing asphalt concrete will be deemed to be included in the unit prices for milling existing asphalt concrete in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

27.5.20 Quality Assurance

General

The Engineer is responsible for conducting QA testing and inspection procedures for all HMA aggregates, asphalt cement, and compaction to monitor compliance with the requirements of this Specification. QA HMA testing shall be conducted at a frequency specified in Table 27.12. All QA testing will be completed by a qualified Quality Assurance Laboratory reporting to the Engineer.

The HMA samples shall be randomly taken in the field by the Contractor using sample plates, or other methods approved by the Engineer, as given in Section 27.5.06.

The QA HMA samples and, if required, pavement cores, shall be delivered to the location designated by the Engineer within 4 hours of the sampling time.

27.5.20 Quality Assurance (Cont'd)

General (Cont'd)

All samples require identification of the location, date, and time of sampling; HMA type; and HMA lift, as given in Section 27.05.06.

Acceptance of hot mix aggregates and asphalt cement shall be according to Sections 27.4.02, 27.4.03 and 27.4.05, and subject to verification by the Engineer.

The Engineer may reject visually defective HMA areas based on, but not limited to, a condition survey of the following defects: flushing, bleeding, segregation, fat spots, ravelling, surface damage (roller marks, tire marks, checking, cracking and tearing), open and/or improperly matched joints, improperly reinstated sampling locations, and surface contamination. Such defective HMA and/or defective areas shall be removed from the work and replaced with acceptable HMA.

For surface quality assurance purposes, the Engineer may complete a visual evaluation of the surface of each finished paving course to check that it is homogeneous, free from segregation, and uniform with respect to surface texture. Segregation is defined as an area of the asphalt concrete pavement surface where the texture differs visually from the texture of the surrounding pavement. The severity of segregation, based on a field visual evaluation, will be categorized as follows (Asphalt Institute MS 22):

Slight: Area where the mastic is in place between aggregate particles; however, there is slightly more coarse aggregate than in the surrounding acceptable mix;

Medium: Area has significantly more coarse aggregate than the surrounding acceptable mat and usually exhibits some lack of surface mastic;

Severe: Area appears very coarse in comparison to the surrounding acceptable mat, with stone against stone, and little or no mastic.

The following remedial actions will be considered to be acceptable for the severity of segregation involved:

Slight: Accepted into the Work;

Medium: Left in place for lower courses or shoulder, and subject to full lane width removal and replacement at the contractor's cost for upper (surface) course; and

Severe: Subject to full lane or shoulder width removal and replacement at the contractor's cost for all courses.

The removal and replacement of any Superpave HMA asphalt concrete shall meet the overall quality requirements of this Specification.

Where the Contractor fails to consistently provide HMA that meets this Specification, the Engineer may refuse further material from the Contractor

27.5.20 Quality Assurance (Cont'd)

General (Cont'd)

until the mix properties are verified for quality by taking samples to determine and establish compliance to asphalt cement content, aggregate gradation, and Superpave mix properties in accordance with the requirements of this Specification.

Where the Contractor fails to consistently place hot-mix asphalt pavement that meets this Specification, the Engineer may stop the paving operations until such time that the Contractor demonstrates the ability, through for instance placing HMA off-site, to consistently meet this Specification.

Any asphalt pavement work that does not meet the requirements of this Specification and is rejected by the Engineer, shall be repaired by the Contractor at the Contractor's cost. Such repairs required in accordance with the Specification shall be carried out for the full width of the asphalt pavement lane. The full thickness of the rejected asphalt pavement course shall be removed by cold milling, or by other means acceptable to the Engineer. All milled surfaces and joints shall be tack coated.

Aggregate Gradation Requirements

Aggregate gradation test results for HMA samples shall meet the JMF tolerance requirements specified in Table 27.14.

Asphalt Cement Content Requirements

Asphalt cement content test results for HMA samples shall meet the JMF tolerance requirements specified in Table 27.14.

Table 27.14: Tolerances for the Job-Mix Formula Aggregate Gradation and Asphalt Cement Content

Mix	Attribute (Note 1)	Tolerances on the Job-Mix Formula (Note 2) %		
		Acceptable	Borderline	Rejectable
Upper Course	DLS, 4.75 mm sieve size	< 5.0	5.0 to 7.5	> 7.5
	600 µm sieve size	< 3.5	3.5 to 5.0	> 5.0
	75 µm sieve size	< 0.5	0.5 to 1.0	> 1.0[3]
Lower and Levelling Course	DLS, 4.75 mm sieve size	< 7.0	7.0 to 10.0	> 10.0
	600 µm sieve size	< 4.5	4.5 to 6.0	> 6.0
	75 µm sieve size	< 0.5	0.5 to 1.0	> 1.0[3]
All Mixes	Asphalt Cement Concrete	< 0.30	0.30 to 0.50	> 0.5

Table 27.14: Tolerances for the Job-Mix Formula Aggregate Gradation and Asphalt Cement Content (Cont'd)

Notes:
1. DLS for Superpave 19.0 is 12.5 mm; DLS for Superpave 12.5 is 9.5 mm; DLS for Superpave 9.5 is 4.75 mm; and DLS for Superpave 4.75 is 2.36 mm.
2. Tolerances on the Job-Mix Formula apply as both plus and minus from the Job-Mix Formula percent.
3. More than 7.0 percent passing the 75 µm sieve size shall be considered to be rejectable for all HMA mixes except the 4.75 mm mix. More than 9.0 percent passing the 75 µm sieve size shall be considered to be rejectable for the 4.75 mm HMA mix.

27.5.21 Aggregate Gradation and Asphalt Cement Content Acceptance

If the HMA is borderline for aggregate gradation or asphalt cement content as specified in Table 27.14, the Contractor shall be notified in writing by the Engineer and shall take immediate corrective action through process control at the asphalt plant. A total of three borderline test results for the same attribute representing up to 3,000 tonnes of HMA production shall result in the work being deemed rejectable.

Rejected HMA due to aggregate gradation, such as non-compliance on the DLS 4.75 mm, 600 µm, or 75 µm sieve sizes, or non-compliance due to the asphalt cement content specified in Table 27.14, shall be removed and replaced with acceptable HMA.

27.5.22 Hot-Mix Asphalt Properties

General

The production air voids for all Superpave HMA shall be in the range of 3% to 5%.

Acceptance Criteria

If the Superpave HMA mix does not meet AASHTO M 323 and the air voids are within ± 1.0% of the production range, the Contractor will be notified in writing by the Engineer and shall take immediate corrective action.

If the air voids are outside ± 1.0% of the production range, the HMA represented by the test shall be removed and replaced by the Contractor with acceptable HMA of the same type and compacted to the satisfaction of the Engineer, all at the Contractor's cost.

27.5.23 Compaction Requirements

General

Acceptance for compaction based upon core testing, or calibrated nuclear density gauge testing, shall be conducted by the Engineer.

Compaction testing of the placed HMA shall meet the requirements given in Table 27.15.

27.5.23 Compaction Requirements (Cont'd)

Compaction Determined by Core Density Testing

Density testing of the cores will be in accordance with AASHTO T 166. If the percent water absorbed by the specimen is found to exceed 2% by volume as described in AASHTO T 166, then the bulk specific gravity will be according to AASHTO T 275, LS-306, or ASTM D 6752. Per cent compaction will be determined by comparing the core BRD to the average MRD, both according to AASHTO T 209, of the plant produced HMA.

Compaction Determined by Calibrated Nuclear Density Gauge

Compaction testing will be conducted randomly at a minimum frequency of every 100 m per lane or 150 m² area. Percent compaction will be determined by comparing the nuclear density in situ BRD to the average plant produced HMA MRD, both according to AASHTO T 209.

Acceptance

If the average percent compaction for the completed course of HMA pavement does not meet the acceptable minimum percent compaction, the Contractor will be notified in writing by the Engineer and shall take immediate corrective action. If the average percent compaction is rejectable, then the HMA pavement shall be removed and replaced to the satisfaction of the Engineer, all at the Contractor's cost.

Table 27.15: Pavement Compaction Requirements Based on Maximum Relative Density

Mix	Acceptable %	Borderline %	Rejectable %
Superpave 19.0	91.0 to 96.5	96.6 to 97.5	< 91.0 or > 97.5
All other Superpave Mixes	92.0 to 96.5	96.6 to 97.5	< 92.0 or > 97.5

27.5.24 Frames and Appurtenances

The Contractor shall be responsible for breaking out and resetting such frames and covers, reconstructing asphalt pavement around them and repaving with hot mix, all at the Contractor's cost, if the variances from grade are rejectable, as given in Table 27.16. If the variances from grade are borderline, the Contractor will be warned by the Engineer in writing and shall take immediate corrective action with the adjustment procedure.

27.5.24 Frames and Appurtenances (Cont'd)

Table 27.16: Frames and Appurtenances Adjustment Requirements Variances from Grade

Variance from Grade (Gap), mm	Action
Up to 3.0	Acceptable
3.0 to 5.0	Borderline
Greater than 5.0	Rejectable

27.5.25 Dispute Resolution

In the case of dispute, the Contractor may request, in writing stating the technical reasons, the Engineer to undertake a coring and testing program to verify the mix using a mutually agreed upon third party Referee Testing Laboratory. If the mix is confirmed to be rejectable, the Contractor shall be responsible for all associated costs of the coring and testing program, otherwise the Engineer will be responsible for the costs. Referee cores may be used to verify compliance, if cores were previously extracted. Results of the Referee testing shall be used to assess the degree of remedial action required, if applicable. Referee testing of samples shall be under the same requirements as the Quality Assurance Laboratory.

Both the Contractor and the Engineer may have representatives present during Referee testing. During the Referee testing, each representative shall immediately comment on any aspect of the testing which the representative does not consider valid, and the Referee laboratory representative will respond to the comments. Prior to leaving the laboratory, any unresolved comments regarding testing procedures are to be given to the Referee laboratory's representative in writing.

27.5.26 Rejectable Work

The finished surface of any asphalt pavement shall have a uniform texture and be free of visible signs of poor workmanship and bumps and/or dips exceeding 3mm as measured with a 3 m straight edge. Any obvious defects, as determined by the Engineer, shall be cause for rejection of the work.

Such defects shall include but not necessarily be limited to the following:

1. Segregated areas;
2. Ravelling;
3. Roller marks;
4. Cracking or tearing;
5. Improper matching of longitudinal and transverse joints;
6. Tire marks;
7. Sampling locations not properly reinstated;
8. Improperly constructed patches;
9. Contaminant spills on the mat;
10. Flushed areas; and
11. Pneumatic-tired roller pickup.

Any asphalt pavement work that does not meet the requirements of this Specification and is rejected by the Engineer, shall be repaired by the Contractor at the Contractor's cost. Such repairs required in accordance with the

27.5.26 Rejectable Work (Cont'd)

Specification shall be carried out for the full width of the asphalt pavement lane. The full thickness of the rejected asphalt pavement course shall be removed by cold milling, or by other means acceptable to the Engineer. All milled surfaces and joints shall be tack coated.

All rejectable work shall be repaired by the Contractor within ten (10) working days of notification in writing by the Engineer, but in no case later than October 15th. If the ten (10) working day period extends beyond the October 15th deadline, the Contractor shall complete the repairs between June 1st and June 15th of the following year. Repaired areas will be tested for acceptance in accordance with this Specification, and those not meeting the requirements of this Specification will be rejected and require further repair by the Contractor, all at the Contractor's cost.

Where line and grade permits, rejectable asphalt concrete pavement may be overlaid, with written approval from the Engineer. Overlays shall extend the full width of the underlying asphalt concrete pavement surface and have a finished compacted thickness of not less than 50 mm for lower course(s) and 40 mm for upper (surface) course. If such an overlay requires adjustment or repair of curbs, appurtenances or other works, these repairs or adjustments shall be carried out by the Contractor to the satisfaction of the Engineer, all at the Contractor's cost. These overlaid areas will be tested for acceptance in accordance with this Specification, and those areas not meeting the requirements of this Specification will be rejected and require further repair by the Contractor, all at the Contractor's cost. Regardless, a second overlay will not be permitted.

27.6 METHOD OF PAYMENT

27.6.01 Measurement for Payment

The unit of measurement for payment for hot-mix, hot-laid asphalt concrete shall be the number of tonnes (t) of HMA, scale weighed, acceptably incorporated into the Work at the specified thickness, including all preparatory work. Any HMA quantity placed in excess of 110% of the theoretical quantity in tonnes (t) shall not be included for payment unless otherwise authorized in writing by the Engineer. The theoretical HMA quantity shall be determined by the following formula: (specified thickness in mm x final measured asphalt concrete pavement area in m^2 x in place density in kg/m^3) / 1,000,000.

All HMA that is delivered to the Site shall be accompanied by an electronic truck weigh ticket showing the truck number, type of HMA, Contract number, truck loading time at the hot-mix plant, tare mass to the nearest 50 kg, gross mass to the nearest 50 kg, net mass in kg and driver's signature. The tare mass for the truck shall include the vehicle, operator, fuel, spare tire, etc.

The Contractor shall be responsible for ensuring that the truck weigh ticket for each load is handed to the Engineer's Representative inspecting the asphalt paving operation at the time the delivery truck unloads at the paving Site. The Engineer will not accept any responsibility for delivery tickets that are not submitted at the proper time, or are submitted in groups after the delivery trucks have left the Site. Asphalt weigh tickets are to be signed on-site by the Engineer's Representative during placement, with one (1) copy being retained by the Engineer's Representative and the other copy to be submitted with the Contractor's monthly invoice.

27.6.01 Measurement for Payment (Cont'd)

The following items shall not be measured for payment and shall be considered as incidental to the work:

(a) Hauling of HMA to the site, sweeping and cleaning, and site restorations;

(b) Sampling and testing of aggregates, calibration of asphalt plants, and trial batches;

(c) Removal of surplus granular material as a result of fine grading, including disposal off-site;

(d) Cutting existing asphalt concrete edges prior to resurfacing;

(e) Handwork to complete HMA paving around catch basins, street hardware, valves, etc., to complete swales or any other place where handwork is carried out concurrently with the spreader operation;

(f) Removal and replacement of any part of the Work not meeting the requirements of the Specifications; and

(g) The use of tack coat at joints, curb lines, aprons, around street hardware and catch basin frames or any other vertical faces.

Measurement for payment of HMA padding shall be the number of tonnes (t) scale weighed and acceptably incorporated into the work.

Measurement for payment of HMA patching shall be the number of tonnes (t) scale weighed and acceptably incorporated into the work.

Measurement for payment of asphalt concrete curb and asphalt concrete sidewalk shall be per metre (m) of curb or sidewalk, including all labour, materials and equipment necessary to complete the work.

Measurement for payment of miscellaneous HMA work shall be the number of tonnes (t) scale weighed miscellaneous HMA acceptably incorporated into the work.

Measurement for payment for cold milling shall be per square metre (m^2) of asphalt concrete pavement acceptably removed and hauled from the site to an approved location.

Tack coat that is specified to treat the entire cold milled, aged asphalt concrete or any other surfaces, shall be measured for payment per square metre (m^2) of acceptably tack-coated surface.

27.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

Performance graded asphalt binder will be adjusted based on the New Brunswick Department of Transportation and Infrastructure (NBDTI) Asphalt Binder Price Index. The price index is published monthly and is available on the NBDTI website.

27.6.02 Basis of Payment (Cont'd)

A payment adjustment for the change in price of asphalt binder between the month preceding the month in which tenders were opened for the Contract and the time of the placement of the HMA will apply to the quantity of asphalt binder (cement) accepted into the Work and will be calculated as follows if the price index between the two (2) months differs by more than 5 %:

PA = Payment adjustment for asphalt binder in dollars
T = PG asphalt binder price index for the month prior to tender opening
P = PG asphalt binder price index for the month of paving
Q = Quantity of asphalt binder in tonnes

When P > 1.05 T, the Contractor receives additional payment as follows:

$$PA = (P - 1.05T) \times Q$$

When P < 0.95 T, the Owner receives a credit as follows:

$$PA = (0.95T - P) \times Q$$

This payment adjustment for the change in the price of asphalt binder during the Work is not considered to be extra work.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 28

CHIP SEAL

City of Saint John

TABLE OF CONTENTS

DIVISION 28 – CHIP SEAL

CHIP SEAL

28.1 SCOPE OF WORK

The work included in this Division consists of the requirements for supplying, loading, hauling and placing of single and double layer chip seal surface treatment as per the Drawings and Specifications.

28.2 DEFINITIONS

Not applicable to this Division.

28.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract .....Div. 6

(b) Construction of Municipal Services .....Div. 7

(c) Roadway Construction.....Div. 24

(d) Standard Drawings

28.4 MATERIALS

28.4.01 Samples

At least four (4) weeks prior to commencing work, the Contractor shall submit to the Engineer, samples of the following materials proposed for use:

(a) 10 kg. of aggregate; and

(b) two 4-litre plastic containers of asphalt material.

28.4.02 Aggregates

(a) Crushed stone or gravel consisting of hard, durable, and angular particles; free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

(b) Aggregates with known polishing characteristics will not be used.

(c) Gradations to be within the limits specified in Table 28.1 when tested to ASTM C136 and ASTM C117, latest editions.

28.4.02 Aggregates (Cont'd)

Table 28.1: Grading Limits – Chip Seal Aggregate

ASTM Sieve Size (mm)	Washed Chips 9.5 mm (% Passing)	Washed Chips 12.5 mm (% Passing)
16.0		100
12.5	100	90 - 100
9.5	75 - 100	30 - 75
6.3	0 - 40	0 - 30
4.75	0 - 10	0 - 10
2.36	-	-
1.18	-	-
0.075	0 - 1	0 - 1

Table 28.2: Physical Requirements of Aggregate

Los Angeles abrasion, max. loss, %	35
Magnesium sulphate soundness 5 cycles max. loss, %	12
Absorption max. %	1.75
Flat and Elongated pieces max. %	20
Crushed materials min. %	60
Petrographic number, max.	135

28.4.03 Asphalt Emulsion

Asphalt emulsion shall be anionic HP-200, or an approved equal, and shall meet the following requirements:

Viscosity

	MIN	MAX
Saybolt Furol seconds @ 50°C	50	350
% Residual by distillation	65	-
Settlement %, 5 days	-	3
Sieve test - %	0.1	-
Particle charge	NEG	-

On Residue

	MIN	MAX
Penetration @ 25%	100	200
Ductility @ 25°C, cm	60	-
Solubility in Trichloroethylene	97.5	-

28.5 CONSTRUCTION METHODS

28.5.01 Equipment

The Contractor shall supply all tools, machinery and equipment required for the execution of all phases of the Works. Maintain equipment in first-class working condition. Equipment will be operated by a skilled and experienced operator at all times.

28.5.02 Pressure Distributor

The pressure distributor used for applying asphalt emulsion shall be capable of applying closely regulated quantities. It shall consist of a fully insulated tank, permanently and rigidly mounted on a truck or trailer capable of accurately maintaining any speed required for spraying.

The pressure distributor shall be provided with the following minimum equipment:

(a) Proper hand spray attachments to uniformly apply emulsion to any areas missed by the pressure distributor;

(b) An efficient and positive means of heating emulsion uniformly to temperatures up to 150°C, and maintaining the contents constantly at any selected temperature without any local overheating and including a satisfactory method of circulating the contents during the entire heating process;

(c) A thermometer with a minimum range of 10°C - 150°C graduated in intervals of not more than 10°C, with sub-divisions at every 1°C, so placed as to accurately show the temperature of the pressure distributor contents, and to be assessable to the Engineer;

(d) A tachometer, driven from a fifth wheel, mounted so that it is readily visible to the driver, clearly and accurately registers distances travelled when spraying emulsion, and enables the driver to maintain the constant speed required to ensure the specified rate of application of the emulsion;

(e) A pump tachometer which registers pump output;

(f) A pressure gauge which indicates the pressure in the spray bar;

28.5.02 Pressure Distributor (Cont'd)

(g) A rear mounted spray bar set parallel to the surface to be sprayed, and capable of adjustment to provide any required spraying widths from 2.5 m to 3.5 m. The pressure distributor shall be equipped with a spray bar heating device, circulating a uniform viscosity and pressure of the emulsion at each nozzle, both before and during spraying operations. The circulating system shall also be provided with a strainer to prevent clogging of the bar and nozzles. The spray bar height shall be adjustable and shall be set at such a height that the spray fan from any nozzle overlaps the spray fan from the adjacent nozzle by 50% for double-lap to ensure a uniformly sprayed surface. This adjustment shall be made by the height set when the distributor is one-half (½) full, and shall be changed only when so approved by the Engineer;

(h) Spray bar nozzles shall be designed and set as to ensure uniform fan shaped sprays. The nozzles shall not be such as to produce such a fine mist that the emulsion will blow away and not provide an even emulsion coating. All spray nozzles shall be of the same manufacture, size, type and in good condition and shall be provided with valves capable of instant full opening and positive cut-off. All spray nozzles shall be set in the bar so that the nozzle slots make the same horizontal angle (30 degree) with the longitudinal axis of the bar. Before work commences, and periodically as required during spraying operations, the Contractor shall remove the nozzles on the spray bar, and immerse them in a solvent for a period of time sufficient to remove all congealed asphalt and to free the nozzle opening. Each nozzle shall be inspected and approved by the Engineer and installed on the spray-bar at the correct angle;

(i) A strainer shall be provided in the filling line to prevent entry of foreign matter into the tank; and

(j) A sampling cock fitted on the spray bar or circulating line, and readily accessible to allow samples of the emulsion to be obtained directly from the distributor.

28.5.03 Mechanical Aggregate Spreader

The self-propelled aggregate spreader shall be capable of continuously and uniformly spreading closely regulated quantities of aggregate at the application rates selected.

The spreader shall be equipped with a rear-mounted hopper designed so that a loaded truck may supply aggregate to this hopper, while being towed by the spreader. The spreader shall be equipped with a front hopper and means of transferring the aggregate to this hopper from the rear. The front hopper shall be equipped with an oversize reject screen and metering gates. The gates shall adjust the spreading width and be capable of individual adjustment to obtain a uniform flow of aggregate across the spreading width. These gates shall also be designed to provide simultaneous movement or closure from the operator's position. The flow of aggregate from the metering gates shall be further controlled by a spread roller, the rotation of which shall automatically commence when the metering gates are opened.

28.5.04 Rollers

Steel-tired rollers shall have tandem wheels and weigh at least 7 tonnes (t). Pneumatic-tired rollers shall be self-propelled and have a minimum ballasted weight of 8 tonnes (t).

28.5.05 Mechanical Broom

The mechanical broom shall be a type of power broom suitable for pavement use.

28.5.06 Preparation

Before chip seal operations commence, the Contractor shall completely clean the pavement of all dirt and other debris. Cleaning shall be by the use of a power broom or other equipment as required. Should there be any depressions not completely cleaned with the power broom then these areas shall be cleaned with a hand broom.

28.5.07 Temperature and Weather Limitations

The Contractor shall apply treatment only when existing surface is dry, when atmospheric temperature is above 15°C and rain or fog is not imminent.

28.5.08 Timing of Chip Seal Operations

Timing of Chip Seal operations will take place between June 1st and September 15th.

28.5.09 Emulsion

The Contractor shall apply the emulsion at a temperature in the range of 50°C to 70°C. The emulsion shall be applied at the rate of 1.9 L/m² to 2.4 L/m² for a single chip seal application. For a double application, the Contractor shall apply the first at a rate of 2.2 L/m² to 2.7 L/m² and the second at a rate of 2.2 L/m² to 2.7 L/m². The optimum rate of application is related to aggregate gradation, atmospheric conditions and to road surface conditions. For any given area this emulsion shall be applied at the rate designed by Contractor and approved by the Engineer.

28.5.10 Aggregate

The Contractor shall complete crushing and stockpiling of 100% of chip seal aggregates prior to application of the chip seal aggregates to the road surface. The Contractor shall apply 9.5 mm aggregate immediately following application of asphalt material at a rate of 11.9 kg/m² to 16.3 kg/m² for single surface treatment.

For double surface treatment the Contractor shall first apply 12.5 mm aggregate at a rate of 24.4 kg/m² to 32.6 kg/m² followed by a second application of asphalt material at the specified rate and an application of 9.5 mm aggregate at a rate of 11.9 kg/m² to 16.3 kg/m². For any given area the aggregate shall be applied at the rate designed by the Contractor and approved by the Engineer.

28.5.10 Aggregate (Cont'd)

The Contractor shall apply aggregate in such a manner that the tires of the aggregate spreader at no time, contact uncovered and newly applied asphalt material.

Immediately after aggregate is spread, the Contractor shall cover deficient areas with additional aggregate.

The Contractor shall coordinate the aggregate application operation with the emulsion application so that no more than 15 m separates the emulsion application from the aggregate spreading. Complete the application of aggregate at least two (2) hours before sunset.

28.5.11 Rolling

The Contractor shall roll immediately after aggregate is spread, making at least two (2) passes with a pneumatic tired roller or until material is tied in.

Final rolling shall consist of at least one (1) coverage with a steel wheel roller.

The minimum number of rollers required is one (1) pneumatic tired roller and one (1) steel roller. If this combination of rollers is not sufficient to maintain the completed rate of progress the Contractor shall provide additional rollers as required, or as directed by the Engineer.

28.5.12 Mechanical Brooming

After rolling, the Contractor shall lightly broom or otherwise maintain the final surface as directed by the Engineer. Maintenance will include distribution of aggregate material over surface to absorb free asphalt material, and covering all areas deficient in aggregate material.

The Contractor shall conduct maintenance after the treatment has set-up sufficiently so as not to displace embedded material. The Contractor shall sweep excess material from the entire surface by means of rotary brooms at a time directed by Engineer.

28.5.13 Traffic Controls

The Contractor shall direct traffic through the Site with warning signs and flaggers in a manner that provides maximum safety for workers and least interruption of work.

The Contractor shall keep traffic off freshly sprayed asphalt.

If it is necessary to route traffic over newly treated areas, the Contractor shall restrict speed to 10 km/h or less until rolling is completed and asphalt has taken initial set.

28.6 METHOD OF PAYMENT

28.6.01 Measurement for Payment

The unit prices submitted by the Contractor in the Form of Tender for this item shall include for all cost of labour, material and equipment to complete the work in accordance with Specifications. The unit price shall also include for all necessary means for controlling traffic and flagging.

All chip seal treated areas will be measured, whether single or double treatment. Following completion, the area will be measured for length and width as treated, or any other pertinent dimensions needed to obtain an area of treatment. Measurement for payment will be based on the square meter (m^2) of applied asphalt emulsion.

28.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 29

GABIONS

City of Saint John

TABLE OF CONTENTS

DIVISION 29 – GABIONS

GABIONS

29.1 SCOPE OF WORK

The Work included in this Division consists of the supplying of all labour, materials and equipment necessary for the installation of gabions as per the Drawings and Specifications.

29.2 DEFINITIONS

Not applicable to this Division.

29.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Constructions of Municipal Services ..... Div. 7

(c) Restoration ..... Div. 21

(d) Standard Drawings

29.4 MATERIALS

Gabions shall consist of a uniform hexagonal wire mesh woven in a triple twist pattern with openings approximately 80 mm x 100 mm fabricated in such a manner as to be non-raveling and designed to provide the required flexibility and strength. All wire mesh shall conform to the latest editions of applicable ASTM Standards.

The perimeter edges of the twisted wire mesh shall be woven around a reinforcing wire in a manner designed to prevent slippage. The edges of the mesh and the diaphragm shall be secured so that the joints formed by tying the selvedges shall have approximately the same strengths as the body of the mesh.

29.4.01 Wire Mesh Gabions

PVC coated, galvanized wire mesh gabions are to be used for all applications.

Wire shall conform to the requirements of Table 29.1.

29.4.01 Wire Mesh Gabions (Cont'd)

Table 29.1: Gabion Wire Dimensions

Description	Dimension
Mesh Opening (Approx.)	80 mm x 100 mm
Mesh (Diam.)	2.7 mm
Selvedges & Corners (Diam.)	3.4 mm
Bindings and Connecting (Diam.)	2.20 mm
Interlocking Wire Fasteners (Diam.)	3.17 mm (stainless steel)
Weight of Zinc Coating	260 g/m²
PVC Coating Thickness	0.5 mm

29.4.02 Geotextile

Refer to Sections 24.4.03 and 24.5.13, "Geotextile Fabric".

29.5 CONSTRUCTION METHODS

The gabions shall be placed on a prepared bed, comprising of a minimum 300 mm of crushed gravel base compacted in 150 mm layers to a minimum density of 95% Standard Proctor (ASTM D698, latest edition), and shall be level with a smooth finish.

Each unit shall be securely wired to the adjacent units along the top and the vertical edges prior to placing the stone. To achieve better alignment and finish, the gabions shall be stretched before filling.

Where permitted by the thickness of the structure, the gabions shall be placed back to back and front to front to facilitate the filling and closing of the lids.

The material used to fill the gabions shall be 75 mm to 200 mm durable hard stone. Voids shall be kept to a minimum. The stone on the exposed areas shall be hand placed.

After the gabions have been filled to 300 mm in depth, connecting wires shall be placed one in each direction with these wires looped around two (2) meshes at each end.

After filling has been completed, the top shall be folded shut and wired to the ends, sides and diaphrams.

Geotextile shall be placed so as to create a surface that is smooth and free of tension stress, folds, wrinkles and creases.

Geotextile shall be installed where shown on the Drawings and in accordance with the manufacturer's recommendations.

Where more than one width of fabric is used, the fabric shall be joined by sewing or by an overlap of at least 500 mm and all overlap joints shall be securely held in place.

Empty gabions placed on top of a completed row must be wired to the filled gabions at front and back.

29.6 METHOD OF PAYMENT

29.6.01 Measurement for Payment

Payment for gabions shall be on a cubic metre (m^3) basis, which shall include all labour, materials and equipment necessary for the full completion of the work, including excavation, backfill, supply and installation of gabion, rock fill, and geotextile as well as other work described in this Specification.

29.6.02 Basis of Payment

Payment shall be made at the Contract Unit Price as contained in the Schedule of Quantities and Unit Price, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 30

CLAY BRICK PAVERS

City of Saint John

TABLE OF CONTENTS

DIVISION 30 – CLAY BRICK PAVERS

CLAY BRICK PAVERS

30.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all necessary labour, materials and equipment for the supply and installation of clay brick pavers including, concrete slab base and mortar bed, as per the Drawings and Specifications.

30.2 DEFINITIONS

Not applicable to this Division.

30.3 RELATED WORK UNDER OTHER SECTIONS

30.4 MATERIALS

The latest CSA and ASTM Specifications are considered part of these Specifications.

30.4.01 Clay Brick Pavers

Clay brick pavers shall be manufactured to conform to ASTM C902. Clay brick pavers shall be 100% solid Shaw Lantz Colonial Bricks conforming to SSA. A82-1M, 90% Red and 10% Black. Paver Size: Standard 200 mm x 100 mm x 57 mm. Clay brick pavers shall be supplied in the Lantz colour range as approved by the Engineer. Clay brick pavers supplied to the Site shall have a total range of colour supplied on each pallet, in a random mix. Individual pallets of uniform coloured brick will not be accepted. Bricks of different sizes shall also have the same mixture of colour in the brick.

30.4.02 Cement

Masonry cement to CSA A179, latest edition.

Portland cement to CSA A5, latest edition.

30.4.03 Sand

Sand shall be clean, sharp, siliceous sand and shall be free from salt, organic, friable or deleterious matter to CSA A 82.5/6.

30.4.04 Samples

Prior to ordering materials, the Contractor shall submit to the Engineer for approval, samples of clay brick pavers and masonry accessories. Samples of other materials to be used and samples for testing shall be submitted as requested by the Engineer. Clay brick pavers sample shall indicate the total colour range and be supplied in a 1 m x 1 m square.

30.5 CONSTRUCTION METHODS

30.5.01 Storage

All materials shall be delivered, stored, and handled to protect them from wetting, staining, chipping and any other damage. Store cement and similar perishable materials in water-tight sheds with elevated floors. Store bricks and masonry units off the ground and under water-tight covers.

30.5.02 Mixes

Use the same manufactured brands and sources for mortar materials to ensure uniformity of mix.

Mix mortar ingredients thoroughly in quantities needed for immediate use. All mixing shall be done by machine.

Mix mortar in mechanical mixer operated until materials are homogeneously blended, but not less than three (3) minutes after all materials are in the mixer.

For all clay brick pavers laid on horizontal surfaces, mortar shall be a dry mix unless otherwise noted. This mix shall consist of two (2) parts Portland cement to five (5) parts sand aggregate.

30.5.03 Installation

The Contractor shall inspect the concrete base to ensure that it is in proper condition, is at the proper level, and has the proper pitch to receive the dry mortar mix bedding and clay brick pavers.

The grades of the clay brick pavers shall be designed to provide proper drainage at all points. If any condition is encountered between given elevations where good drainage is questionable, the Contractor shall notify the Engineer thereof and not proceed with the work until instructions are given by the Engineer. The finished work shall not deviate from the given elevations more than +/- 5 mm. Individual clay brick pavers shall not deviate from the overall alignment and elevations.

30.5.03 Installation (Cont'd)

Before commencing work, slabs shall be thoroughly cleaned of all dust, dirt and foreign matter.

Coursing shall be laid out so that at the end conditions no brick will have to be cut to a width less than 38 mm.

Clay brick pavers shall be laid with tight butt joints. All staggered joints must be accurately angled to provide a precise bonding pattern throughout. Bricks varying in size to an extent that would adversely affect the bonding pattern shall be rejected prior to laying.

Thoroughly saturate the concrete base slab before installing the dry mortar mix.

Spread and place dry mortar mix to at least 50 mm thickness (uncompacted) with hand rake making sure it is not compressed.

Place clay brick pavers in strict bonding pattern working from hard edge and set 10 mm above finished grade. Place brick as tight to each other as possible.

Soak down clay brick pavers with water.

Compact to proper elevation using a vibratory plate compactor with a special rubber padded bottom or by running vibrator over a uniformly flat sheet of plywood placed directly on the clay brick pavers.

Realign any joints which may have been disrupted during compaction with hand hammer.

Clay brick paver surface shall be kept moist for three (3) days.

Use a portable concrete mixer to properly blend sand and cement.

Sweep dry mix in any joints fourteen (14) days after the initial spray application and rinse with a hose. Remove any mortar which has discoloured the brick surface.

Pedestrian traffic may be permitted after twenty-four (24) hours of placement with vehicular traffic after seventy-two (72) hours, if it is deemed suitable by the Contractor.

Broken or damaged clay brick pavers shall not be permitted in the Works.

30.5.04 Cold Weather Installation

For masonry work which will be done below 5°C, measure temperatures of masonry material prior to use; maintain temperature as close as possible for mortar batches; ensure mortar temperatures on mortar boards does not exceed 50°C; use dry masonry units or units which have been wet and are not frozen; lay masonry on unfrozen surfaces free from snow or ice; and use windbreaks while laying masonry not protected by enclosures when wind exceeds 25 km/hr.

When mean air temperatures, over a twenty-four (24) hour period go below 5°C, but not below 0°C, conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C.

When mean air temperatures, over a twenty-four (24) hour period, go below 0°C, but not below -4°C, conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C and maintain temperature of mortar boards above 0°C. Protect entire constructed masonry by enclosing with weather proof membrane for twenty-four (24) hours.

When mean air temperatures are below -4°C, conduct laying of masonry in enclosures heated to maintain air temperature above 0°C. Conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C and heat units if necessary so that temperature of it at time of laying is minimum 0°C. Maintain enclosure in position for twenty-four (24) hours and maintain air temperature within enclosure at minimum 0°C.

30.5.05 Concrete Base Slab

See Division 23, “Portland Cement Concrete”, for Specifications for this item.

30.5.06 Workmanship

Clay brick pavers shall be installed by a skilled mason or tile setter.

Install to smooth uniform surface with maximum spacing 2 mm between bricks and vertical tolerance of 10 mm over a 5 m distance.

Any low areas which allow ponding shall have the clay brick pavers removed and the mortar bed adjusted until grade is maintained.

Clay brick pavers shall be cut with a suitable wet cut masonry saw to produce neat edges and vertical cuts and to control dust.

The clay brick pavers must be at same elevation as adjacent curb or concrete sidewalk.

30.6 METHOD OF PAYMENT

30.6.01 Measurement for Payment

Measurement for payment for clay brick pavers shall be the number of square metres (m^2) of clay brick pavers acceptably placed including; supply, installation of concrete base slab (unless otherwise specified), jointing, clay brick pavers, dry mortar mix and incidentals.

30.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Division 4 of the Contract Specifications.

City of Saint John

GENERAL SPECIFICATIONS

DIVISION 31

GUIDE RAIL AND GUIDE POSTS

City of Saint John

TABLE OF CONTENTS

DIVISION 31 – GUIDE RAIL AND GUIDE POSTS

GUIDE RAIL AND GUIDE POSTS

31.1 SCOPE OF WORK

The Work included in this Division consists of the supply of all labour, materials and equipment necessary for the supply and installation of steel beam guide rail and preservative treated hardwood guide posts as per the Drawings and Specifications.

31.2 DEFINITIONS

Not applicable to this Division.

31.3 RELATED WORK UNDER OTHER SECTIONS

(a) General Administration of Contract ..... Div. 6

(b) Construction of Municipal Services ..... Div. 7

(c) Restoration ..... Div. 21

(d) Roadway Construction ..... Div. 24

(e) Standard Drawings

31.4 MATERIALS

All materials shall be supplied by the Contractor.

31.4.01 Guide Rail

Guide rail shall be Class A, Type II, W-section steel beams conforming to AASHTO M180. Offset blocks shall conform to 31.4.02. Offset blocks and delineators shall be sized in accordance with the details indicated on the Standard Drawing.

31.4.02 Guide Posts

Guide posts shall be of the maple, birch or beech species of hardwood. The posts shall be sound and rot-free and shall meet or exceed the requirements for No.1 Structural Posts and Timbers, graded in accordance with the National Lumber Grading Authority (NLGA) Standard Grading Rules for Canadian Lumber. Preparation, handling and treatment of posts shall be in accordance with CAN/CSA-080 and the American Wood Preservers' Association (AWPA) standards. Prior to pressure treating, posts shall be incised on all four sides and dried to their fibre saturation point of 25 to 30% at 25mm depth. The preservative shall be as follows: for pressure treating, chromated copper arsenate (CCA); and for field-cut surfaces, Wolman End Cut Preservative (Green) or equivalent applied in two coats. Preservation and wood products

31.4.02 Guide Posts (Cont'd)

supplied shall be in accordance with CAN/CSA 080.2 and 080.14. Guide posts shall be sized as indicated on the respective Standard Drawing.

Backfill materials used shall be selected material from the excavation subject to the approval of the Engineer. If additional materials are required for backfilling, the Contractor shall import materials to the Work Site from a source and of a type approved by the Engineer and supplied in accordance with Division 13.

31.5 CONSTRUCTION METHODS

The Contractor shall carry out the Work as indicated in the Contract Documents and/or as specifically directed by the Engineer. Guide posts and guide rail shall be installed in accordance with the Standard Drawings.

Alignment of guide posts shall be established by the Engineer. Installation shall be carried out in a manner so as to avoid damage to the adjacent and surrounding roadway. The Contractor shall be responsible at his own expense to repair any such damage resulting from the Work. Areas around guide posts shall be backfilled with approved material, compacted during placement and finished to match the surrounding grade.

Guide rail sections shall be installed to produce a smooth continuous rail, paralleling the line and grade of the finished roadway surface. Guide rail sections shall be lapped in the direction of traffic flow.

Offset blocks and delineators shall be installed on the guide rail as specified and indicated on the Standard Drawing. The colour of the delineator shall be consistent with the colour of the adjacent pavement line marking.

Cut surfaces of all wood products shall be treated with an approved preservative, as detailed in the manufacturer's application instructions.

Waste materials shall become the property of the Contractor and shall be disposed of outside of the Work Site in accordance with applicable regulations. Cost of all removals, deliveries and off-site disposal of all items (including creosote posts and blocking) to be considered incidental to the works.

31.6 METHOD OF PAYMENT

31.6.01 Measurement for Payment

Payment for guide rail shall be made per lineal metre (m) of guide rail supplied and installed in accordance with this Item.

Payment for guide posts shall be made under a unit price basis for the number of guide posts supplied and installed in accordance with this Item.

31.6.02 Basis of Payment

Payment shall be made at the Contract Unit Prices as contained in the Schedule of Quantities and Unit Prices, Div. 4.5, of the Contract Specifications.

City of Saint John

TABLE OF CONTENTS

SAMPLE FORMS

TITLE

City of Saint John

ADDITIONAL WORK OR DOWNTIME REQUEST
FIELD REPORT

CONTRACT NO. _____ DATE: _____

CONTRACT TITLE: _____ INSPECTOR: _____

LOCATION: _____

DESCRIPTION OF WORK: _____

ITEM DESCRIPTION	QTY.	UNIT
LABOUR:		
EQUIPMENT:		
MATERIALS:		

NOTE: THIS FORM SHALL BE COMPLETED AT THE TIME THE ADDITIONAL WORK IS CARRIED OUT FOR ANY WORK WHICH THE CONTRACTOR WILL BE CLAIMING FOR EXTRA PAYMENT. THE ENGINEER SHALL REMAIN THE SOLE JUDGE AS TO WHETHER EXTRA PAYMENT IS WARRANTED UNDER THE CONTRACT FOR THE WORK DESCRIBED HEREON.

ENGINEER'S REPRESENTATIVE	DATE

CONTRACTOR'S REPRESENTATIVE	DATE

COPIES:
1 ENGINEER
2 CONTRACTOR
3 INSPECTOR

Date

Contractor's Address

Attention:

Re: Contract No. : Contract Name

Please find enclosed the Certificate of Final Acceptance for the above contract.

The Certificate of Final Acceptance, Section 6.20.06, is issued with the understanding that the Period of Maintenance, Section 6.18, has expired and that all contract requirements have been fulfilled by the contractor to the engineer's satisfaction.

Yours truly,

Engineer
Municipal Engineer

CERTIFICATE OF FINAL ACCEPTANCE

Contract No. :
Contract Name

Under Section 6.20.06 of the Specifications of the above Contract between the City of Saint John and the Contractor, _____, we hereby certify that the Maintenance Period has expired as of _____ and that all requirements of the Contract have been fulfilled by the Contractor.

SIGNED: _____
Engineer
Municipal Engineer

DATE: _____

Date

Contractor's Address

Attention:

Re: Contract No. : Contract Name

Please find enclosed the Certificate of Final Completion for the above Contract.

The Certificate of Final Completion, Section 6.20.05, is issued as a result of the City having received the Contractor's release of the Owner (the City) from any and all claims for work relating to the Contract up to the date of Final Measurement.

Under Section 6.18, the Maintenance Period shall be a period of twelve (12) calendar months from the date of issue of the Certificate of Final Completion.

Yours truly,

Engineer
Municipal Engineer

CERTIFICATE OF FINAL COMPLETION

Contract No. :
Contract Name

Under Section 6.20.05 of the Specifications of the above Contract between the City of Saint John and the Contractor, _____ , we hereby certify that the said Contract is Finally Completed as_____. This same date is the date of commencement of the Maintenance Period (Section 6.18).

SIGNED: _____
Engineer
Municipal Engineer

DATE: _____

Date

Contractor's Address

Attention:

Re: Contract No. : Contract name

Please find enclosed the Certificate of Substantial Completion along with a Form 7 pursuant to the C*onstruction Remedies Act* for the above noted Contract.

The Certificate of Substantial Completion is issued on the understanding that the Contractor will complete any outstanding work expeditiously during the Maintenance Period (Section 6.18) and will discharge all unfulfilled obligations under the Contract. Under Section 6.21.02, all the Holdback (10% due to the Contractor) shall be released after sixty-one (61) days from the date of the Form 7 attached to the Certificate of Substantial Completion.

In the event of any known Deficiency or portion of the Work that remains incomplete, funds in addition to the 10% will be retained as detailed in the Deficiency Retention and the Completion Retention pursuant to the Contract.

We require a Statutory Declaration to the effect that;

(1) all expenses incurred by the Contractor in carrying out the Contract have been paid except for statutory holdbacks properly retained;

(2) The *Construction Remedies Act, Regulation 2021-81*, Form 7 was posted in the manner and within the time required by the *Construction Remedies Act*; and,

(3) The Contractor is not aware of any Claim for Lien made with respect to the public owner's holdback as contemplated by the *Construction Remedies Act.*

We will also require a current Clearance Certificate from WorkSafeNB.

We will also require a certificate issued to the City of Saint John by a lawyer who is in good standing with the Law Society of New Brunswick wherein the lawyer certifies that no liens have been filed in the Registry Office with respect to the Work and/or the Site which remain outstanding sixty-one (61) days after the Certificate of Substantial Completion has been issued.

I would recommend that we agree on the Final Measurement as soon as possible so that the Certificate of Final Completion, Section 6.20.05, can be issued and the Maintenance Period (Section 6.18) can commence. The Certificate of Final Completion will be issued after the Contractor releases the Owner in writing from any and all claims for work relating to the Contract up to the date of Final Measurement.

Yours truly,

Engineer
Municipal Engineer

CERTIFICATE OF SUBSTANTIAL COMPLETION

Contract No. :
Contract Name

Under Section 6.20.03 of the Contract between the City of Saint John and the Contractor, _____, we hereby certify that the said Contract is Substantially Complete as of date of the attached Form 7 with the exception of any outstanding work (Section 6.20.04) or deficiencies that may occur during the Maintenance Period (Section 6.18).

SIGNED: _____
Engineer
Municipal Engineer

DATE: _____

FORM 7

CERTIFICATE OF SUBSTANTIAL PERFORMANCE OF THE CONTRACT

(*Construction Remedies Act*, S.N.B. 2020, c.29, s.42)

_____

(County and Rural Community/Regional Municipality/Town/City/Village in which land is located)

_____

(civic address or, if there is no civic address, the location of the land)

Name of owner:

Address for service:

Name of contractor:

Address for service:

Name of payment certifier (if applicable):

Address:

I/We certify that the contract for the improvement described below to the identified land was substantially performed on: .

(date the contract was substantially performed)

_____

_____

(short description of the improvement)

Date certificate signed:

_____

(payment certifier if there is one)

_____

(owner and contractor, if there is no payment certifier)

FORMULE 7

CERTIFICAT D'EXÉCUTION SUBSTANTIELLE DU CONTRAT

(*Loi sur les recours dans le secteur de la construction*, L.N.-B. 2020, ch. 29, art. 42)

_____

(Comté et communauté rurale / municipalité régionale / ville/ cité / village où le bien-fonds est situé)

_____

(adresse de voirie du bien-fonds ou s'il n'y en a pas l'emplacement de celui-ci)

Nom du propriétaire :

Adresse aux fins de signification:

Nom du l'entrepreneur :

Adresse aux fins de signification:

Nom du certificateur pour paiement, s'il y en a un :

Adresse :

Je certifie / Nous certifions par les présentes que le contrat pour l'amélioration décrite ci-dessous au bien-fonds indiqué a fait l'objet d'une description substantielle le : .

(date à laquelle le contrat a fait l'objet d'une exécution substantielle)

_____

_____

(courte description de l'amélioration)

Date de la signature du certificat :

_____

(certificateur pour paiement, s'il y en a un)

_____

(propriétaire et entrepreneur, s'il n'y a pas de certificateur pour paiement)

Loi sur les recours dans le secteur de la construction

(use A or B, whichever is applicable)

☐ A. If a lien attaches to land, a description of the land sufficient for registration, including all approved parcel identifiers:

_____

_____

_____

☐ B. If a lien is against a public owner's holdback, the name and address of the office where or the person to whom a copy of the claim for lien must be given:

Clerk of City of Saint John

_____

_____

_____

(cocher A ou B, selon le cas)

☐ A. Description du bien-fonds suffisante pour l'enregistrement et tous les numéros d'identification approuvés, si le privilège grève le bien-fonds :

_____

_____

_____

☐ B. Bureau où la revendication de privilège doit être donnée ou personne à qui elle doit être donnée, si le privilège est sur la retenue de garantie faite par un propriétaire public:

_____

_____

_____

City of Saint John

CONCRETE TESTING SUMMARY

CONTRACT NO: _____

CONTRACT NAME: _____

CONTRACTOR: _____

LOCATION: _____

APPLICATION:	CURB	SIDEWALK	CURB/GUTTER	RETAINING WALL
METHOD:	FORM	SLIP-FORM	OTHER (SPECIFY):	

Concrete Specifications (Division 23 - Portland Cement Concrete):

Air: 5-8%; **Slump:** Curb 40 mm ± 10 mm; S/W 80 mm ± 20 mm; **Max. Size Aggregate** 19mm; **Strength:** 32 MPa @ 28 days
Conc. Temp. > 10 °C and < 35 °C; **Air Temp.** > 5 °C and < 27°C

CONCRETE SUPPLIER _____ TICKET NO. _____

WEATHER _____ TRUCK NO. _____

TEST NO.	LIMITS OF CONCRETE POUR (From/To)	TIME		AIR %	SLUMP (mm)	TEMPERATURE		WATER ADDED* (Litres)	LOAD SIZE (m^3)
		BATCH	TEST			AIR °C	CONC. °C		

*Water is not to be added to the concrete other than at the batching plant without permission of the Engineer.

CONCRETE TEST CYLINDERS: CYLINDERS TAKEN ON TEST NUMBER: _____

REMARKS: _____

_____

_____

_____

_____ _____

DATE ENGINEER'S REPRESENTATIVE

Copies: 1. Engineer; 2. Inspector; 3. Consultant

City of Saint John

CONCRETE WORK POUR APPROVAL FORM

CONTRACT INFORMATION				
Contract No.:		Contractor:		
Contract Name:				
Location:		Date:		
Inspector:				
Weather Conditions:		Temperature:		Time of Pour:
No.	**Description**	**Accepted**	**Rejected**	**Comments**
1	Sub-grade Conditions			
2	Compaction			
3	Grades & alignment			
4	Driveway layout			
5	Manholes, catch basins, service boxes			
6	Reinforcing steel			
7	Formwork			
8	Fire hydrants, telephone poles, traffic signs			
9	Accessibility ramps			
10				
11				

City Representative	Contractor's Representative
Date	Date

City of Saint John

Construction Safety Checklist

General Instructions:

In conjunction with the City of Saint John General Specifications, latest revisions, and Division 7.9, "Precautions for the Safety of Persons and Property", contractors shall review and submit a signed Construction Safety Checklist to the Engineer prior to commencing work on any City of Saint John contract. Additionally, the contractor is advised to make the following arrangements to ensure conformity with employee health and safety provisions as stated in the applicable Acts and Regulations.

Management and Supervision (by Contractor)

- Comply with all provisions of the Occupational Health and Safety Act of the Province of New Brunswick.
- Report all serious accidents in accordance with s43 of the Occupational Health and Safety Act to the Compliance Division of the WorkSafeNB and the City of Saint John Safety Officer.
- Communicate the "Right to Refuse", s19 – s23 of the Occupational Health and Safety Act, to all employees.
- Ensure adequate supervision at all times on the jobsite.
- Comply with all provisions of General Regulation 91-191, Part XII, "Excavations and Trenches".
- Comply with all provisions of General Regulation 91-191, "Part XVII, "Confined Space".
- Comply with all other provisions of General Regulation 91-191, Occupational Health and Safety Act.

Employee Training (by Contractor)

- Ensure all flag-persons have been trained and certified in highway signaling within the last three (3) years.
- Ensure all flag-persons carry a current Highway Signaler Certification Card, signed by their supervisor (copy of each certification card to be provided to the Engineer).
- Ensure all operators of vehicles and equipment are properly qualified and licensed under the Motor Vehicle Act.
- Ensure all employees are competent to perform assigned work under the Occupational Health and Safety Act., Regulation 91-191.

Traffic Control (by Contractor)

- Use only New Brunswick Department of Transportation and Infrastructure (NBDTI) approved signage.
- Ensure all work zone safety devices meet the standards specified in the Manual of Uniform Traffic Control Devices (MUTCD).
- Provide the Engineer with a copy of the Contractor's traffic control plan prior to the commencement of work. This control plan can alternately be discussed at the pre-construction site meeting, or as directed by the Engineer.
- Provide well-defined safe lanes of transit (which can be satisfied by a combination of pylons and barricades, unless otherwise directed by the Engineer) for equipment and vehicles inside the work zone, adequately separated from employees on foot.
- Use arrow boards (where specified) of sufficient luminosity for all long-term work on multi-lane streets and high volume two (2) lane roadways.
- Ensure all jobs are properly secured at night and outside of working hours, including weekends and holidays.

Personal Protective Equipment (Contractor's Employees)

- Ensure all flag-persons wear a reflective safety vest with reflective striping front and back, CSA standard CAN/CSA-Z195, Grade I safety boots, Class E, Type 1 headwear, and are equipped with NBDTI approved paddles.
- Ensure all vehicles and equipment used in the work zone are equipped with properly functioning flashing lights and back–up alarms.
- Provide first aid kits on each Site.
- Provide portable eyewash stations on each Site. This can be satisfied by the "squeeze bottle" type as distributed by safety equipment suppliers. If an incident occurs, the individual must be immediately transported to a proper eyewash fountain, hospital, or as necessary.
- Ensure all employees on the jobsite are equipped with and wear at all times: safety vest with reflective striping front and back, Class E, Type 1 headwear, CSA standard CAN/CSA-Z195, Grade I safety boots.
- Ensure employees are equipped with and wear any additional personal protective equipment warranted by: environmental conditions, work process employed, and General Regulation 91-191 under the Occupational Health and Safety Act.

Tracked Vehicle Use on City Streets

The following is a description of what the City of Saint John Engineering Department considers to be permissible activity with respect to tracked vehicles on City construction projects.

- Tracked vehicles may only be operated within a clearly established Work Area. A Work Area is generally defined in the NBDTI Work Area Traffic Control Manual (WATCM) as "the entire length of road beginning from the first advance warning sign through to the last Traffic Control Device, where traffic may return to its normal operating conditions."
- When a tracked vehicle must travel within the Work Area, all local traffic shall be halted by trained signalers.
- Work Areas shall be established large enough to permit the safe movement of workers and equipment in carrying out the work.
- The Work Area may be expanded as work progresses. All signage must be in place before moving tracked equipment into the expanded Work Area.
- When moving to a new Work Area, tracked equipment shall not travel on City streets. Tracked equipment shall be transported, on a trailer, from one Work Area to the next.
- The Work Area shall be clearly established with the proper signage before unloading tracked vehicles from their trailers onto the street.

The above was written for tracked vehicles but, shall apply to other types of vehicles and equipment that cannot be licensed for use on City streets.

I have read and understand these requirements and I agree to comply fully.

Contractor's Representative _____ Date _____

Maintenance Summary Sheet

Preventative Maintenance Activities									
Frequency									
Equipment	**Visual Inspection**	**Lubrication**	**Cleaning**	**Oil Change**	**Replace Spark Plugs**	**Replace Springs**	**Overhaul**	**Exercise or Test**	**Predicted Life Span**
Pump	I month	2 months	6 months	1 year		2 years	10 years	1 month	20 years
Fan	1 year	1 month	1 year				5 years	1 year	15 years
PRV	2 months	6 months				5 years	5 years	6 months	35 years
VFD	1 year							1 year	45years
Flow meter	1 year	2 years		3 months					30 years
Gate Valve	2 year							1 year	30 years

SANITARY FORCEMAIN LEAKAGE – PRESSURE TEST

City of Saint John

CONTRACT NO.:	**DATE:**
CONTRACT NAME:	**LOCATION:**
CONTRACTOR:	**RED BOOK NO.:**
INSPECTOR:	**PAGE NO.:**

MATERIAL AND TEST INFORMATION

DATA #1

TYPE AND CLASS OF PIPE: _____ **LENGTH OF PIPE:** _____ **m**

DIAMETER OF PIPE: _____ **mm**

Allowable Leakage: $Q\frac{Ld\sqrt{p}}{795{,}000}$ x 2 = _____ X 2 = litres

DATA #2

TYPE AND CLASS OF PIPE: _____ **LENGTH OF PIPE:** _____ **m**

DIAMETER OF PIPE: _____ **mm**

Allowable Leakage: $Q=\frac{Ld\sqrt{p}}{795{,}000}$ x 2 = _____ X 2 = litres

Where: ***Q*** **= allowable leakage (litres/hour)** ***d*** **= nominal diameter of pipe (mm)**
P **= average test pressure (kPa)** **L = length of pipe being tested**

DURATION OF TEST SHALL BE TWO (2) HOURS

TEST RESULTS

TIME TEST STARTED:	**METER READING:**	**AT**	**kPa**
TIME TEST ENDED:	**METER READING:**	**AT**	**kPa**

TOTAL LEAKAGE ALLOWED: (DATA #1 + DATA #2) **litres**

ACTUAL AMOUNT OF LEAKAGE: **litres**

CONVERSION FACTORS:
1 ft = 0.3048 m **1 PSI = 6.895 kPa**

PASS ☐ **FAIL** ☐

ENGINEER'S REPRESENTATIVE	DATE	CONTRACTOR'S REPRESENTATIVE	DATE

COPIES: 1. ENGINEER
2. CONTRACTOR
3. INSPECTOR

City of Saint John

The City of Saint John

Sanitary Sewer Air Test Report

Contract No.:		Date:	
Contract Name:		Weather:	
Contractor:		Red Book No.:	
Inspector:		Page No.:	
Date Flushed:		Date Videoed:	

MATERIAL AND TEST INFORMATION:

From MH# _____ To MH# _____ Length of Test Section _____

Type and Class of Pipe: _____ Type of Manhole: _____

Diameter of Pipe: _____ Type of Joint: _____

Length of Pipe: _____ Type of Bedding: _____

TIME REQUIREMENTS FOR AIR TESTING:

Pipe Diameter (mm)	Minimum Time (min:sec)	Length of Pipe for Minimum Time (m)	Time for Longer Length (sec)
100	1:53	182	0.62 x L
150	2:50	121	1.40 x L
200	3:47	91	2.49 x L
250	4:43	73	3.89 x L
300	5:40	61	5.61 x L
375	7:05	48	8.76 x L
450	8:30	41	12.60 x L
525	9:55	35	17.20 x L
600	11:20	30	22.40 x L

L = Length of test section in metres (m)

Time Required for Test: _____ min:sec (from Table above)

Time Test Started: _____ Pressure: _____ kPa

Time Test Ended: _____ Pressure: _____ kPa

Measured Pressure Drop _____ Allowable Pressure Drop: 7 kPa

PASS ☐ **FAIL** ☐

Engineer's Representative	Date	Contractor's Representative	Date

COPIES: 1. ENGINEER
2. CONTRACTOR
3. INSPECTOR

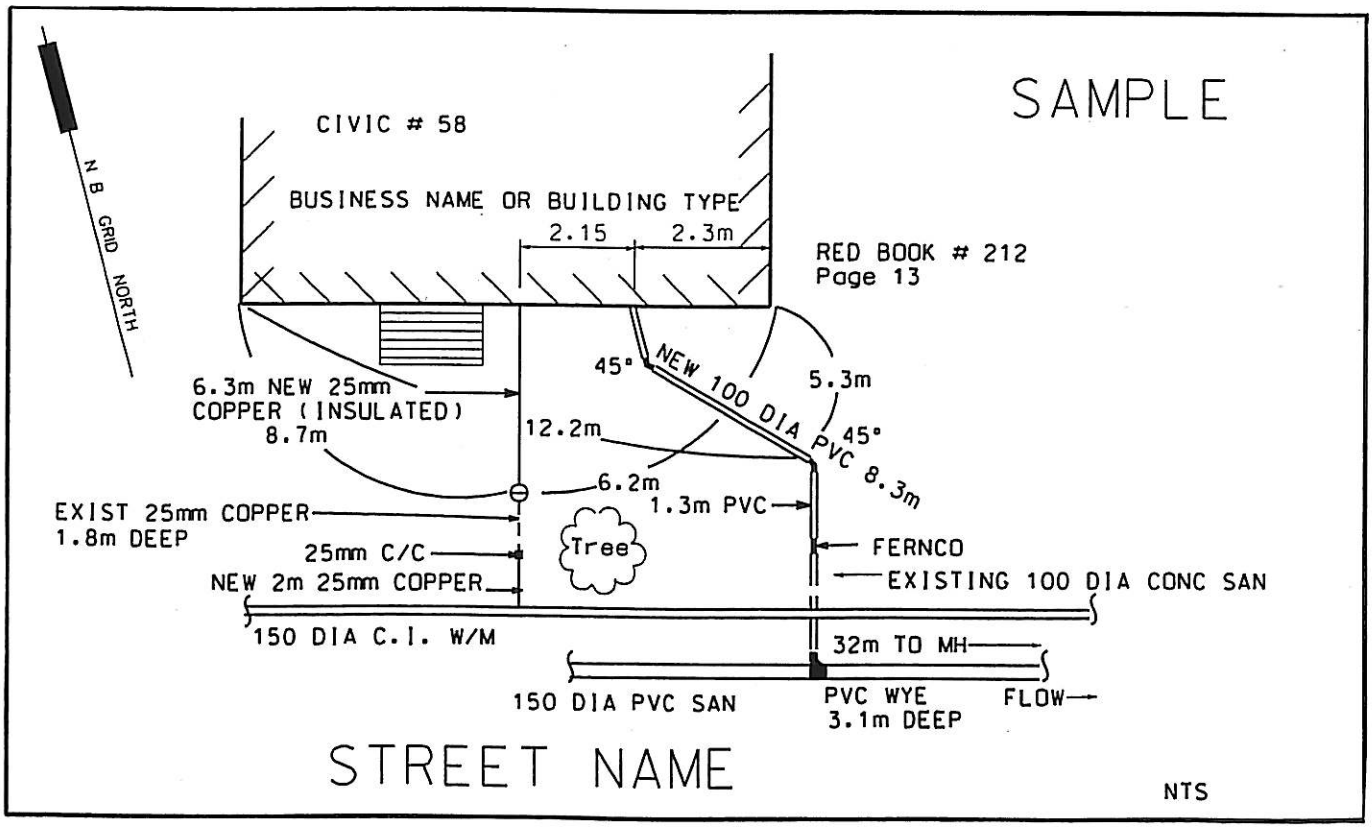
STANDARD SERVICE CARD FORMAT

Service Cards are to show as much information as available during installation, repair or replacement of the water, sewer or storm services to a building.

The following information shall be included on the service card sketch (metric units only):

- Civic address number, type of building and street name;
- Red Book number and page or another reference;
- Swing ties to shutoff valves (curb stops) and sewer bends or tees as required;
- Diameter, length and material of new pipe installed;
- Note size and material of existing pipe with coupling locations;
- If the service is insulated, show location on sketch;
- Note depth of bury at the main and the property line;
- Show main sizes and materials;
- Distance from sewer wye or tee-wye to closest manhole;
- Show all fittings on services;
- Note the length of service pipe to the main;
- Note on sketch if pipes are in common trench; and
- Show any major surface features near the pipes like trees, retaining walls, steps, etc.

Additionally, include the address, date, and any remarks on the "report card" side of the service card.



City of Saint John

The City of Saint John

Storm Sewer Air Test Report

Contract No.:		Date:	
Contract Name:		Weather:	
Contractor:		Red Book No.:	
Inspector:		Page No.:	
Date Flushed:		Date Videoed:	

MATERIAL AND TEST INFORMATION:

From MH# _____ To MH# _____ Length of Test Section: _____

Type and Class of Pipe: _____ Type of Manhole: _____

Diameter of Pipe: _____ Type of Joint: _____

Length of Pipe: _____ Type of Bedding: _____

TIME REQUIREMENTS FOR AIR TESTING:

Pipe Diameter (mm)	Minimum Time (min:sec)	Length of Pipe for Minimum Time (m)	Time for Longer Length (sec)
100	0:28	182	0.16 x L
150	0:43	121	0.35 x L
200	0:57	91	0.62 x L
250	1:11	73	0.97 x L
300	1:25	61	1.40 x L
375	1:46	48	2.19 x L
450	2:08	41	3.15 x L
525	2:29	35	4.30 x L
600	2:50	30	5.60 x L

L = Length of test section in metres (m)

Time Required for Test: _____ min:sec (from Table above)

Time Test Started: _____ Pressure: _____ kPa

Time Test Ended: _____ Pressure: _____ kPa

Measured Pressure Drop _____ Allowable Pressure Drop: 7 kPa

PASS ☐ **FAIL** ☐

Engineer's Representative	Date	Contractor's Representative	Date

COPIES: 1. ENGINEER
2. CONTRACTOR
3. INSPECTOR

City of Saint John
Asphalt Resurfacing Program

City of Saint John

Street Surface Preparedness Inspection Form

Contractor: _____

Contract Number: _____ Date: _____

Location: _____

This form certifies that the following surface conditions have been completed prior to paving operations as directed by the Engineer or Engineer's representative and inspected. Asphalt resurfacing shall take place within fourteen (14) calendar days upon issuing this form.

CONDITION	ACCEPTED	N/A	COMMENTS
Longitudinal & transverse slope control (grades)	❑	❑	_____
All manhole covers and valve boxes raised to specified elevation?	❑	❑	_____
Is surface milled off entirely?	❑	❑	_____
Asphalt padding completed?	❑	❑	_____
Is entire road surface, including vertical surfaces, tacked with bituminous tack coat?	❑	❑	_____
Is entire road surface broomed and debris free?	❑	❑	_____
Other: (Specifiy) _____	❑	❑	_____

This form does not release the contractor from deficiencies that may arise during completion of this project. Further inspections will take place upon completion of the resurfacing operation.

_____ _____

ENGINEER'S REPRESENTATIVE CONTRACTOR'S REPRESENTATIVE

City of Saint John
Asphalt Resurfacing Program

City of Saint John

Underground Structures Inspection Form

Contractor: _____

Contract Number: _____ Date: _____

Location: _____

This form certifies that the following City owned underground structures have been rebuilt and/or adjusted as directed by the Engineer or Engineer's representative and that this operation was done to City standards.

STRUCTURE	NUMBER	N/A	COMMENTS
Water Chamber	_____	☐	_____
Water Service Box	_____	☐	_____
Sanitary Sewer Manhole	_____	☐	_____
Storm Sewer Manhole	_____	☐	_____
Catch Basin	_____	☐	_____
Other: (Specify)	_____	☐	_____

This form does not release the contractor from deficiencies that may arise during the completion of this project. Further inspections will take place upon completion of the resurfacing operation.

_____ _____

ENGINEERING DIVISION REPRESENTATIVE CONTRACTOR'S REPRESENTATIVE

WATERMAIN LEAKAGE – PRESSURE TEST

City of Saint John

CONTRACT NO.:	**DATE:**
CONTRACT NAME:	**LOCATION:**
CONTRACTOR:	**RED BOOK NO.:**
INSPECTOR:	**PAGE NO.:**

MATERIAL AND TEST INFORMATION

DATA #1

TYPE AND CLASS OF PIPE: _____ **LENGTH OF PIPE:** _____ **m**

DIAMETER OF PIPE: _____ **mm**

Allowable Leakage: $Q\dfrac{Ld\sqrt{p}}{795{,}000}$ x 2 = $\dfrac{\qquad\qquad}{795{,}000}$ X 2 = litres

DATA #2

TYPE AND CLASS OF PIPE: _____ **LENGTH OF PIPE:** _____ **m**

DIAMETER OF PIPE: _____ **mm**

Allowable Leakage: $Q=\dfrac{Ld\sqrt{p}}{795{,}000}$ x 2 = $\dfrac{\qquad\qquad}{795{,}000}$ X 2 = litres

Where: *Q* = allowable leakage (litres/hour) *d* = nominal diameter of pipe (mm)
P = average test pressure (kPa) L = length of pipe being tested

DURATION OF TEST SHALL BE TWO (2) HOURS

TEST RESULTS

TIME TEST STARTED:	**METER READING:**	**AT**	**kPa**
TIME TEST ENDED:	**METER READING:**	**AT**	**kPa**
TOTAL LEAKAGE ALLOWED: (DATA #1 + DATA #2)		**litres**	
ACTUAL AMOUNT OF LEAKAGE:		**litres**	
CONVERSION FACTORS: 1 ft = 0.3048 m 1 PSI = 6.895 kPa 1 Imp. Gal. = 4.546 L		**PASS** ☐	**FAIL** ☐

This test procedure meets municipal requirements for the City of Saint John. It is the contractor/developer/ property owner's responsibility to meet any other testing requirements, including those of the NB Department of Public Safety, Office of the Fire Marshal.

ENGINEER'S REPRESENTATIVE	DATE	CONTRACTOR'S REPRESENTATIVE	DATE

Rev. January 2011

COPIES: 1. ENGINEER
2. CONTRACTOR
3. INSPECTOR

City of Saint John

TABLE OF CONTENTS

STANDARD DRAWINGS

City of Saint John

TABLE OF CONTENTS

STANDARD DRAWINGS

City of Saint John

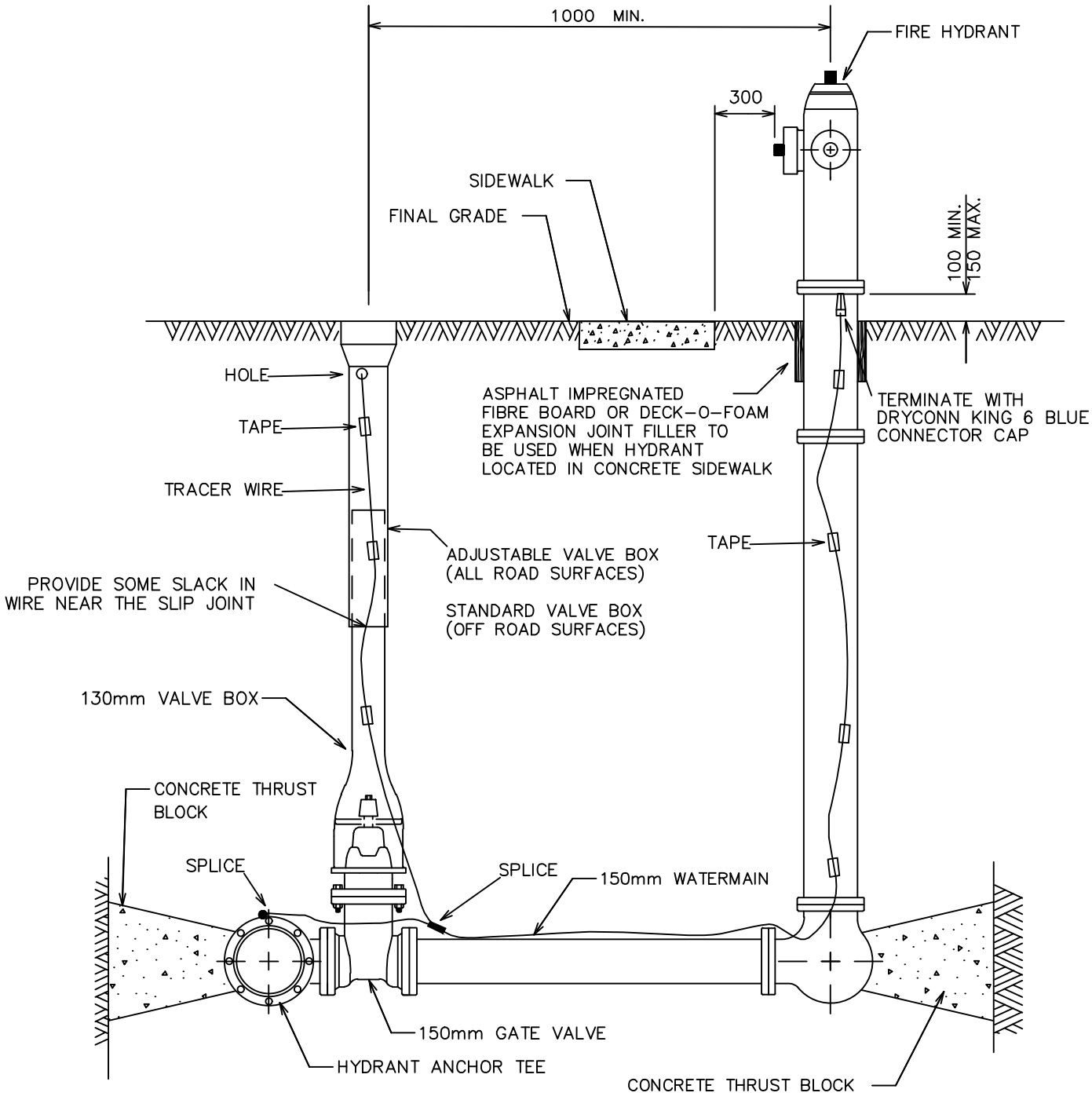
TABLE OF CONTENTS

STANDARD DRAWINGS

City of Saint John

TABLE OF CONTENTS

STANDARD DRAWINGS

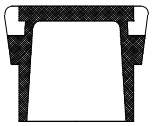


NOTE
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. ALL DUCTILE IRON PIPING INCLUDING BURIED SECTION OF HYDRANT SHALL BE ENCASED WITH 8 MIL THICK POLYETHYLENE AS PER SECTION 10.4.013. ATTACH TRACER WIRE TO PIPE AND VALVE BOX AS PER S045-116
3. IF HYDRANT IS LOCATED BEHIND DITCH, PROVIDE MINIMUM 5m OF CULVERT AND BACKFILL TO LEVEL OF ADJACENT ROADWAY. INSULATE BETWEEN CULVERT AND HYDRANT LEAD

City of Saint John

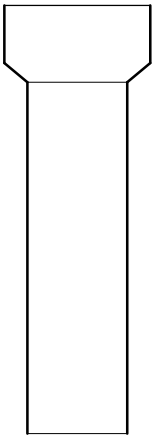
HYDRANT INSTALLATION

DWN. BY J GRANGER	DATE DEC. 2005	REV. No. 4		DWG. No. S045-100
CHECKED BY	SCALE N.T.S.	DATE JUN 2018		



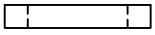
COVER

(FLUSH SHOWN)
OPTIONS – RECESSED/LOCKABLE



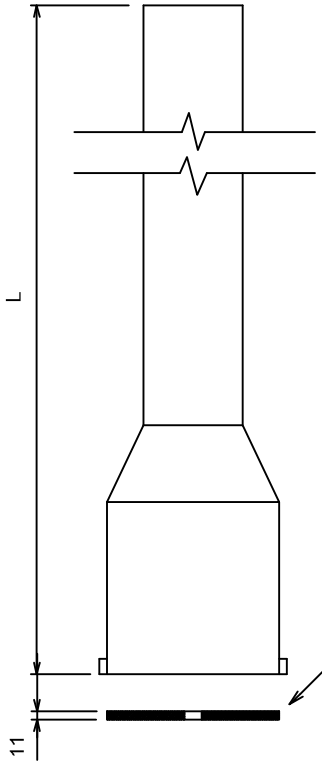
UPPER SECTION

750
(SLIDING)



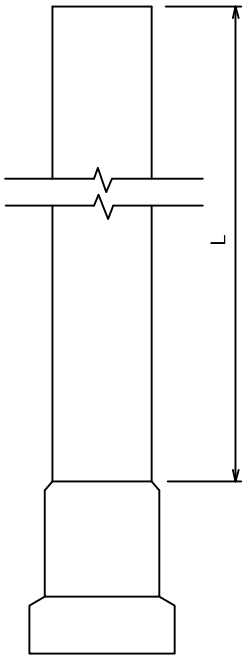
LOCKING RING

(SLIDE STOP)



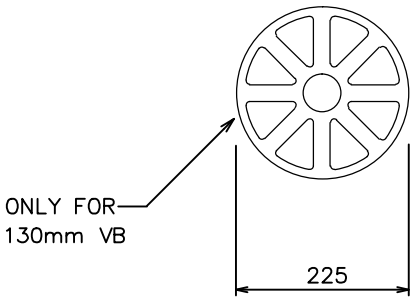
LOWER SECTION

L = 900, 1200, 1500



EXTENSION

L = 300, 450, 600
(ALSO CUSTOM)



GUIDE PLATE

GUIDE PLATE
SIDE VIEW

NOTES :

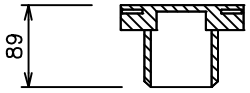
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. MATERIAL IS GREY CAST IRON TO ASTM 126, CLASS 30
3. 130mm VB SHALL BE USED ON VALVES 100mm 0 TO 300mm Ø
4. 105mm VB SHALL BE USED ON VALVES LESS THAN 100mm Ø
5. GATE VALVES LARGER THAN 300mm Ø SHALL USE A VALVE CHAMBER

City of Saint John

SLIDE VALVE BOX (105mm & 130mm)

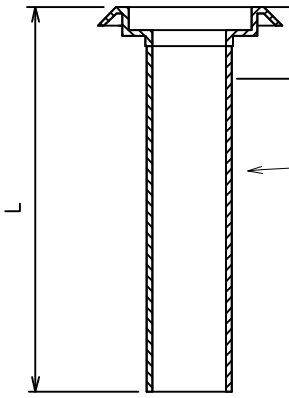
DWN. BY K. MORRIS	DATE JAN. 2004	REV. No. 2		DWG. No. S045–101
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		

ADJUSTABLE VALVE BOX



COVER

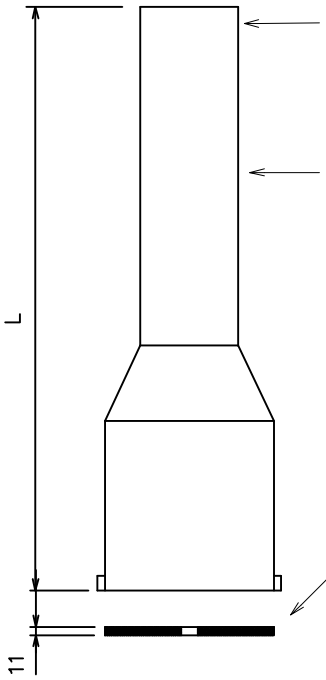
CAST IRON



— ASPHALT UPPER COURSE (40mm TYP)
— ASPHALT LOWER COURSE (THICKNESS VARIES)

ADJUSTABLE TOP SECTION

DUCTILE IRON
L= 686

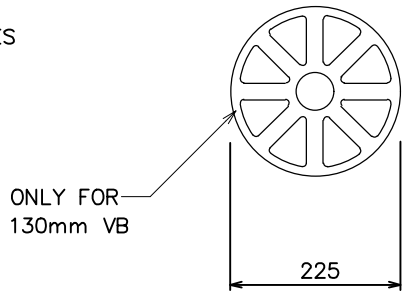


TRIM LENGTH OF
BOTTOM SECTION SO THAT IT IS 50mm
BELOW ASPHALT BASE MATERIAL

BOTTOM SECTION

POLYMER
L = VARIES

GUIDE PLATE
SIDE VIEW



GUIDE PLATE

DUCTILE IRON

NOTES :

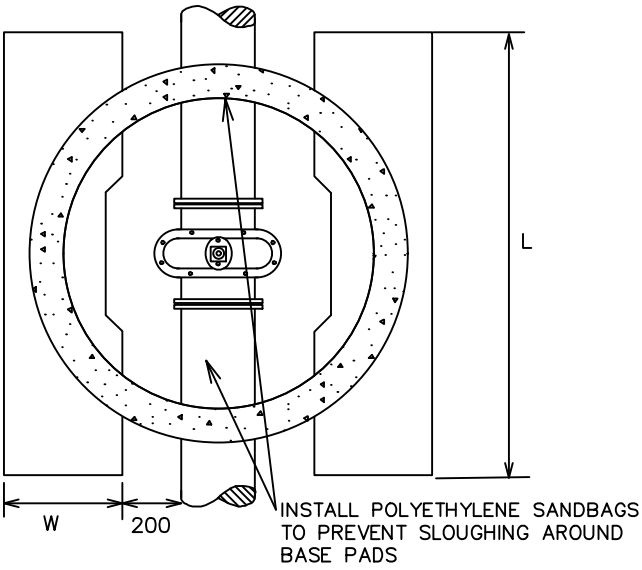
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. COVER MATERIAL IS GREY CAST IRON TO ASTM 126, CLASS 30 UNLESS NOTED
3. 130mm VB SHALL BE USED ON VALVES 100mm Ø TO 300mm Ø
4. GATE VALVES LARGER THAN 300mm Ø SHALL USE A VALVE CHAMBER

City of Saint John

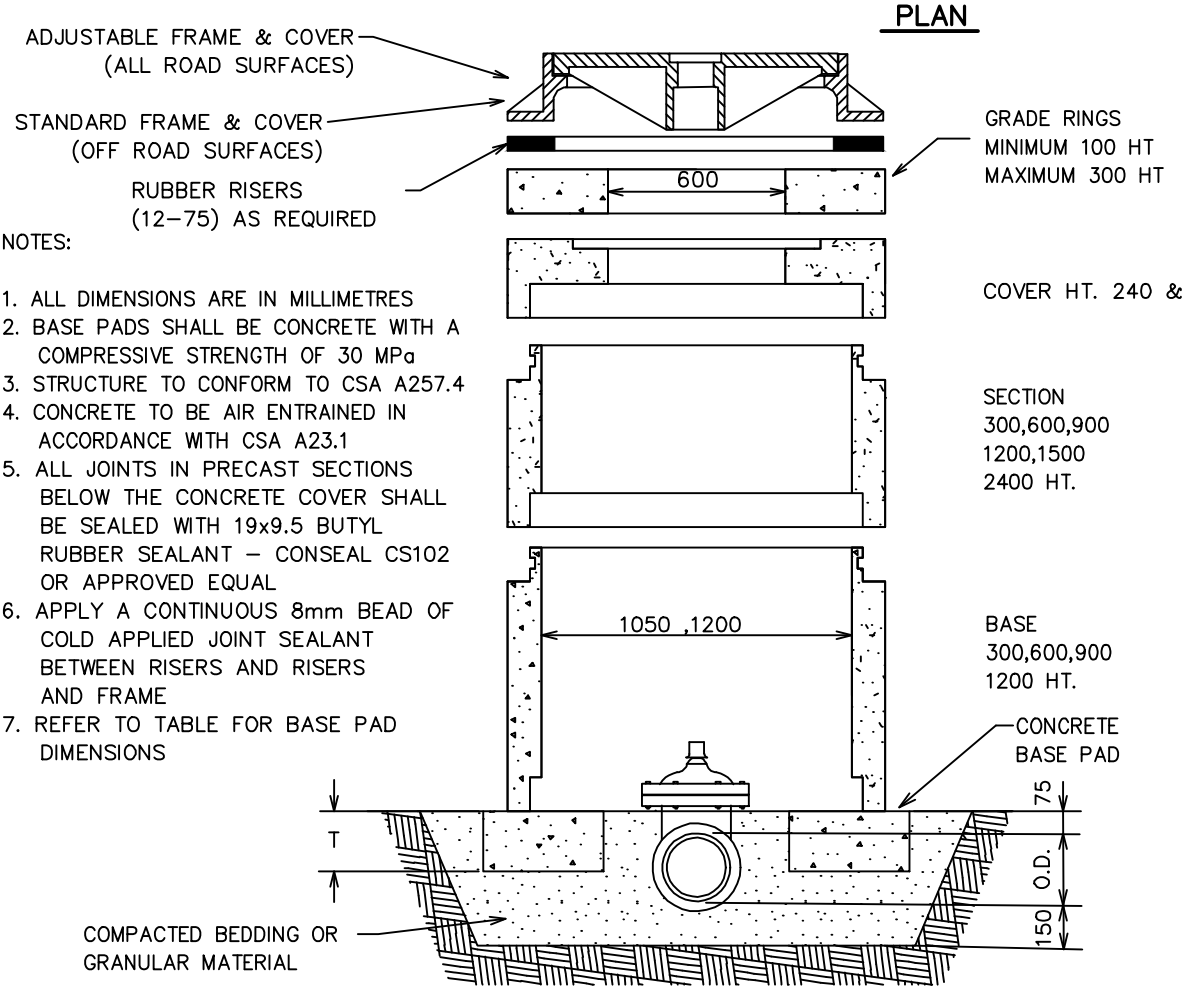
ADJUSTABLE
VALVE BOX

DWN. BY P. WOODHOUSE	DATE JAN 2006	REV. No. 4		DWG. No. S045–101A
CHECKED BY	SCALE N.T.S.	DATE OCT 2019		

CHAMBER DIA.	BASE PAD SIZE (LxWxT)
1050,1200	1500x400x200
1500,1800,2100	2400x300x200
2400,3000,3600	3500x1000x300



PLAN



SECTION

NOTES:

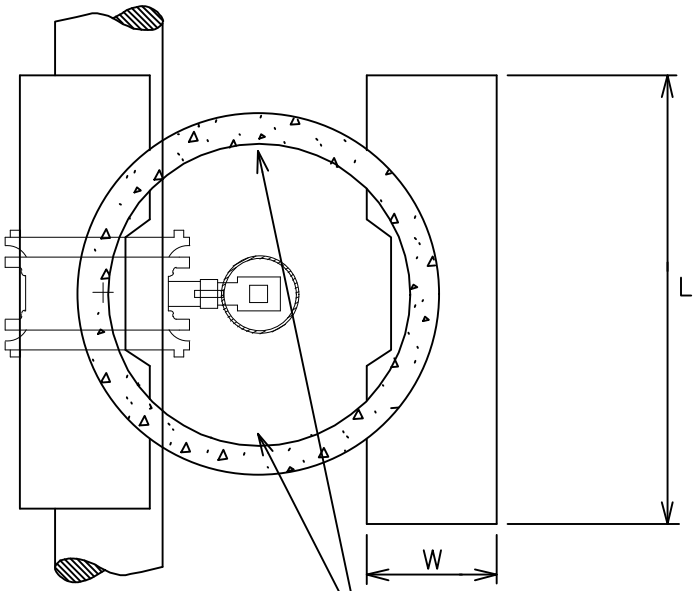
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. BASE PADS SHALL BE CONCRETE WITH A COMPRESSIVE STRENGTH OF 30 MPa
3. STRUCTURE TO CONFORM TO CSA A257.4
4. CONCRETE TO BE AIR ENTRAINED IN ACCORDANCE WITH CSA A23.1
5. ALL JOINTS IN PRECAST SECTIONS BELOW THE CONCRETE COVER SHALL BE SEALED WITH 19x9.5 BUTYL RUBBER SEALANT – CONSEAL CS102 OR APPROVED EQUAL
6. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT BETWEEN RISERS AND RISERS AND FRAME
7. REFER TO TABLE FOR BASE PAD DIMENSIONS

City of Saint John

VALVE CHAMBER DETAIL (GATE VALVE)

DWN. BY J.DAIGLE	DATE JAN. 2004	REV. No. 4		DWG. No. S045–102
CHECKED BY	SCALE N.T.S.	DATE FEB 2018		

CHAMBER DIA.	BASE PAD SIZE (LxWxT)
1050,1200	1500x400x200
1500,1800,2100	2400x300x200
2400,3000,3600	3500x1000x300

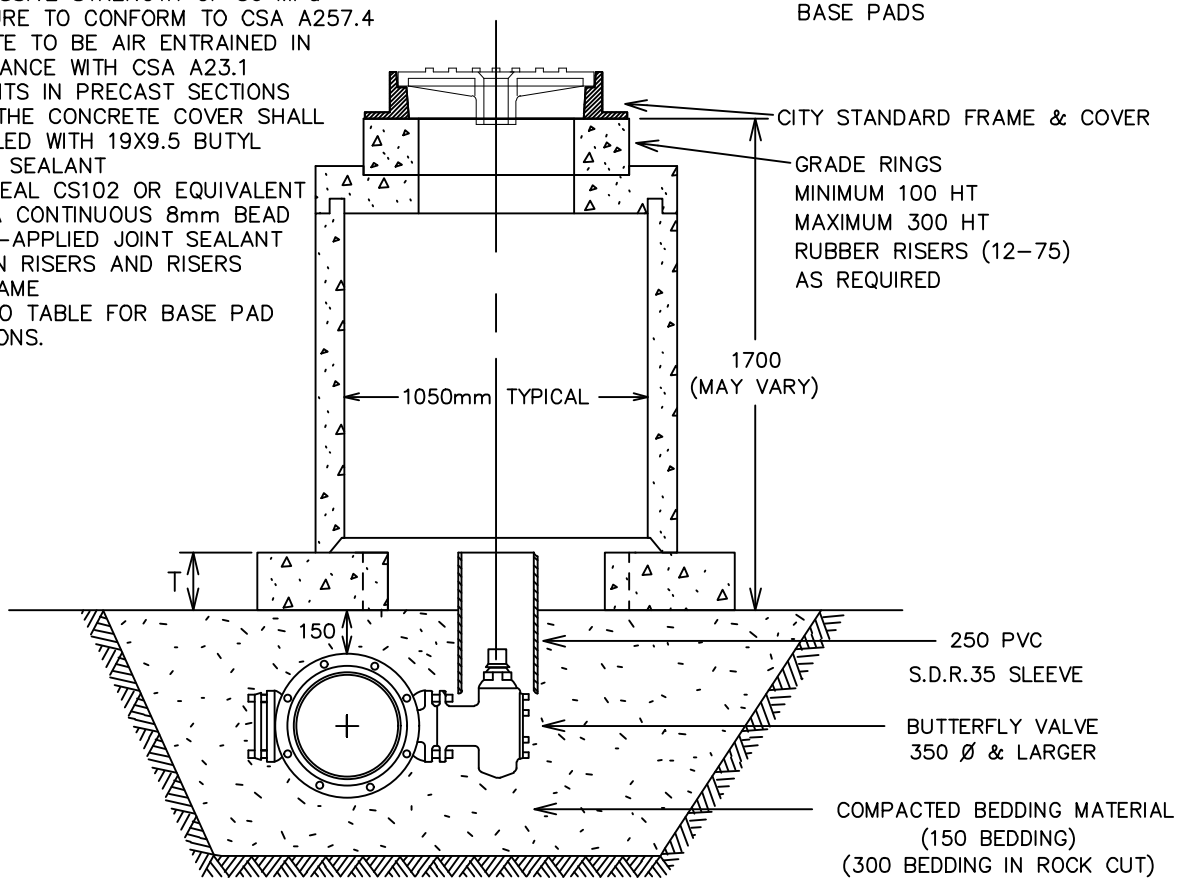


PLAN

INSTALL POLYETHYLENE SANDBAGS TO PREVENT SLOUGHING AROUND BASE PADS

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. BASE PADS SHALL BE CONCRETE WITH A COMPRESSIVE STRENGTH OF 30 MPa
3. STRUCTURE TO CONFORM TO CSA A257.4
4. CONCRETE TO BE AIR ENTRAINED IN ACCORDANCE WITH CSA A23.1
5. ALL JOINTS IN PRECAST SECTIONS BELOW THE CONCRETE COVER SHALL BE SEALED WITH 19X9.5 BUTYL RUBBER SEALANT – CONSEAL CS102 OR EQUIVALENT
6. APPLY A CONTINUOUS 8mm BEAD OFCOLD–APPLIED JOINT SEALANT BETWEEN RISERS AND RISERS AND FRAME
7. REFER TO TABLE FOR BASE PAD DIMENSIONS.

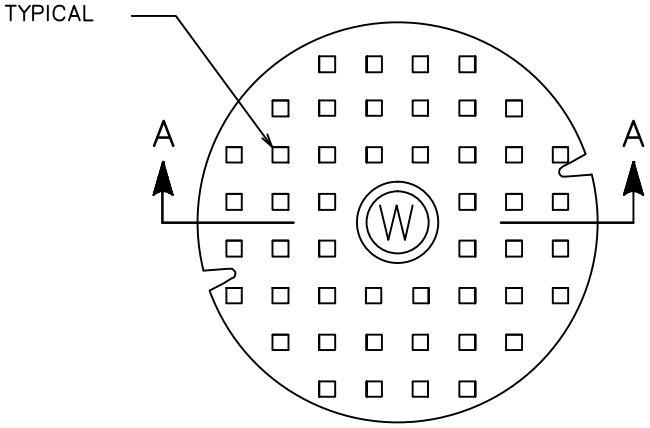


SECTION

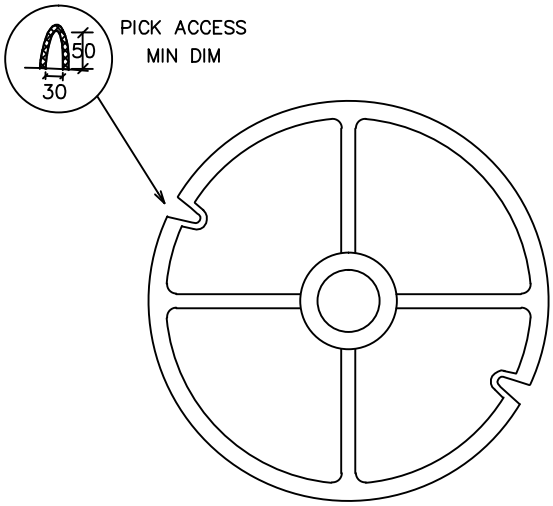
City of Saint John

VALVE CHAMBER DETAIL (BUTTERFLY VALVE)

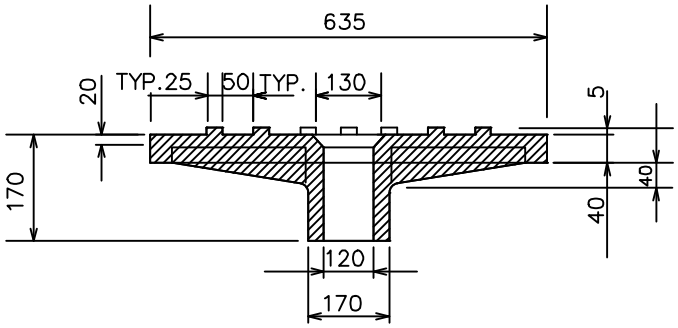
DWN. BY J. DAIGLE	DATE JAN. 2004	REV. No. 4		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE FEB. 2018		S045–103



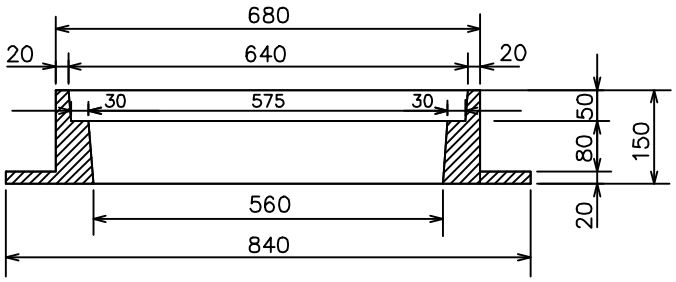
COVER – TOP VIEW



COVER – BOTTOM VIEW



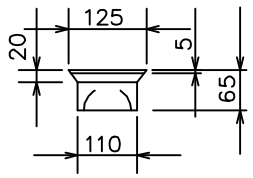
COVER SECTION A–A



FRAME SECTION

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. MATERIAL–CAST IRON TO ASTM A48, CLASS 30 B
3. FRAME AS PER STANDARD DRAWING S045–207
4. MASS OF COVER: 70 kg

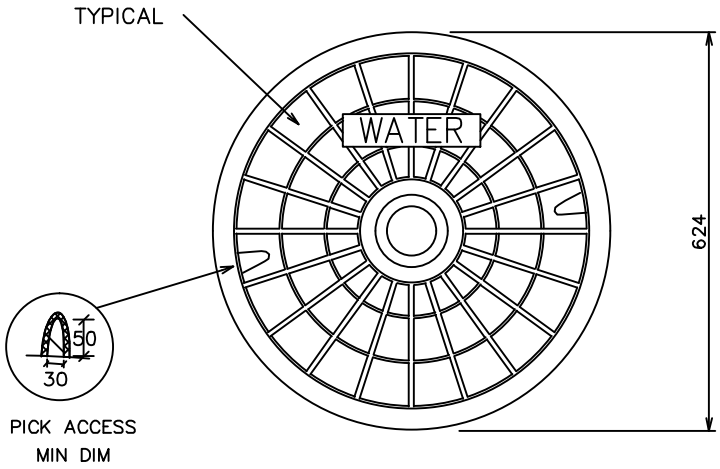


PLUG

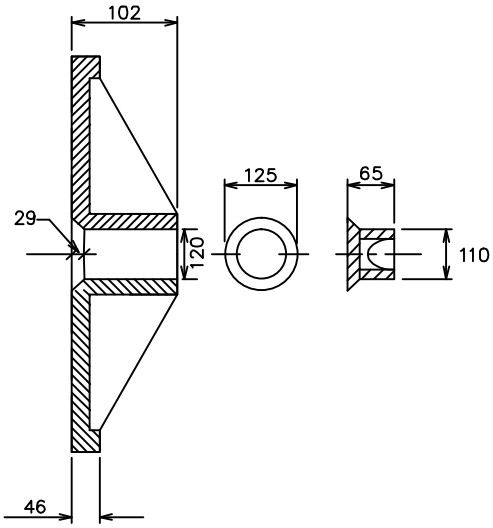
City of Saint John

STANDARD VALVE CHAMBER COVER (GATE AND BUTTERFLY VALVES)

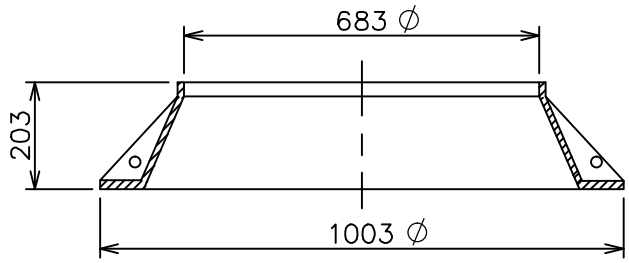
DWN. BY J GRANGER	DATE JAN. 2004	REV. No. 1	DWG. No. S045–104
CHECKED BY	SCALE N.T.S.	DATE JAN 2007	



COVER – TOP VIEW

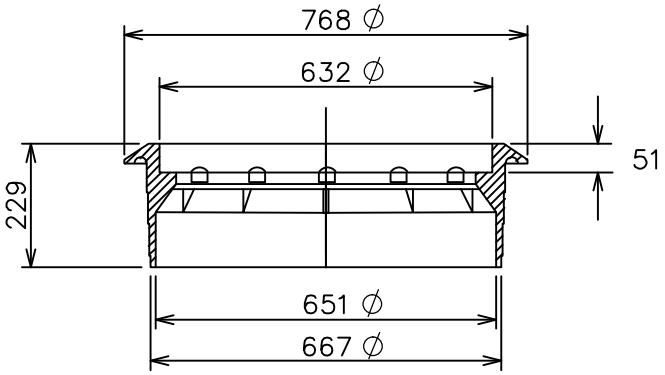


COVER – SIDE VIEW



CONICAL GUIDE

624mm
62 kg
GRAY IRON
ASTM A48 CLASS 30



FRAME

624mm
76 kg
DUCTILE IRON
ASTM A536 65–45–12

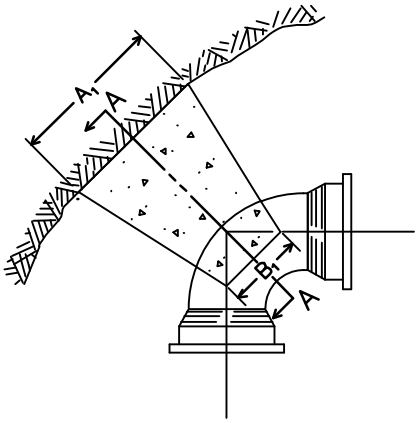
NOTES:

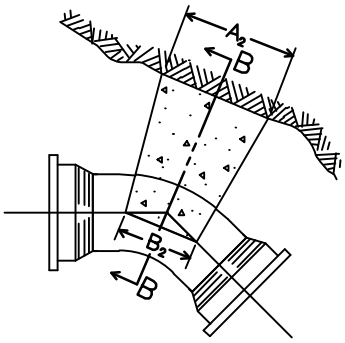
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. MATERIAL–CAST IRON TO ASTM A48, CLASS 30
3. MASS OF FRAME 76 kg
4. MASS OF COVER: 86 kg

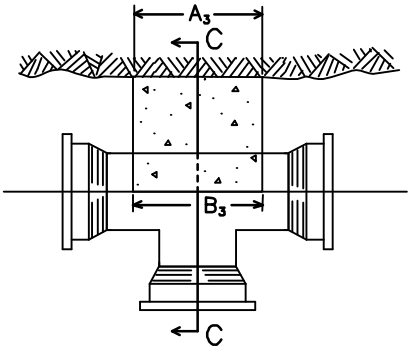
City of Saint John

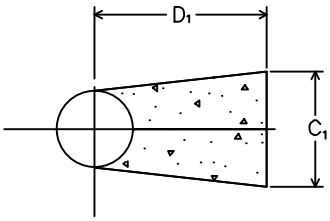
ADJUSTABLE VALVE CHAMBER FRAME & COVER (GATE AND BUTTERFLY VALVES)

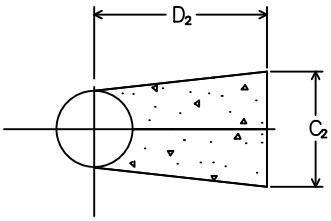
DWN. BY J. GRANGER	DATE JAN. 2006	REV. No. 2		DWG. No. S045–104A
CHECKED BY	SCALE N.T.S.	DATE JAN 2011		

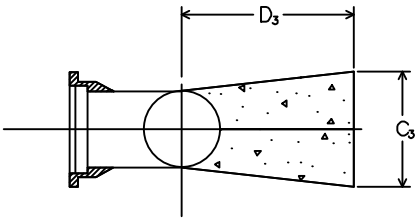












SECTION A–A

TYPE 1

60° TO 90° BENDS

SECTION B–B

TYPE 2

45° OR SMALLER BENDS

SECTION C–C

TYPE 3

TEES & DEAD ENDS

NOTE:

1. DIMENSIONS FOR THE ABOVE ARE SHOWN ON STANDARD DRAWING S045–106
2. WRAP FITTING WITH 8 MIL THICK POLYETHYLENE PRIOR TO POURING THRUST BLOCK

City of Saint John

HORIZONTAL THRUST BLOCKS

DWN. BY J. WELLS	DATE JAN. 2004	REV. No. 1		DWG. No. S045–105
CHECKED BY	SCALE N.T.S	DATE JAN. 2011		

SOIL: SOFT AND VERY SOFT BEARING VALUE 72 kPa TO 144 kPa

PIPE	60° TO 90° BENDS				45° OR SMALLER BENDS				TEES & DEAD ENDS			
DIA	A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	C3	D3
100	700	150	300	450	350	150	300	450	700	700	300	450
150	1050	150	450	450	525	150	450	450	1050	1050	450	450
200	1100	200	750	450	550	200	750	450	1100	1100	750	450
250	1200	250	1050	450	625	250	1050	450	1200	1200	1050	450

300 AND LARGER PIPE SIZES REQUIRE SPECIAL DESIGN OF PIPE ANCHORAGE

SOIL: MEDIUM BEARING VALUE 144 kPa TO 240 kPa

PIPE	60° TO 90° BENDS				45° OR SMALLER BENDS				TEES & DEAD ENDS			
DIA	A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	C3	D3
100	450	150	150	450	250	150	150	450	450	450	150	450
150	500	150	300	450	300	150	250	450	500	500	300	450
200	600	200	450	450	450	200	300	450	600	600	450	450
250	750	250	600	450	500	250	400	450	750	750	600	450
300	800	300	750	450	600	300	450	450	800	800	750	450
350	1050	350	900	450	750	350	600	450	1050	1050	900	450
400	1200	400	1050	450	800	400	750	450	1200	1200	1050	450

450 AND LARGER PIPE SIZES REQUIRE SPECIAL DESIGN OF PIPE ANCHORAGE

SOIL: HARD BEARING VALUE 240 kPa AND GREATER

PIPE	60° TO 90° BENDS				45° OR SMALLER BENDS				TEES & DEAD ENDS			
DIA	A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	C3	D3
100	300	150	150	450	200	150	150	450	300	300	150	450
150	450	150	225	450	250	150	150	450	450	450	225	450
200	600	200	300	450	300	200	150	450	600	600	300	450
250	750	250	400	450	450	250	225	450	750	750	400	450
300	800	300	450	450	600	300	300	450	800	800	450	450
350	850	350	600	450	750	350	400	450	850	850	600	450
400	1000	400	700	450	800	400	450	450	1000	1000	700	450
450	1050	450	800	525	850	450	600	525	1050	1050	800	525
500	1200	500	850	550	1000	500	700	550	1200	1200	850	550
600	1500	600	1150	600	1050	600	800	600	1500	1500	1150	600

900 AND LARGER PIPE SIZES REQUIRE SPECIAL DESIGN OF PIPE ANCHORAGE

WHERE:

A = WIDTH AT TRENCH EDGE

B = WIDTH AT PIPE FITTING

C = HEIGHT AT TRENCH EDGE

D = MINIMUM DISTANCE OF TRENCH TO PIPE FITTING

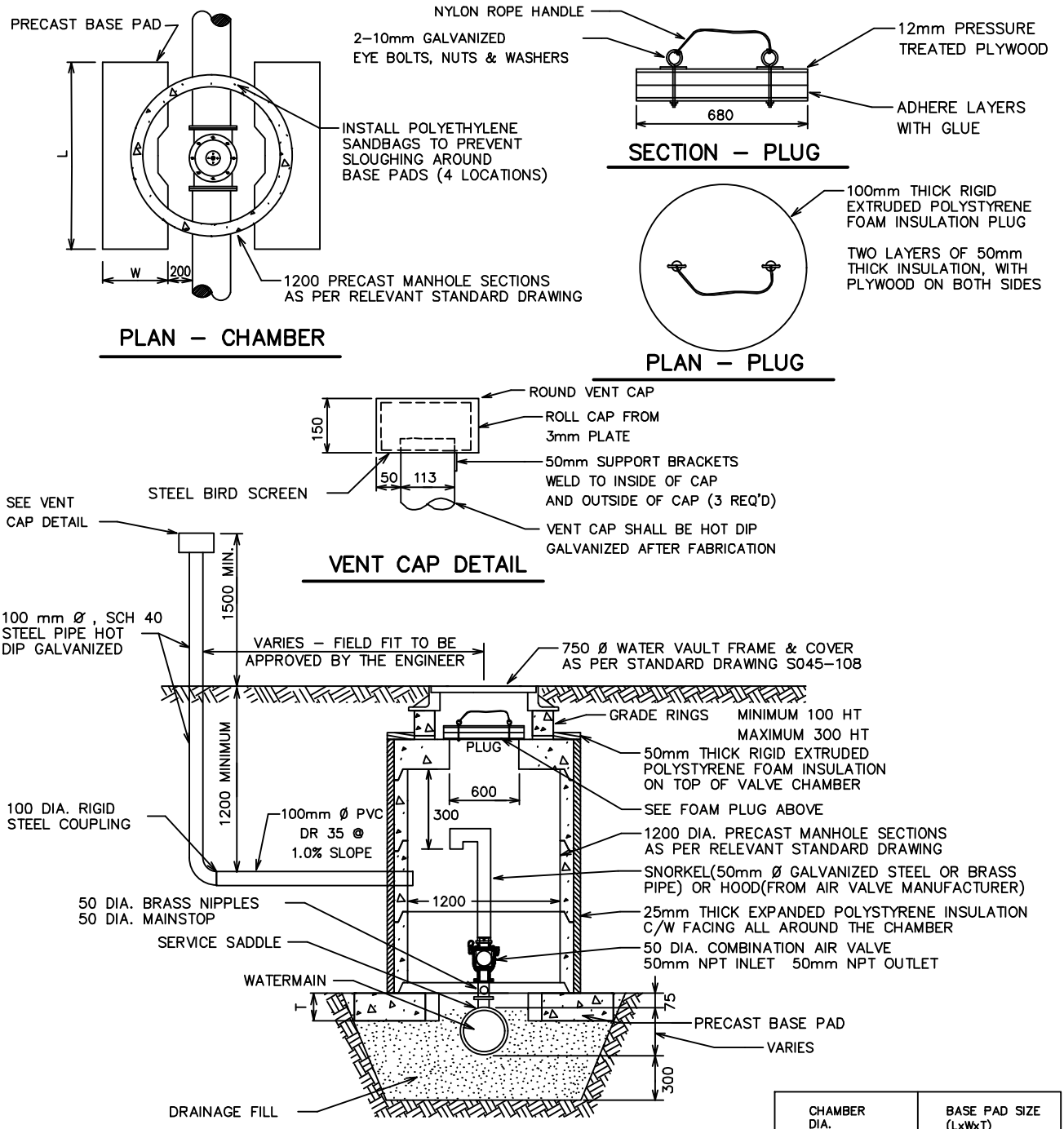
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL THRUST BLOCK DIMENSIONS TO BE APPROVED BY THE ENGINEER
3. THE BACK OF THRUST BLOCKS SHALL REST AGAINST UNDISTURBED SOIL
4. IF UNDISTURBED SOIL CANNOT BE REACHED BY USING THE "D" MEASUREMENTS THEN THE CONTRACTOR SHALL INCREASE THEM TO DO SO

City of Saint John

HORIZONTAL THRUST BLOCK DIMENSIONS

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No.		DWG. No. S045–106
CHECKED BY	SCALE N.T.S.	DATE		



CHAMBER DIA.	BASE PAD SIZE (LxWxT)
1050,1200	1500x400x200
1500,1800,2100	2400x300x200
2400,3000,3600	3500x1000x300

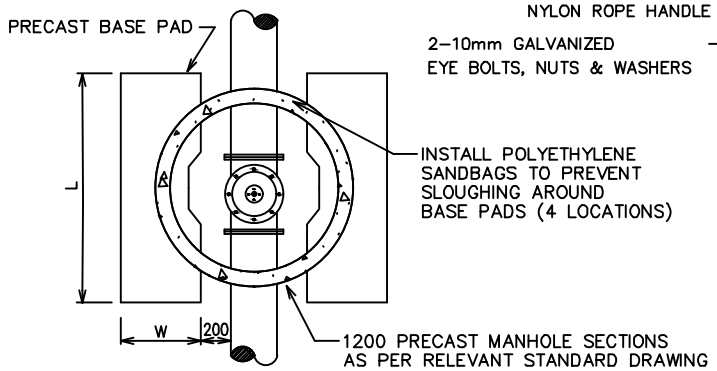
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. REFER TO SECTION 10.4.20 – INSULATION, FOR APPROVED TYPES OF INSULATION.
3. ALL JOINTS IN THE PRECAST SECTIONS BELOW THE CONCRETE COVER SHALL BE SEALED WITH 19x9.5 BUTYL RUBBER SEALANT – CONSEAL CS102 OR EQUIVALENT
4. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT BETWEEN RISERS AND RISERS AND FRAME.

City of Saint John

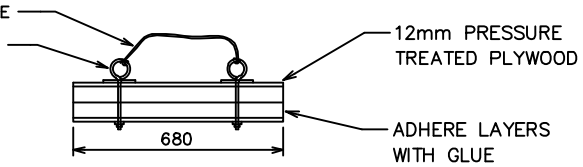
AIR VALVE CHAMBER DETAIL

(STANDARD FRAME & COVER)

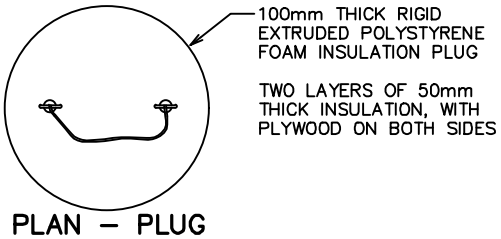
DWN. BY J.D.	DATE APR. 2018	REV. No. 8		DWG. No. S045–107
CHECKED BY	SCALE N.T.S	DATE 2018		



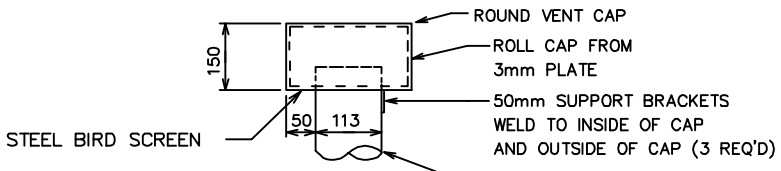
PLAN – CHAMBER



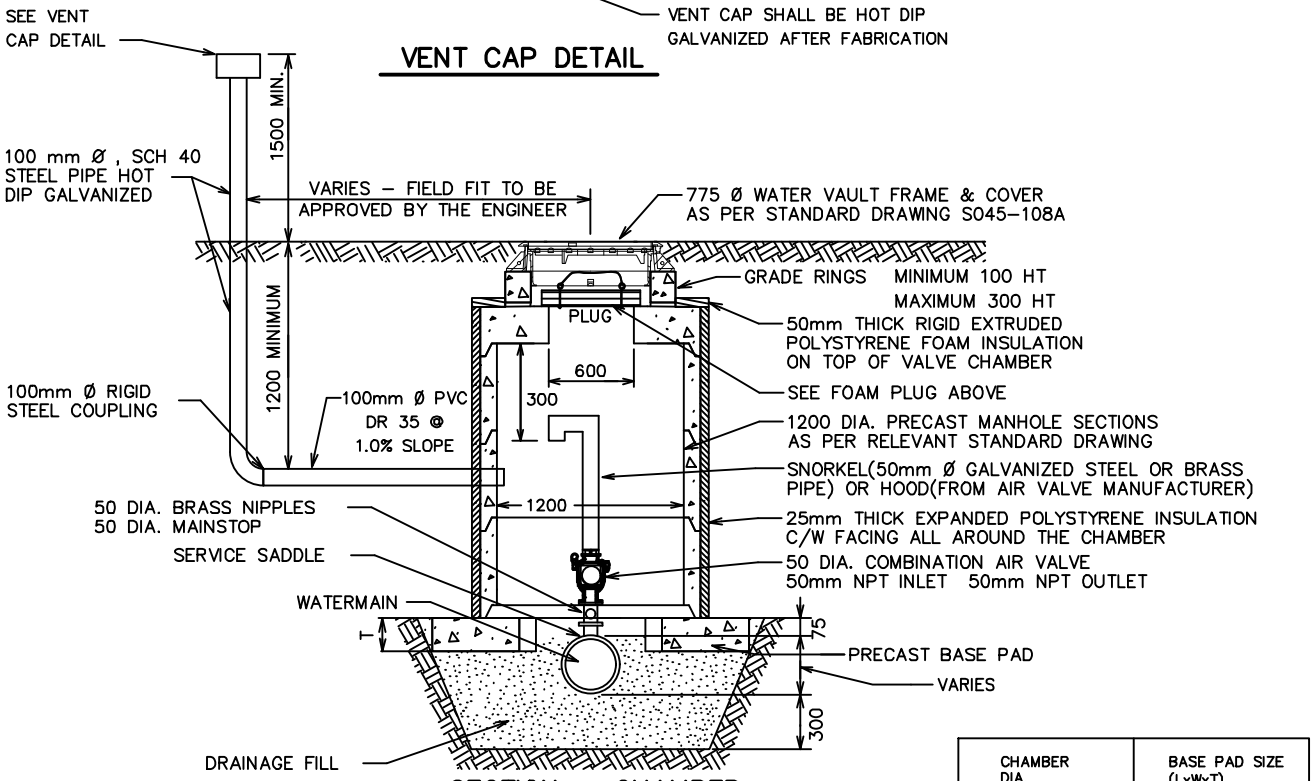
SECTION – PLUG



PLAN – PLUG



VENT CAP DETAIL



SECTION – CHAMBER

CHAMBER DIA.	BASE PAD SIZE (LxWxT)
1050,1200	1500x400x200
1500,1800,2100	2400x300x200
2400,3000,3600	3500x1000x300

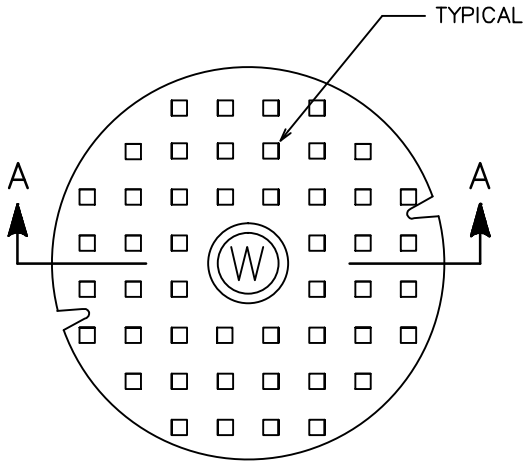
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. REFER TO SECTION 10.4.20 – INSULATION, FOR APPROVED TYPES OF INSULATION.
3. ALL JOINTS IN THE PRECAST SECTIONS BELOW THE CONCRETE COVER SHALL BE SEALED WITH 19x9.5 BUTYL RUBBER SEALANT – CONSEAL CS102 OR EQUIVALENT
4. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT BETWEEN RISERS AND RISERS AND FRAME.

City of Saint John

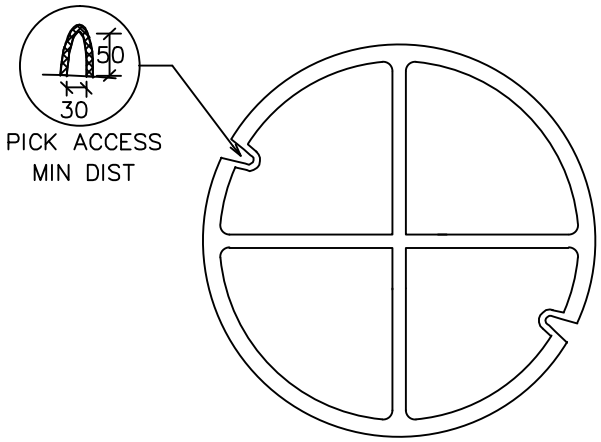
AIR VALVE CHAMBER DETAIL

(ADJUSTABLE FRAME & COVER)

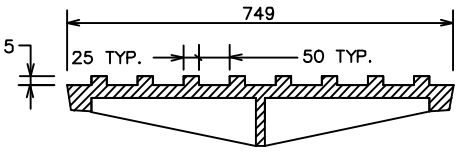
DWN. BY J.D.	DATE APR. 2018	REV. No. 6		DWG. No. S045–107A
CHECKED BY	SCALE N.T.S	DATE APR. 2018		



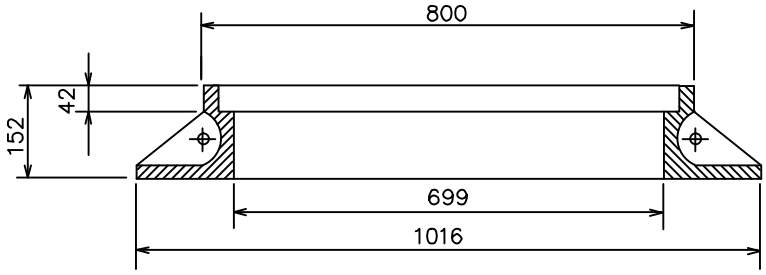
COVER–TOP VIEW



COVER–BOTTOM VIEW



COVER SECTION A–A



FRAME SECTION

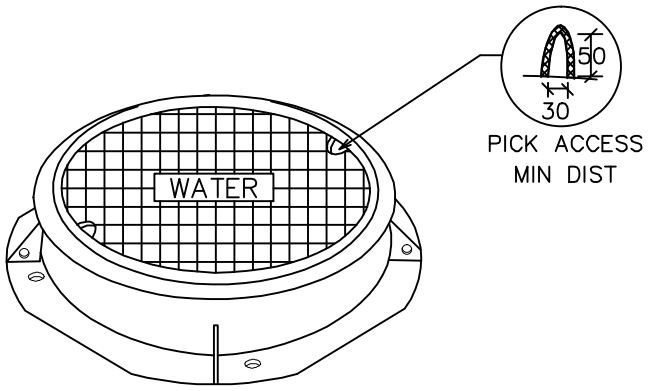
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. MATERIAL–CAST IRON TO ASTM A48, CLASS 30 B
3. MASS OF COVER : +/– 104 kg
4. MASS OF FRAME : +/– 132 kg

City of Saint John

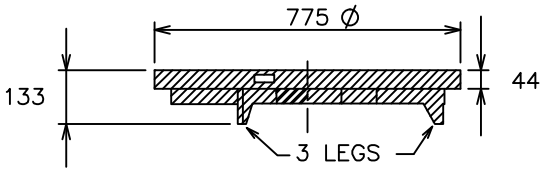
STANDARD AIR VALVE CHAMBER COVER (750 Ø)

DWN. BY JAM	DATE JAN. 2004	REV. No. 1		DWG. No. S045–108
CHECKED BY	SCALE N.T.S.	DATE JAN 2007		



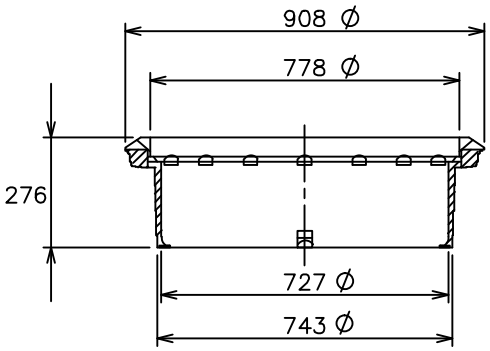
COVER

775mm
85kg
DUCTILE IRON
ASTM A536 65–45–12



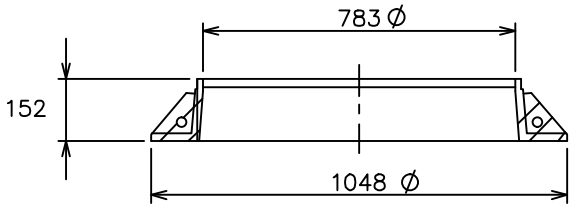
FRAME

775mm
93kg
DUCTILE IRON
ASTM A536 65–45–12



CONICAL GUIDE

775mm
64kg
GRAY IRON
ASTM A48 CLASS 30

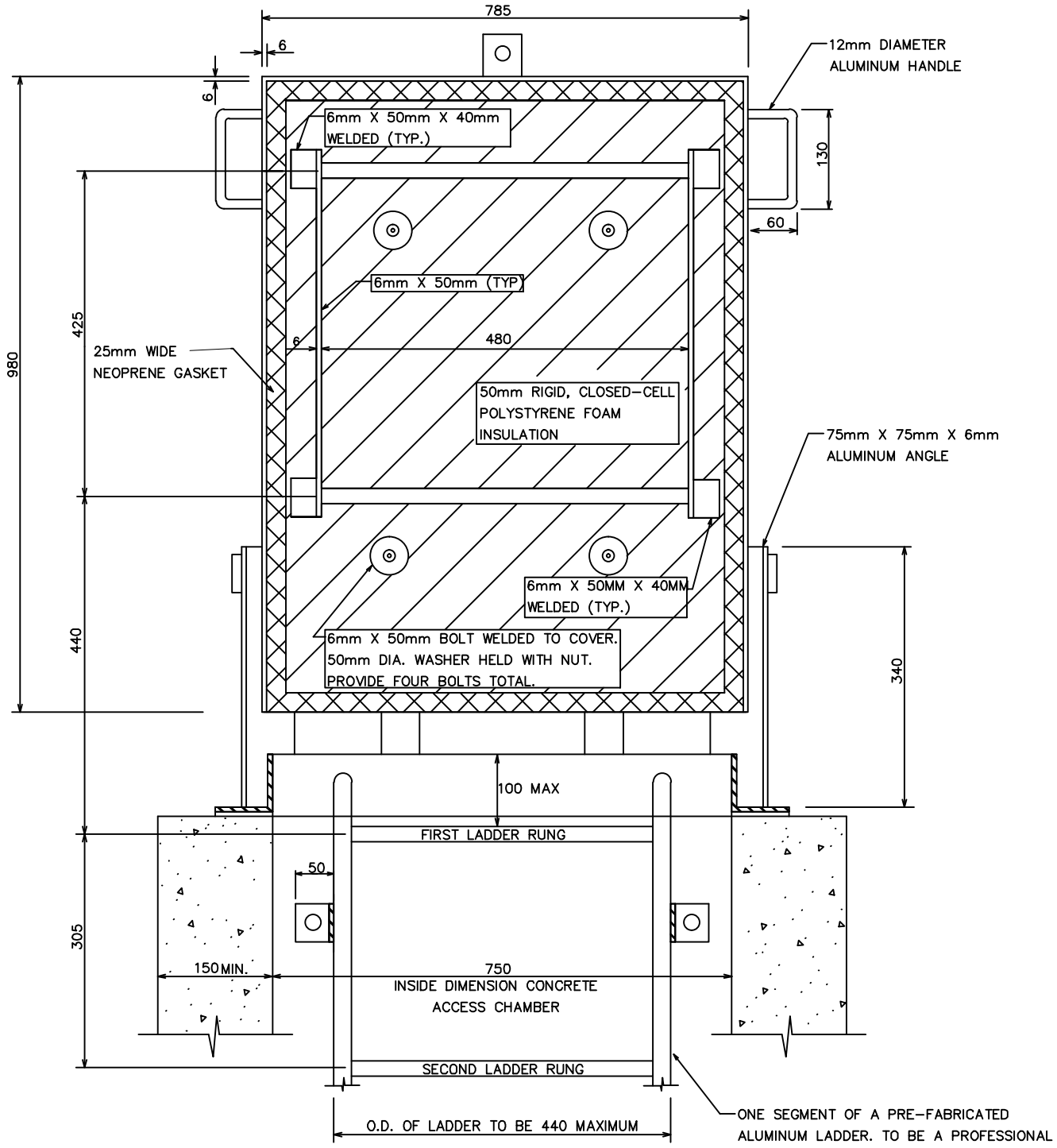


NOTES:
1) ALL DIMENSIONS ARE IN MILLIMETRES
2) TOTAL WEIGHT 242kg

City of Saint John

ADJUSTABLE AIR VALVE CHAMBER FRAME & COVER (775 Ø)

DWN. BY P.WOODHOUSE	DATE JAN. 2006	REV. No. 1		DWG. No. S045–108A
CHECKED BY	SCALE N.T.S.	DATE JAN 2007		



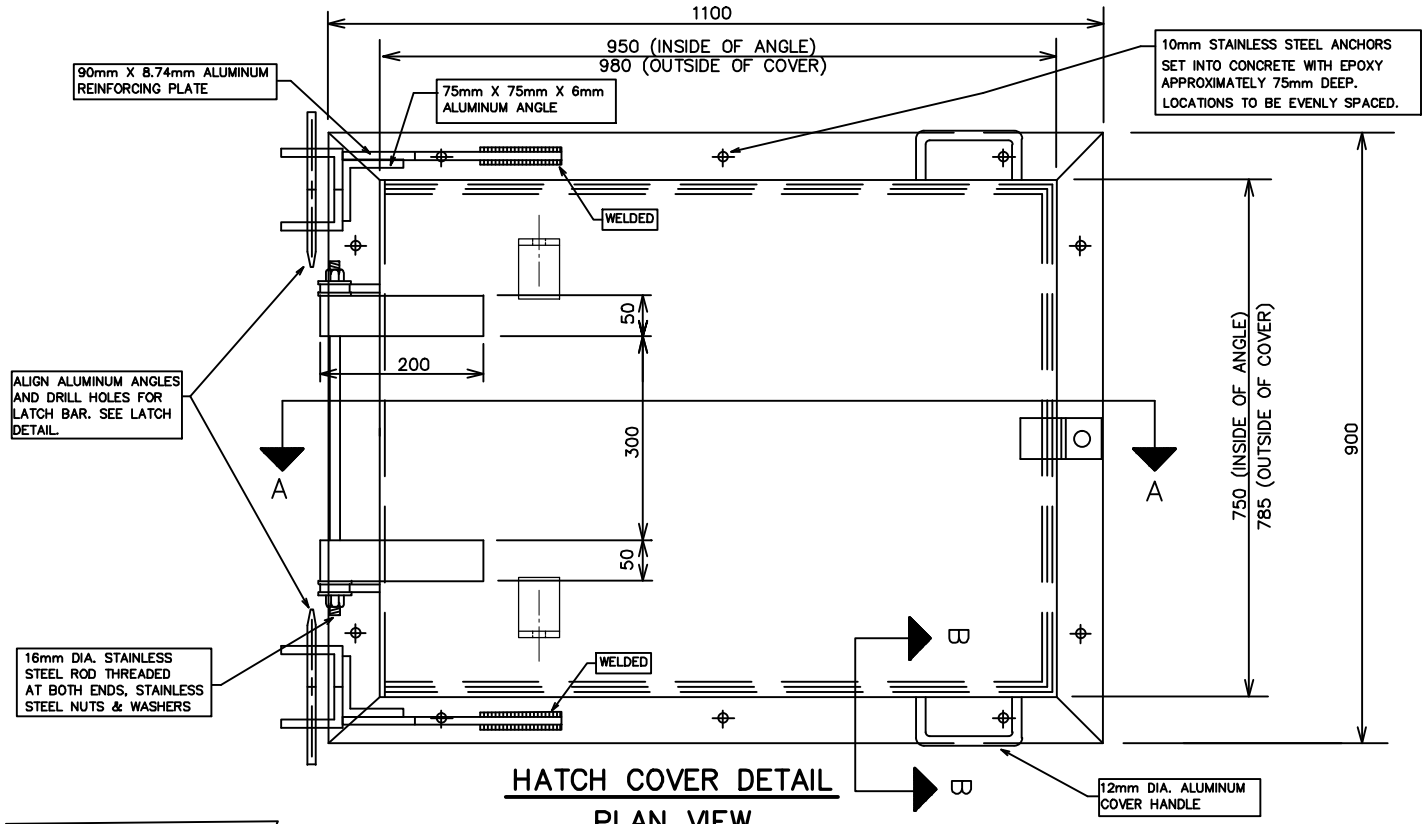
HATCH COVER DETAIL
INSIDE VIEW

NOTE:
1. REFER TO STANDARD DRAWINGS S045-010 & S045-111 FOR ADDITIONAL INFORMATION

City of Saint John

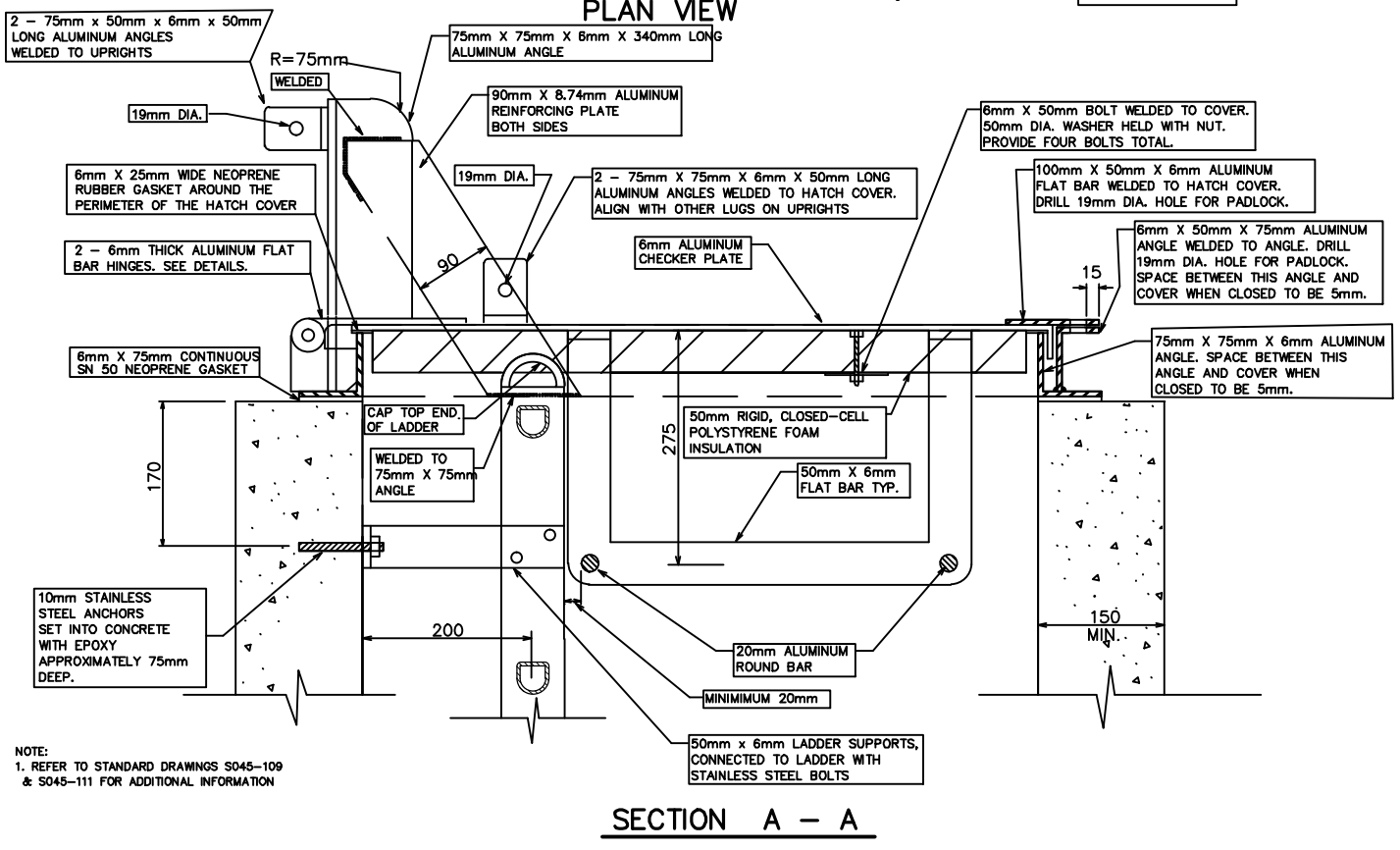
STANDARD ALUMINUM HATCH COVER

DWN. BY P.W	DATE JAN. 2004	REV. No. 1		DWG. No. S045-109
CHECKED BY	SCALE N.T.S	DATE FEB. 2005		



HATCH COVER DETAIL

PLAN VIEW



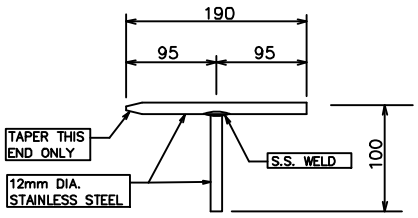
NOTE:
1. REFER TO STANDARD DRAWINGS S045-109 & S045-111 FOR ADDITIONAL INFORMATION

SECTION A – A

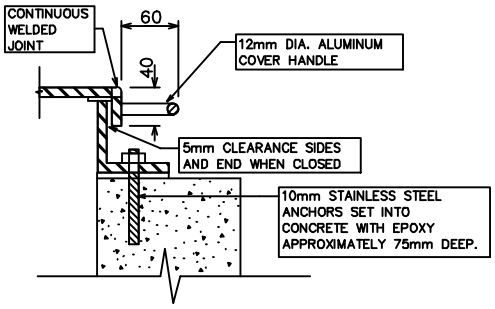
City of Saint John

STANDARD ALUMINUM HATCH COVER

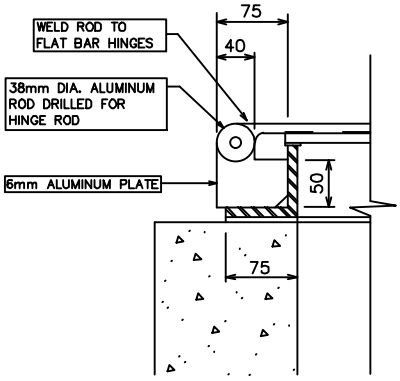
DWN. BY P.W	DATE JAN. 2004	REV. No. 1		DWG. No. S045-110
CHECKED BY	SCALE N.T.S	DATE FEB. 2005		



LATCH BAR DETAIL



SECTION B – B



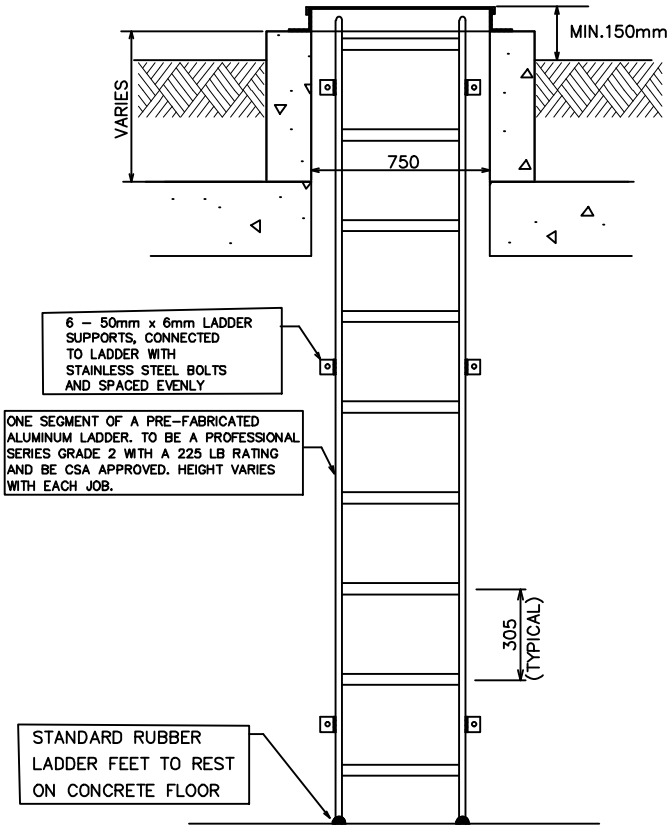
HINGE DETAIL

NOTES:

1. THIS HATCH DESIGN IS INTENDED FOR USE IN UNDERGROUND WATER BOOSTER AND P.R.V. CHAMBERS. IF USED FOR SEWAGE WET WELLS, THE LADDER AND THE GRAB BARS ARE TO BE DELETED. CONFIRM THE OVERALL SIZE OF OPENING FOR EXTRACTION OF SEWAGE PUMPS AND ADJUST DIMENSIONS AS REQUIRED
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED
3. GAS SPRINGS, IF REQUESTED, SHALL BE 316 STAINLESS STEEL
4. REFER TO STANDARD DRAWINGS S045–109 & S045–110 FOR ADDITIONAL INFORMATION

ALUMINUM NOTES

1. ALL ALUMINUM WELDING TO BE IN ACCORDANCE WITH CSA W59.2–M1991 "WELDED ALUMINUM CONSTRUCTION" ALL ALUMINUM WELDING BY CONTRACTOR SHALL BE CERTIFIED TO W47.2–M1987 "CERTIFICATION OF COMPANIES FOR FUSION WELDING OF ALUMINUM"
2. ALL ALUMINUM TO BE 6061 – T6
3. ALL ALUMINUM SURFACES IN CONTACT WITH CONCRETE SHALL RECEIVE 2 COATS OF BITUMINOUS PAINT, OR A NEOPRENE GASKET



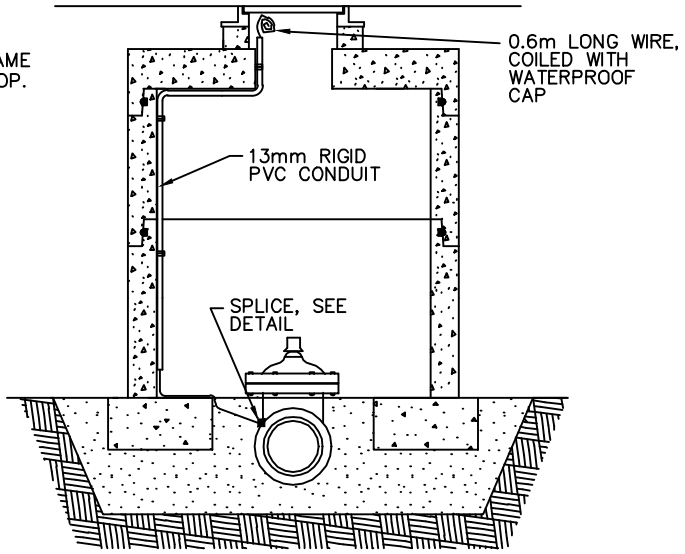
LADDER DETAIL

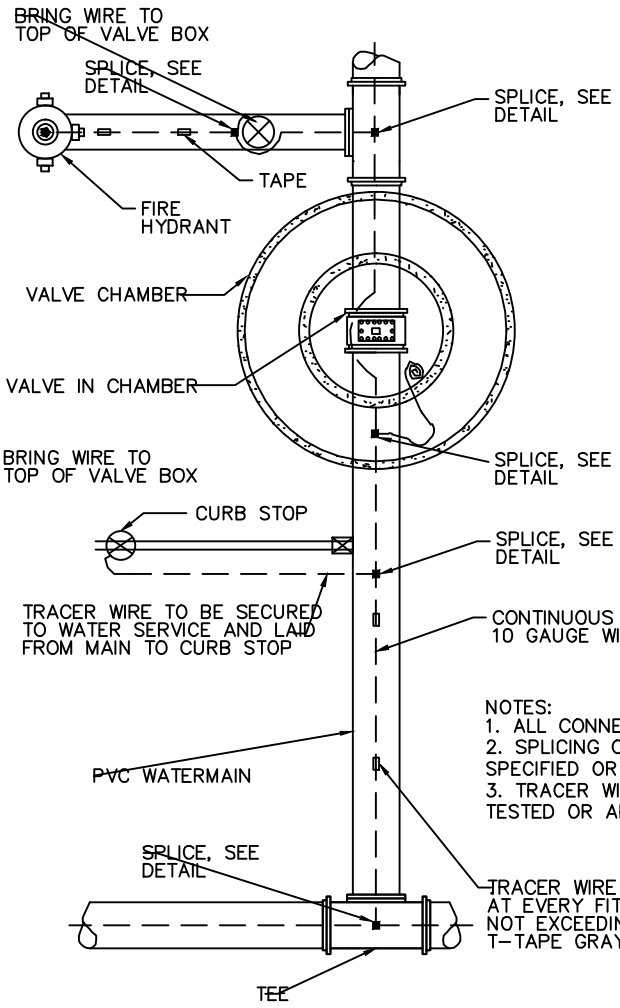
City of Saint John

STANDARD ALUMINUM HATCH COVER

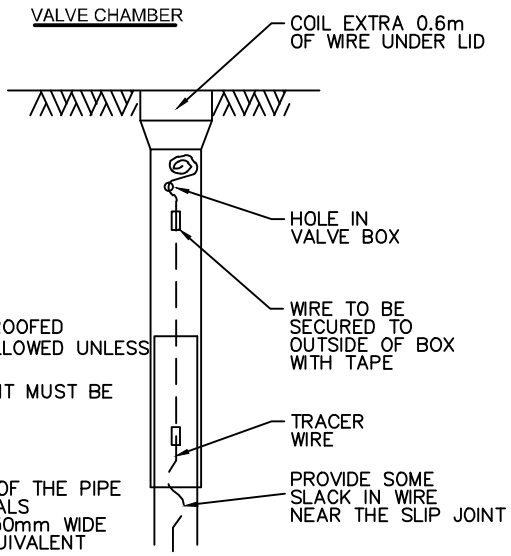
DWN. BY P.W	DATE JAN. 2004	REV. No. 2		DWG. No. S045–111
CHECKED BY	SCALE N.T.S	DATE JAN 2015		

NOTE:
IN ALL GATE VALVE CHAMBERS,
THE WIRE SHALL BE BROUGHT TO THE UNDERSIDE OF THE FRAME AND COVER BY ATTACHING IT TO THE SIDE OF THE CHAMBER. THIS SHALL BE DONE BY USING 13mm RIGID PVC CONDUIT AND CLAMPS FROM THE TOP OF THE WATER MAIN TO THE UNDERSIDE OF THE FRAME & COVER. LEAVE A MINIMUM OF 0.6m OF WIRE EXPOSED AT THE TOP.

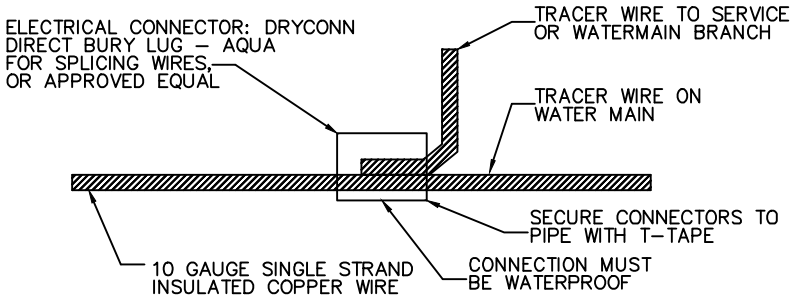




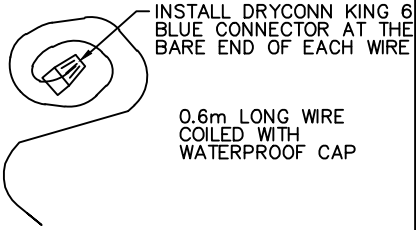
NOTES:
1. ALL CONNECTIONS MUST BE WATERPROOFED
2. SPLICING OF TRACER WIRE IS NOT ALLOWED UNLESS SPECIFIED OR APPROVED
3. TRACER WIRE CONTINUITY OF CURRENT MUST BE TESTED OR APPROVED



VALVE BOXES FOR CURB STOPS & GATE VALVES



SPLICE DETAIL



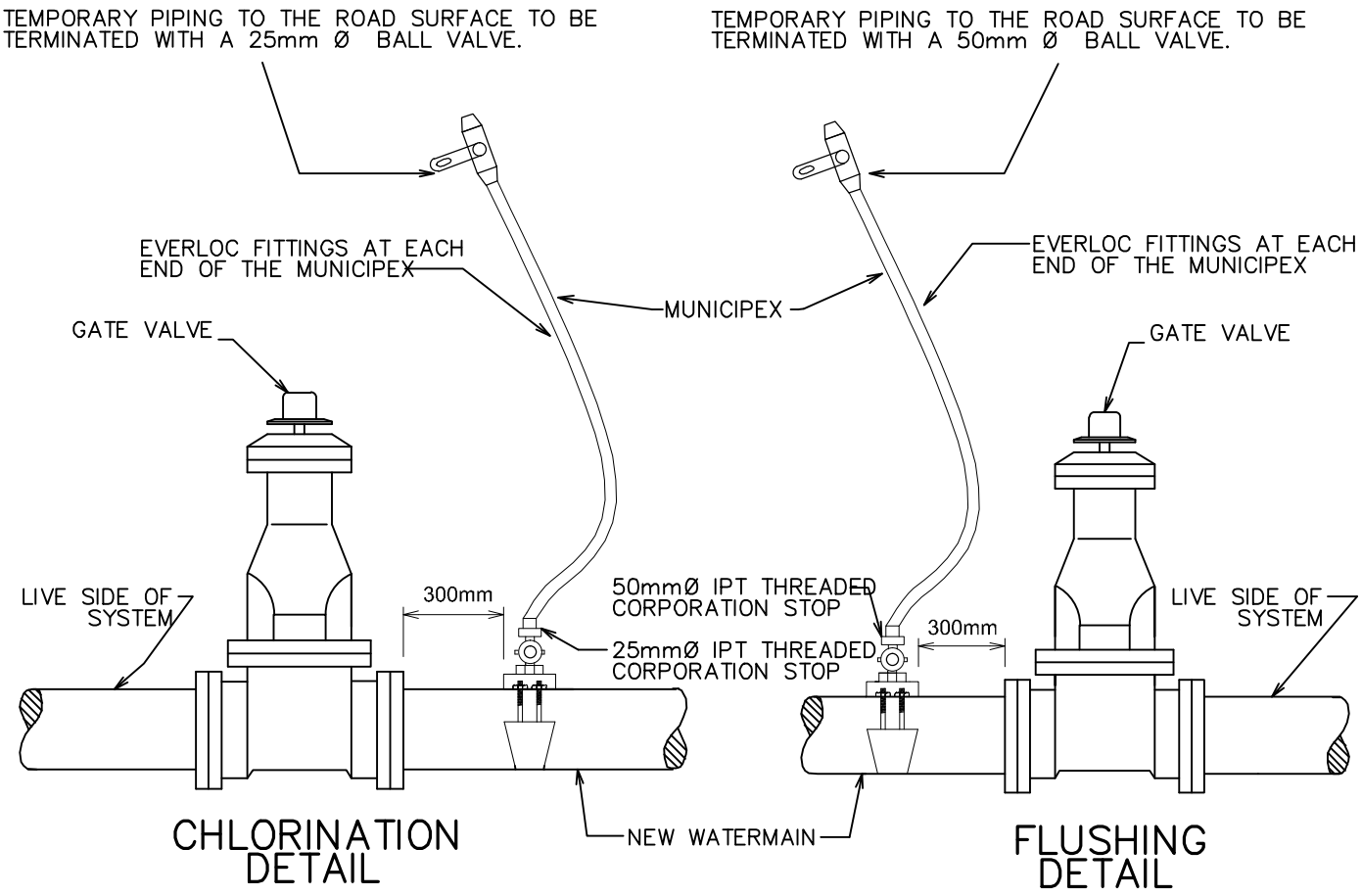
COILED WIRE ENDS

NOTE: ADD 105mm VB WHEN SPACING BETWEEN ANY TWO TEST POINTS EXCEEDS 180m

City of Saint John

TRACER WIRE DETAIL

DWN. BY M. A. M.	DATE JAN 2009	REV. No. 1		DWG. No. S045–116
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		



NOTES:

1. CONTACT SJ WATER TO PRESSURIZE LINE.
2. SUCCESSFUL PRESSURE TEST IS REQUIRED BEFORE CHLORINATION CAN COMMENCE.
3. SJ WATER WILL CHLORINATE AND FLUSH NEW LINES.
4. TWO SUCCESSFUL BACTERIOLOGICAL TESTS ARE REQUIRED BEFORE LINE CAN BE PUT INTO SERVICE.
5. CITY WILL PUT LINE INTO SERVICE.
6. WHEN USING A CHAMBER, IT SHALL BE A MINIMUM 1200mm Ø

City of Saint John

CHLORINATION & FLUSHING DETAILS

DWN. BY : J. WELLS	DATE : JAN 2010	REV. No. 2		DWG. No. S045–118
CHECKED BY :	SCALE : N.T.S.	DATE : FEB 2012		

City of Saint John

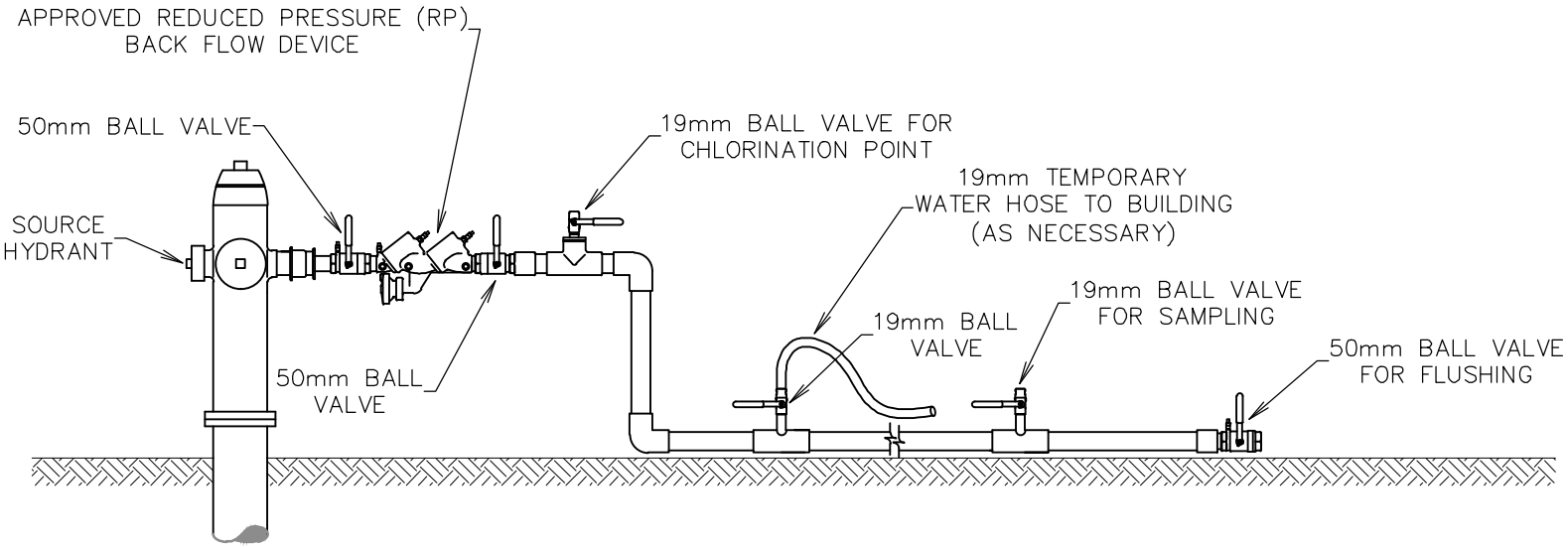
DWN. BY: D. BERUBE | CHECKED BY

DATE AUG. 2015 | SCALE N.T.S

REV. No. | DATE

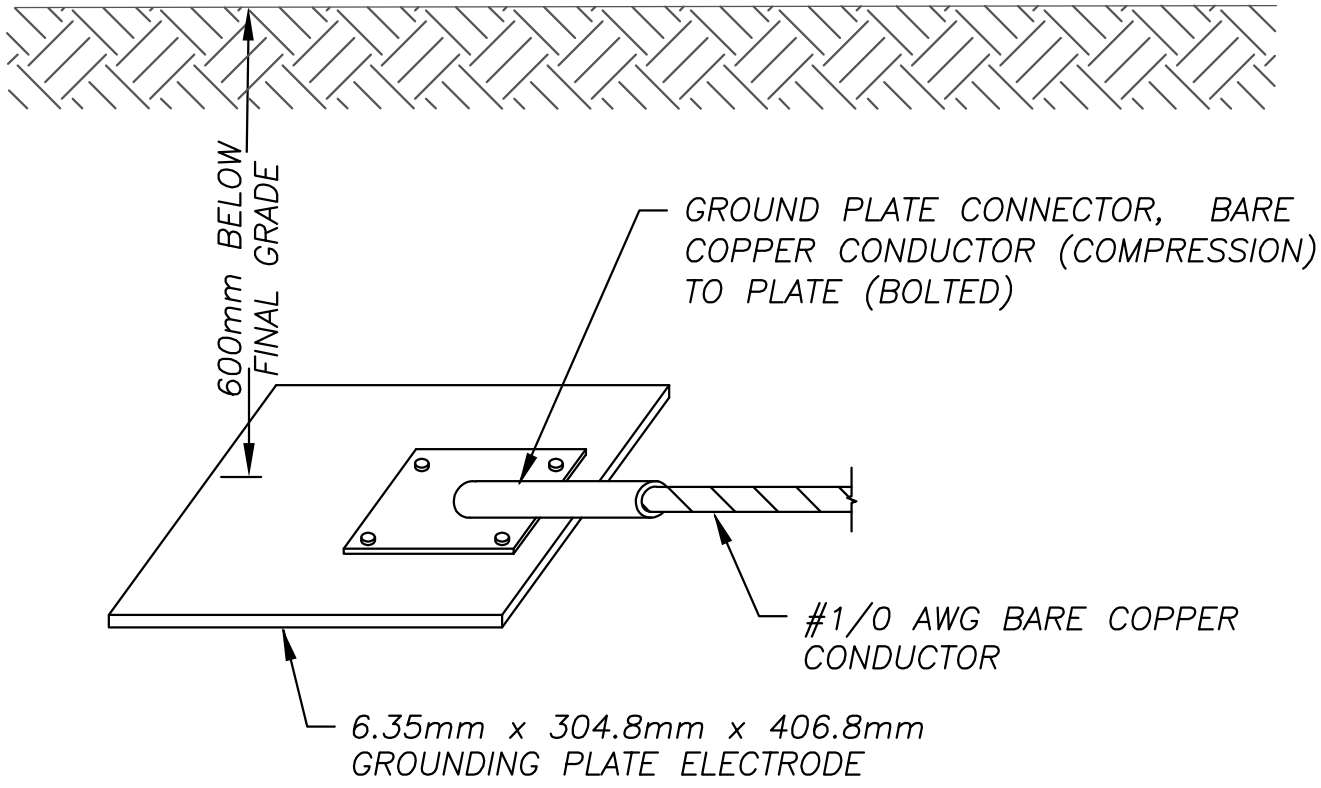
TEMPORARY WATER SUPPLY PIPING DETAILS

DWG. No. S045-119



NOTES:

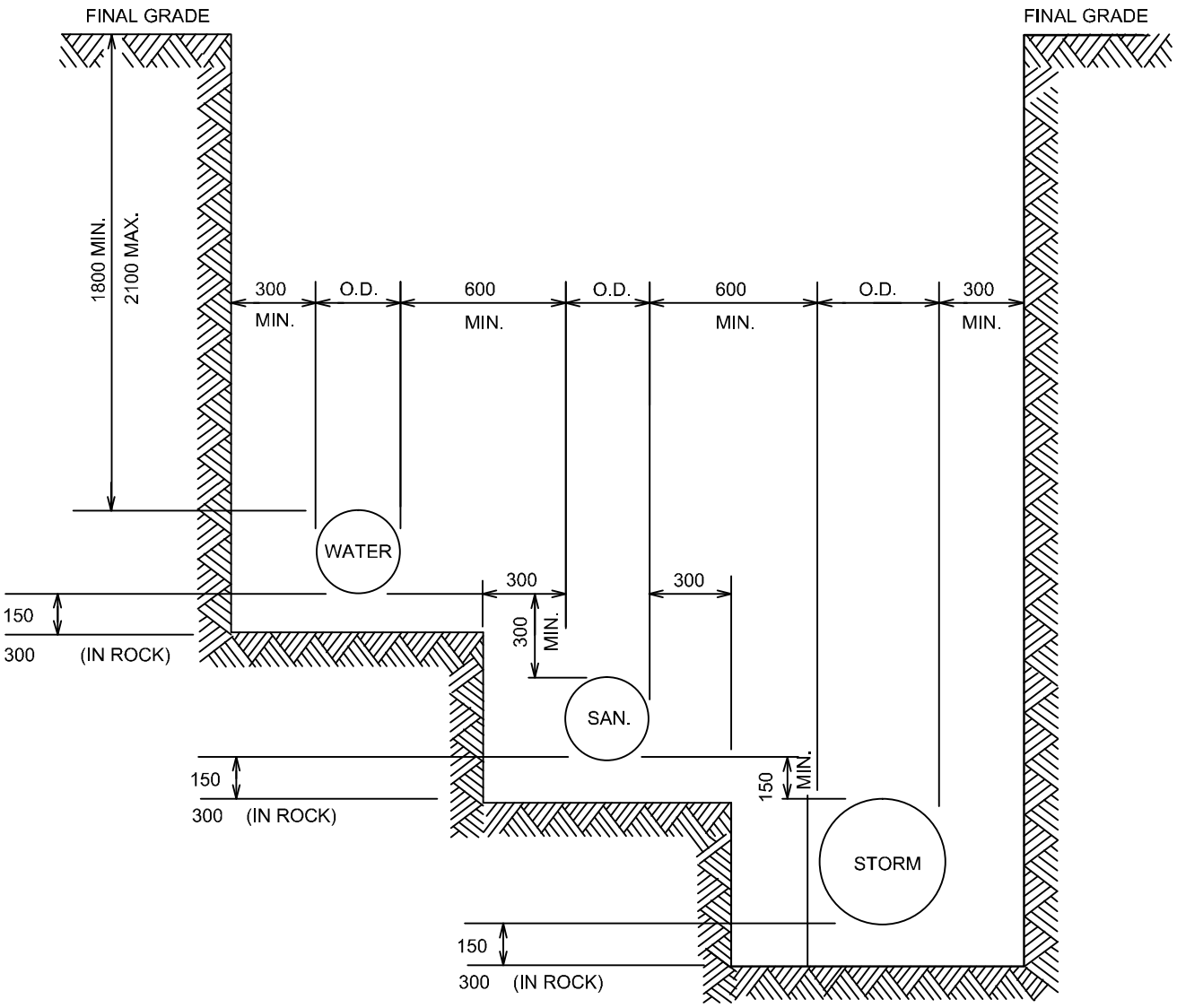
1. ALL PIPING MUST BE ADEQUATELY SUPPORTED AND RESTRAINED FROM MOVEMENT.
2. ALL PIPES, VALVES, FITTINGS ETC., SHALL BE ANSI/NSF 61 APPROVED.



City of Saint John

GROUNDING PLATE DETAIL

DWN. BY J.D.	DATE FEB 15 2022	REV. No. 1		DWG. No. S045–120
CHECKED BY	SCALE N.T.S.	DATE FEB 15 2022		



WATER, SANITARY & STORM: TYPICAL TRENCH

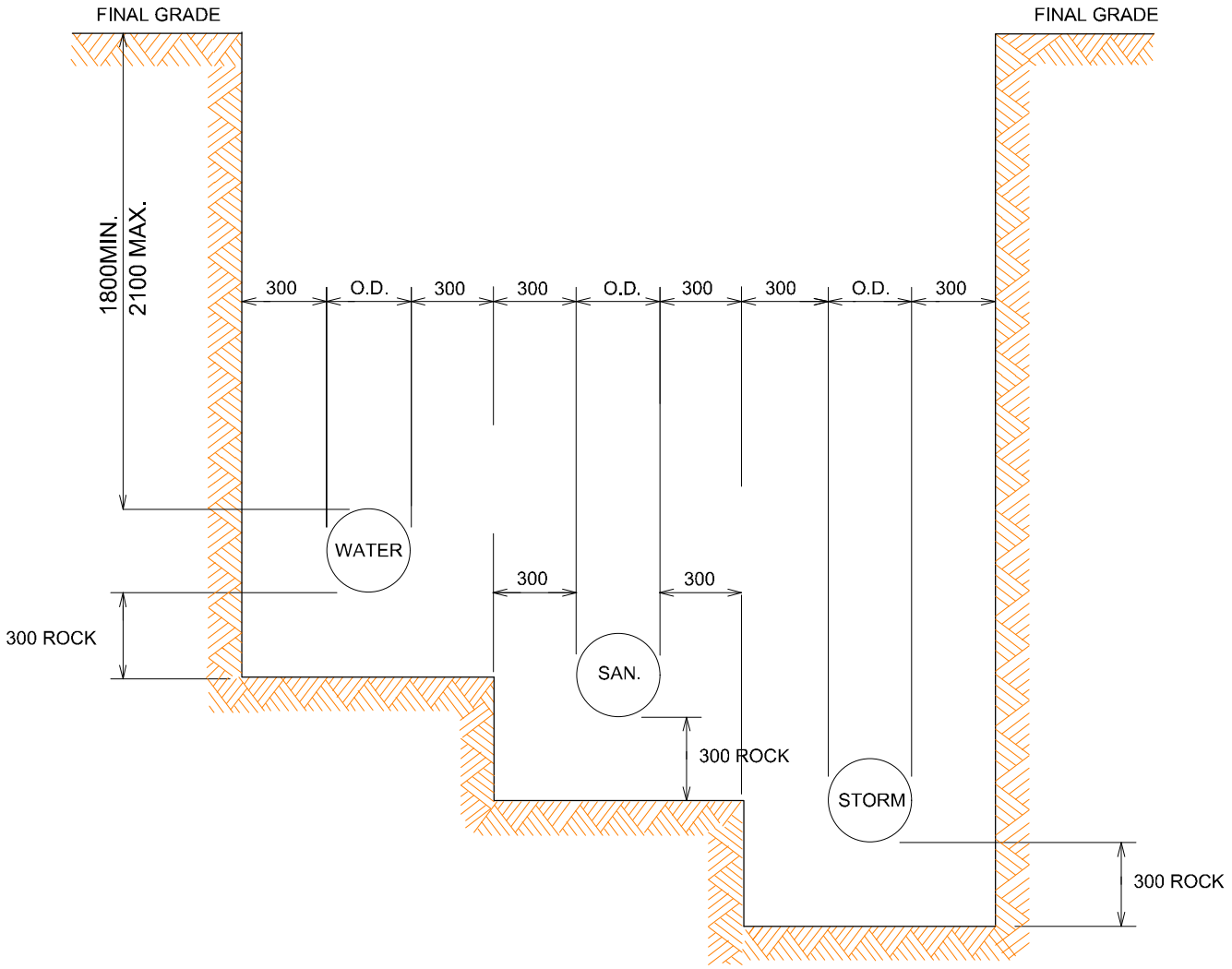
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. VERTICAL & HORIZONTAL CLEARANCE TO CONFORM WITH NB DEPARTMENT OF ENVIRONMENT RULES & REGULATIONS
3. TRENCH SIDES TO BE SHORED OR SLOPED IN ACCORDANCE WITH NB OCCUPATIONAL HEALTH & SAFETY ACT

City of Saint John

TRENCH LAYOUT

DWN. BY J. GRANGER	DATE JAN 2004	REV. No. 2		DWG. No. S045–200
CHECKED BY	SCALE N.T.S.	DATE JAN 2011		



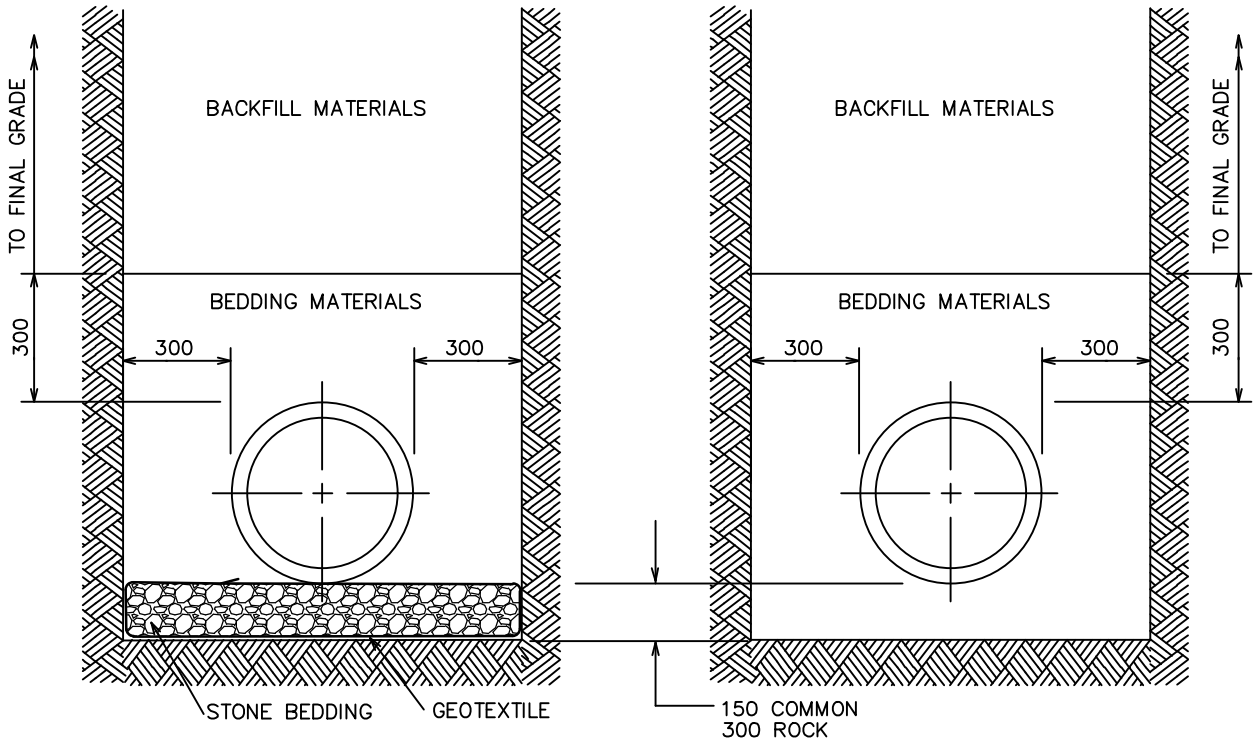
NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. VERTICAL AND HORIZONTAL CLEARANCE TO CONFORM WITH ATLANTIC CANADA GUIDELINES MANUAL FOR WASTEWATER AND WATER.
3. TRENCH SIDES TO BE SHORED OR SLOPED IN ACCORDANCE WITH NB OCCUPATIONAL HEALTH AND SAFETY ACT.

City of Saint John

TRENCH LAYOUT PAYMENT LIMITS (ROCK EXCAVATION)

DWN. BY D. BERUBE	DATE MAY 2018	REV. No. 2		DWG. No. S045–201
CHECKED BY	SCALE N.T.S.	DATE MAY 2018		



TRENCH BEDDING (STONE)

STANDARD TRENCH BEDDING

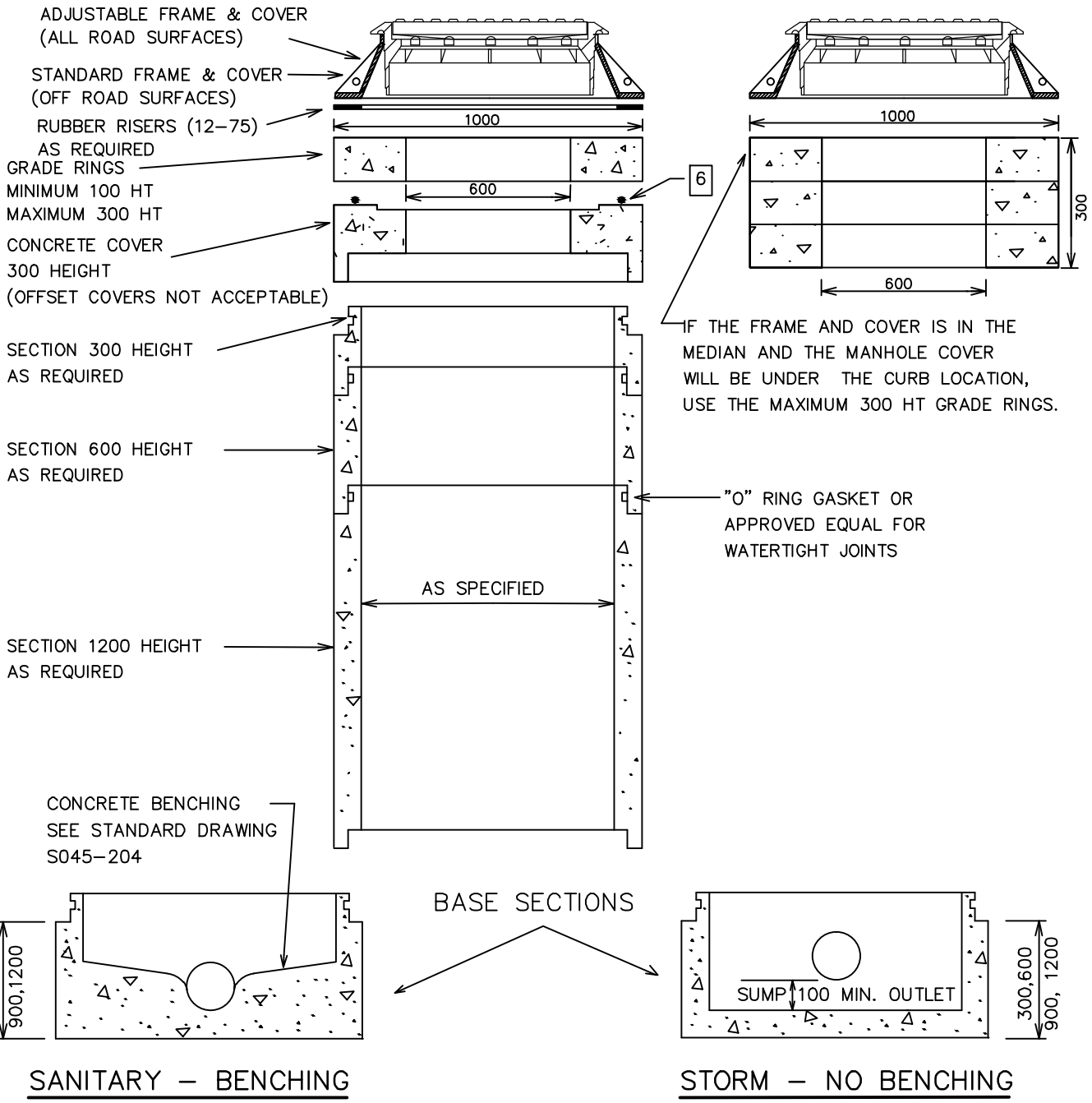
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. FOR ROCK OR OTHER INCOMPRESSABLE MATERIAL, THE TRENCH SHALL BE EXCAVATED A MINIMUM OF 300 mm BELOW THE BARREL OF THE PIPE AND REFILLED WITH APPROVED GRANULAR MATERIAL
3. BEDDING MATERIAL COMPACTED IN 150 mm LAYERS AS PER DIVISION 13
4. BACKFILL MATERIALS TO BE COMPACTED IN 300 mm LAYERS ACCORDING TO CITY SPECIFICATIONS
5. STONE BEDDING MAY BE USED ONLY IF AUTHORIZED BY THE ENGINEER

City of Saint John

TRENCH BEDDING

DWN. BY K. MORRIS	DATE JAN. 2004	REV. No. 1		DWG. No. S045–202
CHECKED BY	SCALE N.T.S.	DATE FEB 2017		



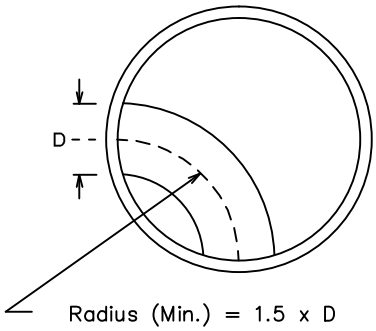
NOTES:

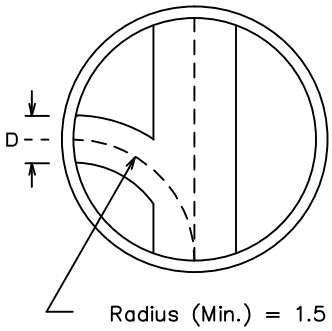
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. STRUCTURE TO CONFORM TO CSA A257.4
3. CONCRETE TO BE AIR ENTRAINED IN ACCORDANCE WITH CSA A23.1
4. ALL JOINTS TO BE RUBBER GASKETS AND CONFORM TO CSA A257.3
5. BENCHING SHALL BE IN ACCORDANCE WITH STANDARD DRAWING S045–204
6. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT
7. ALL JOINTS IN PRECAST SECTIONS BELOW THE CONCRETE COVER SHALL BE SEALED WITH 19x9.5 BUTYL RUBBER SEALANT – CONSEAL CS102 OR APPROVED EQUAL

City of Saint John

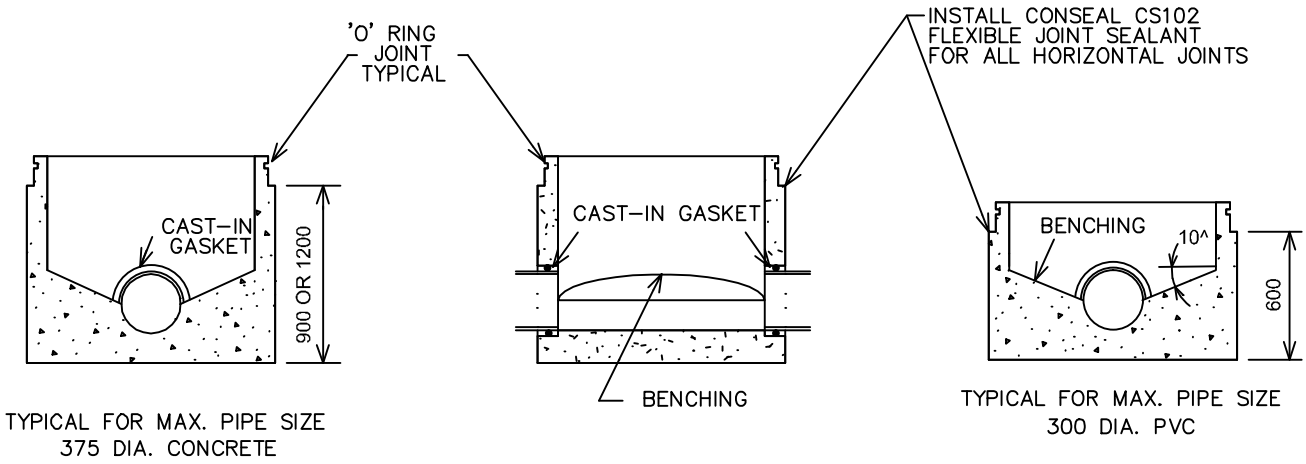
STANDARD MANHOLE SECTIONS

DWN. BY J. DAIGLE	DATE JAN. 2004	REV. No. 7		DWG. No. S045–203
CHECKED BY	SCALE N.T.S.	DATE FEB 2012		





TYPICAL BENCHING



TYPICAL FOR MAX. PIPE SIZE 375 DIA. CONCRETE

TYPICAL FOR MAX. PIPE SIZE 300 DIA. PVC

TYPICAL SANITARY MANHOLE BASE & GASKET

(1050 DIA. MINIMUM)

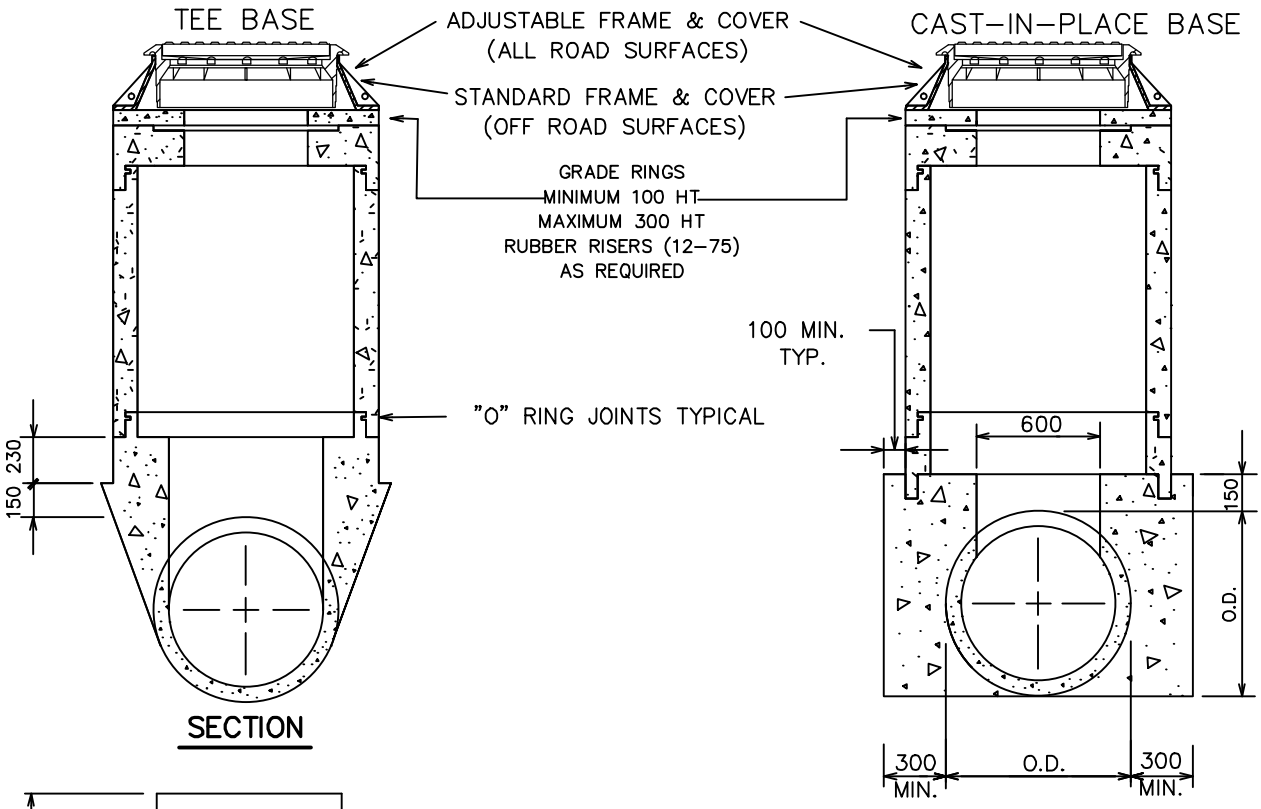
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. REFER TO STANDARD DRAWING S045-203
3. MINIMUM RADIUS FOR CHANNEL BENCHING TO BE 1.5 X DIAMETER (D) OF INLET PIPE

City of Saint John

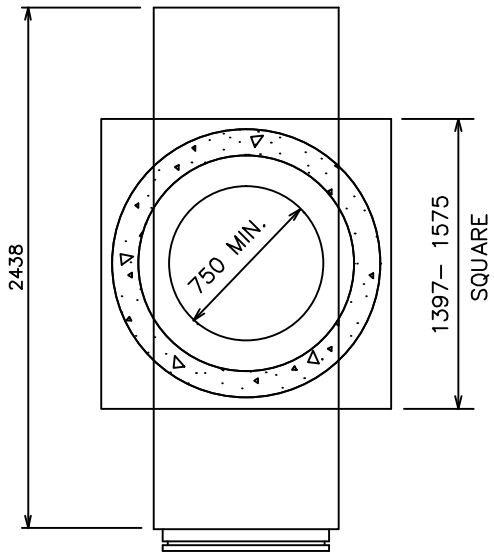
STANDARD MANHOLE BENCHING DETAILS

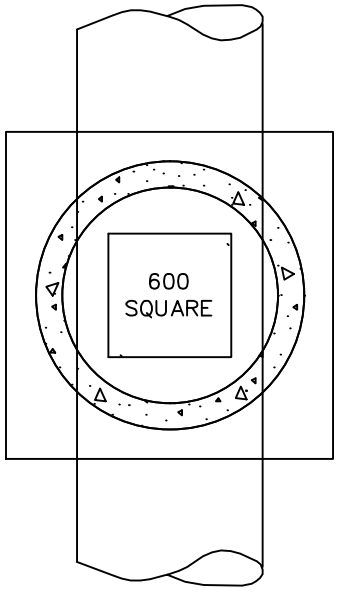
DWN. BY M. MORRISON	DATE JAN 2004	REV. No. 2		DWG. No. S045-204
CHECKED BY	SCALE N.T.S.	DATE FEB 2009		



SECTION

SECTION





PLAN

PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. STRUCTURE TO CONFORM TO CSA A257.4 & CONCRETE TO BE AIR ENTRAINED IN ACCORDANCE WITH CSA A23.1
3. ALL PIPES AND STRUCTURES SHALL BE WATERTIGHT
4. ALL PIPES LOCATED IN MANHOLES MUST HAVE WATERTIGHT JOINTS
5. ALL JOINTS IN PRECAST SECTIONS BELOW THE CONCRETE COVER SHALL BE SEALED WITH 19 x 9.5 BUTYL RUBBER SEALANT – CONSEAL CS102 OR APPROVED EQUAL
6. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT BETWEEN RISERS AND BETWEEN RISERS AND FRAME

City of Saint John

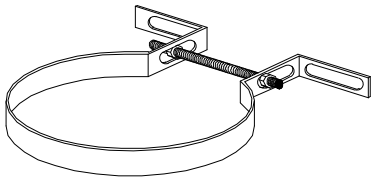
TYPICAL TEE-BASE MANHOLE LARGE DIAMETER PIPE

DWN. BY J. DAIGLE	DATE JAN. 2004	REV. No. 3		DWG. No. S045-205
CHECKED BY	SCALE N.T.S.	DATE FEB 2012		

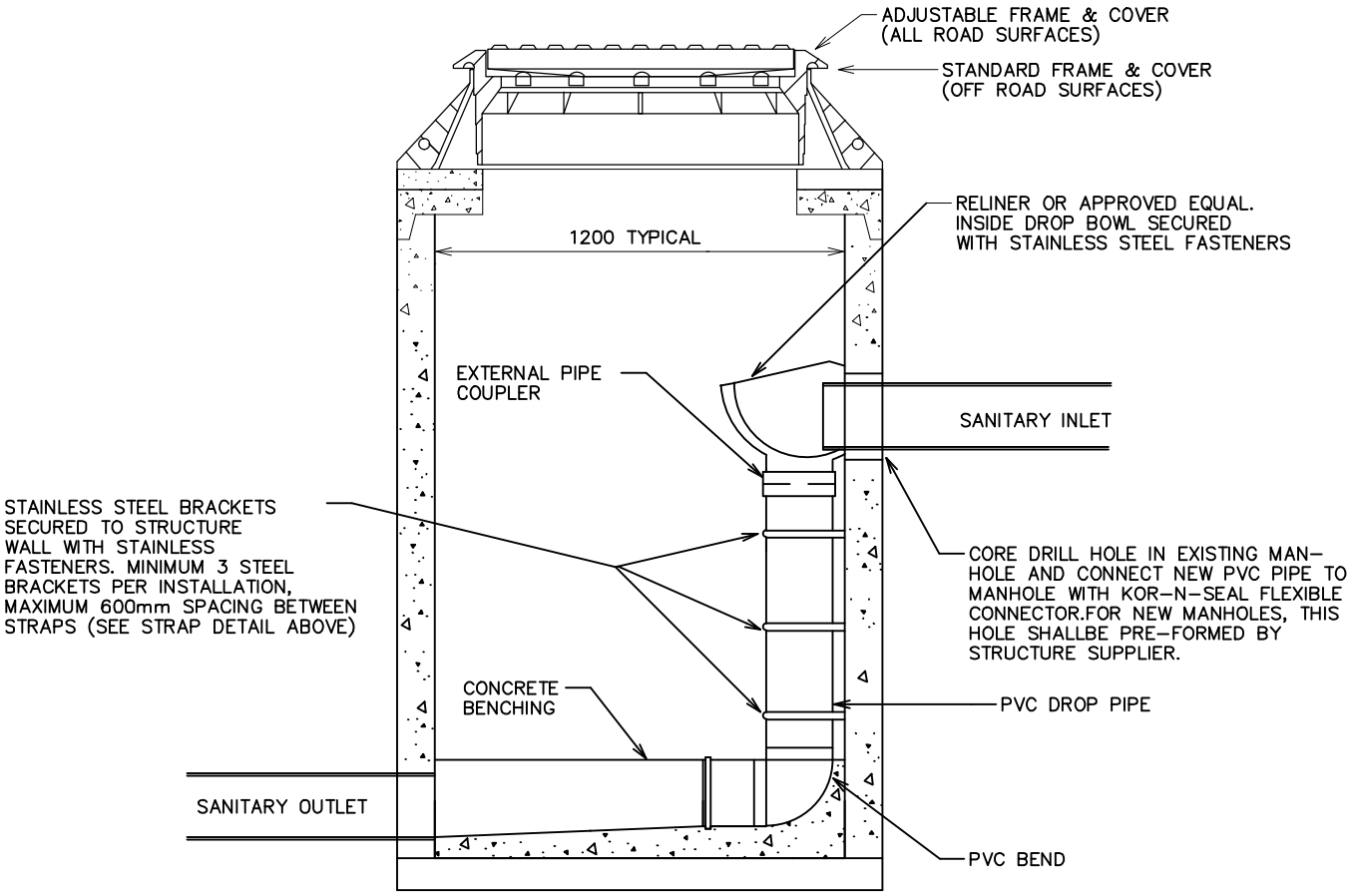
ATTACH BRACKET TO MANHOLE WITH HILTI
6mm Ø, 18–8 STAINLESS STEEL DROP–IN ANCHORS
AND BOLTS. 2 ANCHORS EACH BRACKET.

3mm THICK X 25mm WIDE 11 GAUGE
STAINLESS STEEL BRACKETS

11 GAUGE 304 STAINLESS STEEL.



BRACKET DETAIL



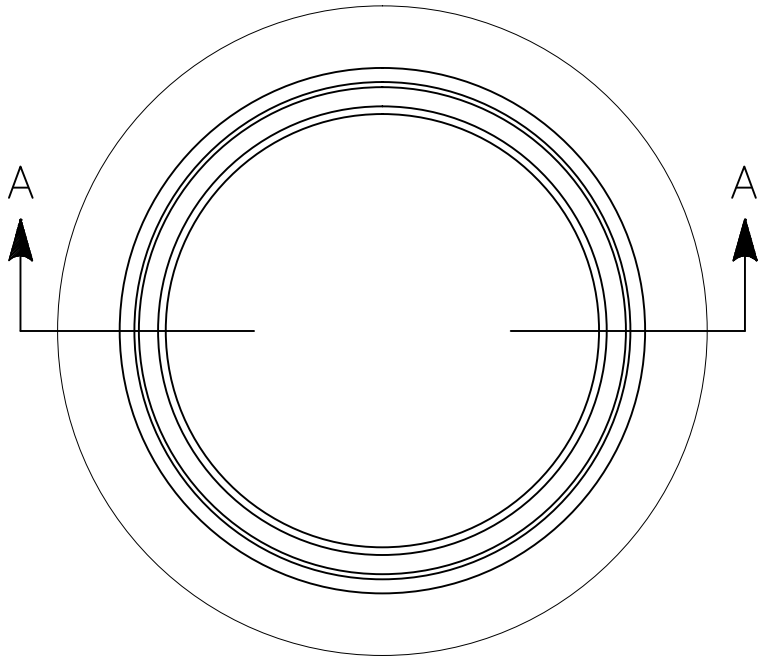
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. STRUCTURE TO CONFORM TO CSA A257.4
3. CONCRETE TO BE AIR ENTRAINED IN ACCORDANCE WITH CSA A23.1
4. INTERIOR DROP DIMENSIONS FOR EACH APPLICATION TO BE SPECIFIED BY THE ENGINEER

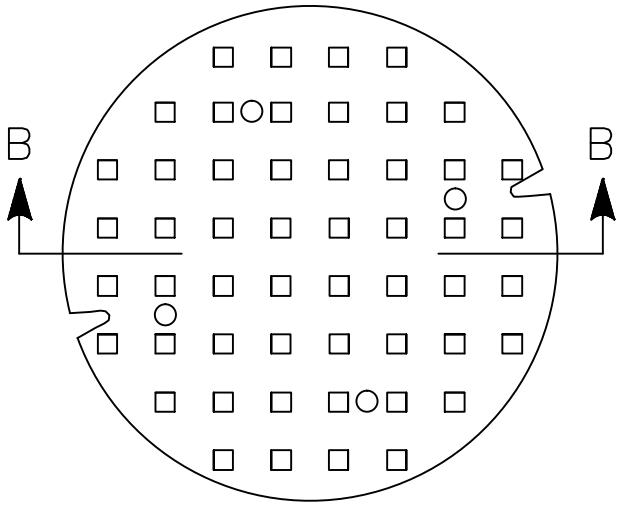
City of Saint John

INTERIOR DROP MANHOLE DETAIL

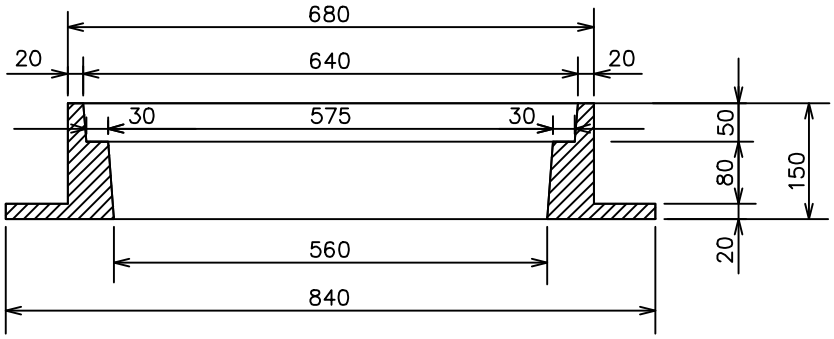
DWN. BY J.DAIGLE	DATE JAN. 2004	REV. No. 3		DWG. No. S045–206
CHECKED BY	SCALE N.T.S.	DATE JAN. 2010		



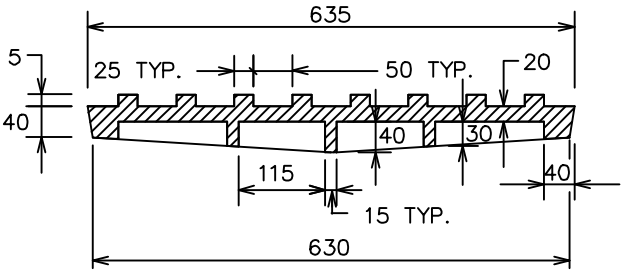
FRAME PLAN



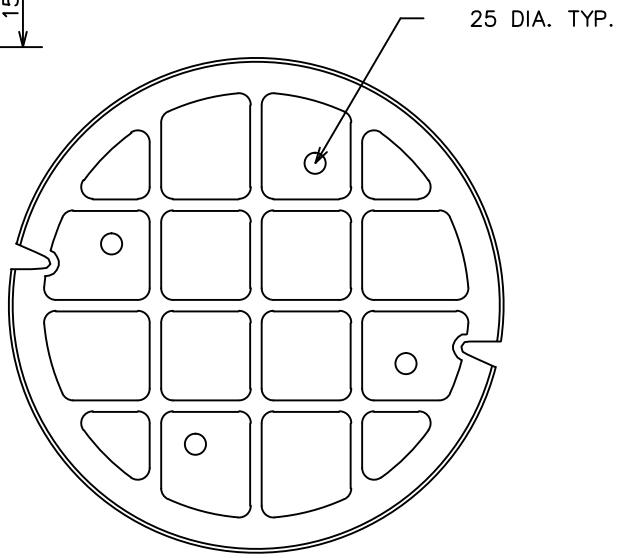
COVER–TOP VIEW



SECTION A–A



SECTION B–B



COVER–BOTTOM VIEW

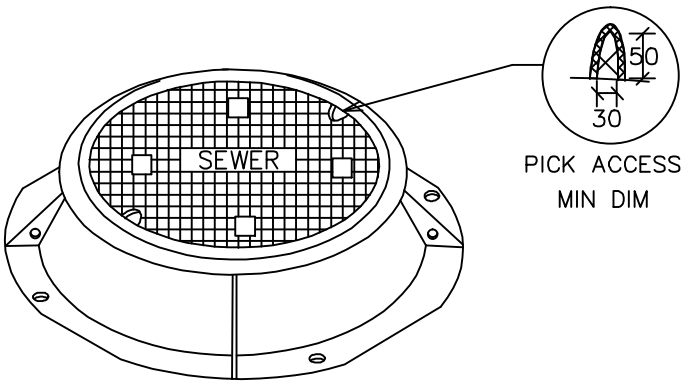
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. MATERIAL: CAST IRON TO ASTM A48, CLASS 30 B
3. MASS: FRAME 125 kg, COVER 63 kg

City of Saint John

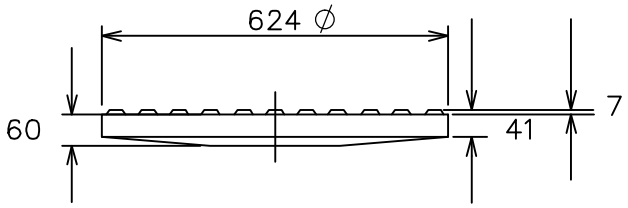
STANDARD MANHOLE FRAME & COVER

DWN. BY K.MORRIS	DATE JAN. 2004	REV. No. 1		DWG. No. S045–207
CHECKED BY	SCALE N.T.S.	DATE JAN. 2006		



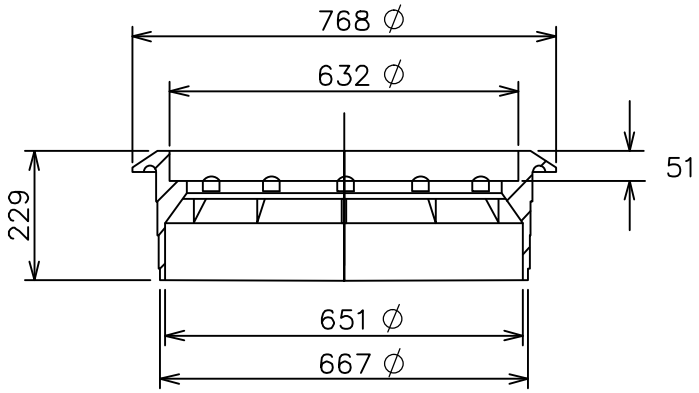
COVER

624mm
78kg
DUCTILE OR GRAY IRON
ASTM A536 65–45–12
ASTM A48 CLASS 30



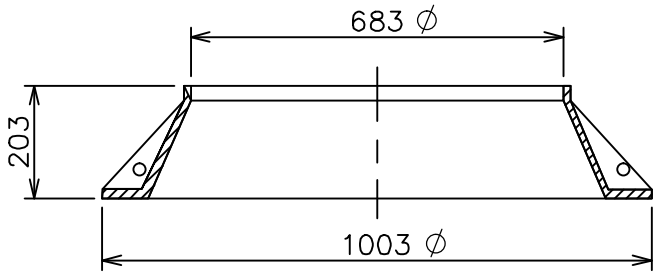
FRAME

624mm
76 kg
DUCTILE IRON
ASTM A536 65–45–12



CONICAL GUIDE

624mm
62 kg
GRAY IRON
ASTM A48 CLASS 30

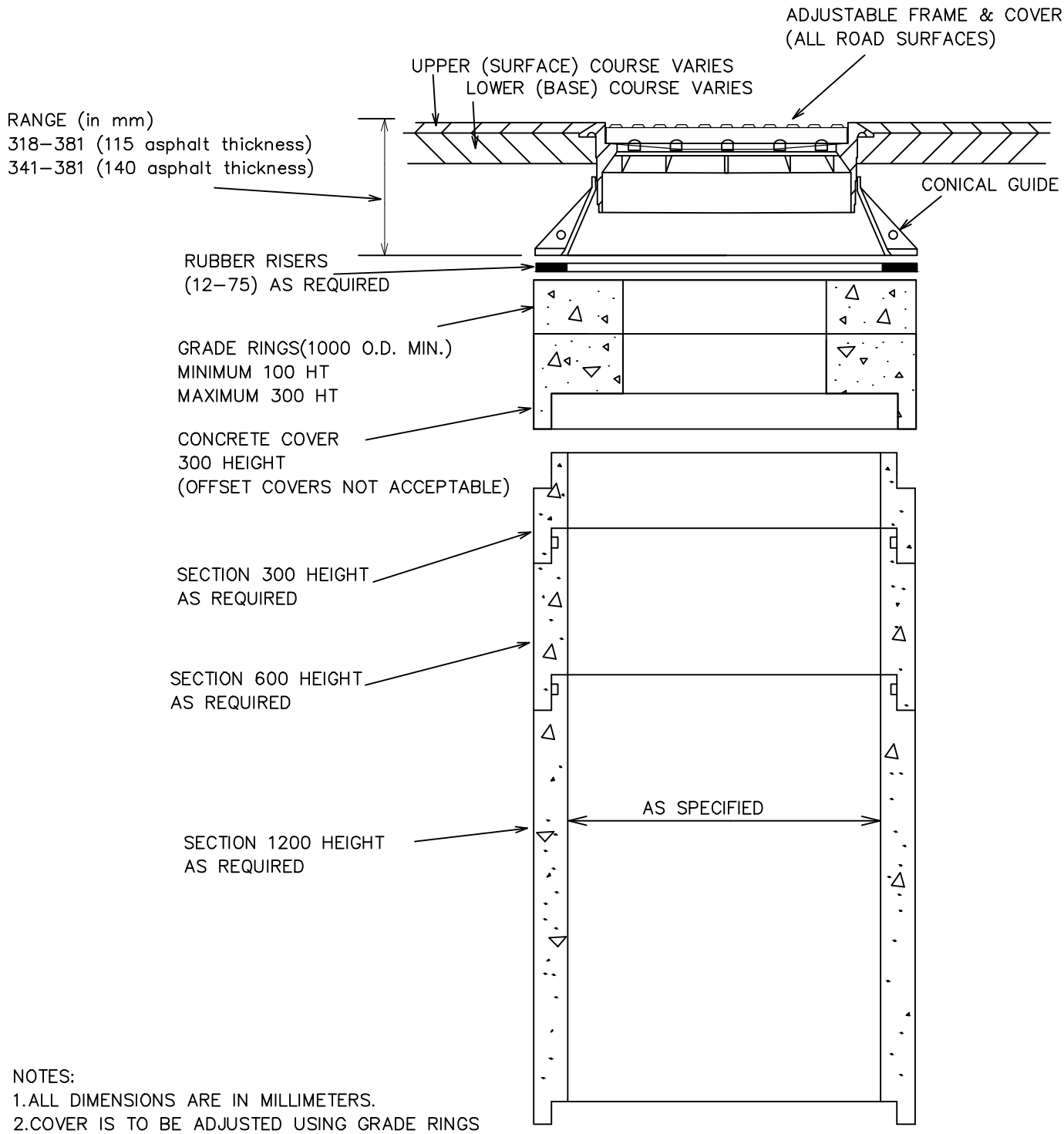


NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. TOTAL WEIGHT 216kg

City of Saint John

ADJUSTABLE MANHOLE FRAME & COVER

DWN. BY J. GRANGER	DATE JAN 2006	REV. No. 2		DWG. No. S045–207A
CHECKED BY	SCALE N.T.S.	DATE JAN 2011		



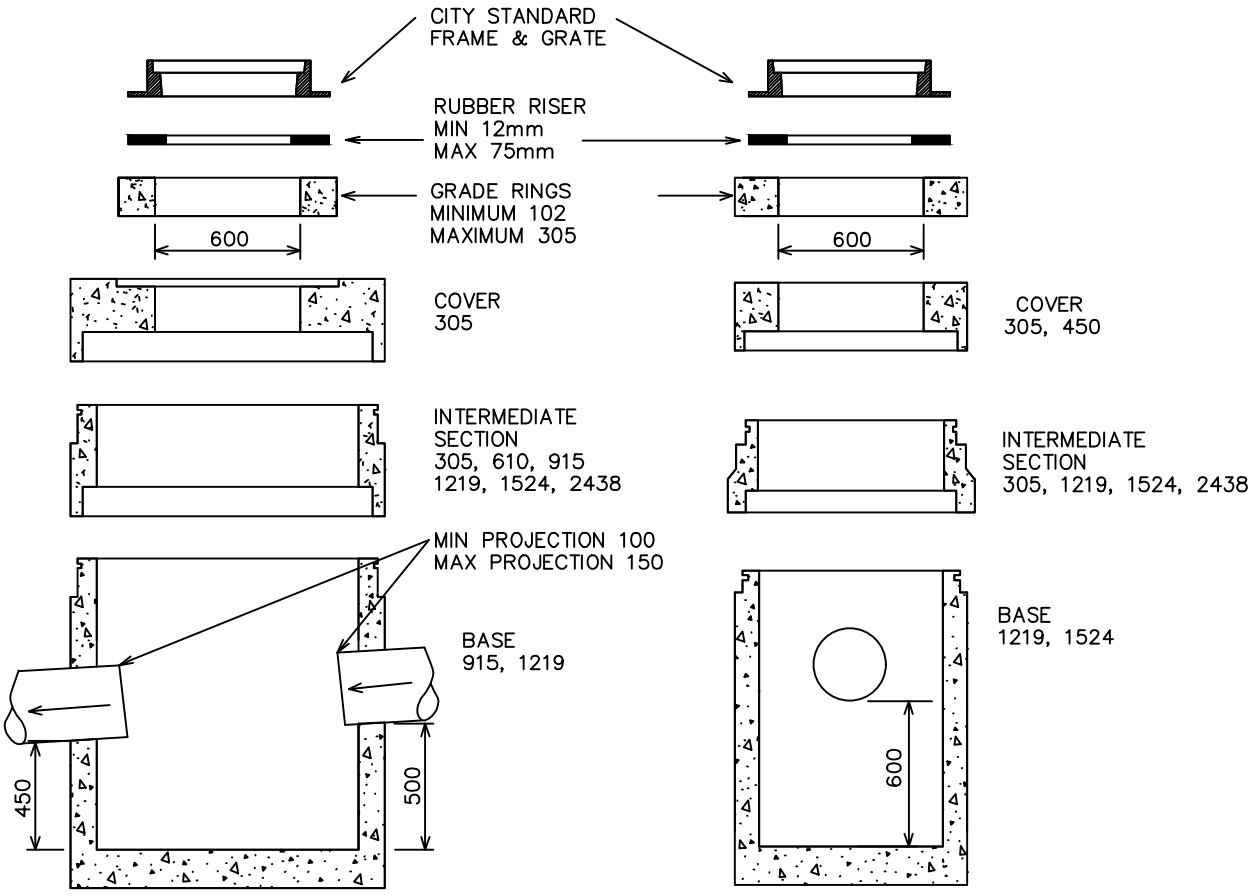
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. COVER IS TO BE ADJUSTED USING GRADE RINGS AND ADJUSTMENT RANGE SHOWN SO THAT THE ASPHALT DOES NOT CONTACT ANY PART OF THE CONICAL GUIDE.
3. ALL JOINTS IN PRECAST SECTIONS BELOW CONCRETE COVER SHALL BE SEALED WITH 19 x 9.5 BUTYL RUBBER SEALANT – CONSEAL CS102 OR APPROVED EQUAL.
4. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT BETWEEN RISERS AND BETWEEN RISERS AND FRAME.
5. FRAME MUST NOT REST ON THE CONICAL GUIDE.

City of Saint John

ADJUSTABLE MANHOLE FRAME & COVER INSTALLATION

DWN. BY J. DAIGLE	DATE FEB 2008	REV. No. 3		DWG. No. S045–207B
CHECKED BY	SCALE N.T.S.	DATE FEB 2012		



1050 CATCH BASIN MANHOLE

750 CATCH BASIN

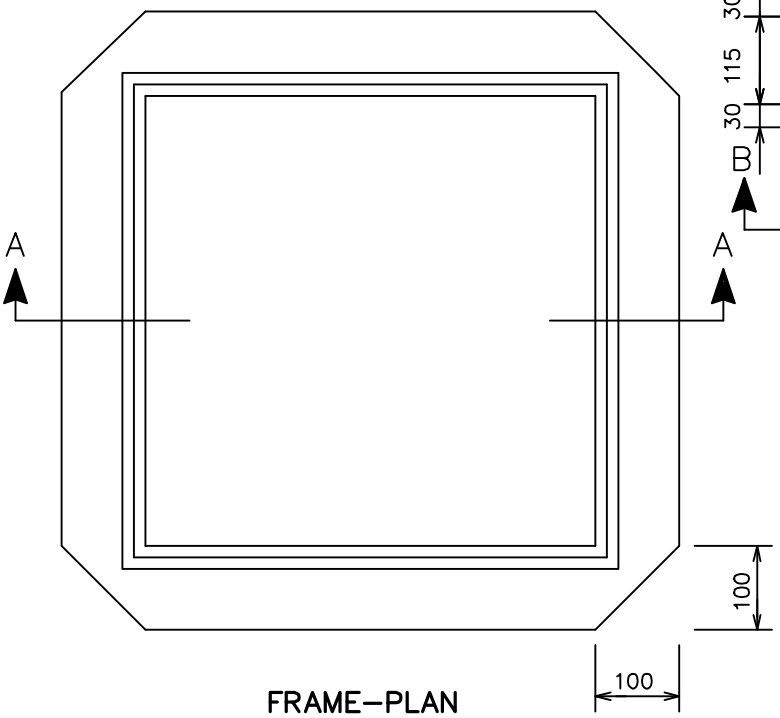
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. STRUCTURES TO CONFORM TO CSA A257.4.
3. CONCRETE TO BE AIR ENTRAINED IN ACCORDANCE WITH CSA A23.1.
4. ALL PIPES IN MANHOLES MUST HAVE WATERTIGHT JOINTS.
5. ALL JOINTS IN SECTIONS BELOW CONCRETE COVER SHALL BE SEALED WITH 19 x 9.5 BUTYL RUBBER SEALANT – CONSEAL CS 102 OR APPROVED EQUAL.
6. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT BETWEEN RISERS AND BETWEEN RISERS AND FRAME.

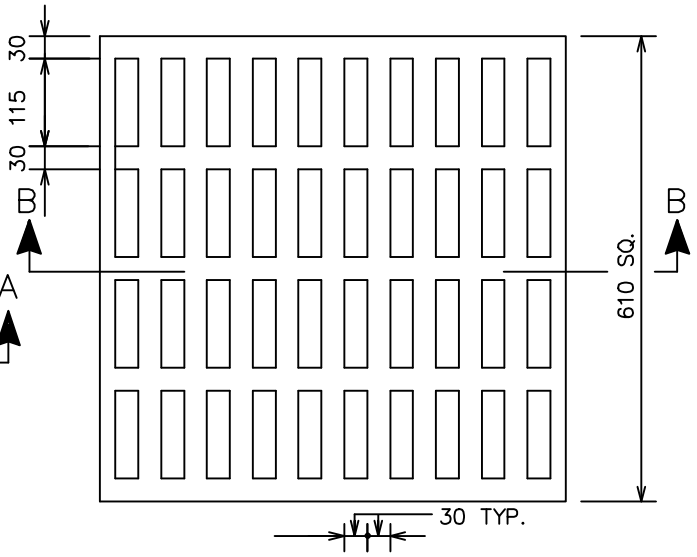
City of Saint John

TYPICAL CATCH BASINS

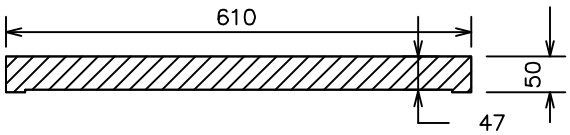
DWN. BY K.MORRIS	DATE JAN. 2004	REV. No. 3		DWG. No. S045–208
CHECKED BY	SCALE N.T.S.	DATE FEB 2017		



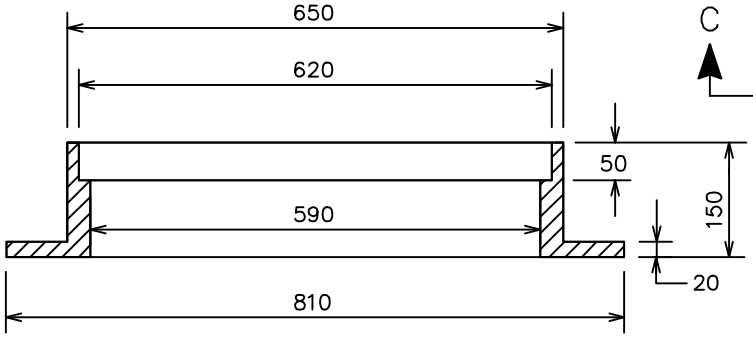
FRAME–PLAN



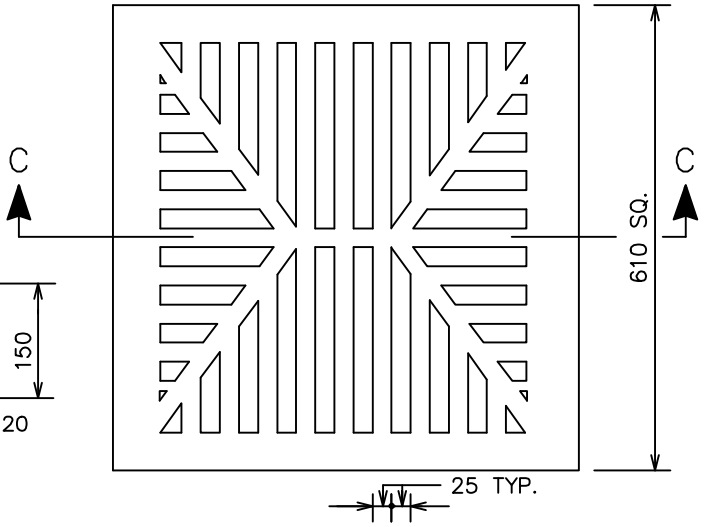
GRATE, FLAT TYPE



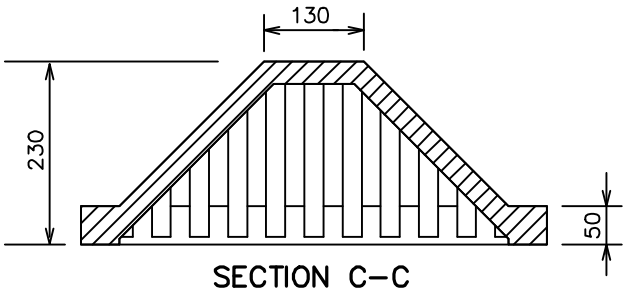
SECTION B–B



SECTION A–A



GRATE, PYRAMID TYPE



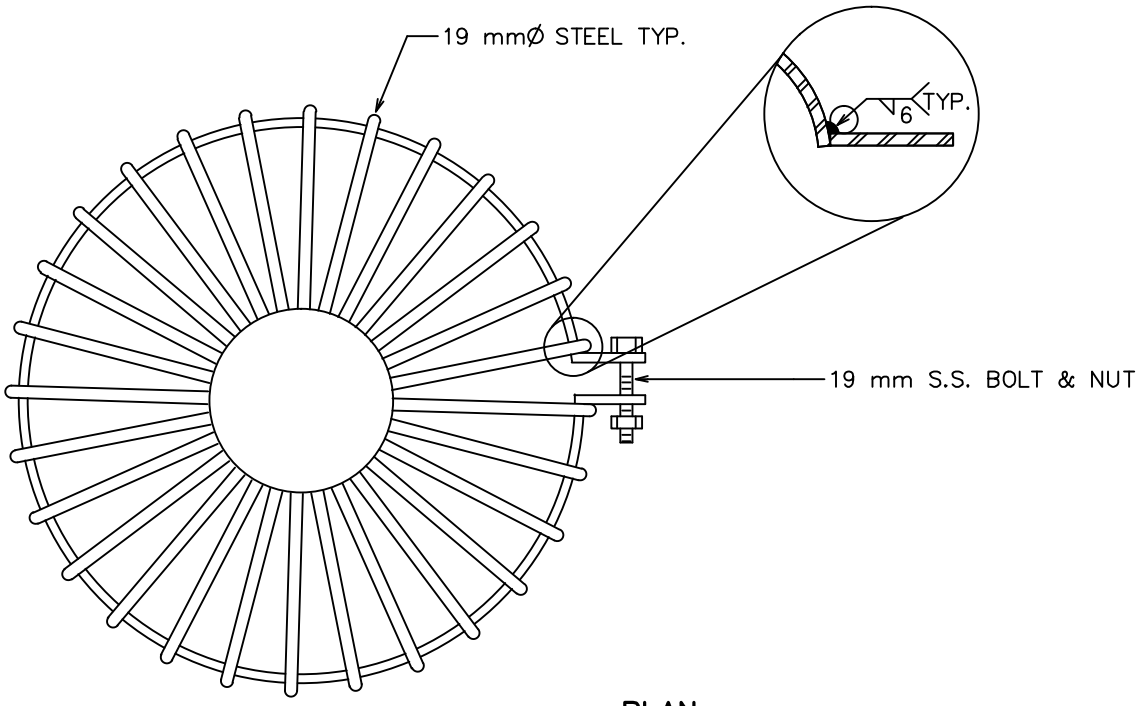
SECTION C–C

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. MATERIAL CAST IRON TO ASTM A48, CLASS 30
3. MASS OF FRAME 110 kg, MASS OF GRATE 85 kg

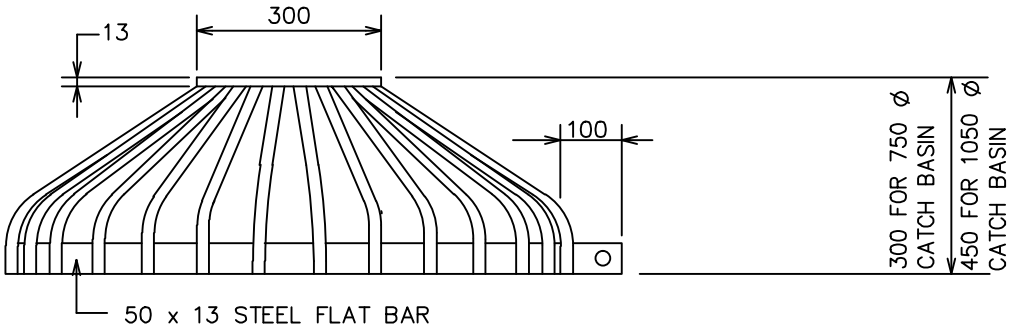
City of Saint John

TYPICAL CATCH BASIN FRAME & GRATE (FLAT & PYRAMID)

DWN. BY J GRANGER	DATE JAN. 2004	REV. No. 1		DWG. No. S045–209
CHECKED BY	SCALE N.T.S.	DATE FEB. 2008		



PLAN



ELEVATION

CATCH BASIN SIZE	750	1050
O.D. SPIGOT END	889	1181
CIRCUM. OF SPIGOT	2792	3708
NO. OF BARS AT 100 mm O/C	27	37

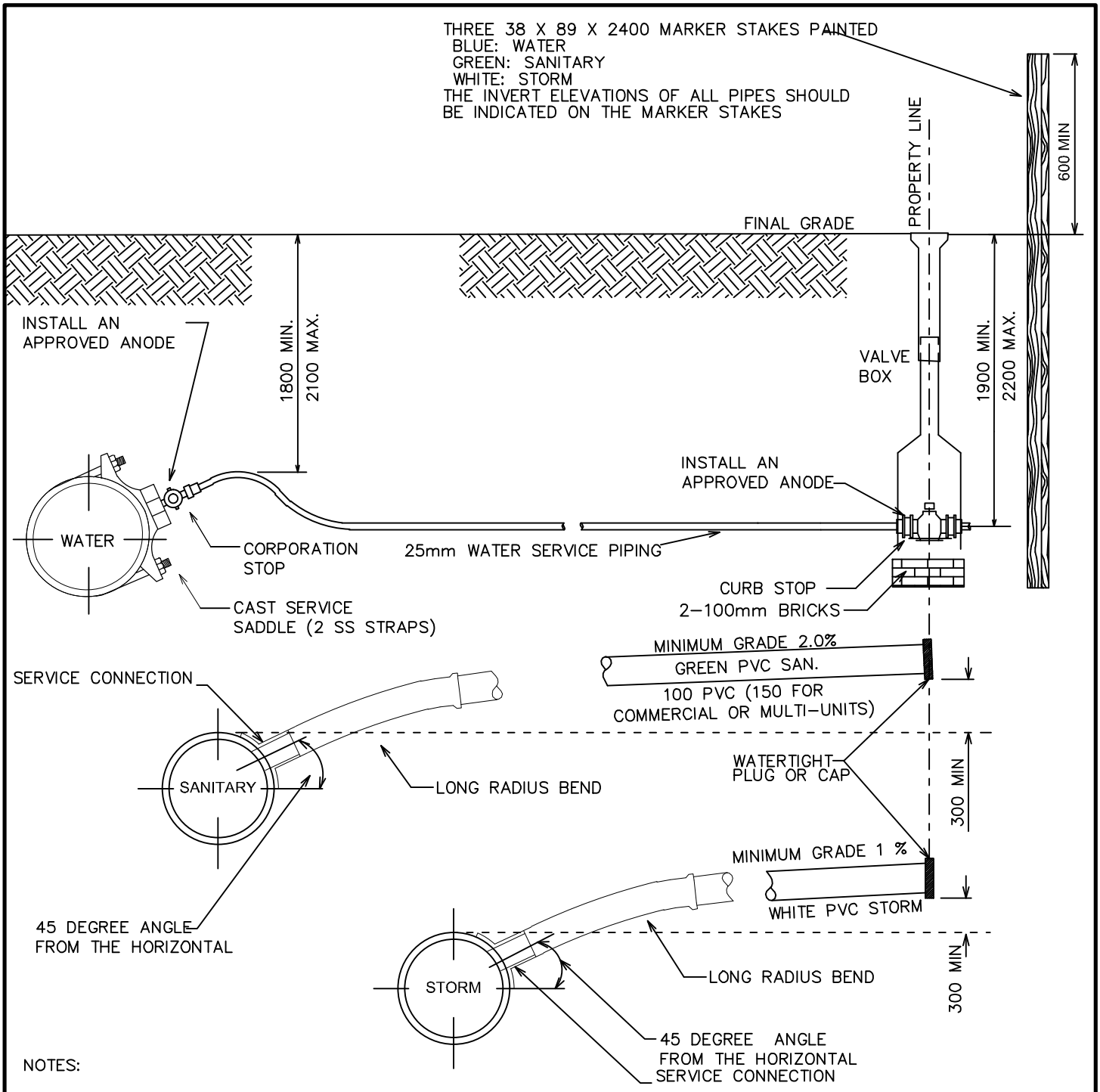
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. FINISH SHALL BE RED OXIDE PRIMER

City of Saint John

OPEN TRASH RACK

DWN. BY K.MORRIS	DATE JAN. 2004	REV. No.		DWG. No. S045–210
CHECKED BY	SCALE N.T.S.	DATE		



NOTES:

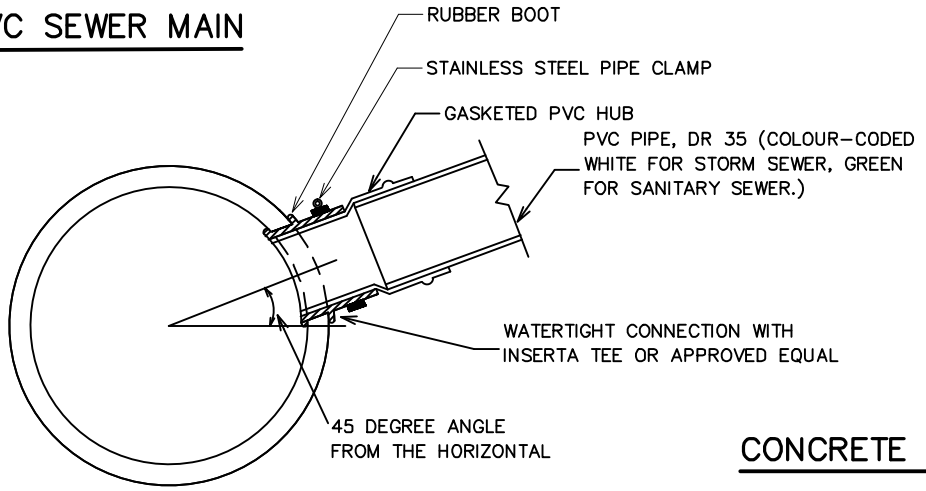
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. SEE STANDARD DRAWING S045–202 FOR BEDDING DETAIL
3. INSPECTION CHAMBERS MAY BE INSTALLED AT THE REQUEST OF THE ENGINEER. SEE STANDARD DRAWING S045–213 FOR INSPECTION CHAMBER DETAIL
4. SEE STANDARD DRAWING S045–212 FOR SERVICE CONNECTIONS
5. SERVICE CONNECTIONS TO NEW PVC SEWER MAINS SHALL BE MADE BY UTILIZING A PVC TEE WYE OR WYE, UNLESS OTHERWISE APPROVED BY THE ENGINEER
6. ONE CONTINUOUS PIECE OF WATER SERVICE PIPE FROM MAIN TO CURB STOP
7. ATTACH TRACER WIRE TO WATER SERVICE AND VALVE BOX AS PER STANDARD DRAWING S045–116

City of Saint John

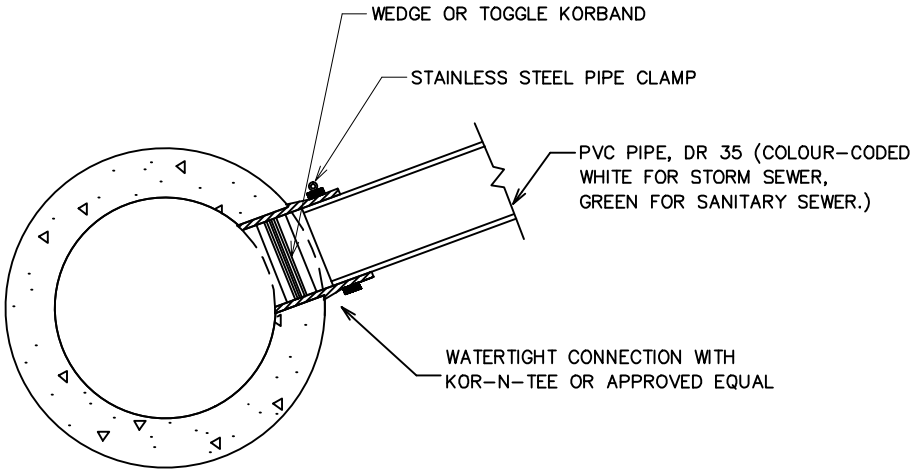
STANDARD SERVICE CONNECTIONS

DWN. BY J. GRANGER	DATE JAN 2004	REV. No. 5		DWG. No. S045–211
CHECKED BY	SCALE N.T.S.	DATE JAN 2011		

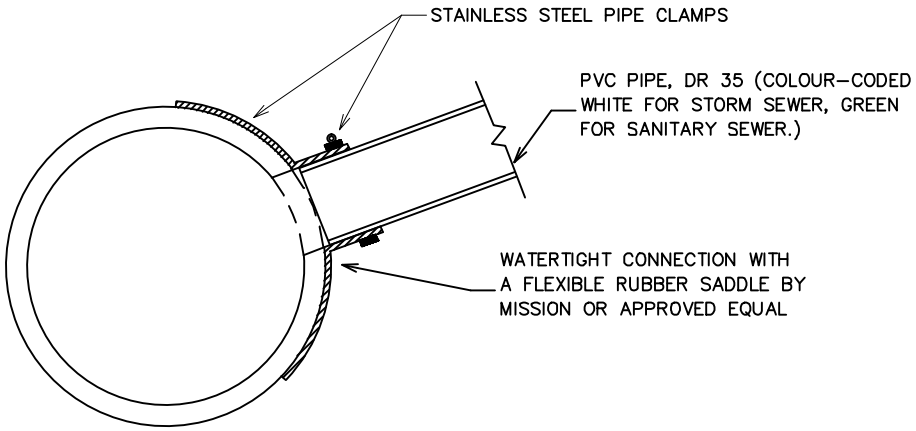
PVC SEWER MAIN



CONCRETE SEWER MAIN



TERRA COTTA SEWER MAIN



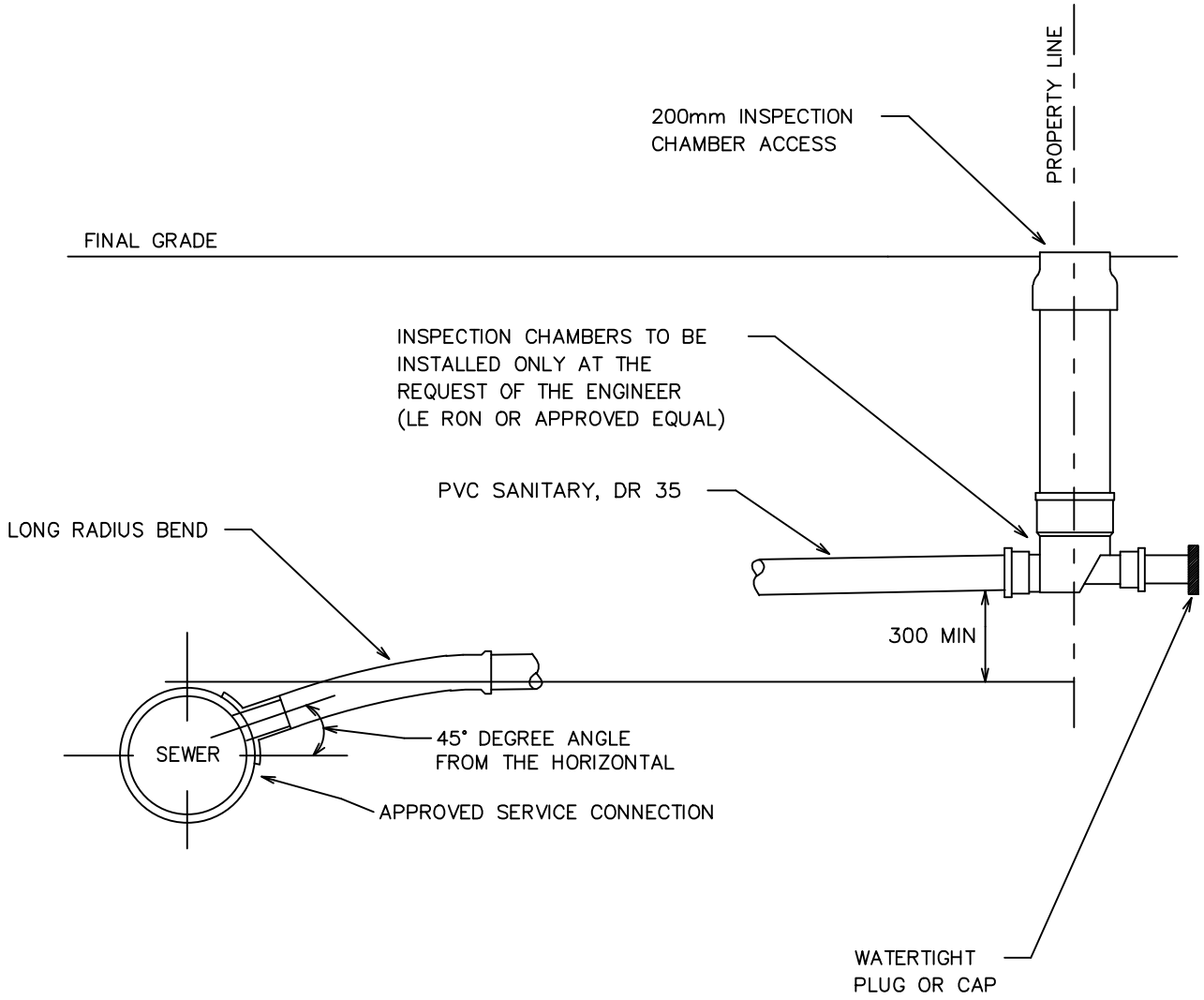
NOTES:

1. BENDS SHALL BE OF LONG RADIUS TYPE ONLY
2. SERVICE CONNECTIONS TO NEW PVC SEWER MAINS SHALL BE MADE BY UTILIZING A PVC TEE WYE OR WYE, UNLESS OTHERWISE APPROVED BY THE ENGINEER

City of Saint John

SERVICE CONNECTIONS INTO SEWERS

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 3		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE JAN. 2011		S045-212

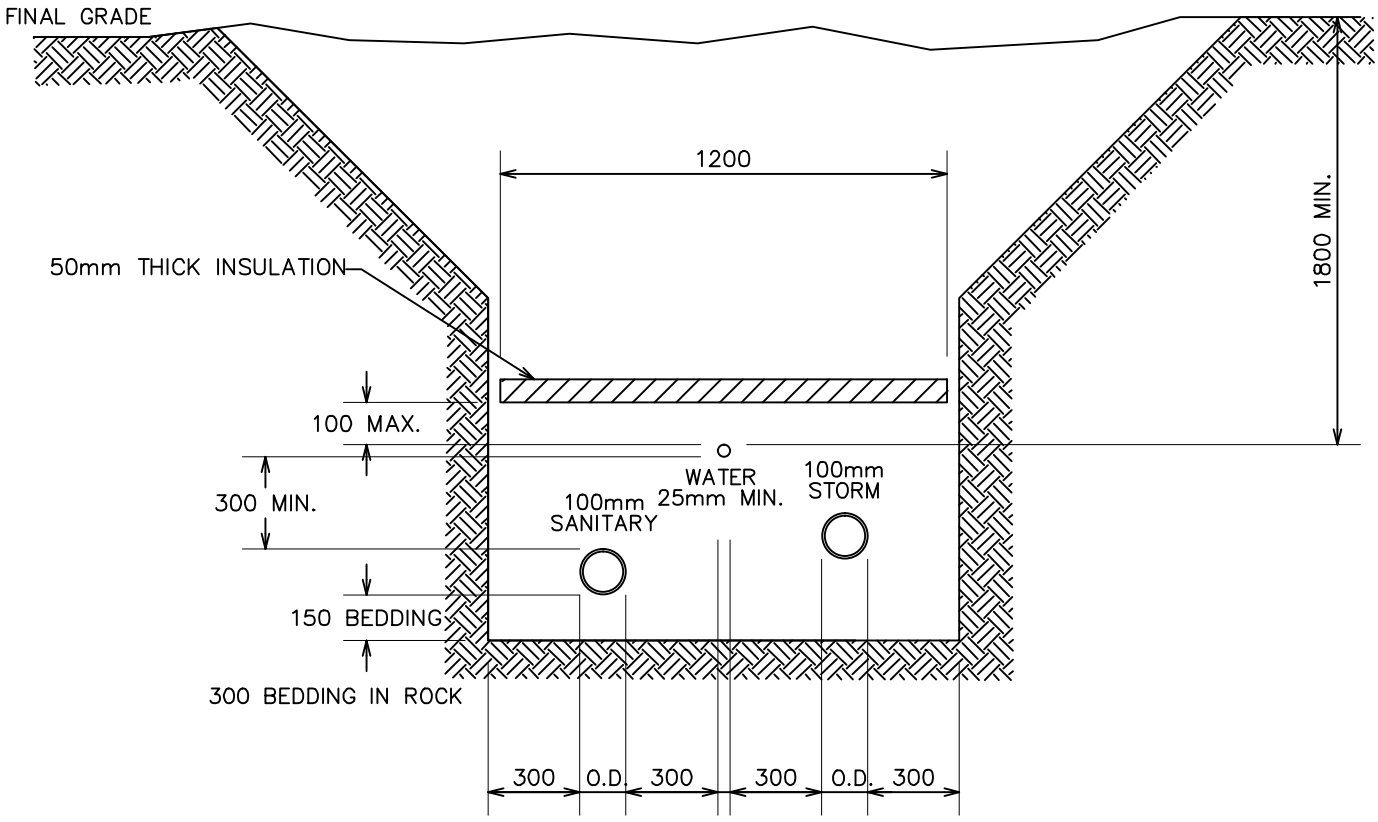


NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. SEE STANDARD DRAWING S045–202 FOR BEDDING DETAIL

City of Saint John

SEWER SERVICE INSPECTION CHAMBER

DWN. BY K.MORRIS	DATE JAN. 2004	REV. No. 3		DWG. No. S045–213
CHECKED BY	SCALE N.T.S.	DATE FEB 2014		



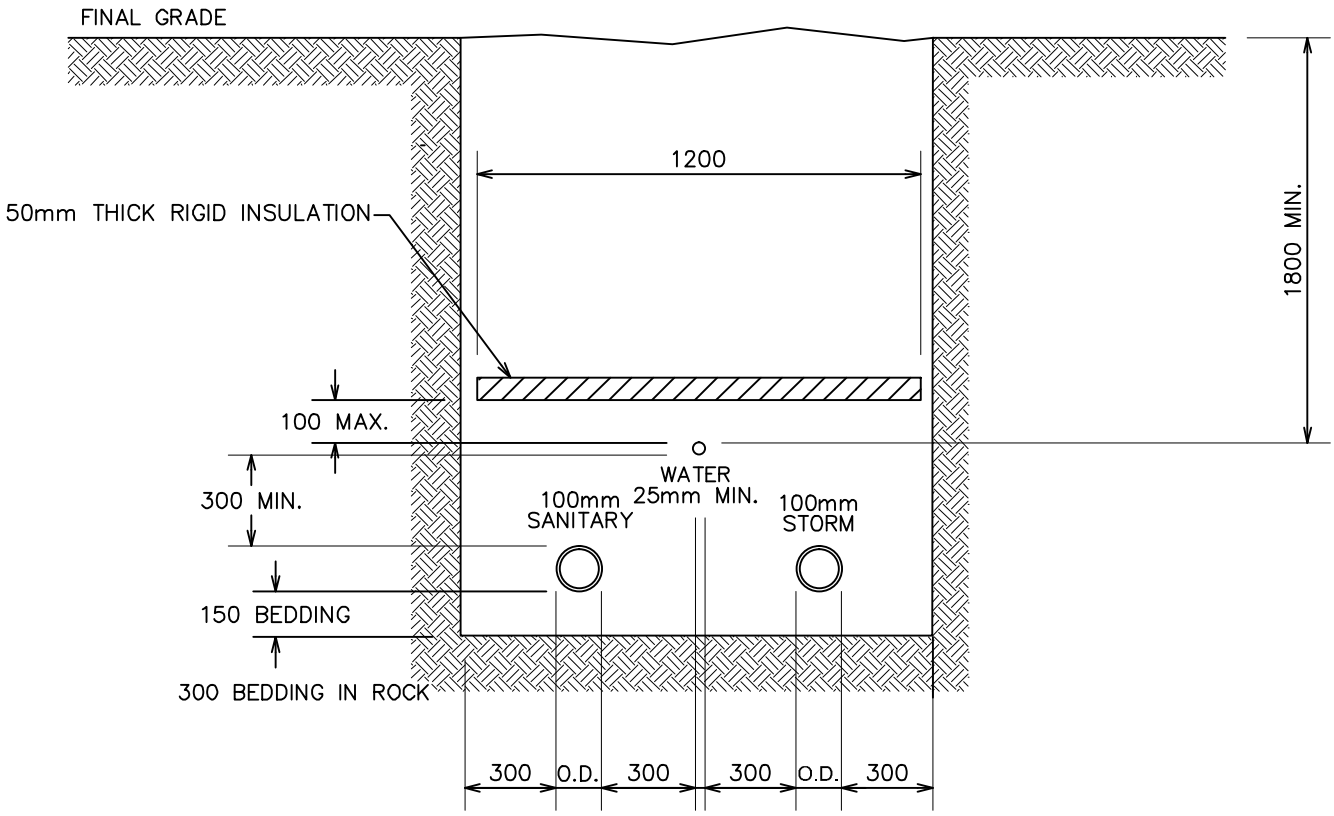
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
2. TRENCH SIDES TO BE SHORED OR SLOPED IN ACCORDANCE WITH THE NB OCCUPATIONAL HEALTH & SAFETY ACT
3. SEWER LATERALS TO BE PVC PIPE, DR 35
   STORM: COLOUR CODED WHITE
   SANITARY: COLOUR CODED GREEN
4. INSULATION TO BE IN ACCORDANCE WITH CITY OF SAINT JOHN SPECIFICATIONS

City of Saint John

SERVICE TRENCH LAYOUT

DWN. BY M.MORRISON	DATE FEB. 2005	REV. No.		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE		S045-214



NOTES:

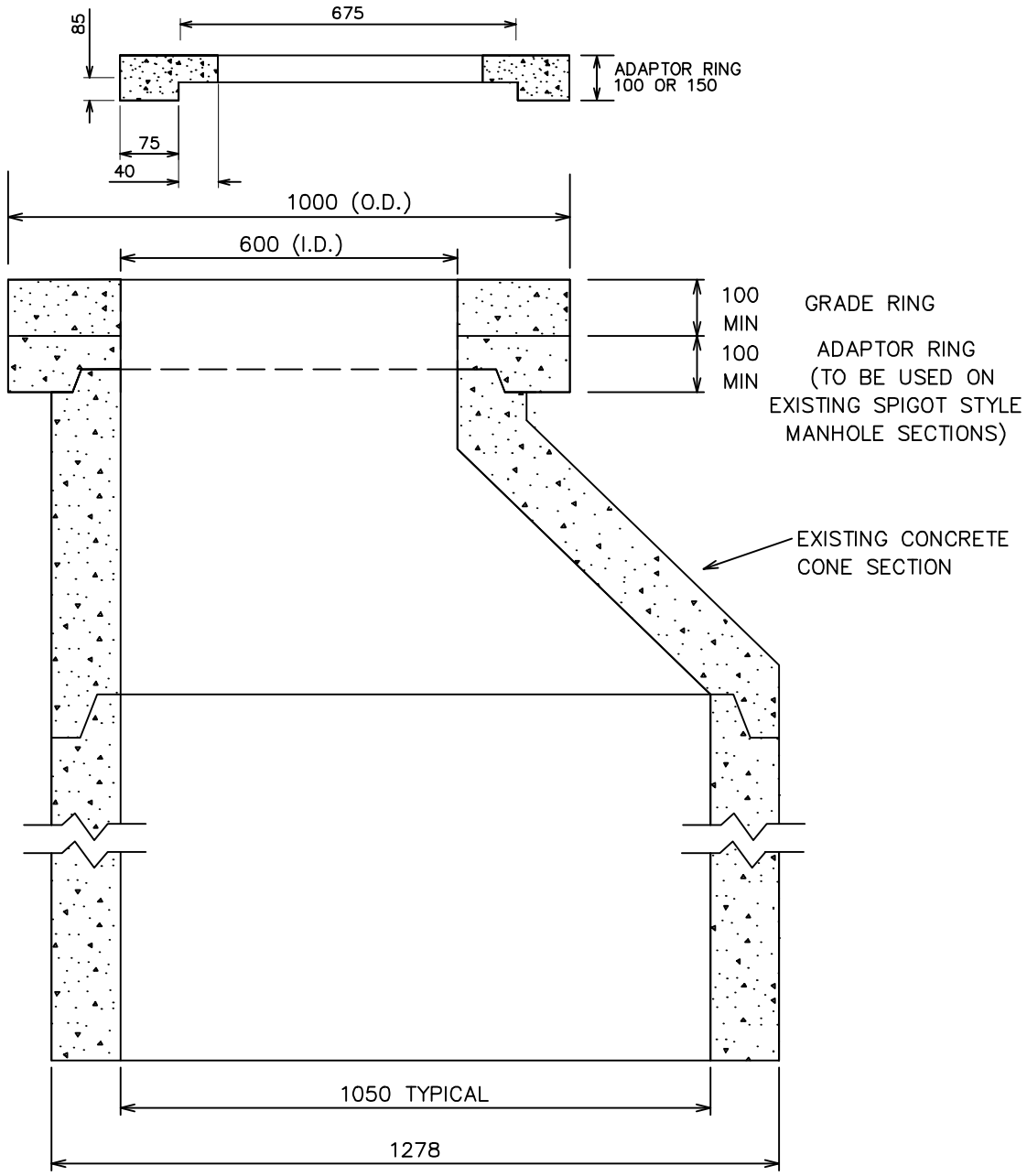
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
2. SEWER LATERALS TO BE PVC PIPE, DR 35
   STORM: COLOUR CODED WHITE
   SANITARY: COLOUR CODED GREEN
3. INSULATION TO BE IN ACCORDANCE WITH CITY OF SAINT JOHN SPECIFICATIONS

City of Saint John

SERVICE TRENCH LAYOUT PAYMENT LIMIT (ROCK EXCAVATION)

DWN. BY J. Granger	DATE FEB 2005	REV. No. 1		DWG. No. S045–215
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		

NOTE: ADAPTOR RINGS SHALL BE WITH ADJUSTABLE FRAME & COVER ONLY
ADAPTOR RINGS SHALL NOT BE USED WITH OTHER TYPES OF FRAMES & COVERS.



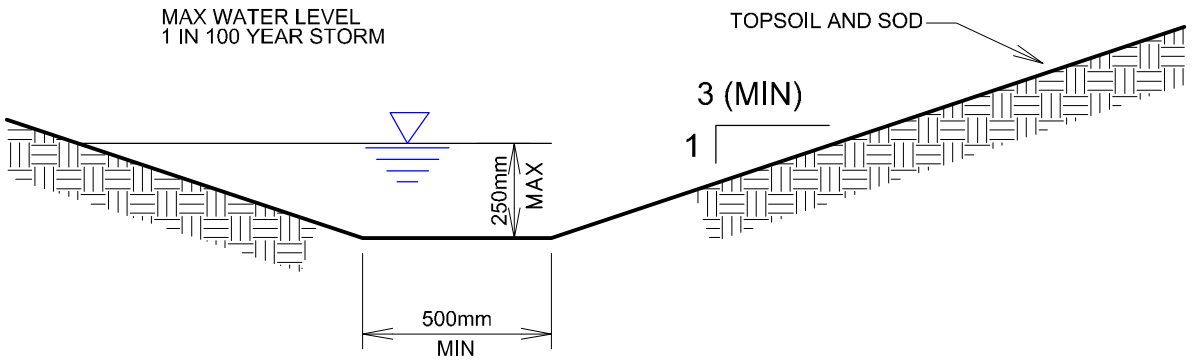
SECTION

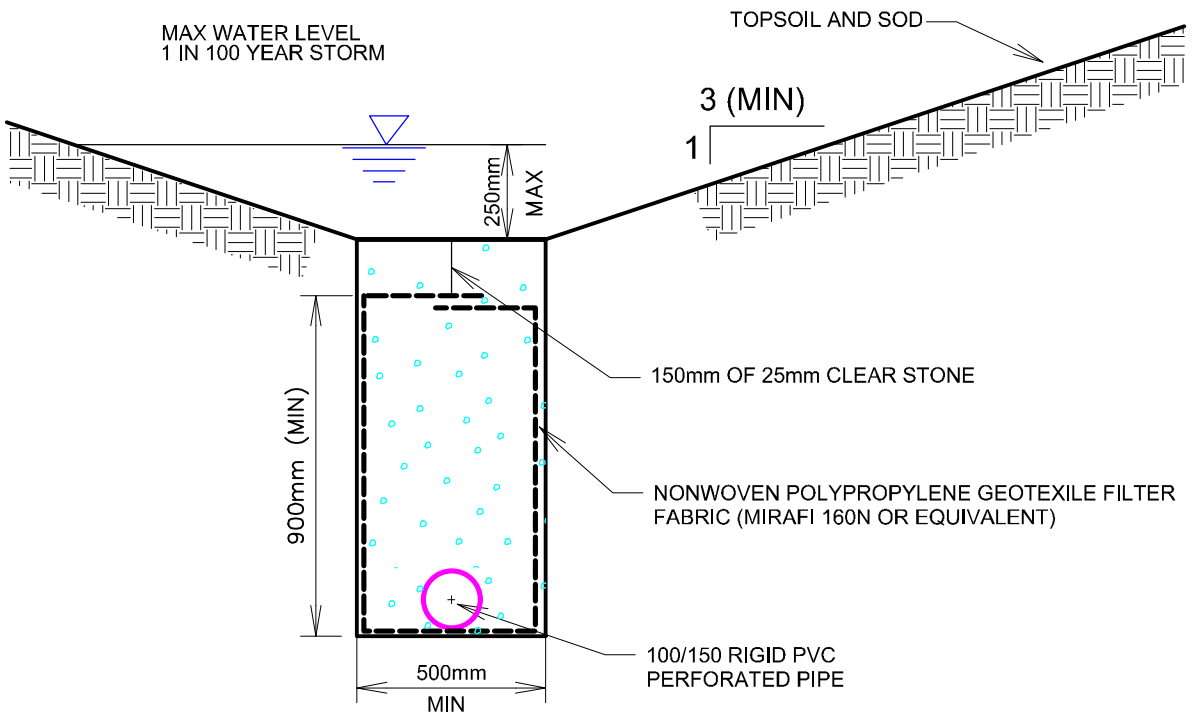
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. STRUCTURE TO CONFORM TO CSA A257.4
3. CONCRETE TO BE AIR ENTRAINED IN ACCORDANCE WITH CSA A23.1
4. ALL JOINTS IN SECTIONS BELOW CONCRETE COVER SHALL BE SEALED WITH 19 x 9.5 BUTYL RUBBER SEALANT –CONSEAL CS102 OR APPROVED EQUAL
5. APPLY A CONTINUOUS 8mm BEAD OF COLD APPLIED JOINT SEALANT BETWEEN RISERS AND BETWEEN RISER AND FRAME
6. RUBBER RISERS SHALL BE USED FOR FINAL ADJUSTMENTS 75mm OR LESS

City of Saint John

GRADE RING AND/OR ADAPTOR RING FOR TRANSITION FROM EXISTING CONCRETE CONE SECTION TO ADJUSTABLE MANHOLE FRAME AND COVER

DWN. BY P.WOODHOUSE	DATE JAN. 2006	REV. No. 1		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE JAN. 2011		S045–216



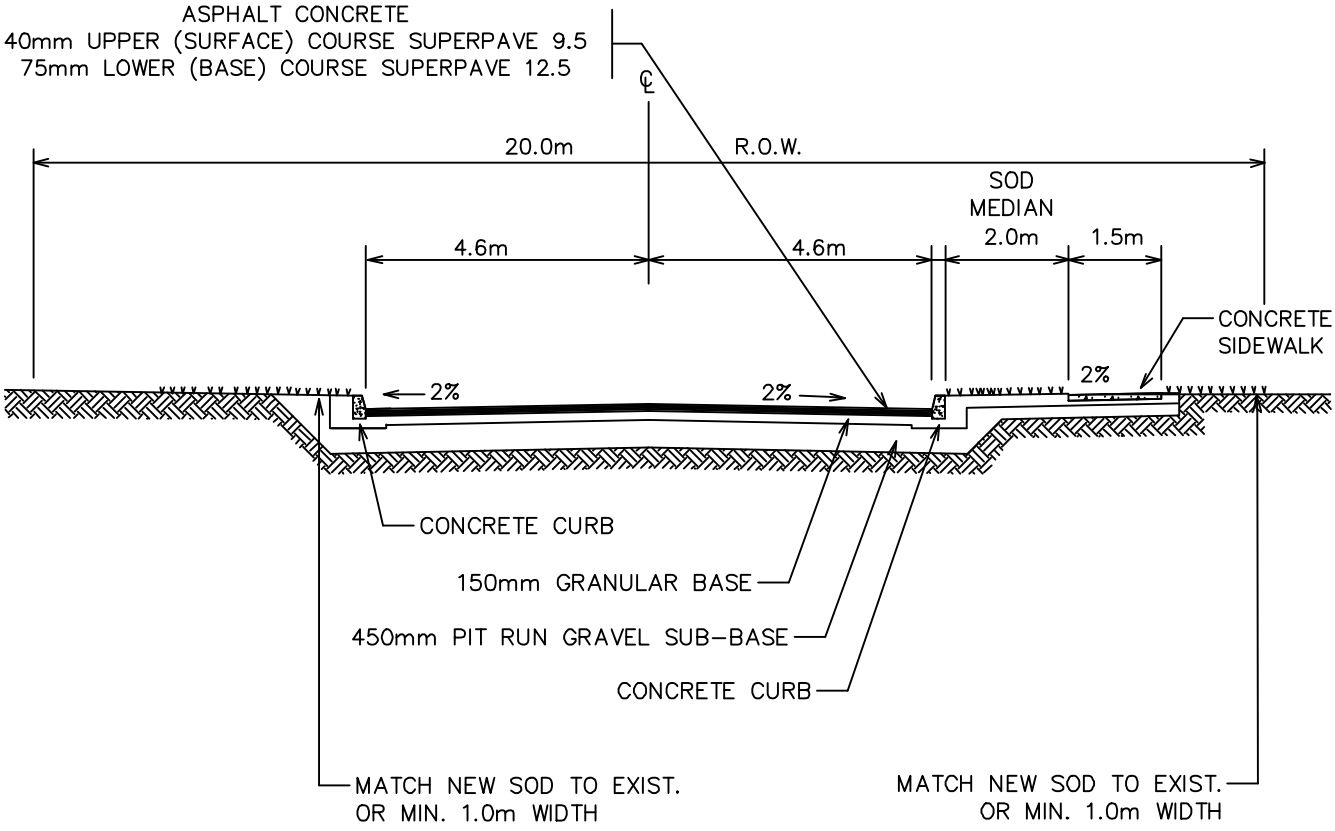


NOTE:
SWALE CAPACITY TO BE ADJUSTED BY INCREASING WIDTH OR FLATTENING SLOPE TO MAINTAIN MAX WATER LEVEL

City of Saint John

SWALE AND UNDERDRAIN DETAILS

DWN. BY J. Granger	DATE JAN 2009	REV. No. 2		DWG. No. S045–218
CHECKED BY	SCALE N.T.S.	DATE MAR 2019		



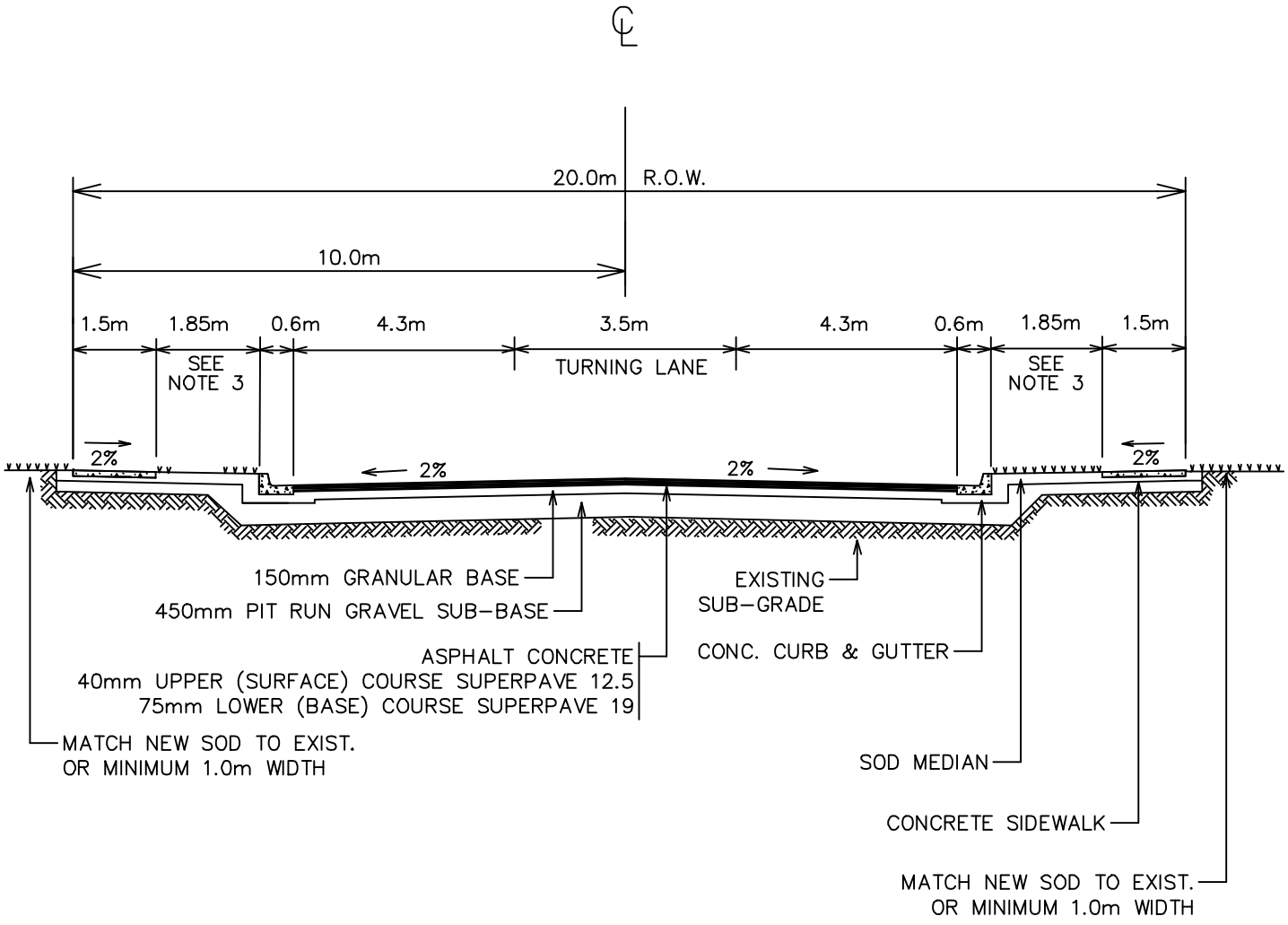
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB AND SIDEWALK DETAILS SEE STANDARD DRAWINGS S045-309 TO S045-315
3. DESIGN ESAL'S: 0.3 TO < 3 MILLION

City of Saint John

TYPICAL CROSS SECTION LOCAL STREET

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 2		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE JAN. 2011		S045-300



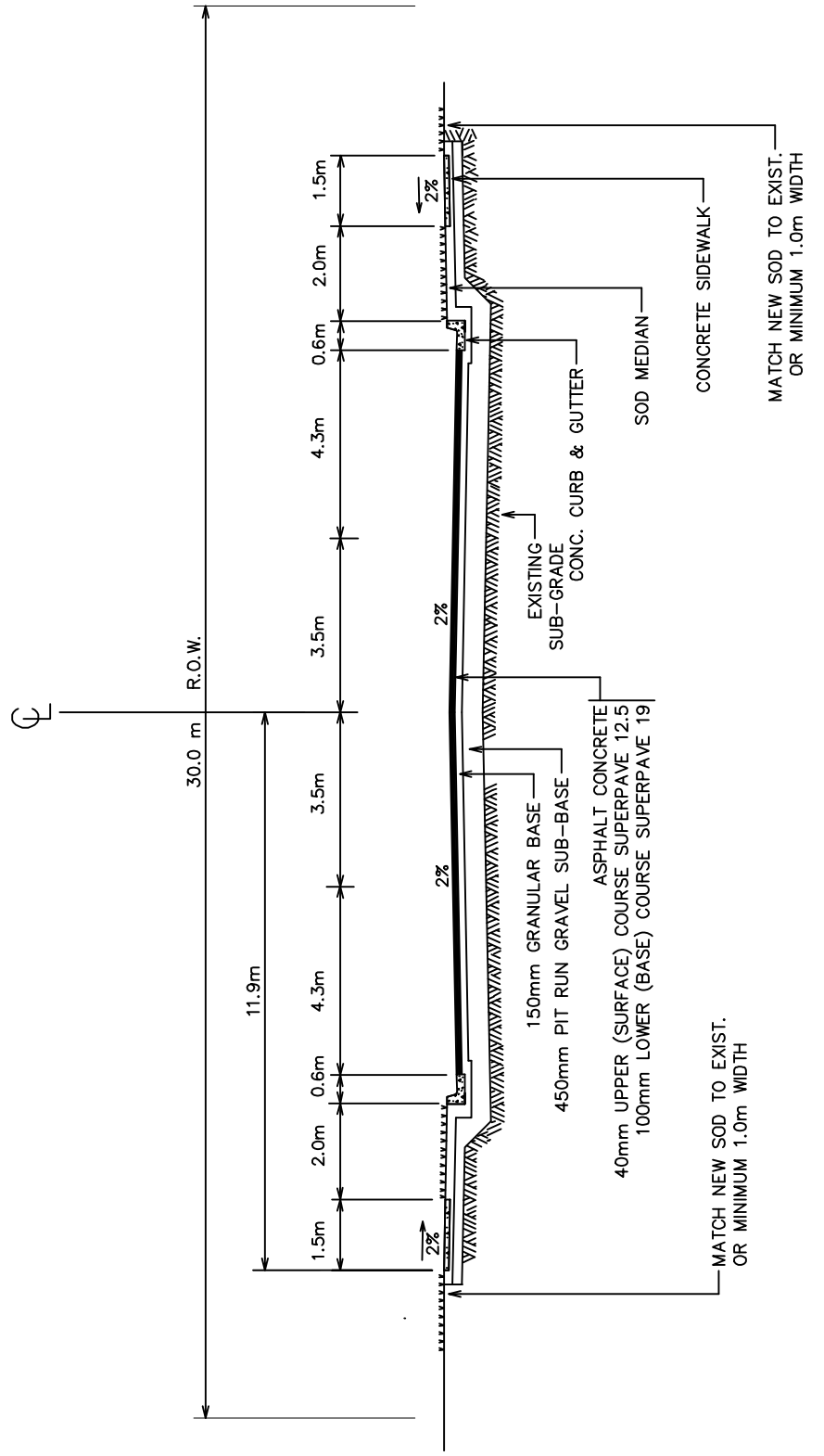
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB & GUTTER AND SIDEWALK DETAILS SEE STANDARD DRAWINGS S045-309 TO S045-315
3. MEDIAN WIDTH TO BE 2.0m WHEN USING BARRIER CURB
4. DESIGN ESAL; S: 3 TO < 10 MILLION

City of Saint John

TYPICAL CROSS SECTION COLLECTOR STREET

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 3		DWG. No. S045-301
CHECKED BY	SCALE N.T.S.	DATE JAN. 2011		



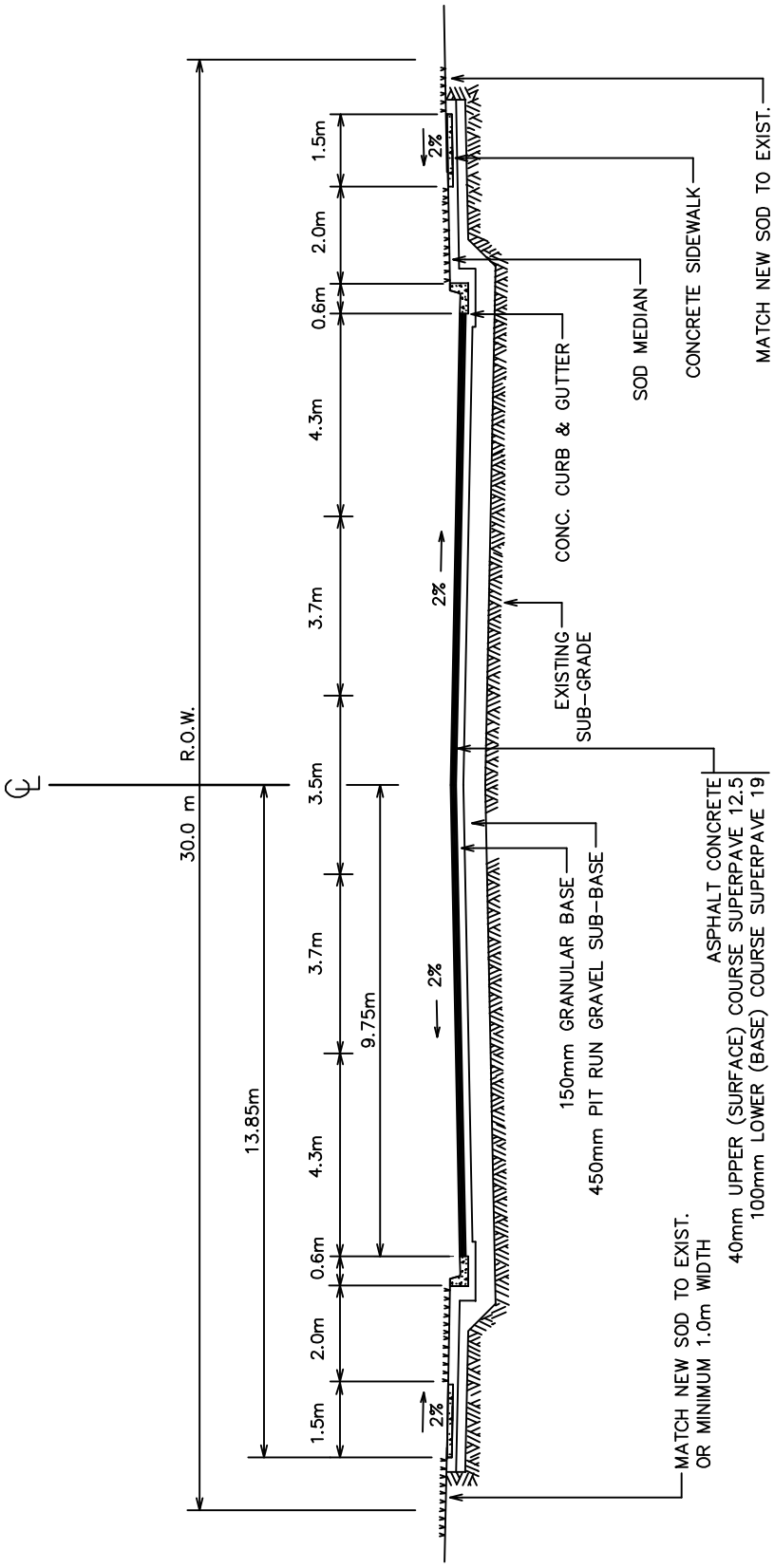
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB & GUTTER AND SIDEWALK DETAILS SEE STANDARD DRAWINGS S045-309 TO S045-315
3. DESIGN ESAL'S: 3 TO < 10 MILLION

City of Saint John

TYPICAL CROSS SECTION
4 LANE COLLECTOR STREET

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 3		DWG. No. S045-302
CHECKED BY	SCALE N.T.S.	DATE JAN. 2011		



NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB & GUTTER AND SIDEWALK DETAILS SEE STANDARD DRAWINGS S045-309 TO S045-315
3. DEIGN ESAL'S: 3 TO < 10 MILLION

City of Saint John

TYPICAL CROSS SECTION
5 LANE ARTERIAL STREET

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 3		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE JAN. 2011		S045-303

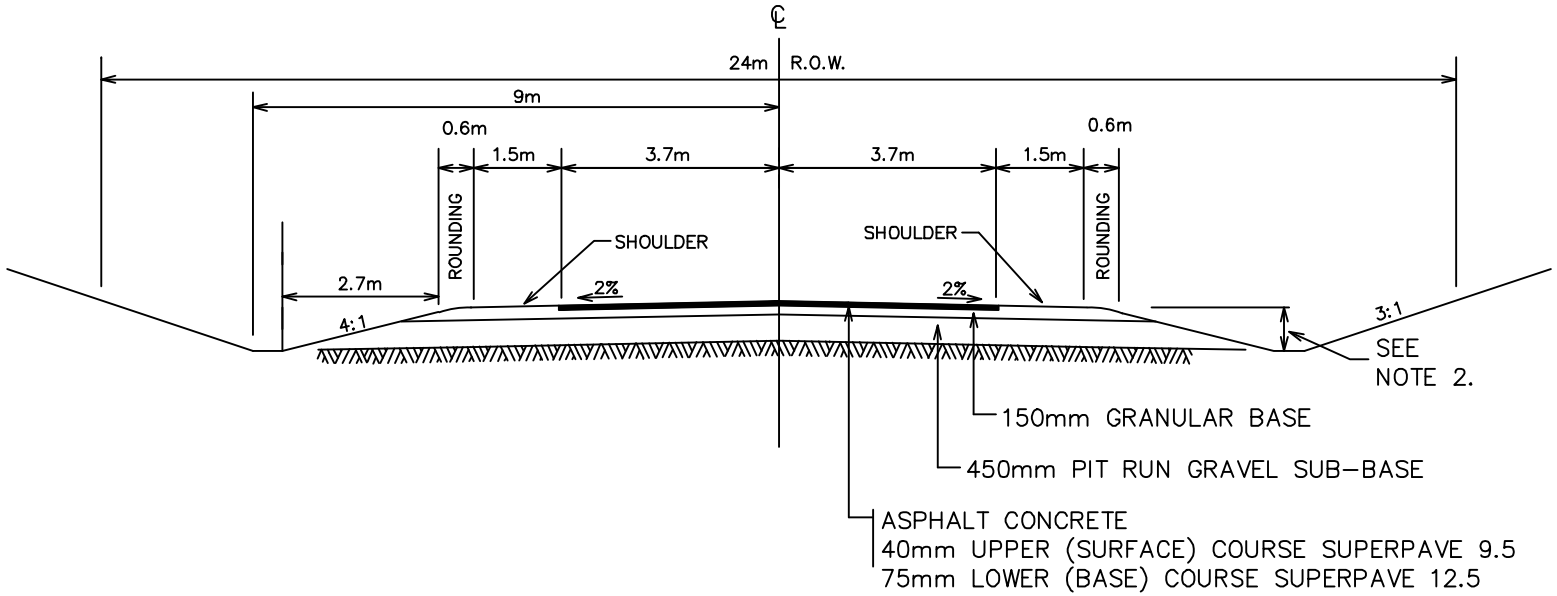
City of Saint John

DWN. BY: D . BERUBE | DATE JAN. 2016 | REV. No. 4

CHECKED BY | SCALE N.T.S | DATE JAN. 2016

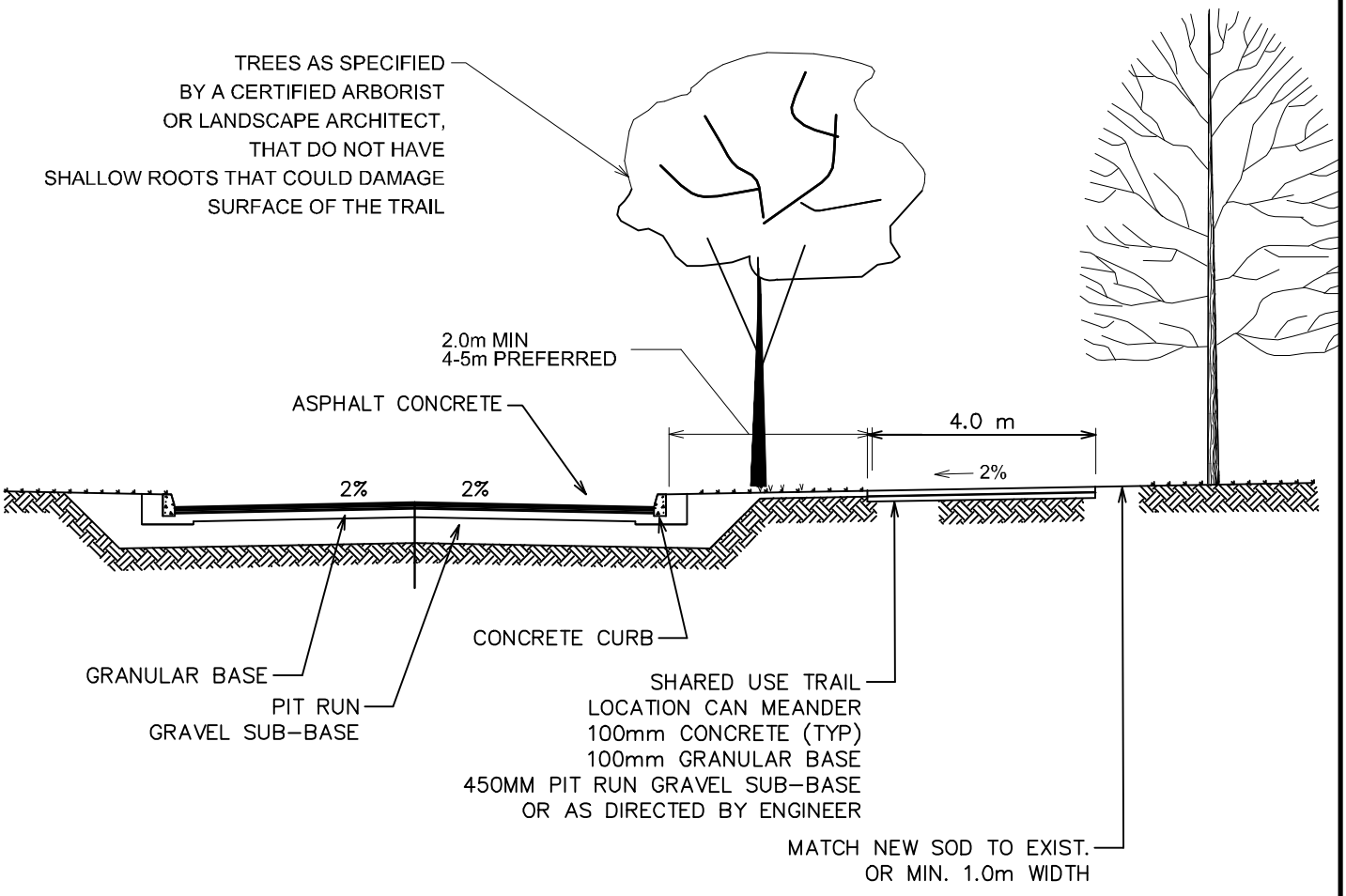
DWG. No. S045-304

TYPICAL CROSS SECTION
RURAL ROAD



NOTES:

1. DIMENSIONS ARE AS SHOWN
2. MINIMUM DEPTH FOR DITCHES IS 0.75m
3. IF ROAD IS DECLARED A "BIKE ROUTE" THEN ASPHALT SHALL BE WIDENED TO ACCOMMODATE BIKE LANES AND 500mm WIDE GRAVEL SHOULDER AREA
4. DESIGN ESAL'S: 0.3 TO < 3 MILLION
5. NEW RURAL ROADS ARE TO BE LOCATED OUTSIDE THE PRIMARY DEVELOPMENT AREA (P.D.A.) OR ON LAND ZONED SUBURBAN RESIDENTIAL (RSS)



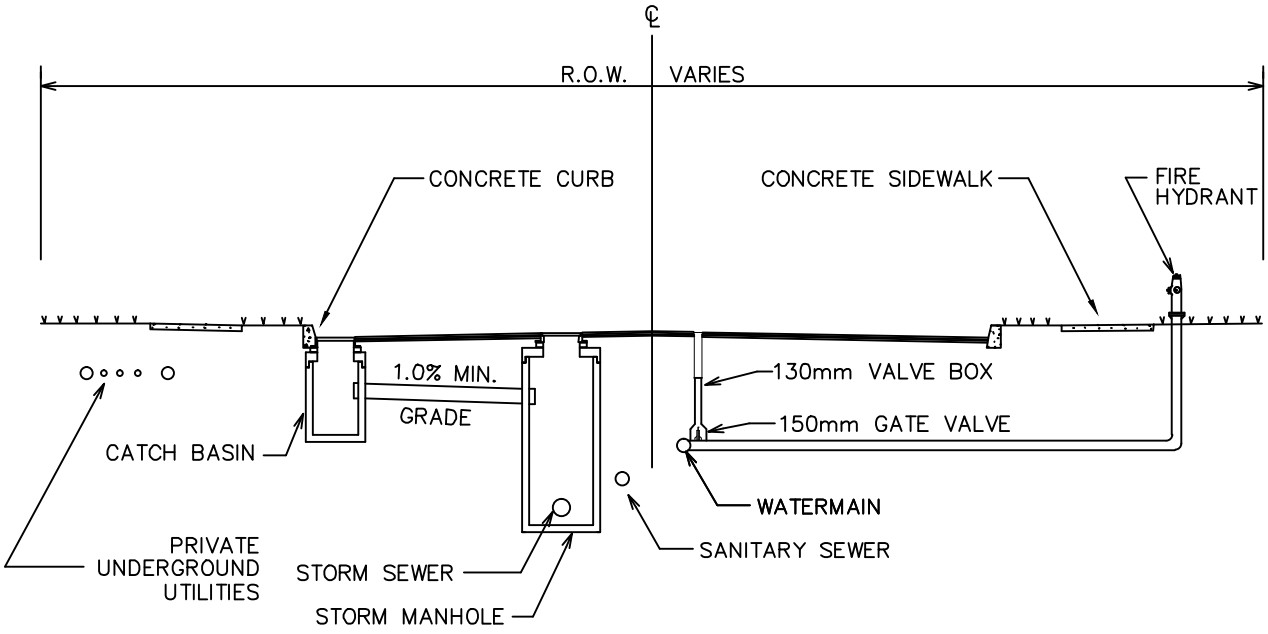
NOTES:

1. FOR CURB AND SIDEWALK DETAILS SEE STANDARD DRAWINGS S045-309 TO S045-315
2. WIDTH OF BOULEVARD BETWEEN ROAD AND TRAIL SHALL BE A MINIMUM OF 2.0m, BUT SHALL INCREASE TO 4.0-5.0m WHERE SPACE PERMITS

City of Saint John

TYPICAL CROSS SECTION SHARED USE TRAIL

DWN. BY J. GRANGER	DATE JAN 2009	REV. No.		DWG. No. S045-304A
CHECKED BY DP	SCALE N.T.S.	DATE		



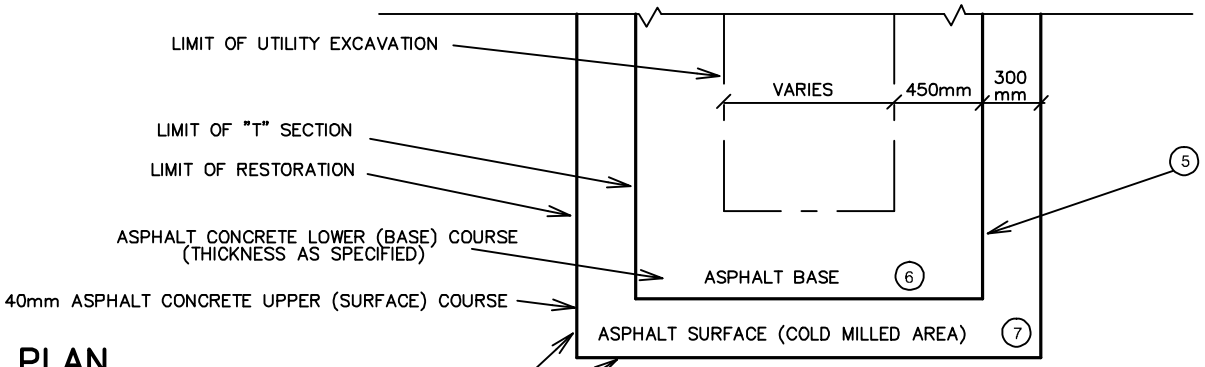
NOTE:

1. SEE RESPECTIVE STANDARD DRAWINGS FOR DIMENSIONS

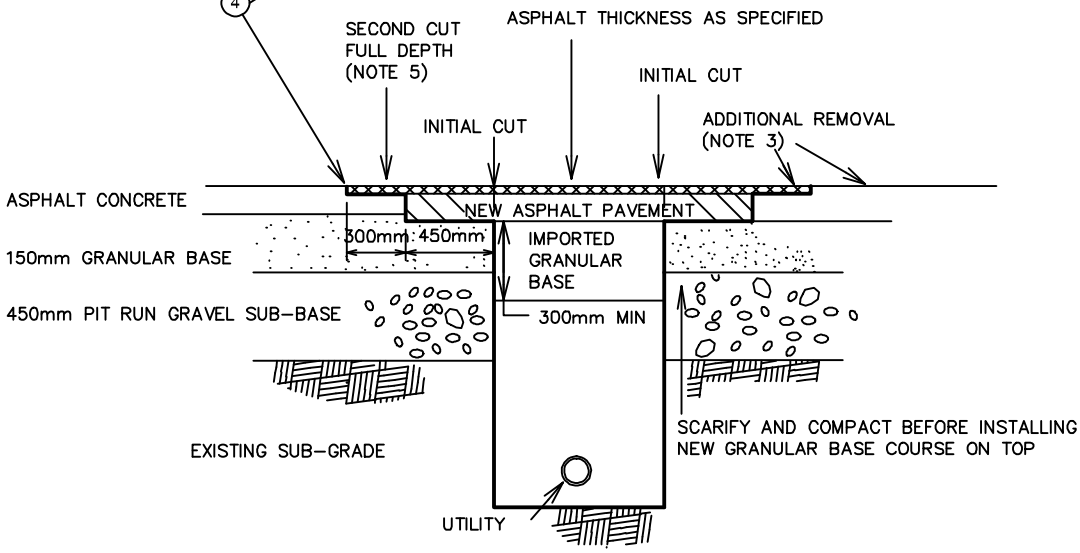
City of Saint John

TYPICAL CROSS SECTION STREETS & SERVICES

DWN. BY J. GRANGER	DATE JAN 2004	REV. No. 2		DWG. No. S045–305
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		



PLAN



SECTION

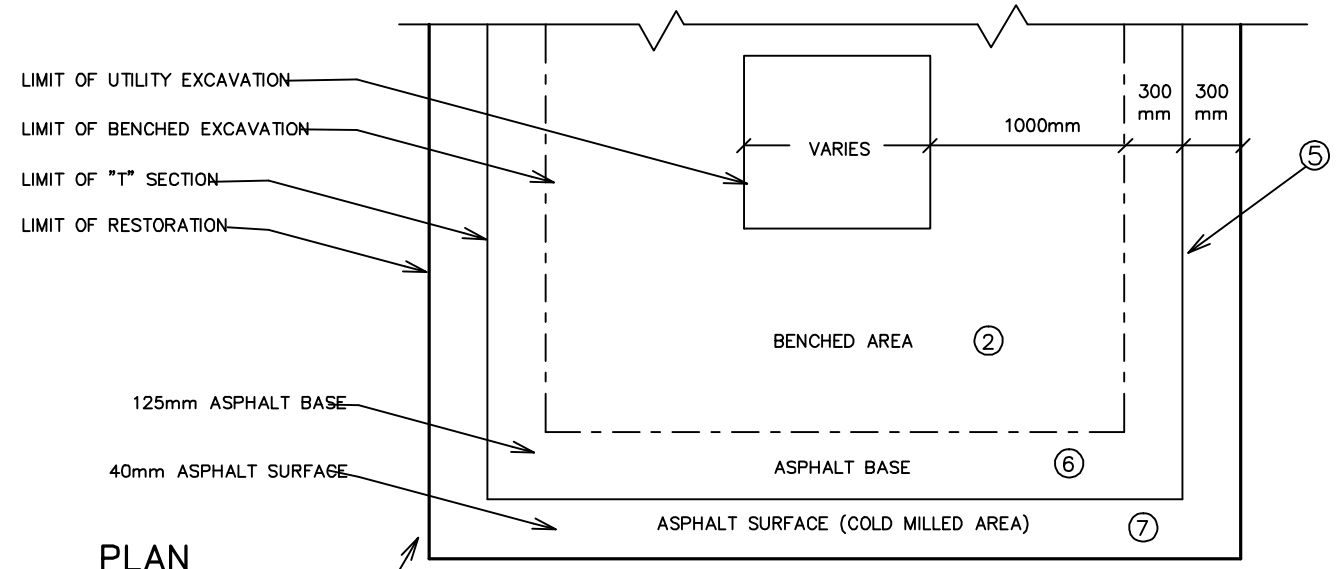
NOTES:

1. PIPE BEDDING AND PIPE ZONE BACKFILL PER CITY SPECIFICATIONS - DO NOT USE QUARRIED LIMESTONE
2. EXCAVATE AND REMOVE ANY UNDERMINED ASPHALT
3. REMOVE ADDITIONAL PAVEMENT TO A PAINTED LANE STRIPE, CURB, OR AN EDGE OF PAVEMENT IF SUCH STREET FEATURE IS WITHIN 600mm OF THE SECOND CUT IN THE ASPHALT
4. THE LIMITS OF RESTORATION SHALL BE A RECTANGULAR AREA EXTENDING 300mm BEYOND THE OUTER EDGE OF THE WIDEST PORTION OF THE "T" SECTION
   THE EXISTING ASPHALT CONCRETE SHALL BE REMOVED TO A DEPTH EQUAL TO THE THICKNESS OF THE UPPER (SURFACE) COURSE (40mm) BY COLD MILLING
5. NEATLY CUT THE PERIMETER OF ALL EXCAVATIONS TO PROVIDE CLEAN STRAIGHT VERTICAL SIDES
6. CONSTRUCT NEW ASPHALT CONCRETE LOWER (BASE) COURSE AS SPECIFIED
7. CONSTRUCT NEW ASPHALT CONCRETE UPPER (SURFACE) COURSE 40mm IN DEPTH
8. PROVIDE FULL TACK COAT COVERAGE ON ALL VERTICAL AND MILLED SURFACES
9. ALL WORK SHALL BE DONE IN ACCORDANCE WITH CITY OF SAINT JOHN SPECIFICATIONS

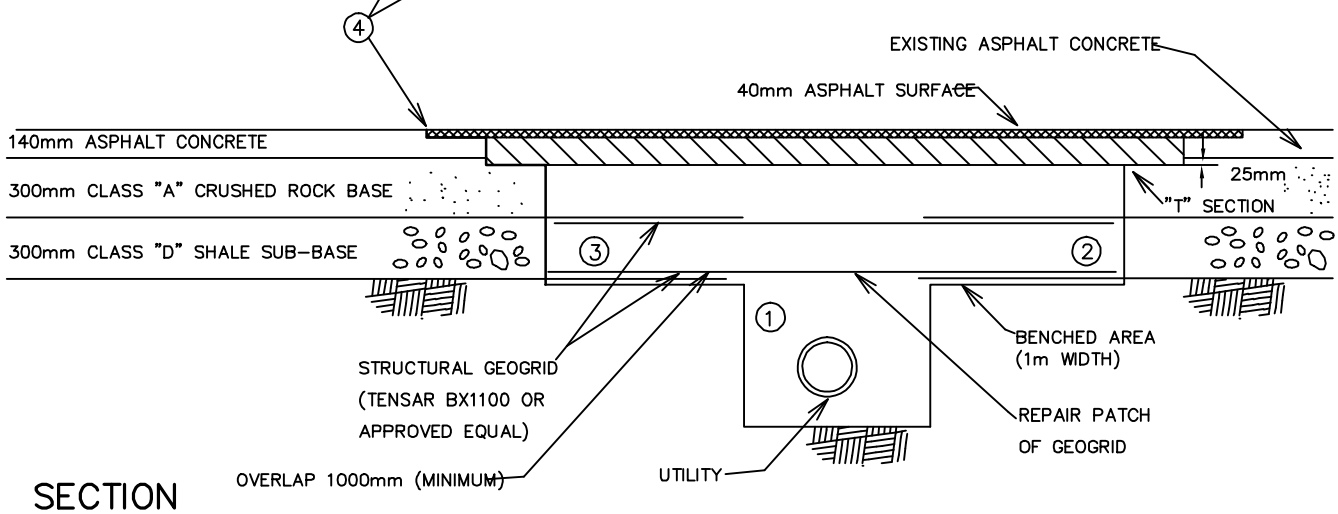
City of Saint John

UTILITY RESTORATION ASPHALT CONCRETE "T" PATCH

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 3		DWG. No. S045-307
CHECKED BY	SCALE N.T.S.	DATE JAN 2011		



PLAN



SECTION

NOTES:

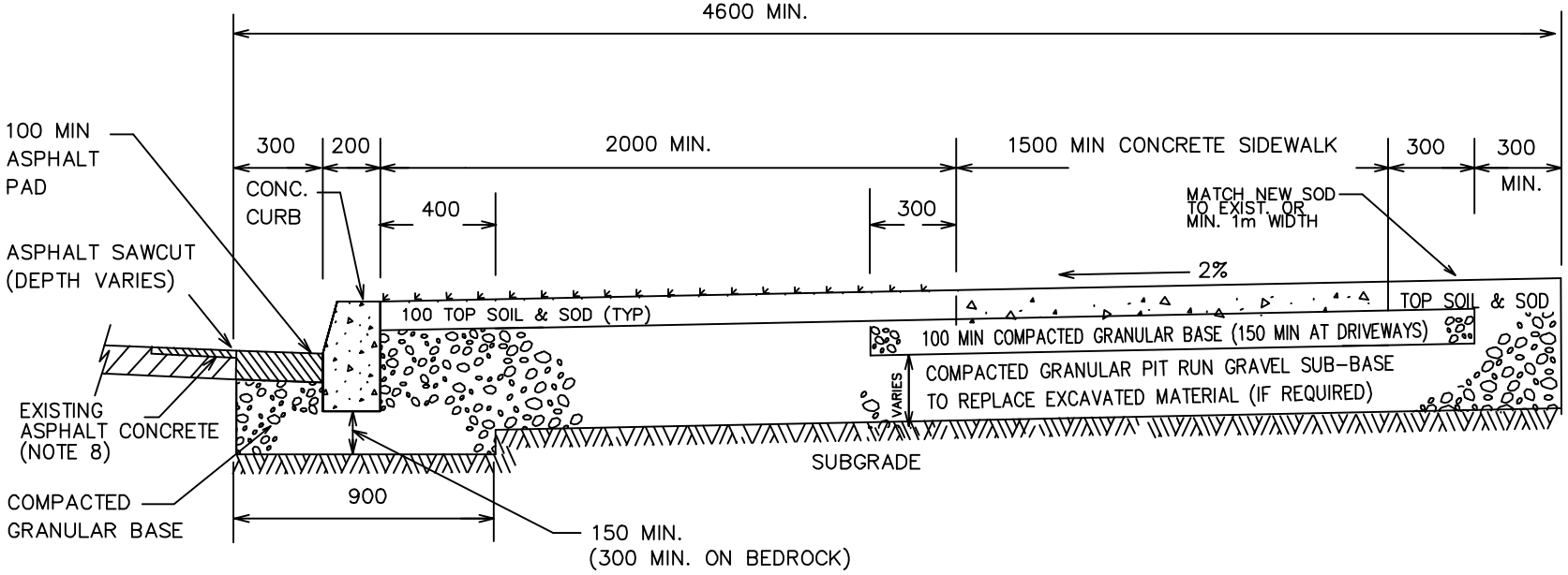
1. PIPE BEDDING AND PIPE ZONE BACKFILL PER CITY SPECIFICATIONS – DO NOT USE QUARRIED LIMESTONE
2. EXCAVATE (BENCH) TRENCH TO EXPOSE 1000mm ON BOTH LAYERS OF GEOGRID
3. FASTEN REPAIR PATCH (WITH NO SLACK) TO EXISTING GEOGRID USING ELECTRICAL "PULL TIES" EVERY 300mm
4. THE LIMITS OF RESTORATION SHALL BE A RECTANGULAR AREA EXTENDING 300mm BEYOND THE OUTER EDGE OF THE WIDEST PORTION OF THE "T" SECTION
   THE EXISTING ASPHALT CONCRETE SHALL BE REMOVED TO A DEPTH EQUAL TO THE THICKNESS OF THE UPPER (SURFACE) COURSE(40mm) BY COLD MILLING
5. NEATLY CUT THE PERIMETER OF ALL EXCAVATIONS TO PROVIDE CLEAN STRAIGHT VERTICAL SIDES
6. CONSTRUCT NEW ASPHALT CONCRETE LOWER (BASE) COURSE 25mm THICKER THAN THE EXISTING SECTION
7. CONSTRUCT NEW ASPHALT CONCRETE UPPER (SURFACE) COURSE 40mm IN DEPTH
8. PROVIDE FULL TACK COAT COVERAGE ON ALL VERTICAL SURFACES AND MILLED SURFACES
9. ALL WORK SHALL BE DONE IN ACCORDANCE WITH CITY OF SAINT JOHN SPECIFICATIONS

City of Saint John

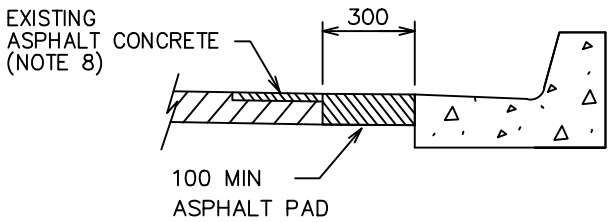
STREET RESTORATIONS OF EXCAVATIONS CONTAINING STRUCTURAL GEOGRID

DWN. BY J. GRANGER	DATE JAN 2004	REV. No. 1		DWG. No. S045–308
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		

City of Saint John



CURB AND GUTTER



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
2. THICKNESS OF REGULAR SIDEWALK SHALL BE 100 mm MINIMUM
3. THICKNESS OF SIDEWALK AT DRIVEWAYS SHALL BE 150 mm MINIMUM
4. MANHOLE COVERS, SERVICE BOXES, ETC. LOCATED IN NEW SIDEWALK SHALL BE ADJUSTED TO FINAL SIDEWALK ELEVATIONS
5. IF CURB AND GUTTER IS INSTALLED (STANDARD DRAWING S045-311), THE GRASS MEDIAN AND SIDEWALK DIMENSIONS REMAIN THE SAME AS SHOWN ABOVE
6. MINIMUM 300mm COMPACTED GRANULAR BASE UNDER SIDEWALK IF IN BEDROCK
7. CURB ELEVATION SHALL BE AS SHOWN ON CONSTRUCTION DRAWINGS, OR AS DIRECTED BY THE ENGINEER
8. REFER TO STANDARD DRAWING S045-307, UTILITY RESTORATION ASPHALT CONCRETE "T" PATCH, FOR COLD MILLING EXISTING ASPHALT CONCRETE

TYPICAL SECTION CONCRETE CURB AND SIDEWALK WITH GRASS MEDIAN

DWN. BY J. GRANGER	
CHECKED BY	
DATE JAN. 2004	
SCALE N.T.S.	
REV. No. 2	
DATE JAN 2011	
DWG. No. S045-309	

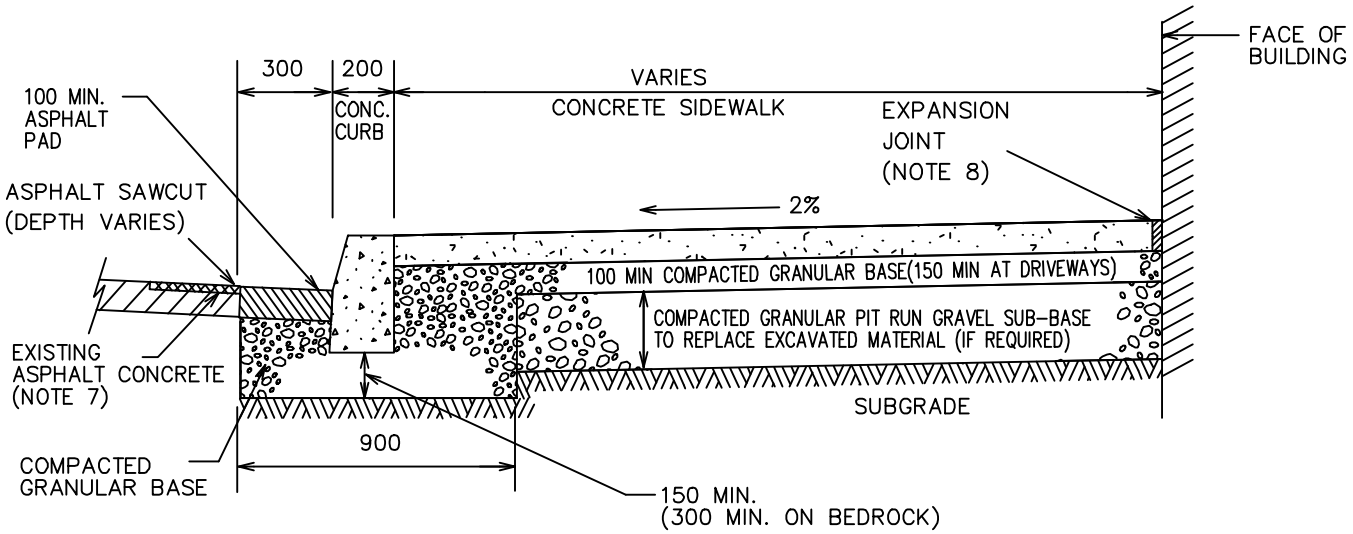
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
2. THICKNESS OF REGULAR SIDEWALK SHALL BE 100 mm MINIMUM
3. THICKNESS OF SIDEWALK AT DRIVEWAYS SHALL BE 150 mm MINIMUM
4. MANHOLE COVERS, SERVICE BOXES, ETC. LOCATED IN NEW SIDEWALK SHALL BE ADJUSTED TO FINAL SIDEWALK ELEVATIONS
5. MINIMUM 300mm COMPACTED GRANULAR BASE UNDER SIDEWALK IF IN BEDROCK
6. CURB ELEVATION SHALL BE AS SHOWN ON CONSTRUCTION DRAWINGS, OR AS DIRECTED BY THE ENGINEER

City of Saint John

TYPICAL SECTION
CONCRETE CURB AND SIDEWALK
WITH BRICK MEDIAN

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 3	DWG. No. S045-309A
CHECKED BY	SCALE N.T.S.	DATE FEB 2022	



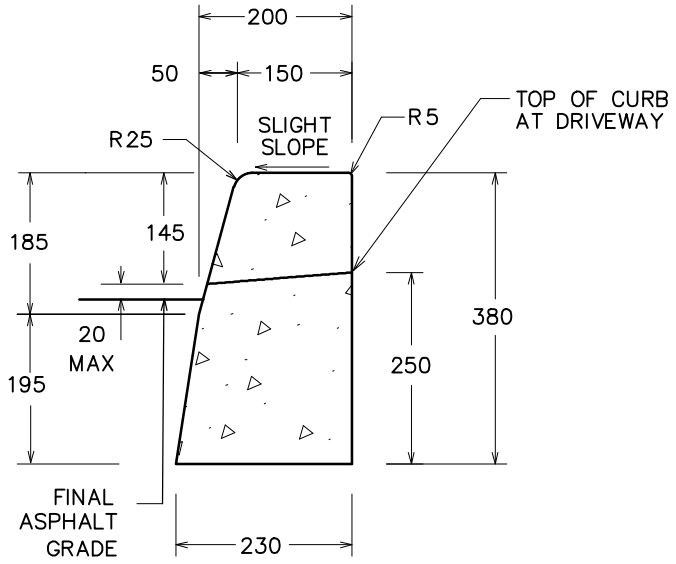
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
2. THICKNESS OF REGULAR SIDEWALK SHALL BE 100 mm MINIMUM
3. THICKNESS OF SIDEWALK AT DRIVEWAYS SHALL BE 150 mm MINIMUM
4. MANHOLE COVERS, SERVICE BOXES, ETC. LOCATED IN NEW SIDEWALK SHALL BE ADJUSTED TO FINAL SIDEWALK ELEVATIONS
5. MINIMUM 300 mm COMPACTED GRANULAR BASE UNDER SIDEWALK IF IN BEDROCK
6. CURB ELEVATION SHALL BE AS SHOWN ON CONSTRUCTION DRAWINGS, OR AS DIRECTED BY THE ENGINEER
7. REFER TO STANDARD DRAWING S045-307, UTILITY RESTORATION ASPHALT CONCRETE "T" PATCH, FOR COLD MILLING EXISTING ASPHALT CONCRETE
8. EXPANSION JOINT SHALL BE DECK-O-FOAM, OR APPROVED EQUAL, AND FINISHED WITH SELF LEVELING POLYURETHANE SEALANT IN ACCORDANCE WITH SECTION 23.5.02

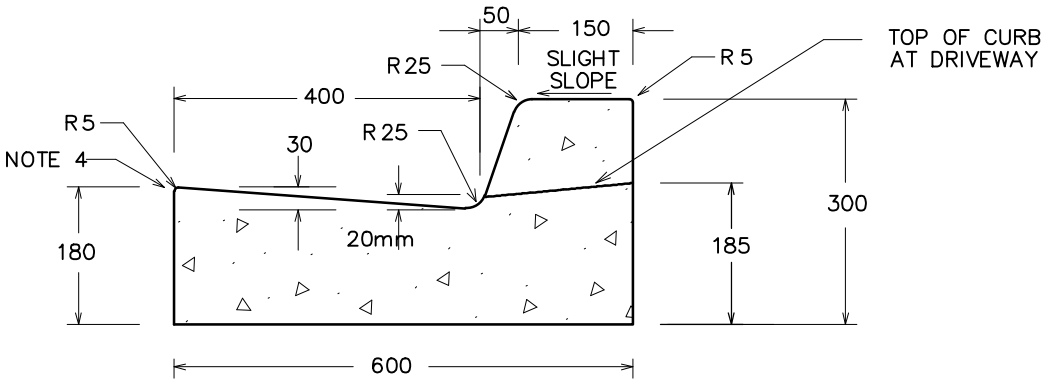
City of Saint John

TYPICAL SECTION CONCRETE CURB AND FULL WIDTH SIDEWALK

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 1		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE JAN 2007		S045-310



CURB



CURB & GUTTER

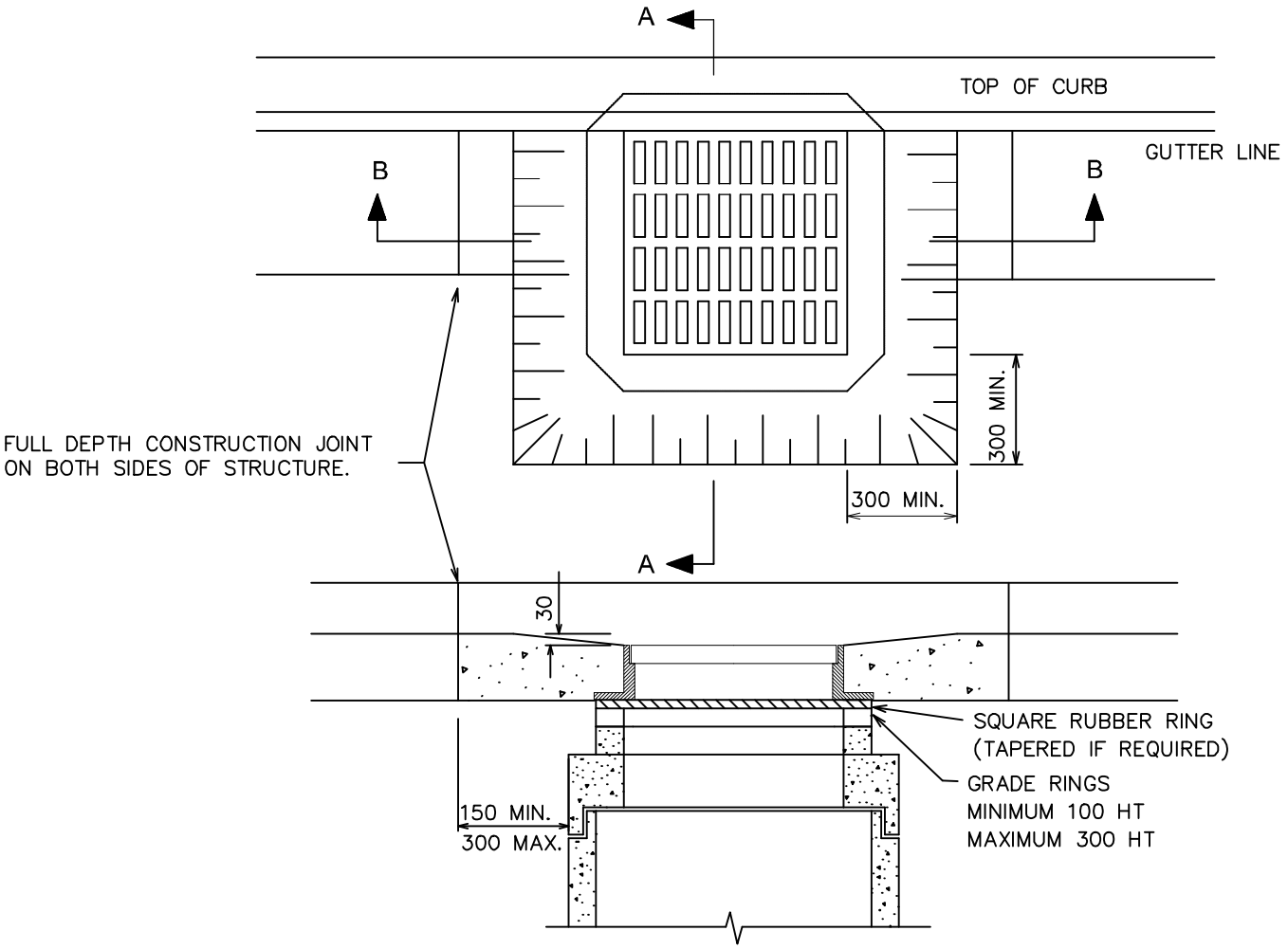
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN
2. DROP CURBS AT DRIVEWAY ENTRANCES AS SHOWN, TO 20 mm MAXIMUM ABOVE FINISHED ASPHALT GRADE
3. SAW CUT/CONTROL JOINTS AT 3m INTERVALS
4. FLEXIBLE AND COMPOSITE PAVEMENT SHALL BE 5mm ABOVE THE ADJACENT GUTTER EDGE

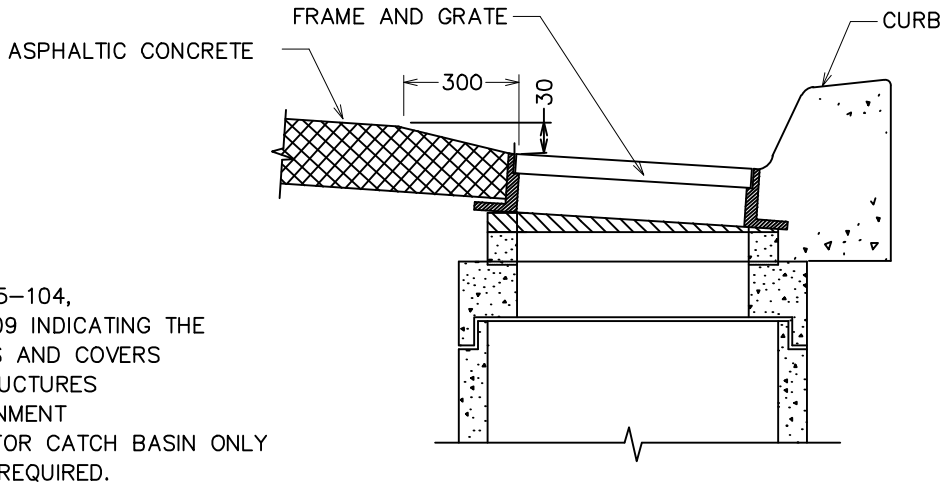
City of Saint John

DETAILS
CONCRETE CURB
CONCRETE CURB & GUTTER

DWN. BY J. GRANGER	DATE JAN 2004	REV. No. 1		DWG. No. S045–311
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		



SECTION B – B



SECTION A – A

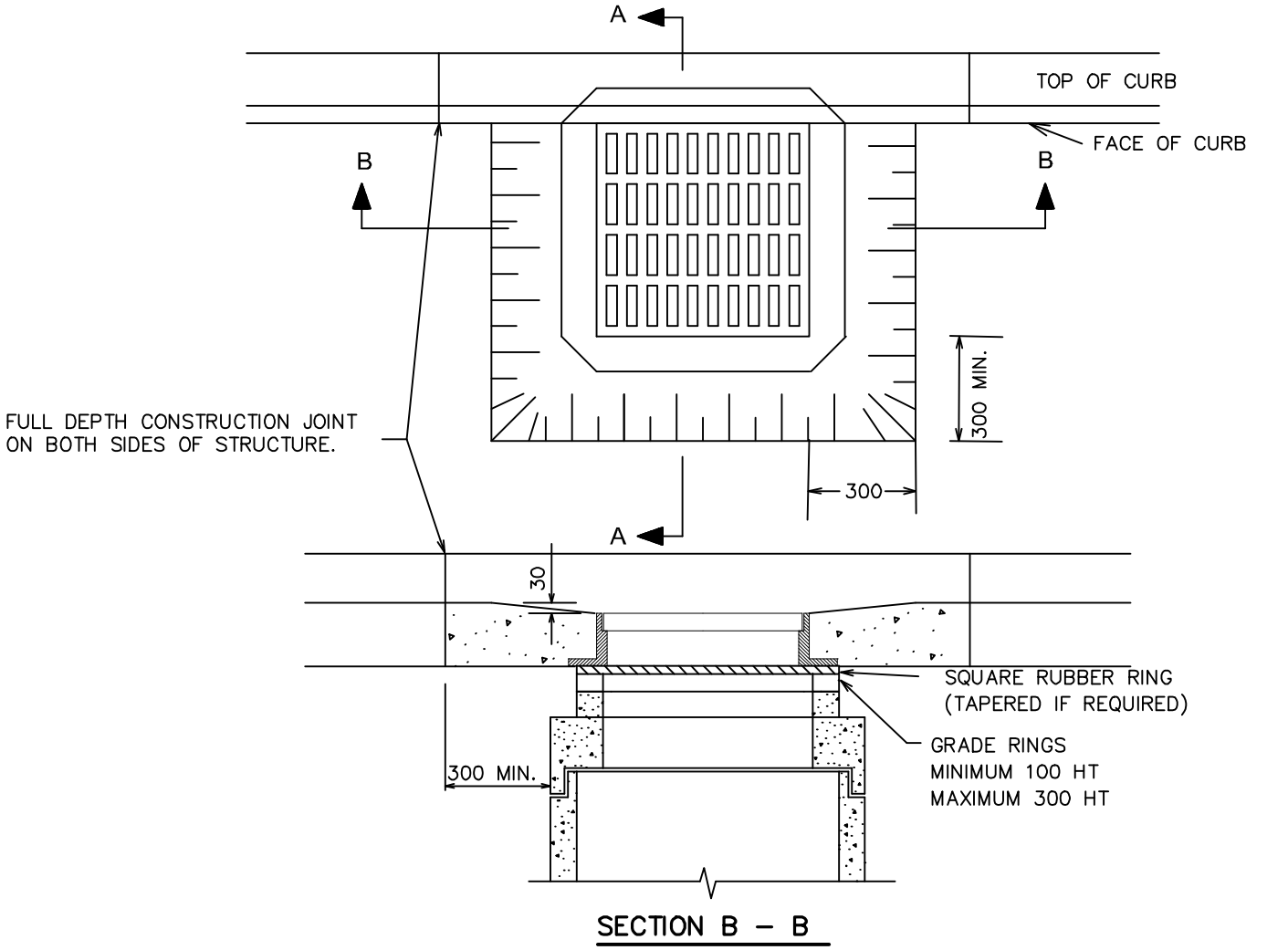
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. REFER TO STANDARD DRAWINGS S045–104, S045–108, S045–207 AND S045–209 INDICATING THE VARIOUS TYPES OF FRAMES, GRATES AND COVERS
3. THIS PRINCIPLE APPLIES TO ALL STRUCTURES THAT MAY FALL ON THE CURB ALIGNMENT
4. SLOPING AROUND FRAME REQUIRED FOR CATCH BASIN ONLY
5. SQUARE RUBBER GRADE RINGS ARE REQUIRED.

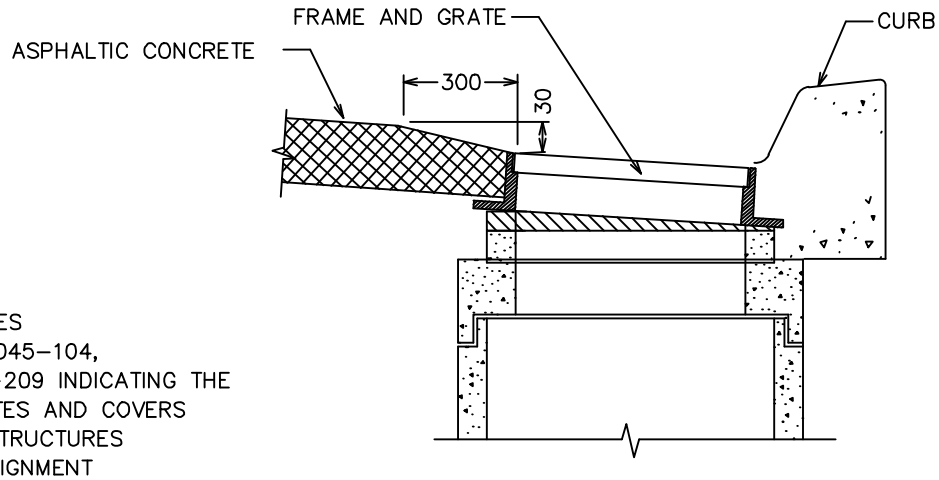
City of Saint John

TYPICAL CONCRETE CURB AND GUTTER AT CATCH BASIN

DWN. BY J. GRANGER	DATE JAN 2004	REV. No. 4		DWG. No. S045–312
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		



SECTION B – B



SECTION A – A

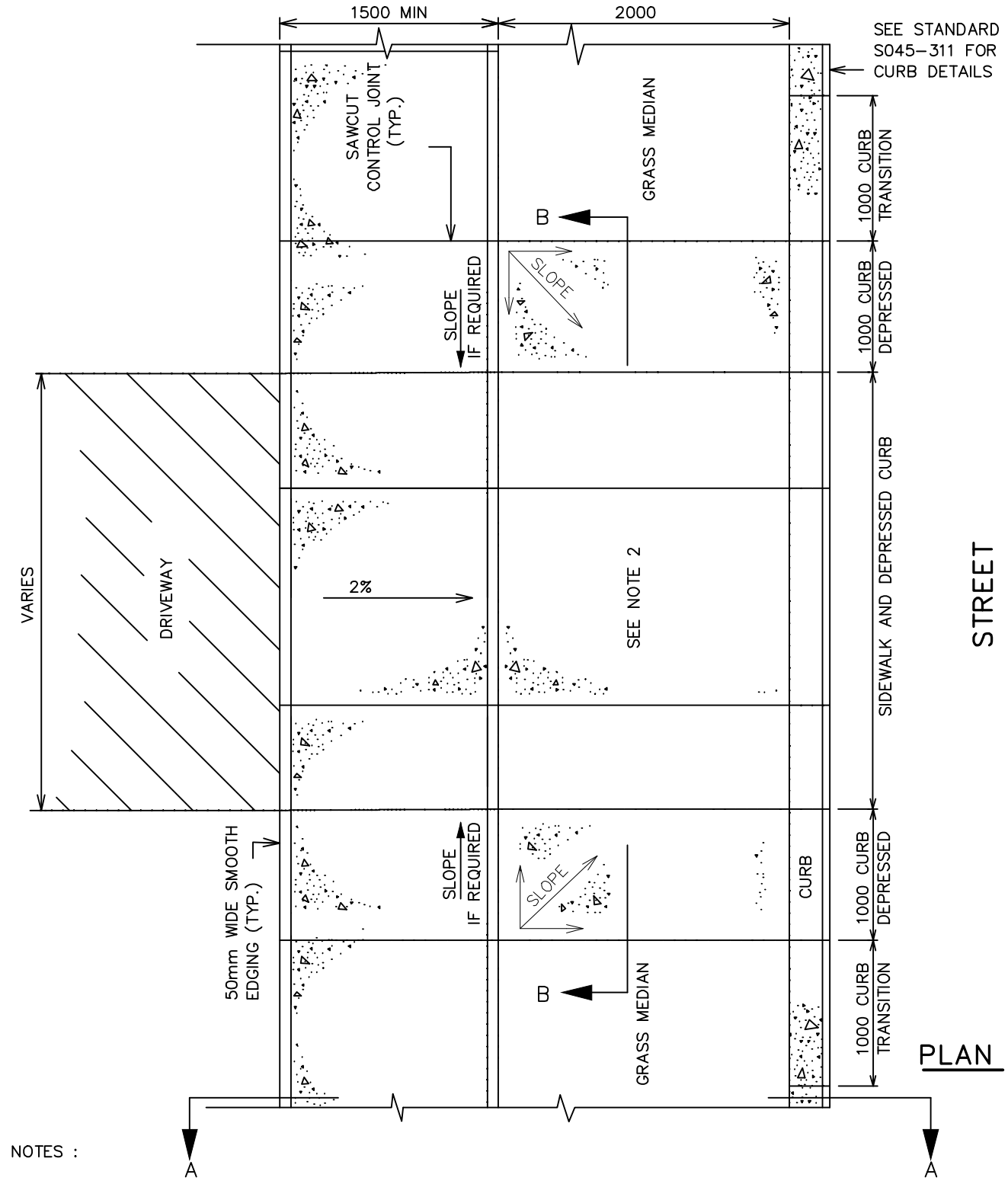
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. REFER TO STANDARD DRAWINGS S045–104, S045–108, S045–207 AND S045–209 INDICATING THE VARIOUS TYPES OF FRAMES, GRATES AND COVERS
3. THIS PRINCIPLE APPLIES TO ALL STRUCTURES THAT MAY FALL ON THE CURB ALIGNMENT
4. SLOPING AROUND FRAME REQUIRED FOR CATCH BASIN ONLY
5. SQUARE RUBBER GRADE RINGS ARE REQUIRED.

City of Saint John

TYPICAL CONCRETE CURB AT CATCH BASIN

DWN. BY J. GRANGER	DATE JAN 2009	REV. No.		DWG. No. S045–312A
CHECKED BY JC	SCALE N.T.S.	DATE		



NOTES :

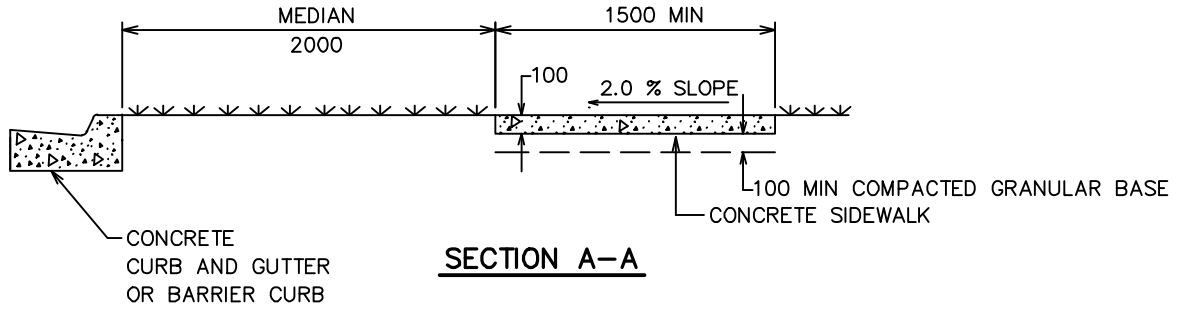
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. DRIVEWAY MEDIAN SHALL BE 150mm THICK CONCRETE UNLESS OTHERWISE SPECIFIED
3. SAW CUT CONTROL JOINTS SHALL HAVE SPACING THE WIDTH OF SIDEWALK
4. WHERE GRADES PERMIT, FULL HEIGHT SIDEWALK IS PREFERRED

FOR SECTION A–A SEE DWG. S045–314
FOR SECTION B–B SEE DWG. S045–314

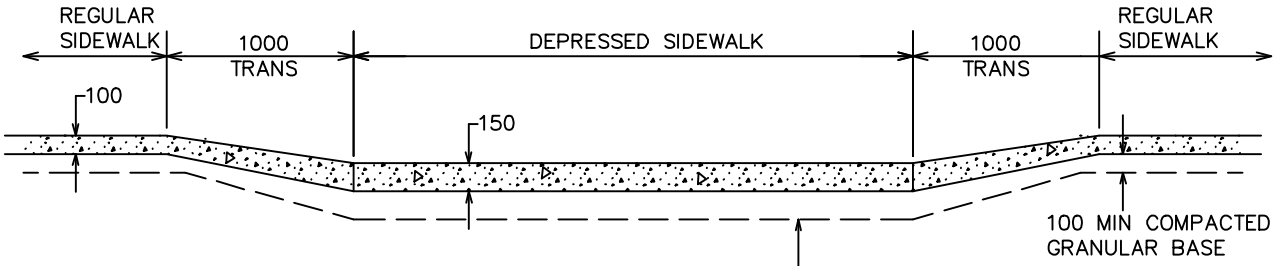
City of Saint John

CONCRETE SIDEWALK TYPICAL PLAN VIEW

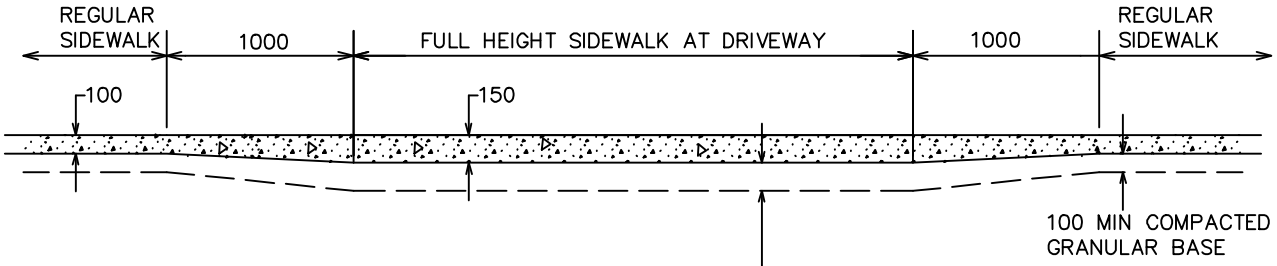
DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 2		DWG. No. S045–313
CHECKED BY	SCALE N.T.S.	DATE JAN. 2010		



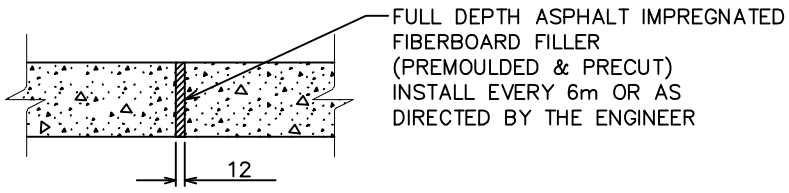
SECTION A–A



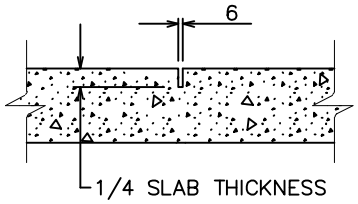
SECTION B–B



SECTION B–B



EXPANSION JOINT



CONTROL JOINT

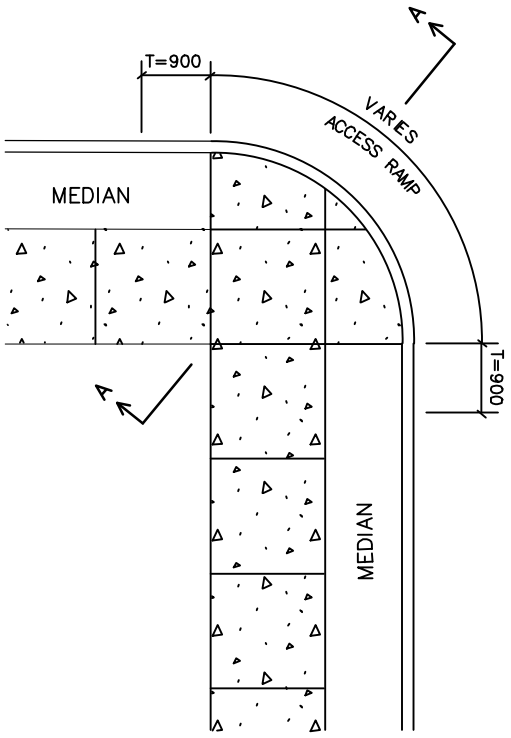
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. SAW CUT CONTROL JOINTS ARE REQUIRED AT OBSTRUCTIONS. E.G. HYDRANTS, LIGHT STANDARDS, ETC.
3. SAW CUT CONTROL JOINTS SHALL HAVE SPACING THE WIDTH OF THE SIDEWALK
4. ALL CONCRETE EDGES TO BE CHAMFERED, 6mm RADIUS
5. SEE DRAWING S045–313 FOR PLAN VIEW OF 1000mm TRANSITION
6. WELDED WIRE FABRIC TO BE USED AT NON–RESIDENTIAL DRIVEWAYS, OR AS DIRECTED BY THE ENGINEER
7, WHERE GRADES PERMIT, FULL HEIGHT SIDEWALK IS PREFERRED

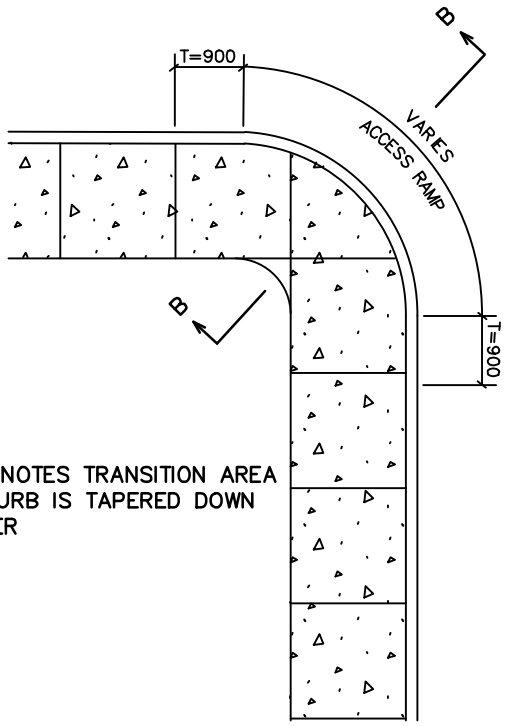
City of Saint John

CONCRETE SIDEWALK TYPICAL CROSS SECTION

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No. 3		DWG. No. S045–314
CHECKED BY	SCALE N.T.S.	DATE FEB 2014		

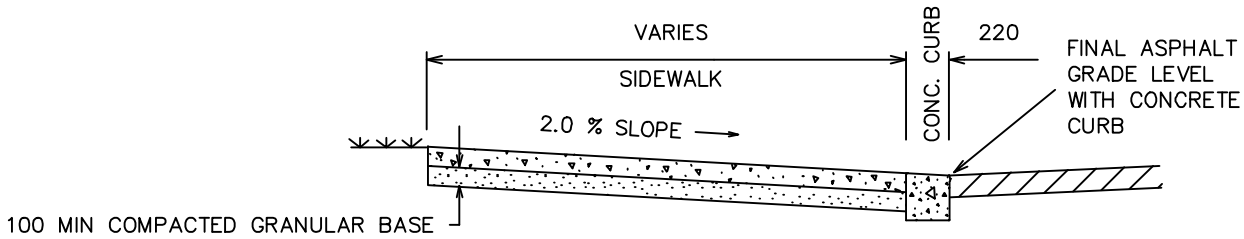


CURB AND SIDEWALK
WITH MEDIAN

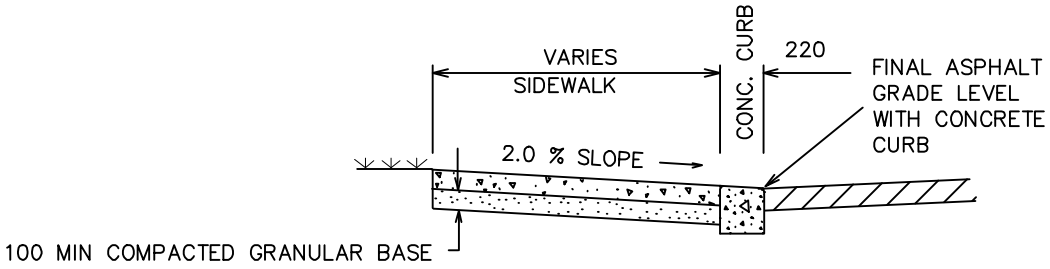


NOTE :
' T ' DENOTES TRANSITION AREA
WHERE CURB IS TAPERED DOWN
TO GUTTER

CURB AND SIDEWALK
WITHOUT MEDIAN



SECTION A–A



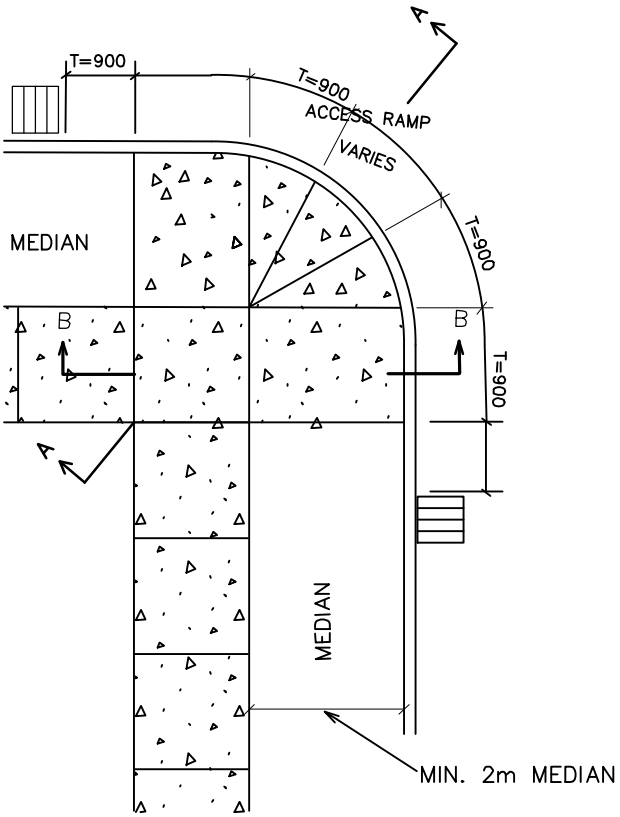
SECTION B–B

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES

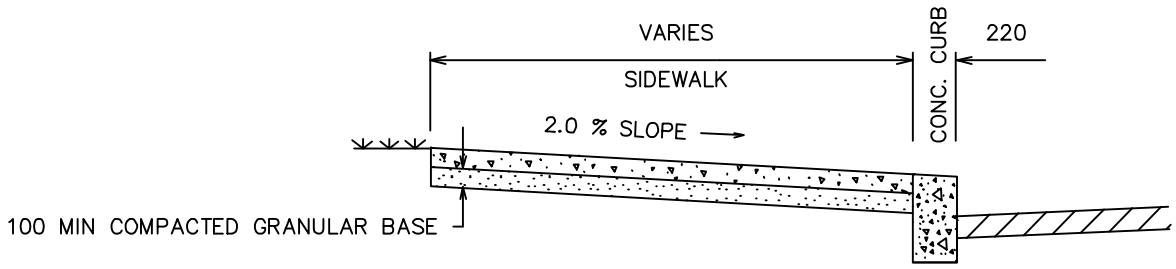
City of Saint John

TYPICAL ACCESS RAMPS

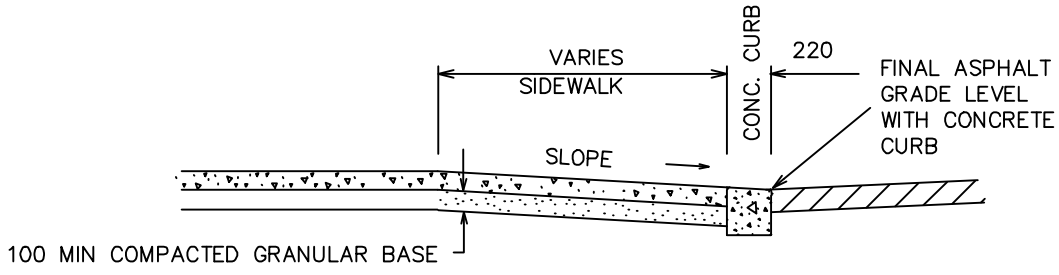
DWN. BY JAM	DATE JAN. 2004	REV. No. 1		DWG. No. S045–315
CHECKED BY	SCALE N.T.S.	DATE FEB 2005		



CURB AND SIDEWALK
WITH MEDIAN



SECTION A–A



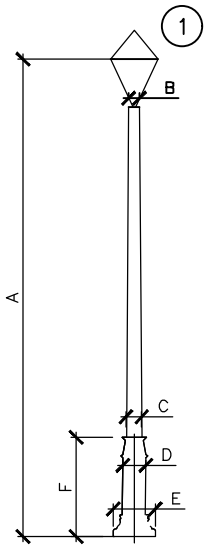
SECTION B–B

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL STRUCTURES SHALL BE LOCATED OUTSIDE THE ACCESS RAMPS AND TRANSITION AREAS

City of Saint John

TYPICAL ACCESS RAMPS WITH MEDIANS GREATER THAN 2m

DWN. BY J. GRANGER	DATE JAN 2011	REV. No.		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE		S045–315A

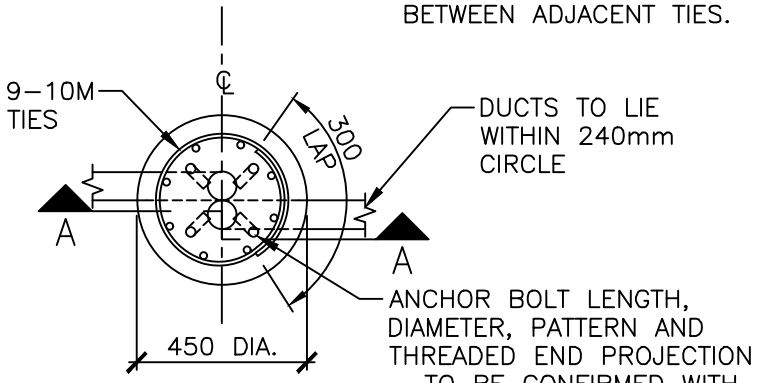


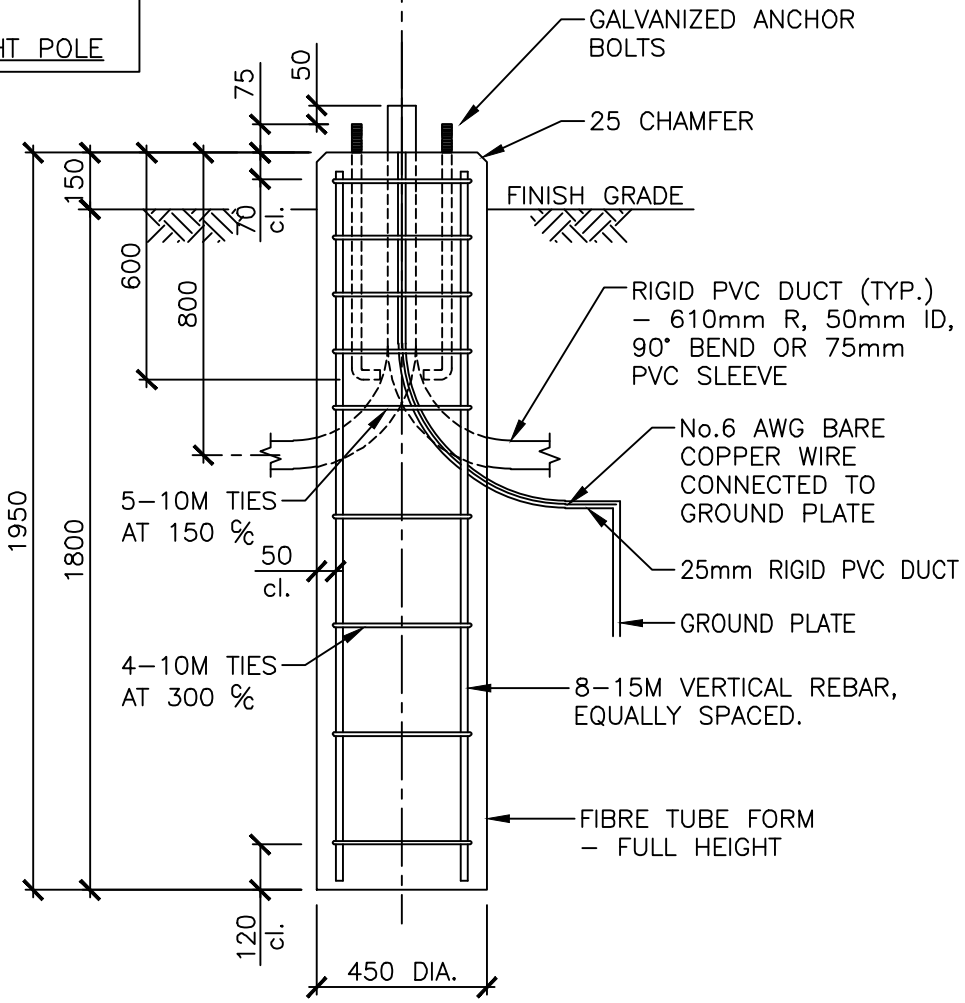
MAX.	DIMENSIONS (mm)
A	4740
B	109
C	157
D	228
E	416
F	1000

(1) LUMINAIRE MAX. EPA=1.9x10^5 mm^2 MAX. WEIGHT=120 N

GEOMETRY – DECORATIVE LIGHT POLE

NOTE: STAGGER TIE SPLICE LOCATIONS 90° BETWEEN ADJACENT TIES.





SECTION 'A–A'

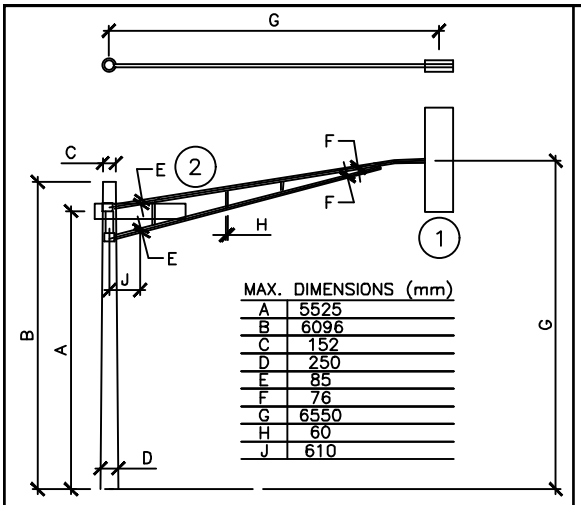
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. BASE IS FOR ALUMINIUM POLES MEETING MAXIMUM LOADING AND GEOMETRY AS NOTED ABOVE, IN GOOD TO AVERAGE SOIL CONDITIONS. INDEPENDENT PROFESSIONAL ENGINEER TO CONFIRM SUITABILITY FOR ALL APPLICATIONS THAT DO NOT MEET THESE CRITERIA.
3. EXACT NUMBER AND CONFIGURATION OF CONDUITS REQUIRED SHALL BE CONFIRMED WITH THE ENGINEER.
4. ANCHOR BOLTS AND TEMPLATE TO BE SUPPLIED BY THE POLE SUPPLIER.

City of Saint John

DECORATIVE LIGHT POLE CONCRETE BASE DETAIL

DRAWN. BY R.K.	DATE MARCH 2017	REV. No. 0		DWG. No.
CHECKED BY R.B.V.	SCALE N.T.S.	DATE MARCH 2017		S045-316

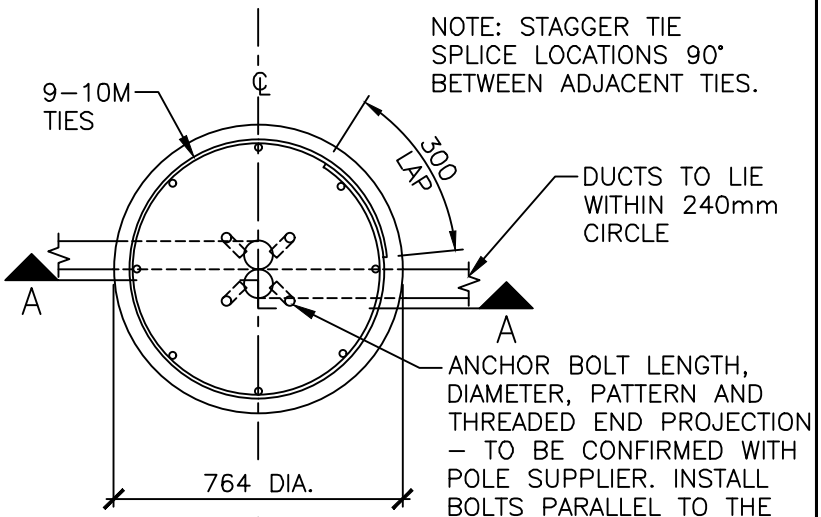


MAX. DIMENSIONS (mm)	
A	5525
B	6096
C	152
D	250
E	85
F	76
G	6550
H	60
J	610

(1) SIGNAL & BACKBOARD MAX. EPA=1.2x10^6 mm^2 MAX. WEIGHT=400 N

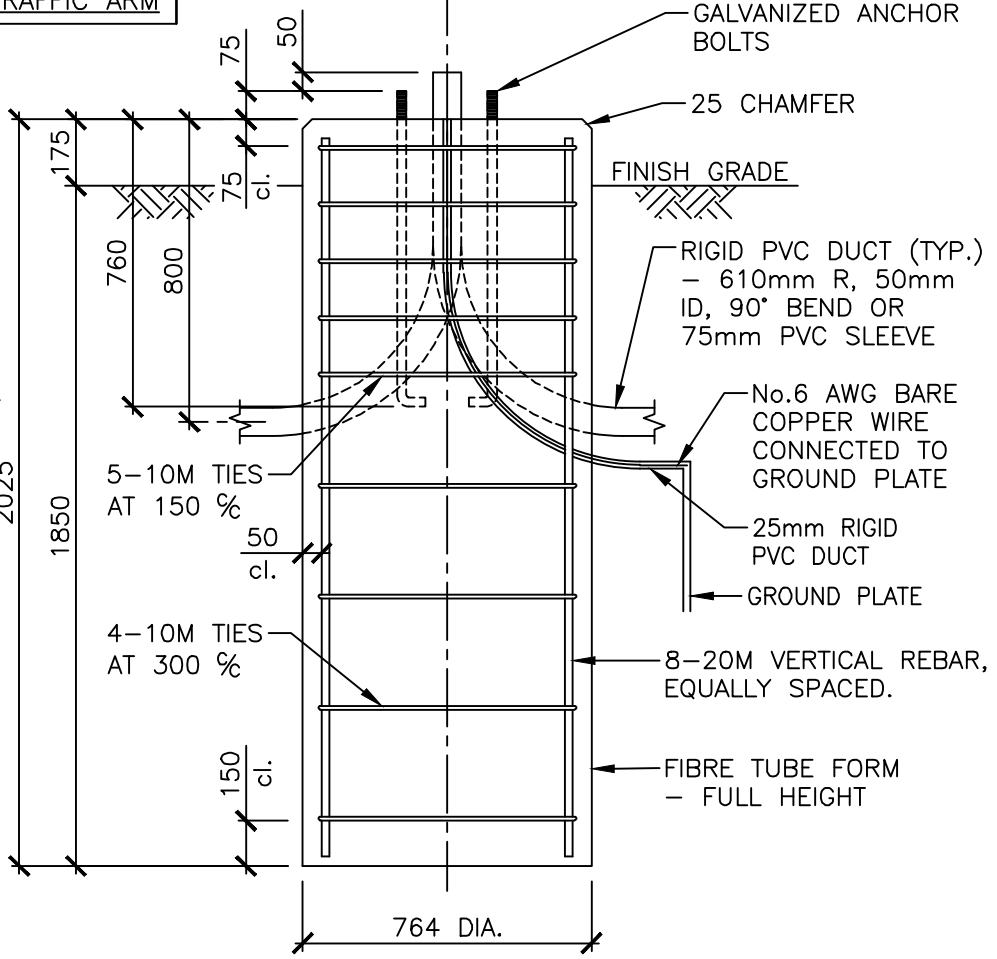
(2) STREET SIGN MAX. EPA=5.6x10^5 mm^2 MAX. WEIGHT=115 N

GEOMETRY – POLE WITH TRAFFIC ARM



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. BASE IS FOR ALUMINIUM POLES MEETING MAXIMUM LOADING AND GEOMETRY AS NOTED ABOVE, IN GOOD TO AVERAGE SOIL CONDITIONS. INDEPENDENT PROFESSIONAL ENGINEER TO CONFIRM SUITABILITY FOR ALL APPLICATIONS THAT DO NOT MEET THESE CRITERIA.
3. EXACT NUMBER AND CONFIGURATION OF CONDUITS REQUIRED SHALL BE CONFIRMED WITH THE ENGINEER.
4. ANCHOR BOLTS AND TEMPLATE TO BE SUPPLIED BY THE POLE SUPPLIER.

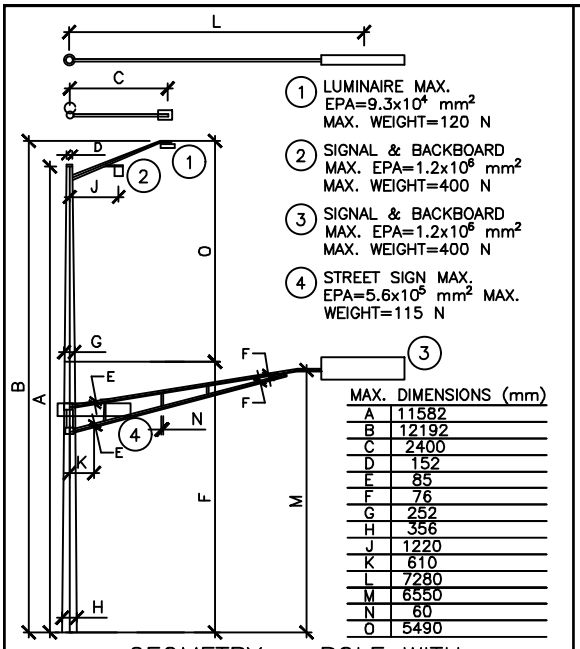


SECTION 'A–A'

City of Saint John

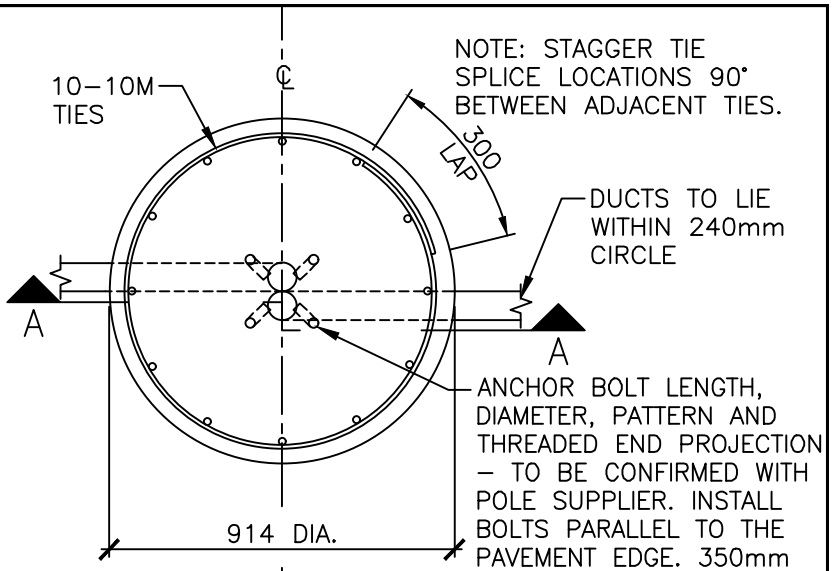
POLE WITH TRAFFIC ARM CONCRETE BASE DETAIL

DRAWN. BY D.B.	DATE MAY 2018	REV. No. 0		DWG. No.
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		S045–316A



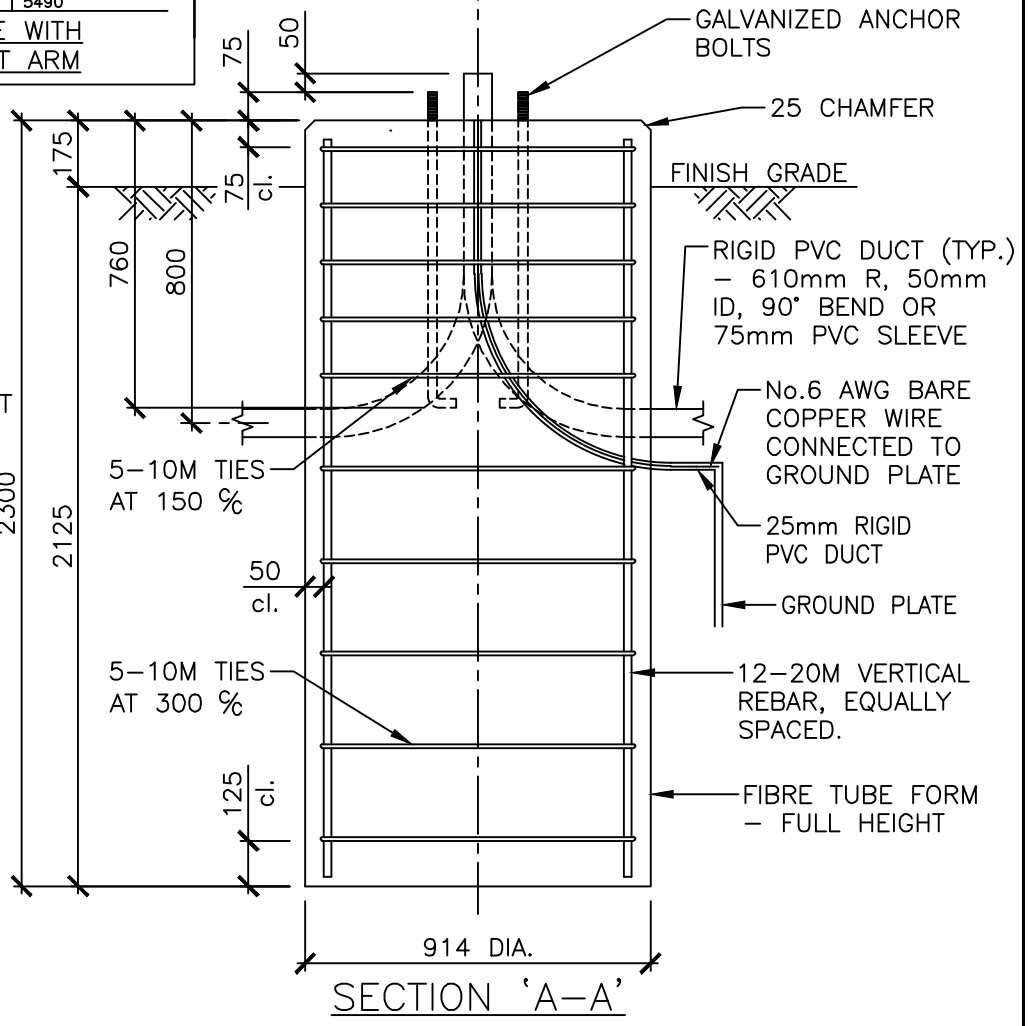
MAX. DIMENSIONS (mm)	
A	11582
B	12192
C	2400
D	152
E	85
F	76
G	252
H	356
J	1220
K	610
L	7280
M	6550
N	60
O	5490

GEOMETRY – POLE WITH TRAFFIC AND LIGHT ARM



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. BASE IS FOR ALUMINIUM POLES MEETING MAXIMUM LOADING AND GEOMETRY AS NOTED ABOVE, IN GOOD TO AVERAGE SOIL CONDITIONS. INDEPENDENT PROFESSIONAL ENGINEER TO CONFIRM SUITABILITY FOR ALL APPLICATIONS THAT DO NOT MEET THESE CRITERIA.
3. EXACT NUMBER AND CONFIGURATION OF CONDUITS REQUIRED SHALL BE CONFIRMED WITH THE ENGINEER.
4. ANCHOR BOLTS AND TEMPLATE TO BE SUPPLIED BY THE POLE SUPPLIER.

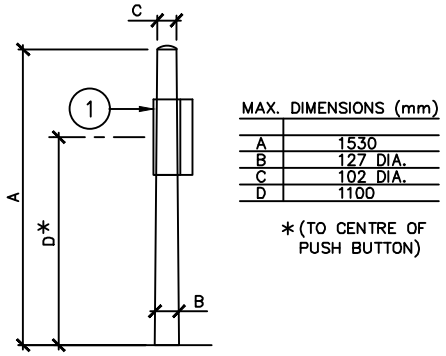


SECTION 'A–A'

City of Saint John

POLE WITH TRAFFIC AND LIGHT ARM CONCRETE BASE DETAIL

DRAWN. BY D.B.	DATE MAY 2018	REV. No. 0		DWG. No. S045–316B
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		



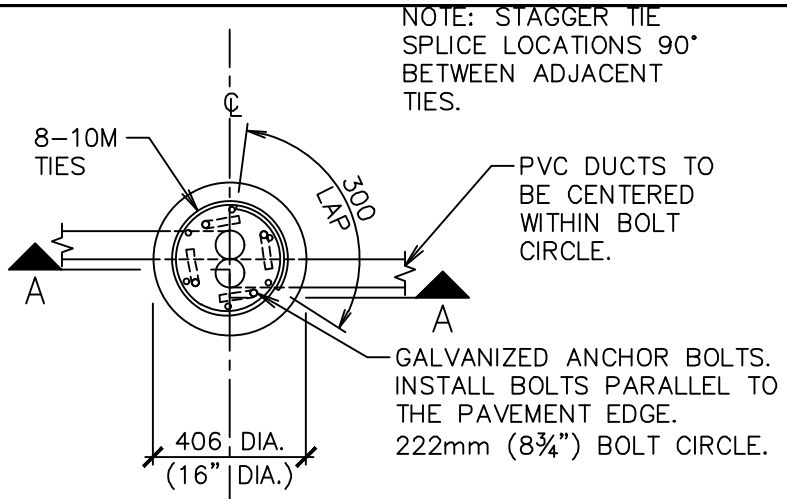
MAX. DIMENSIONS (mm)	
A	1530
B	127 DIA.
C	102 DIA.
D	1100

*(TO CENTRE OF PUSH BUTTON)

(1) PUSH BUTTON
MAX. EPA=1.0×10^5 mm^2
MAX. WEIGHT=100 N

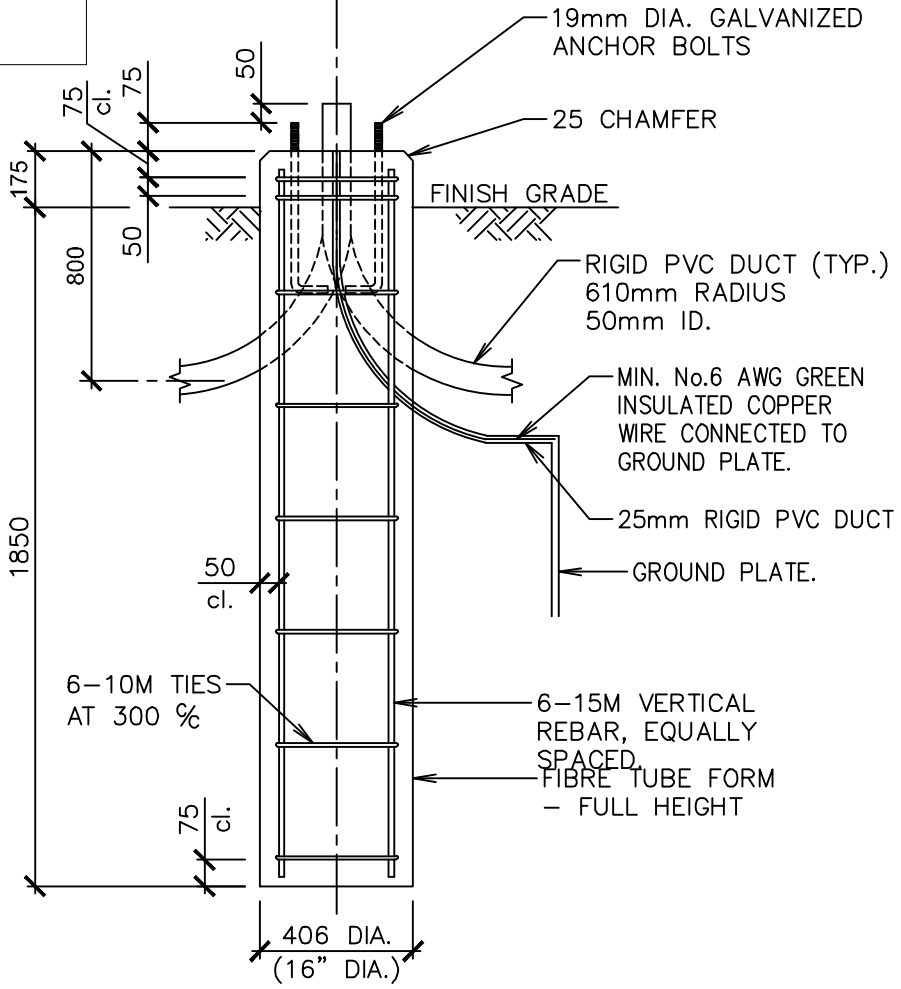
GEOMETRY–1.5m PUSH BUTTON STUB POLE

NOTE: STAGGER TIE SPLICE LOCATIONS 90° BETWEEN ADJACENT TIES.



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES. (UNLESS NOTED OTHERWISE)
2. BASE IS FOR ALUMINIUM POLES MEETING MAXIMUM LOADING AND GEOMETRY AS NOTED ABOVE, IN GOOD TO AVERAGE SOIL CONDITIONS. INDEPENDENT PROFESSIONAL ENGINEER TO CONFIRM SUITABILITY FOR ALL APPLICATIONS THAT DO NOT MEET THESE CRITERIA.
3. EXACT NUMBER AND CONFIGURATION OF CONDUITS REQUIRED SHALL BE CONFIRMED WITH THE ENGINEER.
4. ANCHOR BOLTS AND TEMPLATE TO BE SUPPLIED BY THE POLE SUPPLIER.

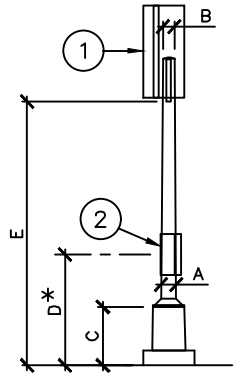


SECTION 'A–A'

City of Saint John

STANDARD 1.5m PEDESTRIAN PUSH BUTTON CONCRETE POLE BASE DETAIL

DRAWN BY D.B.	DATE MAY 2018	REV. No. 2		DWG. No.
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		S045–316C



MAX. DIMENSIONS (mm)	
A	152 DIA.
B	114 DIA.
C	580
D	1100
E	2500

*(TO CENTRE OF PUSH BUTTON)

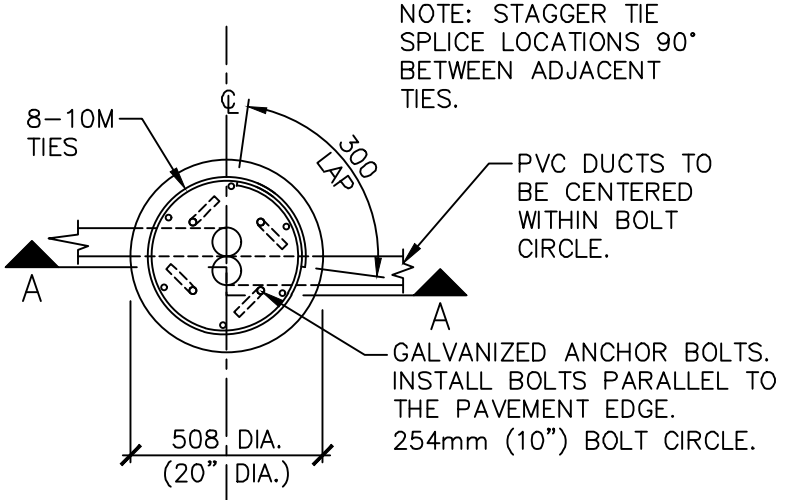
1. TRAFFIC SIGNAL
MAX. EPA=4.0x10^5 mm^2
MAX. WEIGHT=450 N

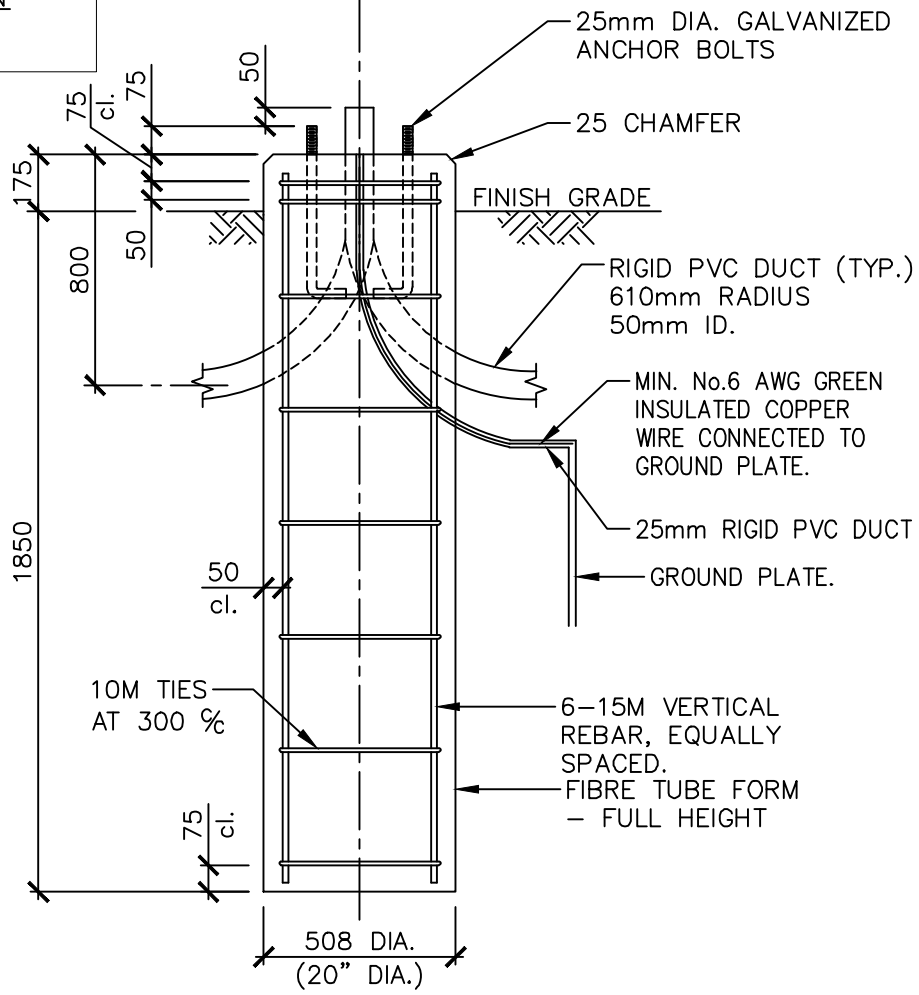
2. PUSH BUTTON
MAX. EPA=1.0x10^5 mm^2 MAX.
WEIGHT=100 N

GEOMETRY–2.4m PEDESTRIAN TRAFFIC SIGNAL POLE

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES. (UNLESS NOTED OTHERWISE)
2. BASE IS FOR ALUMINIUM POLES MEETING MAXIMUM LOADING AND GEOMETRY AS NOTED ABOVE, IN GOOD TO AVERAGE SOIL CONDITIONS. INDEPENDENT PROFESSIONAL ENGINEER TO CONFIRM SUITABILITY FOR ALL APPLICATIONS THAT DO NOT MEET THESE CRITERIA.
3. EXACT NUMBER AND CONFIGURATION OF CONDUITS REQUIRED SHALL BE CONFIRMED WITH THE ENGINEER.
4. ANCHOR BOLTS AND TEMPLATE TO BE SUPPLIED BY THE POLE SUPPLIER.



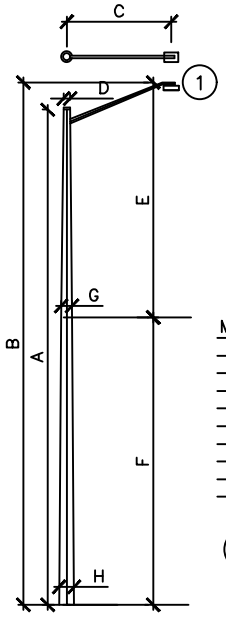


SECTION 'A–A'

City of Saint John

STANDARD 2.4m PEDESTRIAN/TRAFFIC CONCRETE POLE BASE DETAIL

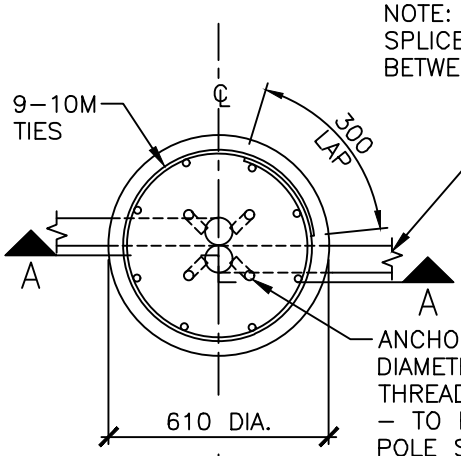
DRAWN BY D.B.	DATE MAY 2018	REV. No. 2		DWG. No. S045–316D
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		



MAX. DIMENSIONS (mm)	
A	11582
B	12192
C	2400
D	152
E	5486
F	6706
G	252
H	356

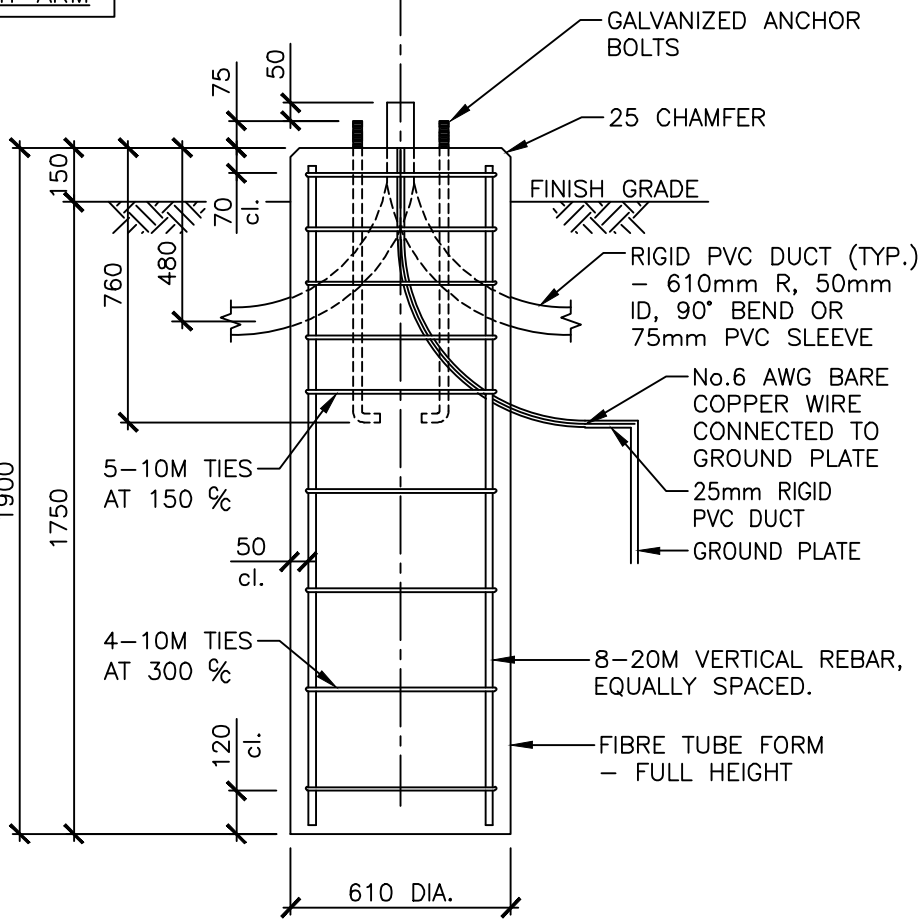
(1) LUMINAIRE MAX. EPA=9.3x10^4 mm^2 MAX. WEIGHT=120 N

GEOMETRY – POLE WITH LIGHT ARM



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. BASE IS FOR ALUMINIUM POLES MEETING MAXIMUM LOADING AND GEOMETRY AS NOTED ABOVE, IN GOOD TO AVERAGE SOIL CONDITIONS. INDEPENDENT PROFESSIONAL ENGINEER TO CONFIRM SUITABILITY FOR ALL APPLICATIONS THAT DO NOT MEET THESE CRITERIA.
3. EXACT NUMBER AND CONFIGURATION OF CONDUITS REQUIRED SHALL BE CONFIRMED WITH THE ENGINEER.
4. ANCHOR BOLTS AND TEMPLATE TO BE SUPPLIED BY THE POLE SUPPLIER.

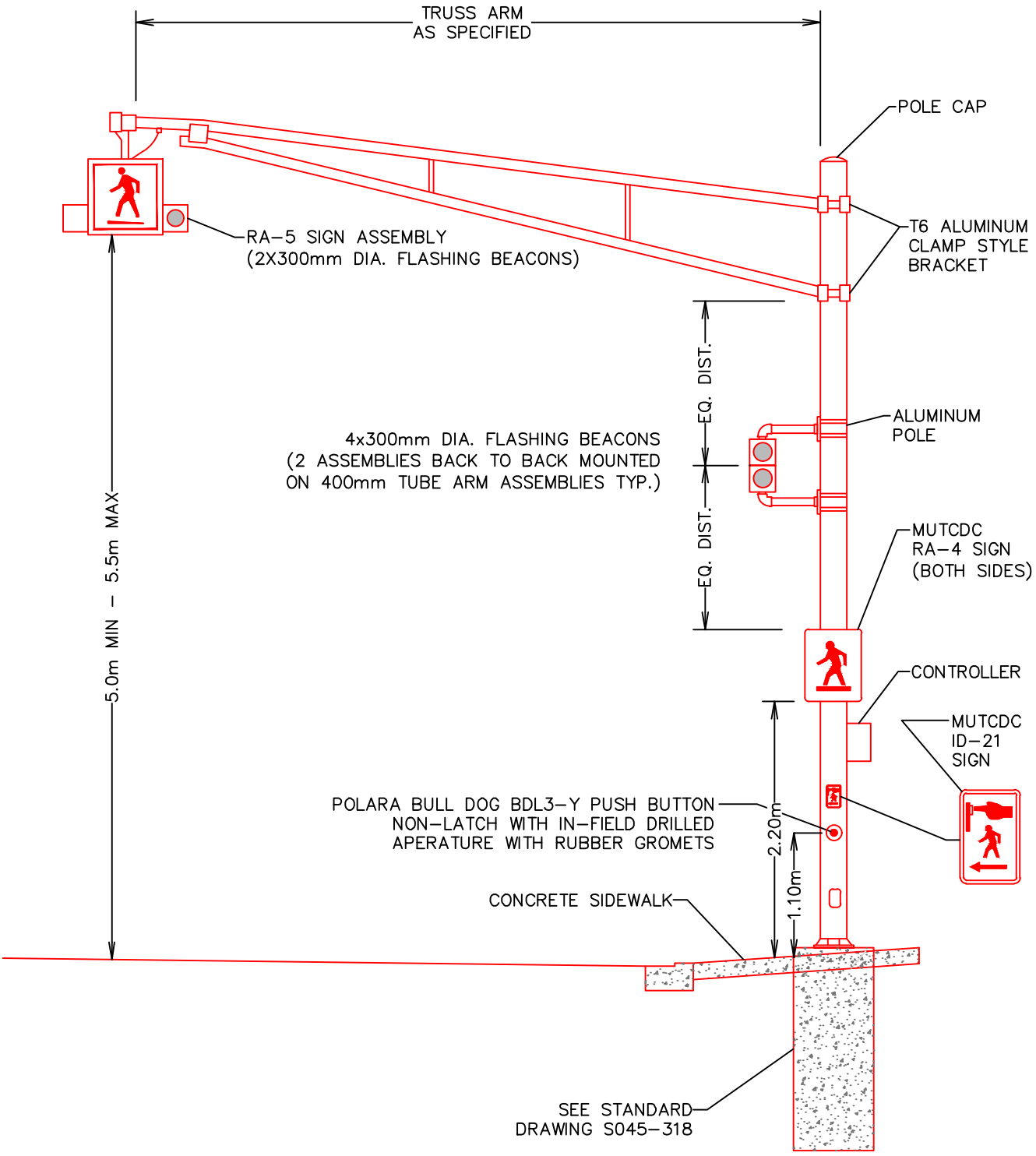


SECTION 'A–A'

City of Saint John

POLE WITH LIGHT ARM CONCRETE BASE DETAIL

DRAWN. BY R.K.	DATE MARCH 2017	REV. No. 0		DWG. No. S045-316E
CHECKED BY R.B.V.	SCALE N.T.S.	DATE MARCH 2017		

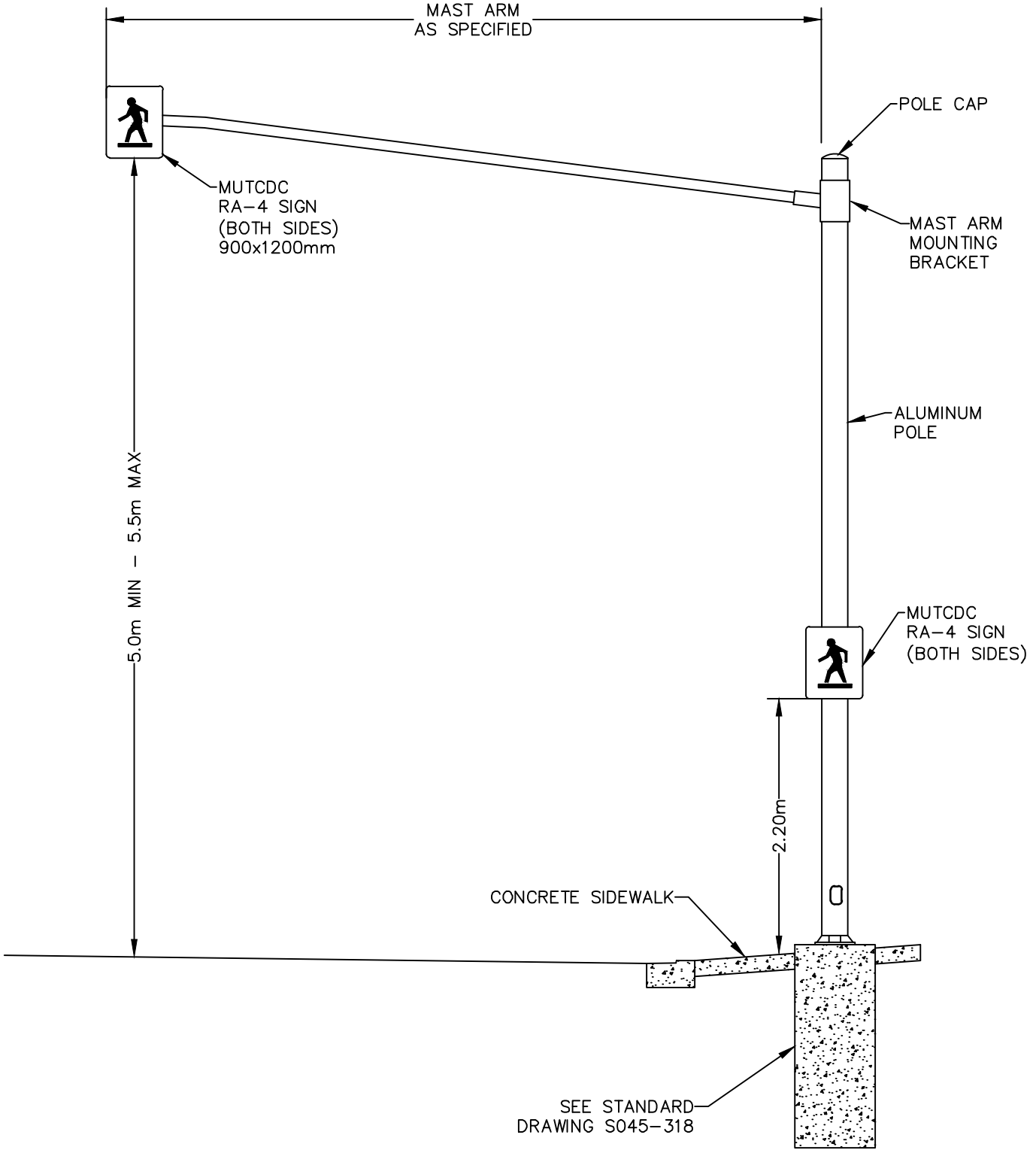


1. POSITIONING OF THE RA-5 SIGN ASSEMBLY TO FOLLOW TRANSPORTATION ASSOCIATION OF CANADA GUIDELINES

City of Saint John

ALUMINIUM POLE RA-5 SIGNAL CONFIGURATION

DWN. BY D.B.	DATE MAY 2018	REV. No. 1		DWG. No. S045-317
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		

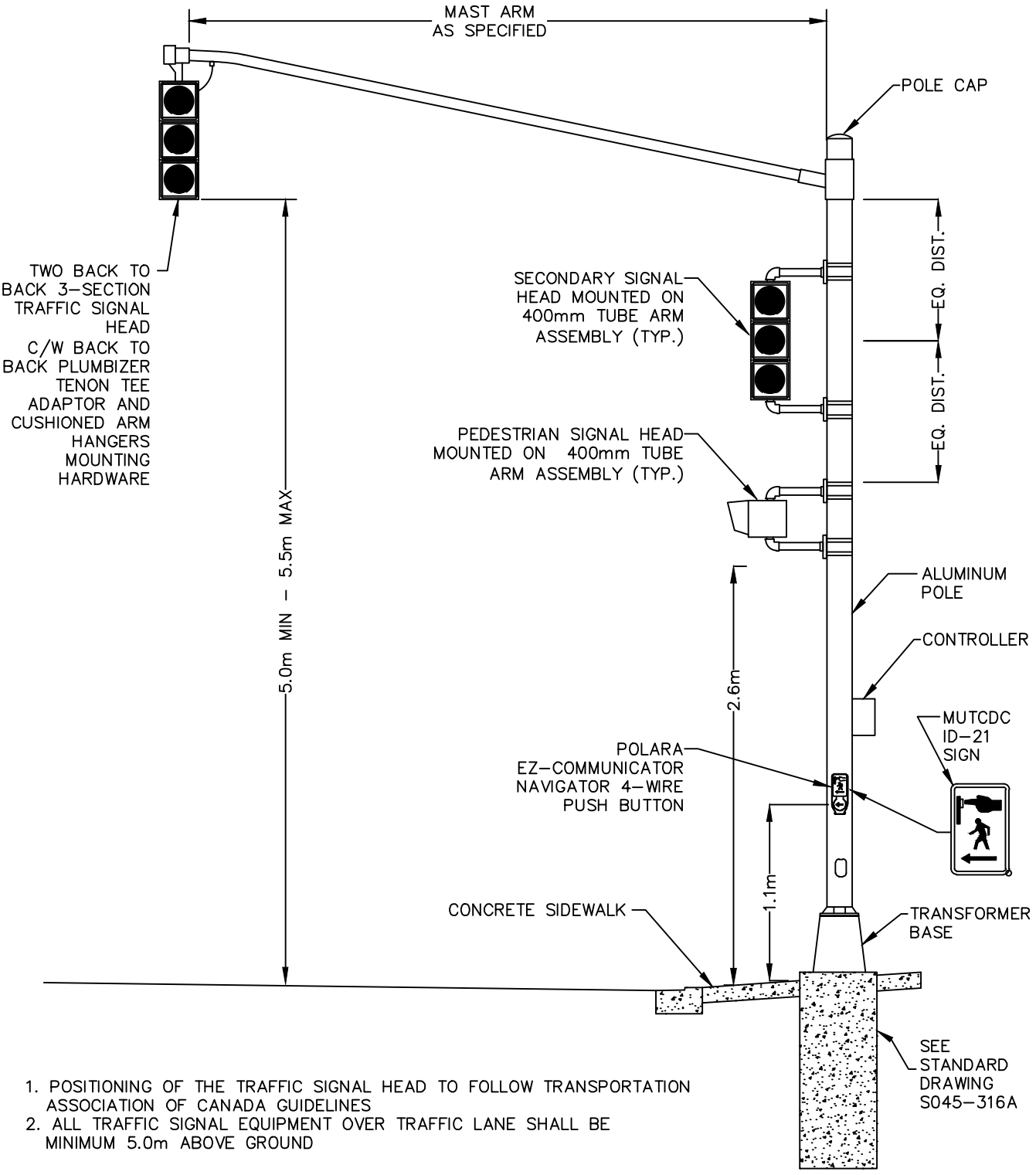


NOTE:
1. POSITIONING OF THE OVERHEAD CROSSWALK SIGN TO FOLLOW TRANSPORTATION ASSOCIATION OF CANADA GUIDELINES

City of Saint John

ALUMINIUM POLE OVERHEAD CROSSWALK SIGN

DWN. BY D.B.	DATE MAY 2018	REV. No. 1		DWG. No.
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		S045–317A

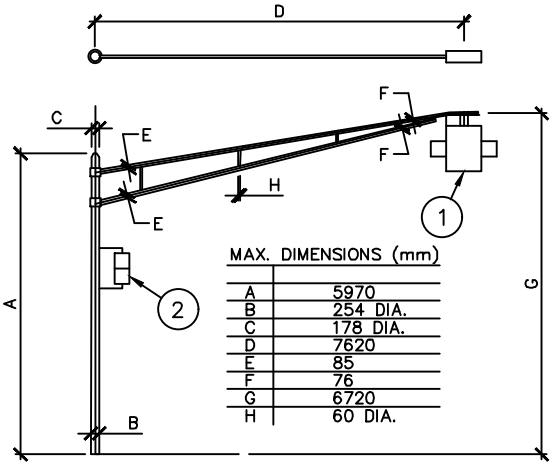


1. POSITIONING OF THE TRAFFIC SIGNAL HEAD TO FOLLOW TRANSPORTATION ASSOCIATION OF CANADA GUIDELINES
2. ALL TRAFFIC SIGNAL EQUIPMENT OVER TRAFFIC LANE SHALL BE MINIMUM 5.0m ABOVE GROUND

City of Saint John

ALUMINIUM POLE PEDESTRIAN SIGNAL AT MID BLOCK LOCATION

DWN. BY D.B.	DATE MAY 2018	REV. No. 2		DWG. No.
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		S045–317B

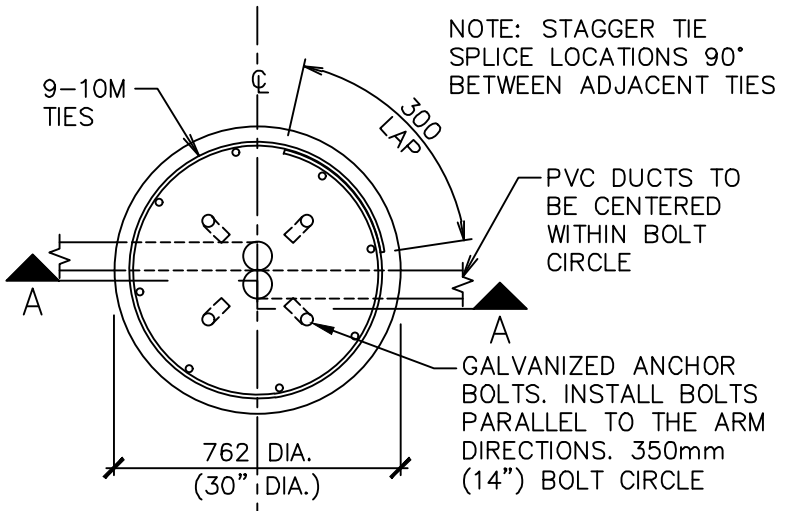


MAX. DIMENSIONS (mm)	
A	5970
B	254 DIA.
C	178 DIA.
D	7620
E	85
F	76
G	6720
H	60 DIA.

(1) ALUMINIUM CROSSWALK SIGN
MAX. EPA=7.5x10^5 mm^2
MAX. WEIGHT=600 N

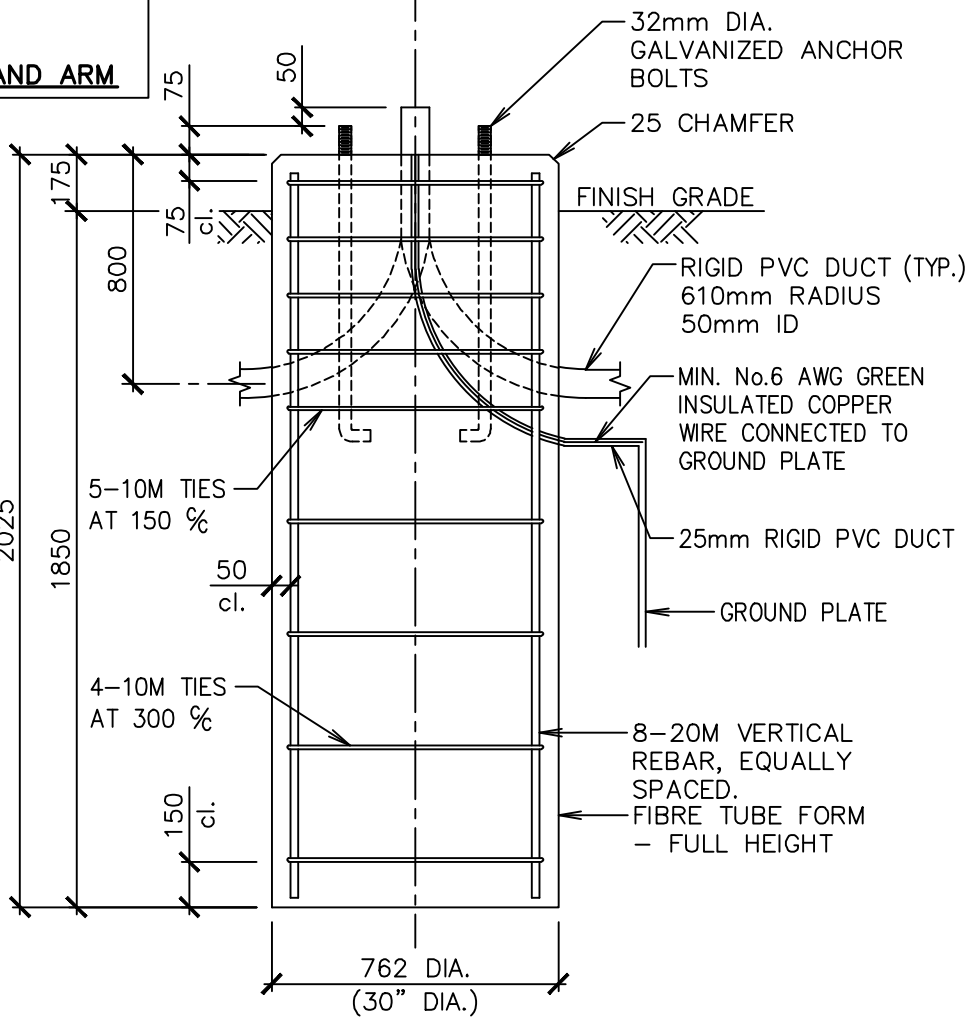
(2) FLASHING BEACONS
MAX. 4 AT EPA=9.0x10^4 mm^2
MAX. WEIGHT=100 N

GEOMETRY–TRAFFIC POLE AND ARM



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES. (UNLESS NOTED OTHERWISE)
2. BASE IS FOR ALUMINIUM POLES MEETING MAXIMUM LOADING AND GEOMETRY AS NOTED ABOVE, IN GOOD TO AVERAGE SOIL CONDITIONS. INDEPENDENT PROFESSIONAL ENGINEER TO CONFIRM SUITABILITY FOR ALL APPLICATIONS THAT DO NOT MEET THESE CRITERIA
3. EXACT NUMBER AND CONFIGURATION OF CONDUITS REQUIRED SHALL BE CONFIRMED WITH THE ENGINEER
4. ANCHOR BOLTS AND TEMPLATE TO BE SUPPLIED BY THE POLE SUPPLIER

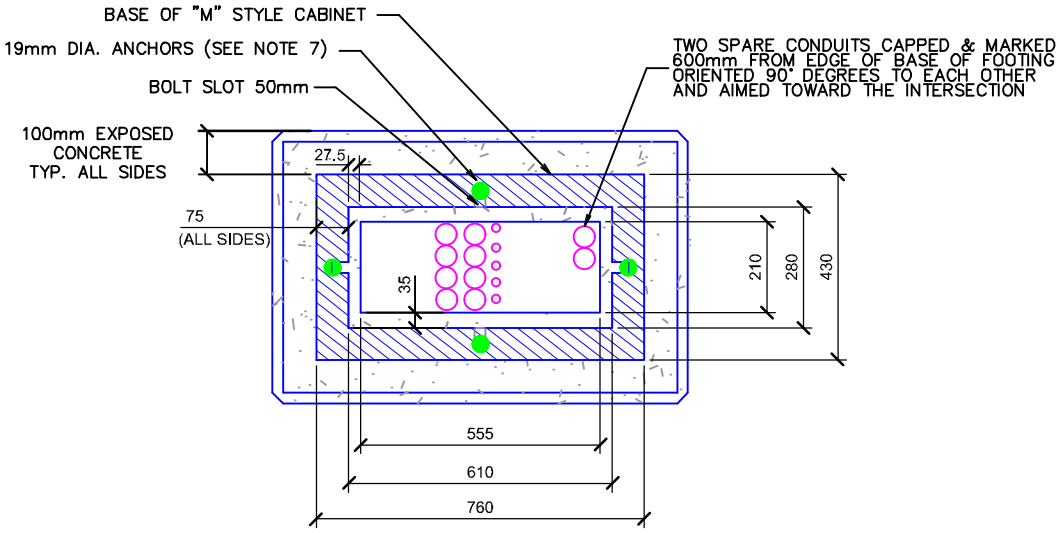


SECTION 'A–A'

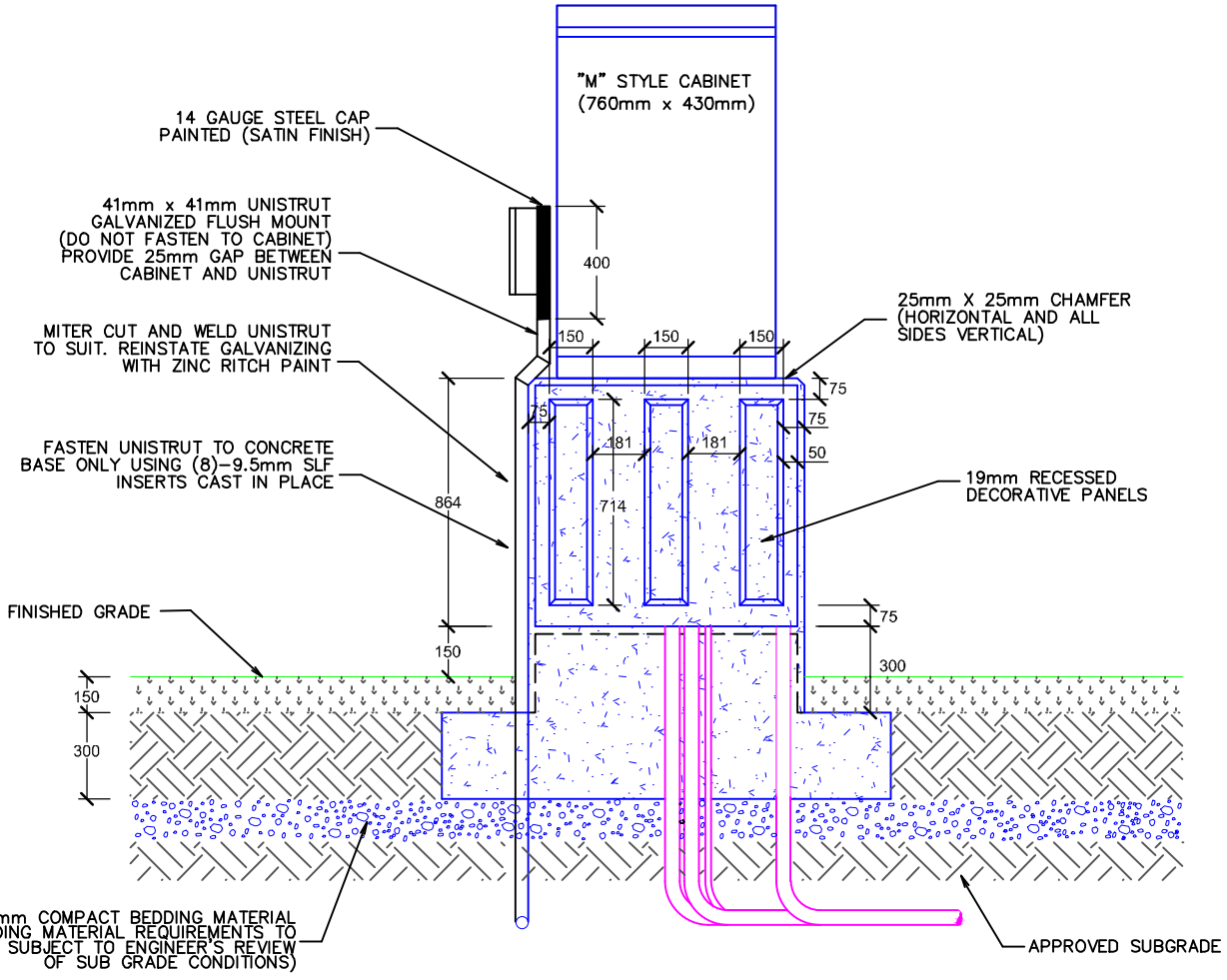
City of Saint John

STANDARD PEDESTRIAN CROSSWALK CONCRETE POLE BASE DETAIL

DRAWN BY D.B.	DATE MAY 2018	REV. No. 2		DWG. No. S045–318
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		



PEDESTAL CONDUIT OPENING DETAIL



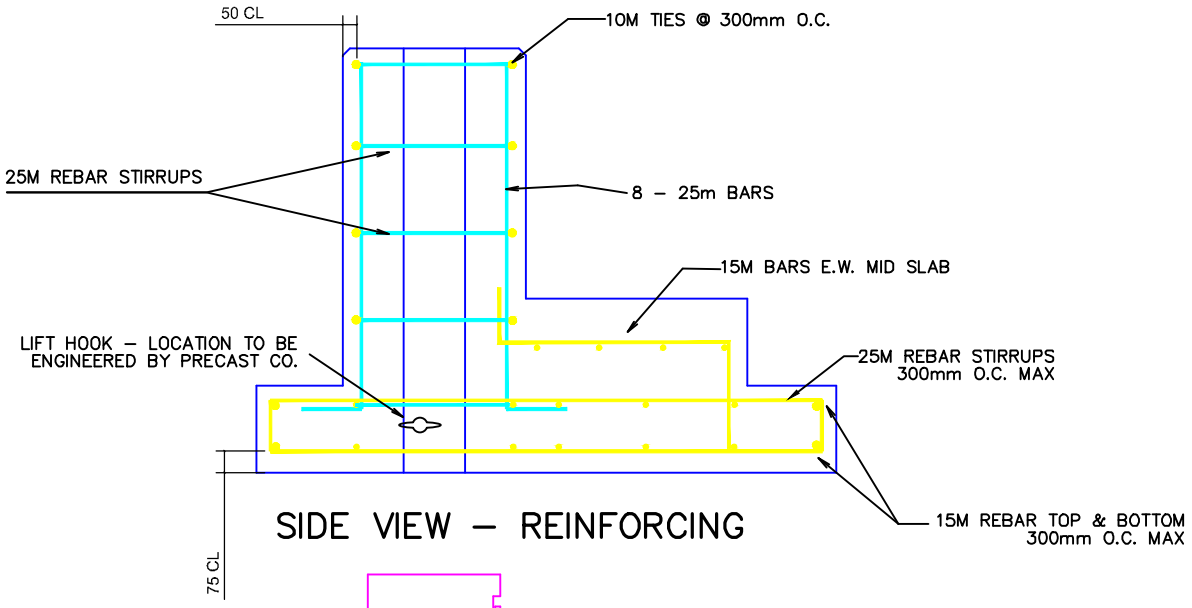
FRONT VIEW

REFER TO SHEET 4 OF 5 FOR NOTES

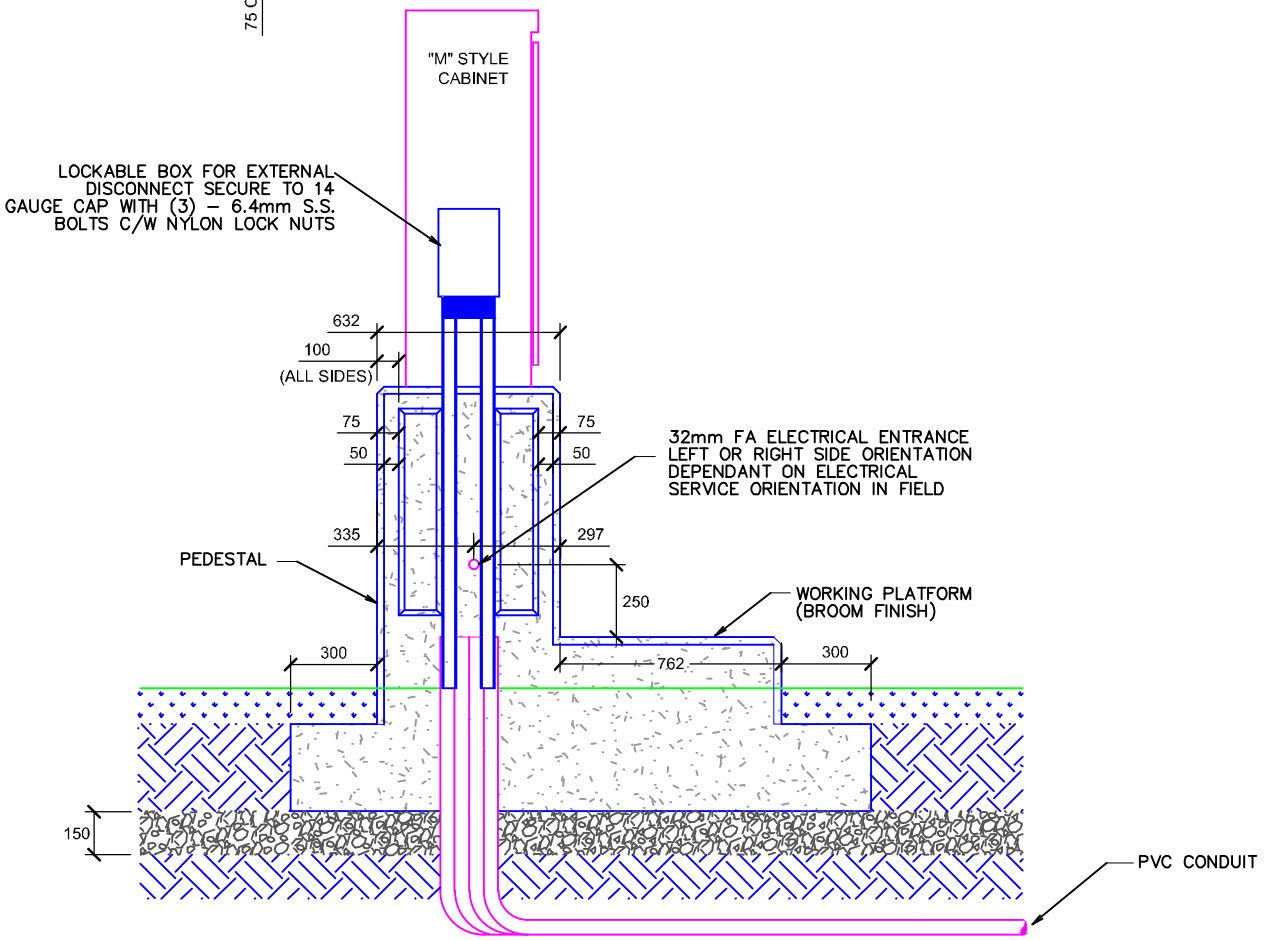
City of Saint John

STANDARD TRAFFIC CONTROLLER BASE FOR "M" STYLE CABINET

DWN. BY	D.B.	DATE	MAY 2018	REV. No.	3		DWG. No. S045-319 SHEET 1 OF 5
CHECKED BY	J.D.	SCALE	N.T.S.	DATE	MAY 2018		



SIDE VIEW – REINFORCING



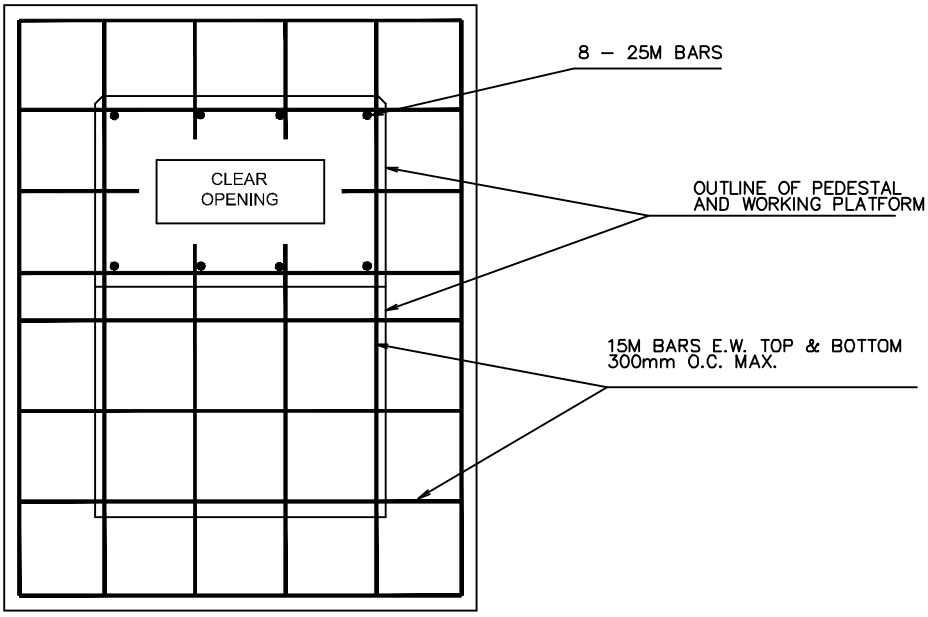
SIDE VIEW

REFER TO SHEET 4 OF 5 FOR NOTES

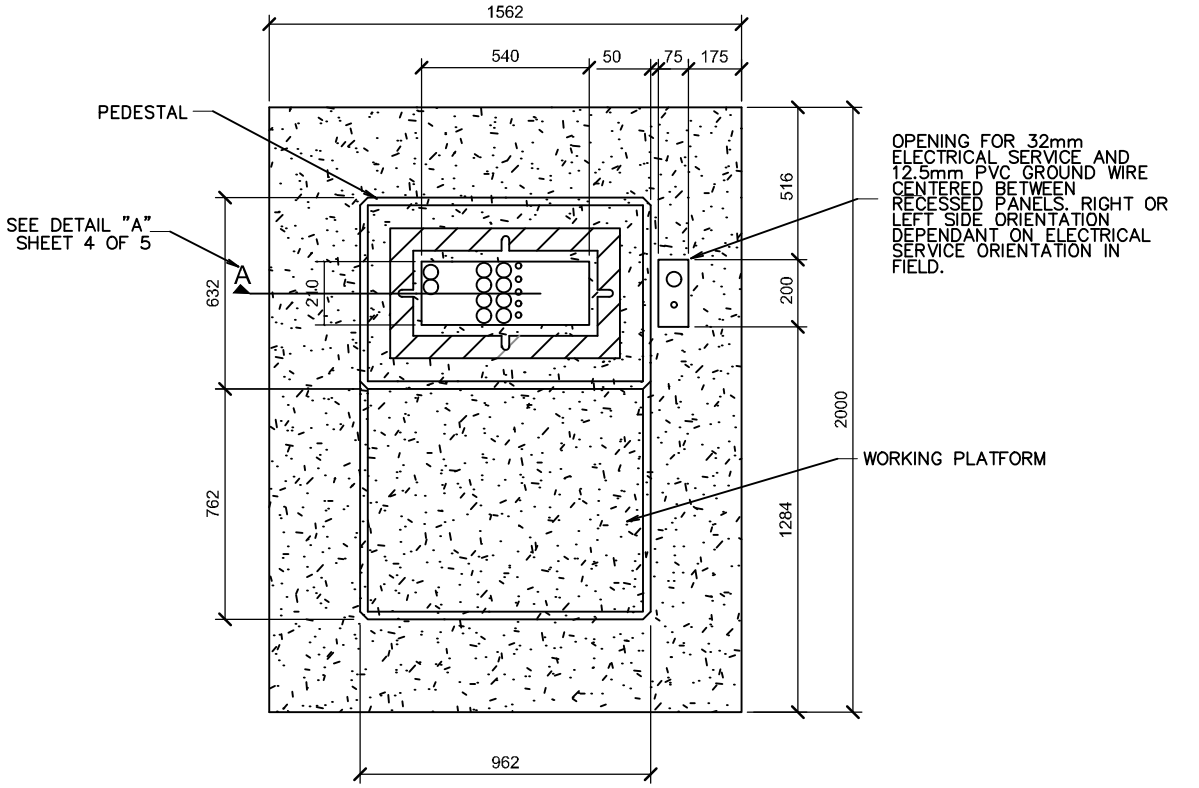
City of Saint John

STANDARD TRAFFIC CONTROLLER BASE FOR "M" STYLE CABINET

DWN. BY D.B.	DATE MAY 2018	REV. No. 3		DWG. No. S045-319 SHEET 2 OF 5
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		



PLAN – BASE SLAB REINFORCING



TOP VIEW

REFER TO SHEET 4 OF 5 FOR NOTES
REFER TO SHEET 4 OF 5 FOR DETAIL A

City of Saint John

STANDARD TRAFFIC CONTROLLER BASE FOR "M" STYLE CABINET

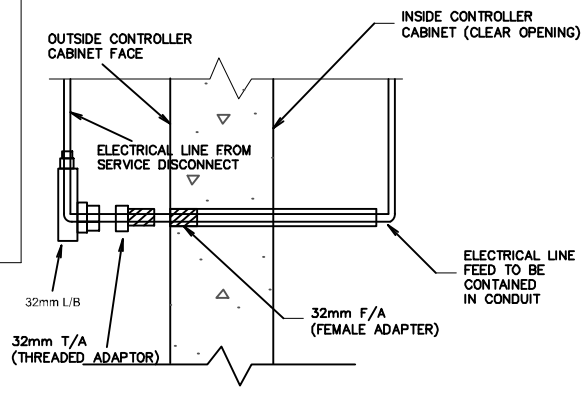
DWN. BY D.B.	DATE MAY 2018	REV. No. 3		DWG. No. S045-319 SHEET 3 OF 5
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL CONCRETE SHALL BE 35 MPa EXPOSURE CLASS "C2".
3. PROVIDE MIN. 50mm COVER FOR ALL REBAR.
4. PROVIDE GROUNDING FOR CABINET.
5. IN ADDITION TO CONDUIT SPECIFIED ON DRAWINGS, PROVIDE 2–50mm DIA. PVC CONDUIT AND STUB OUTSIDE OF BASE.
6. ALL CONDUIT AND FITTINGS SHALL BE TO CANADIAN ELECTRICAL CODE.
7. PROVIDE 19mm DIAMETER x 300mm LONG x 100mm "L" GALVANIZED ANCHORS TO CONNECT CONTROLLER CABINET. ANCHORS TO HAVE 38mm THREADED PROJECTION ABOVE FINISHED CONCRETE. CONFIGURATION OF ANCHORS ARE TO BE CONFIRMED WITH THE CABINET MANUFACTURER PRIOR TO CONSTRUCTION. STANDARD BOLT PATTERN 685mm x 355mm.
8. COMPACTED BEDDING MATERIAL SHALL EXTEND MIN. 150mm BEYOND EDGE OF BASE PAD.
9. BASE DIMENSIONS SUPPORT A NEMA TYPE "M" CABINET.
10. CONCRETE BASE FOR CONTROLLER CABINET WILL BE SUPPLIED BY THE CONTRACTOR.
11. THE CONTRACTOR IS TO INSTALL THE BASE AS SHOWN. ALL DUCTS ARE TO EXTEND TO 300mm BELOW CONCRETE IN THE CLEAR OPENING. ARRANGE DUCTS IN A NEAT, ORDERLY FASHION AS DIRECTED BY THE ENGINEER. CAP ALL END DUCTS WATERTIGHT, WITH PULL–ROPES ATTACHED.
12. ALL COSTS ASSOCIATED WITH THE INSTALLATION OF THE CONCRETE BASE, TO THE SATISFACTION OF THE ENGINEER, ARE TO BE INCLUDED IN THE CONTRACT PRICE.
13. 32mm CONDUIT FROM UNDERGROUND SERVICE TO CABINET AND 12.5mm CONDUIT FOR GROUND WIRE TO BE EQUIPPED WITH EXPANSION JOINT.

ELECTRICAL NOTES:

1. SQUARE D (PART NO. Q0403L100RB) 100 AMP SERVICE ENTRANCE DISCONNECT 3 PHASE.
2. NON METERED LOAD.
3. PROVIDE A SQUARE D 22K(15 AMP DOUBLE POLE) HIGH AMPERAGE INTERRUPTING CAPACITY BREAKER, COORDINATE MAIN BREAKER (PART #Q0215VH)
4. ALL POLES TO BE BONDED BACK TO CONTROLLER CABINET (ADDITIONAL GROUND/ BOND BAR MAY BE REQUIRED TO BE INSTALLED TO SUPORT THIS)
5. CONTROLLER CABINET TO BE GROUNDED WITH A GROUND PLATE OR GROUNDING RODS PER CANADIAN ELECTRICAL CODE 2012 CONNECT WITH #6 WIRE
6. PROVIDE AND INSTALL L#3 RW90 WIRE FROM POLE MOUNTED TRANSFORMER TO LOAD CENTRE

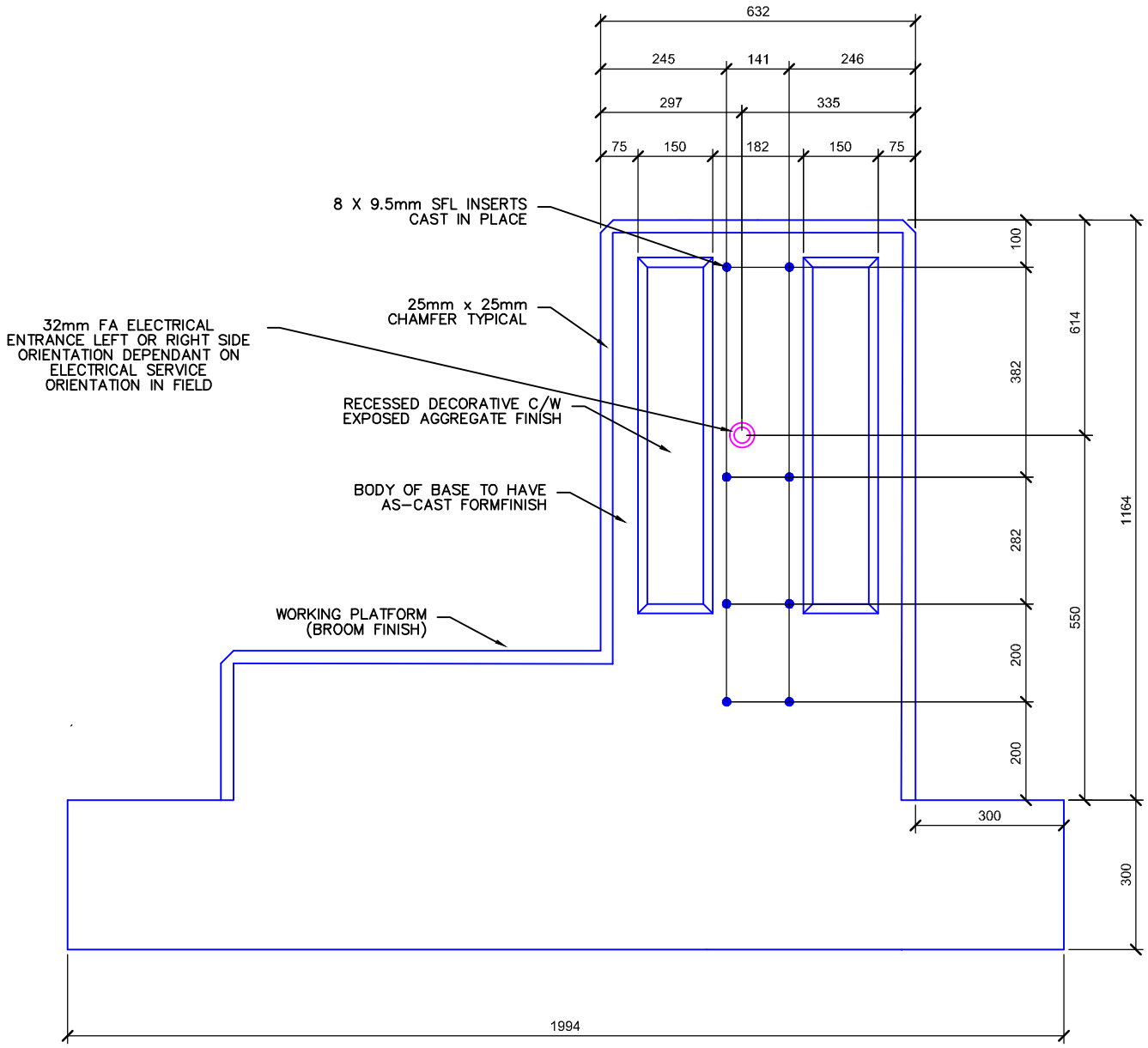


DETAIL A

City of Saint John

STANDARD TRAFFIC CONTROLLER BASE FOR "M" STYLE CABINET

DWN. BY D.B.	DATE MAY 2018	REV. No. 3		DWG. No. S045–319
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		SHEET 4 OF 5



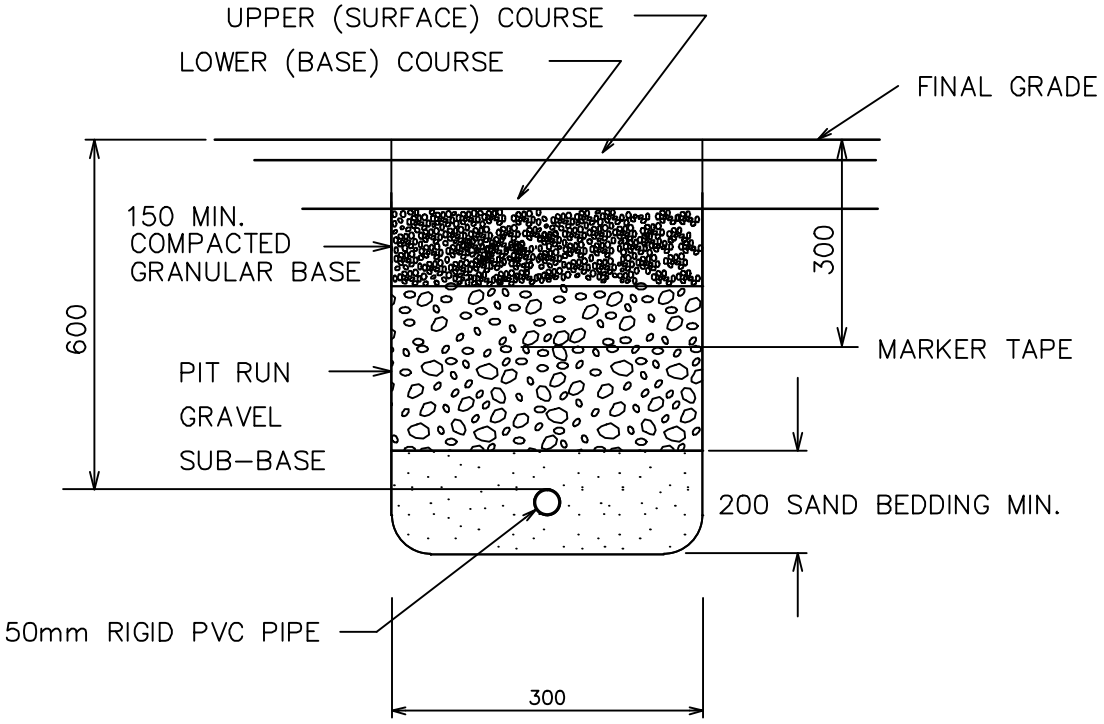
REFER TO SHEET 4 OF 5 FOR NOTES

SIDE VIEW

City of Saint John

STANDARD TRAFFIC CONTROLLER BASE FOR "M" STYLE CABINET

DWN. BY D.B.	DATE MAY 2018	REV. No. 3		DWG. No. S045-319 SHEET 5 OF 5
CHECKED BY J.D.	SCALE N.T.S.	DATE MAY 2018		



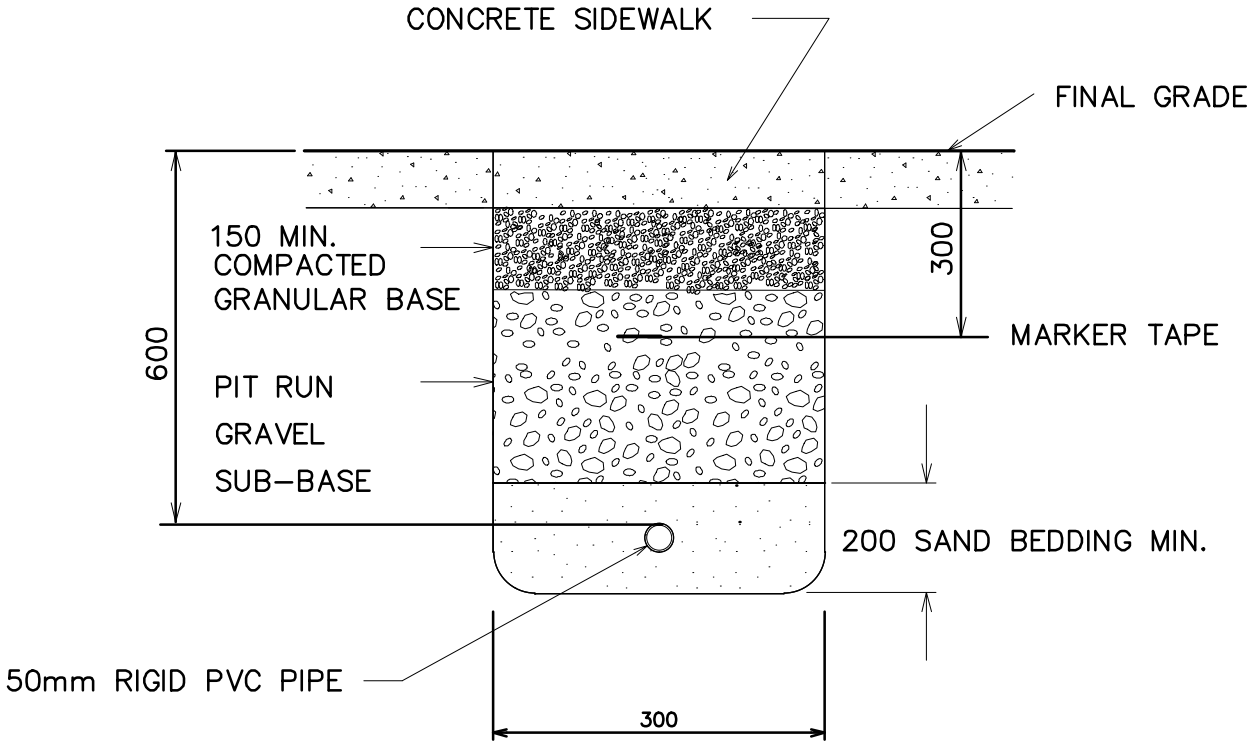
50mm RIGID PVC PIPE
BURIED CONDUIT UNDER ASPHALT ROAD

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL UNDERGROUND TRAFFIC AND LIGHT STANDARD CONDUIT TO ADHERE TO CSA C22.2 No. 211.2

City of Saint John

UNDERGROUND CONDUIT TRENCH DETAIL – ASPHALT ROAD
(FOR TRAFFIC SIGNALS AND LIGHT STANDARDS)

DWN. BY K. MORRIS	DATE JAN. 2004	REV. No. 2		DWG. No. S045–320
CHECKED BY	SCALE NTS	DATE FEB 2012		



50mm RIGID PVC PIPE
BURIED CONDUIT UNDER CONCRETE SIDEWALK

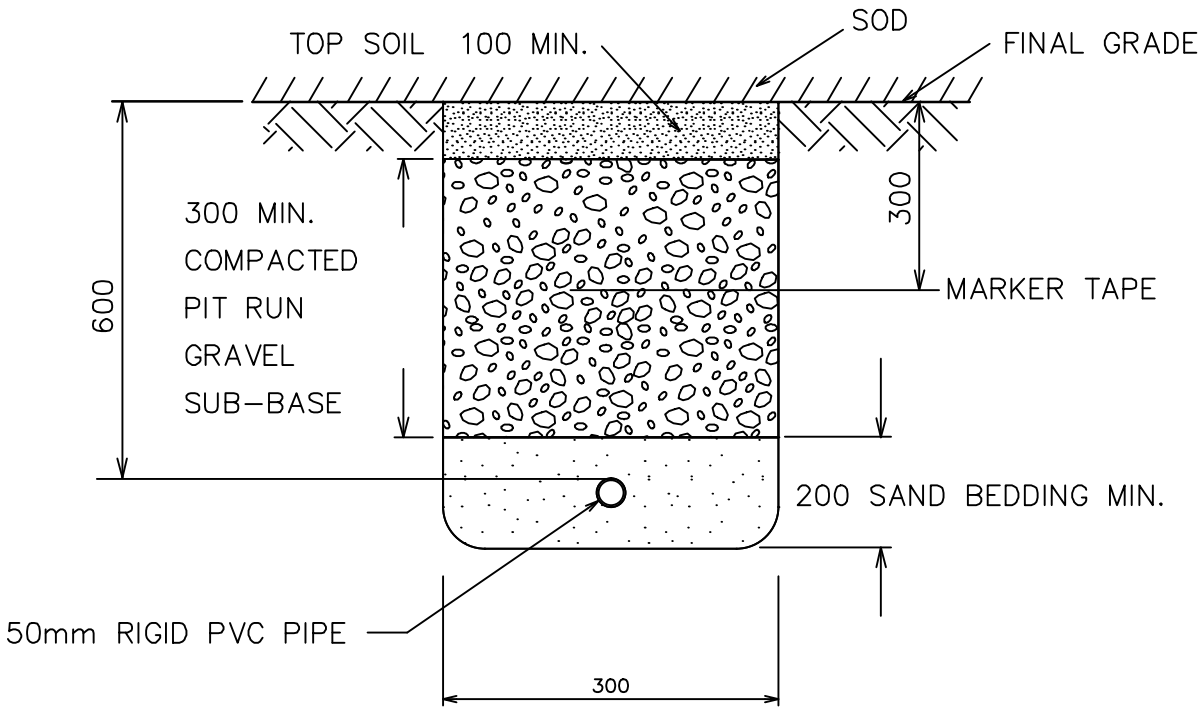
NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL UNDERGROUND CONDUIT FOR TRAFFIC SIGNALS AND LIGHT STANDARDS TO ADHERE TO CSA 22.2 No. 211.2

City of Saint John

UNDERGROUND CONDUIT TRENCH DETAIL–CONCRETE SIDEWALK (FOR TRAFFIC SIGNALS AND LIGHT STANDARDS)

DWN. BY K. MORRIS	DATE JAN. 2004	REV. No. 1		DWG. No. S045–321
CHECKED BY	SCALE NTS	DATE FEB 2012		



50mm RIGID PVC PIPE
BURIED CONDUIT UNDER SOD

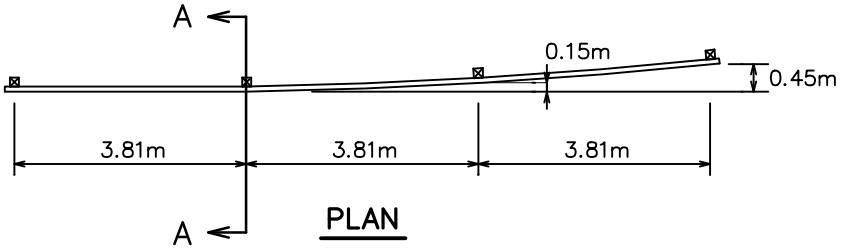
NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL UNDERGROUND CONDUIT FOR TRAFFIC SIGNALS AND LIGHT STANDARDS TO ADHERE TO CSA C22.2 No. 211.2

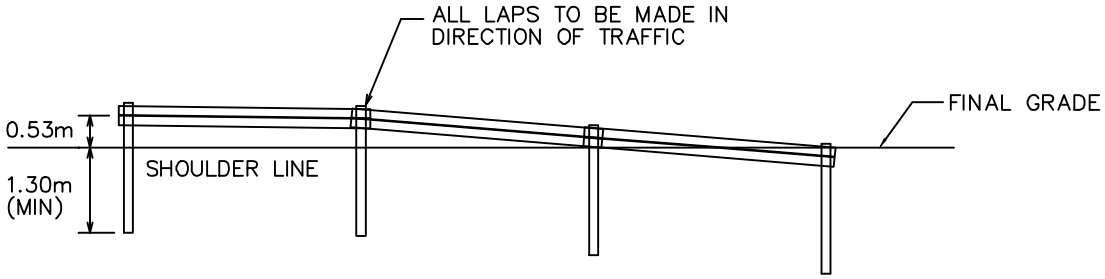
City of Saint John

UNDERGROUND CONDUIT TRENCH DETAIL – SOD
(FOR TRAFFIC SIGNALS AND LIGHT STANDARDS)

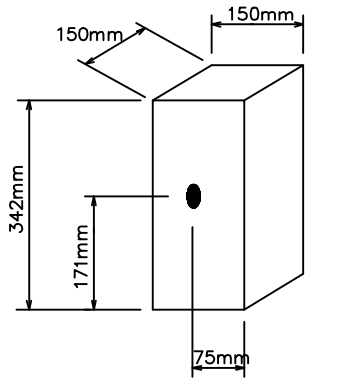
DWN. BY K. MORRIS.	DATE JAN. 2004	REV. No. 1		DWG. No. S045-322
CHECKED BY	SCALE NTS	DATE FEB 2012		



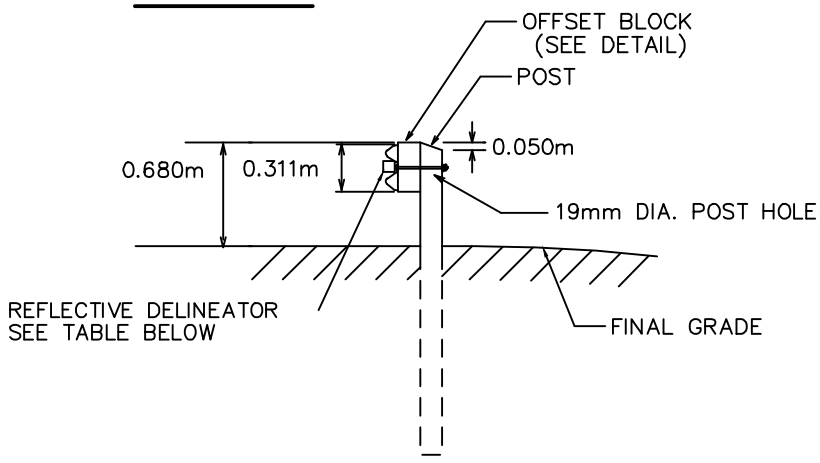
PLAN



ELEVATION



OFFSET BLOCK



SECTION A – A

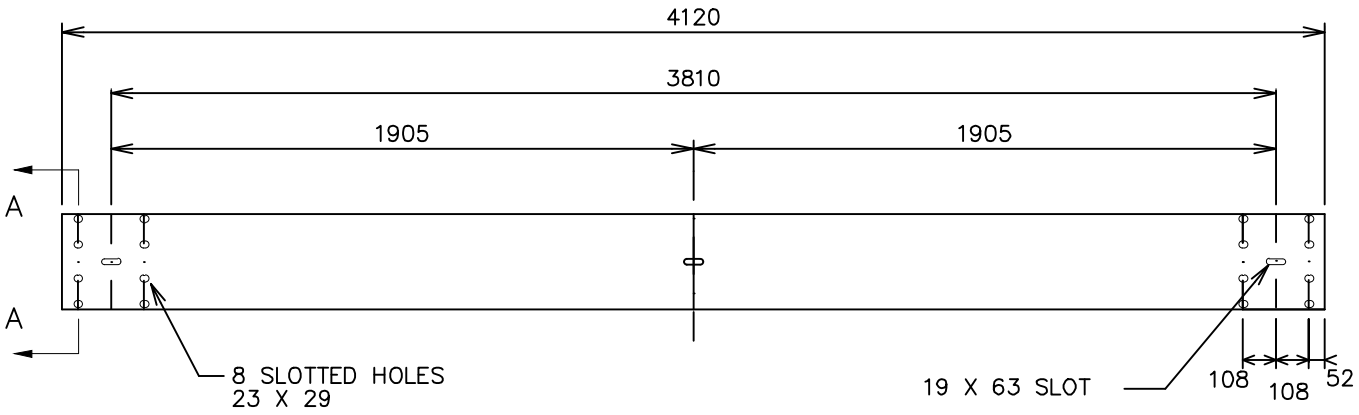
SPACING OF GUIDE RAIL DELINEATOR	
ON TANGENTS	30m
ON CURVES WITHOUT A CURVE SIGN	15m
ON CURVES REQUIRING CURVE SIGN	7.5m

NOTES:
1. DIMENSIONS ARE AS SHOWN
2. BEAM TO BE MADE OF 12 GAUGE CLASS A, TYPE II, W–SECTION STEEL BEAMS CONFORMING TO AASHTO M180
3. TYPICAL GUIDE POSTS TO BE 0.150 X 0.150 X 2.130m
   INTERMEDIATE GUIDE POSTS TO BE 0.200 X 0.200 X 2.130m
4. ALL POSTS TO EXTEND INTO THE GROUND A MINIMUM OF 1.3m BELOW FINAL GRADE
5. GUIDE POSTS SHALL BE MAPLE, BIRCH OR BEECH SPECIES OF HARDWOOD
6. 16mm GALVANIZED STEEL NUTS; 16mm GALVANIZED STEEL WASHERS; 16mm DIA GALVANIZED POST BOLT (350mm TO 450mm LONG)

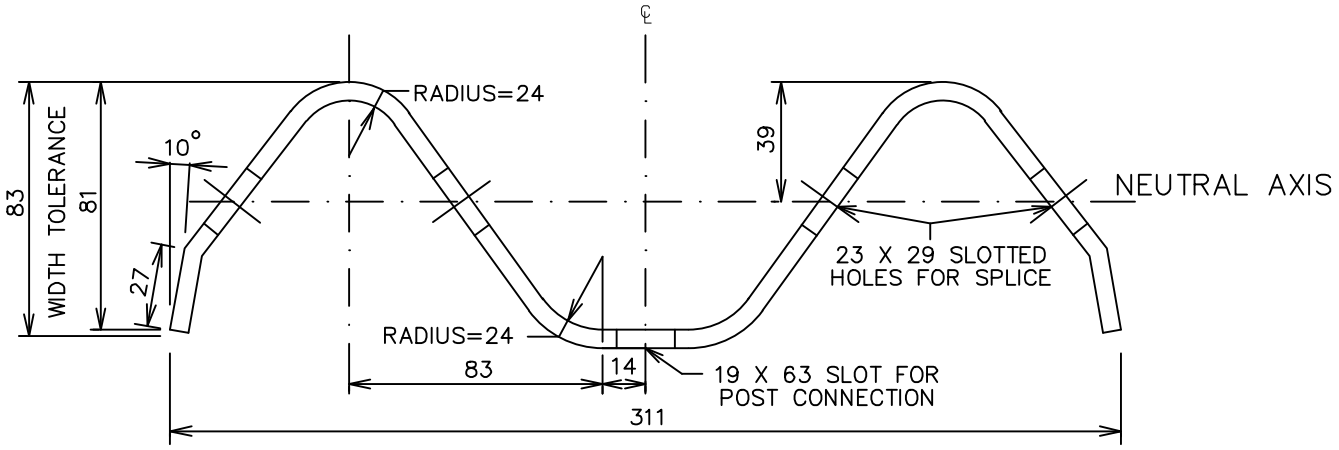
City of Saint John

TYPICAL GUIDE RAIL

DWN. BY J GRANGER	DATE JAN. 2004	REV. No. 2		DWG. No. S045–323
CHECKED BY	SCALE N.T.S	DATE JAN 2011		

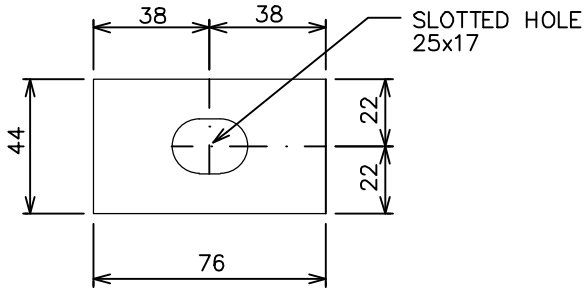


FRONT ELEVATION

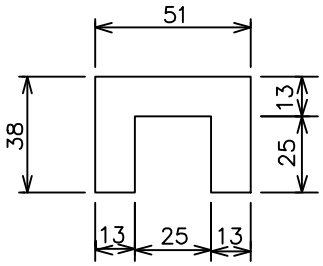


SECTION A–A

(AS PER AASHTO M180)



RECTANGULAR WASHER
(AT EACH POST LOCATION)



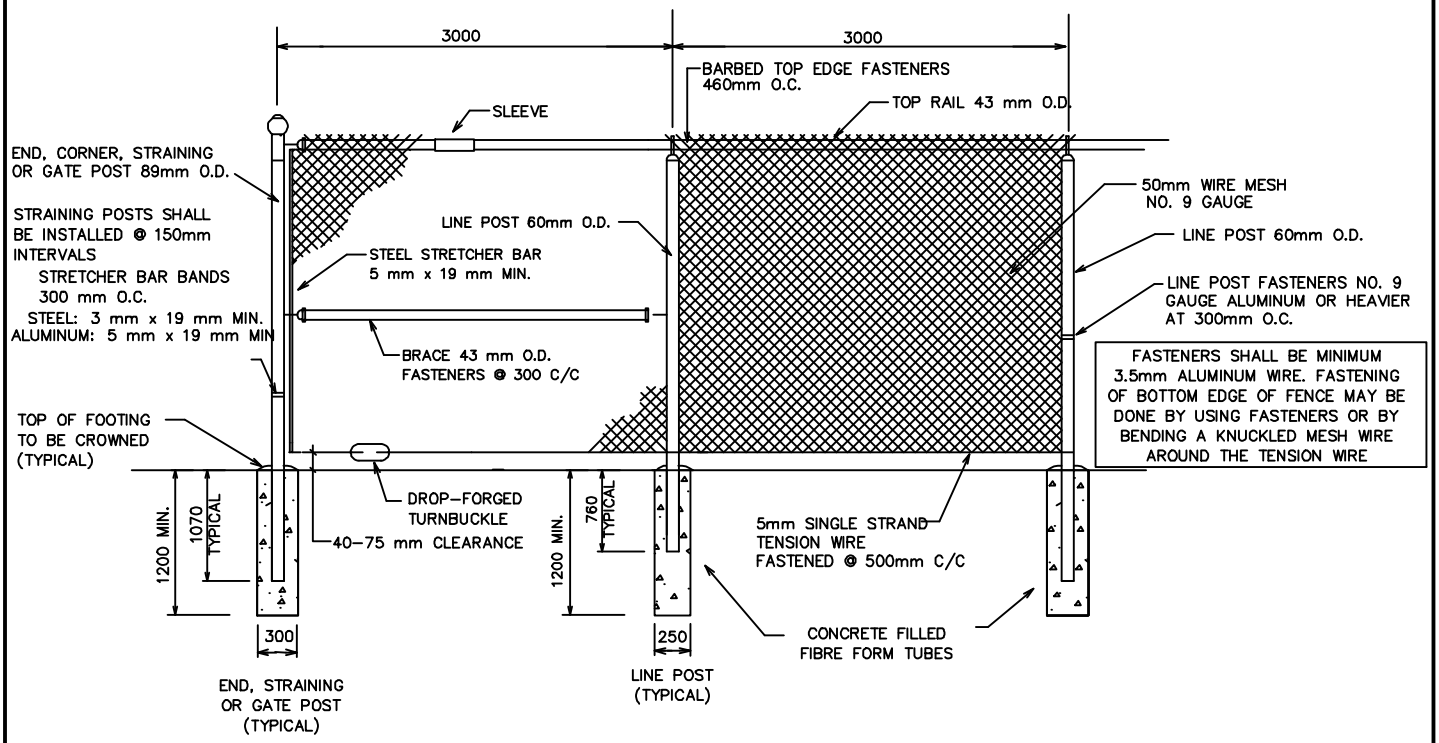
SHIM

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES

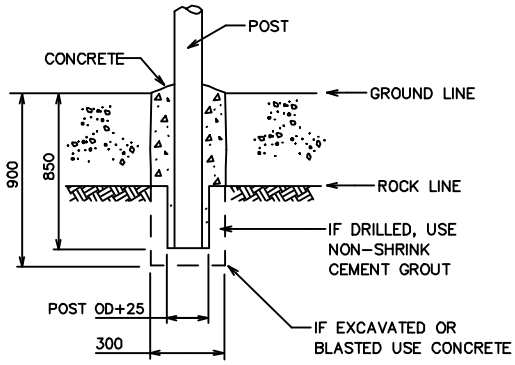
City of Saint John

BEAM GUIDE RAIL DETAILS

DWN. BY K. MORRIS	DATE JAN. 2004	REV. No. 1		DWG. No. S045–324
CHECKED BY	SCALE AS SHOWN	DATE JAN 2007		

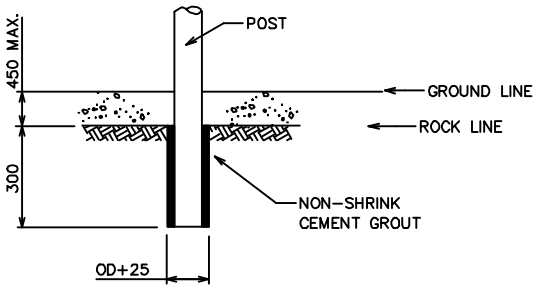


CHAIN LINK FENCE



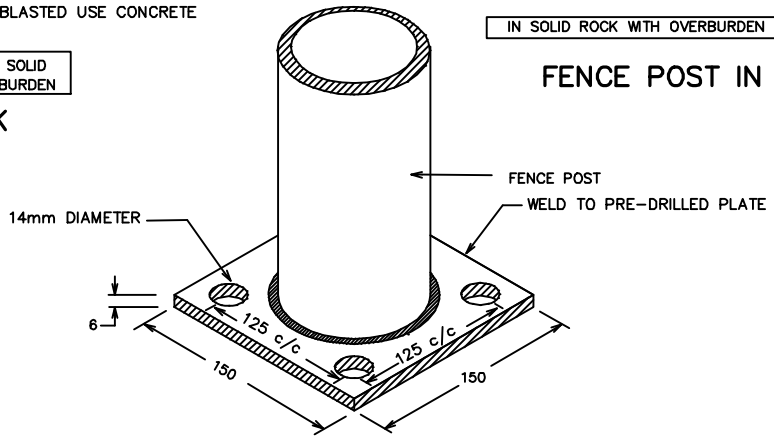
IN SHALE OR FRIABLE ROCK, AND IN SOLID ROCK WITH MORE THAN 450mm OVERBURDEN

FENCE POST IN ROCK



IN SOLID ROCK WITH OVERBURDEN LESS THAN 450mm

FENCE POST IN ROCK

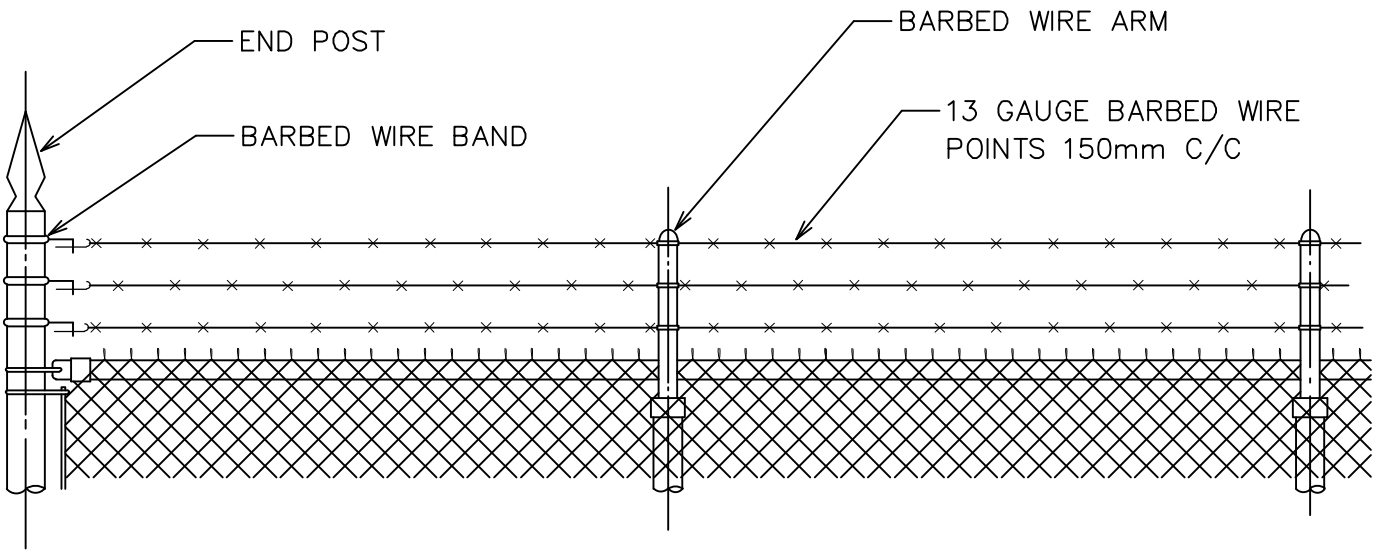


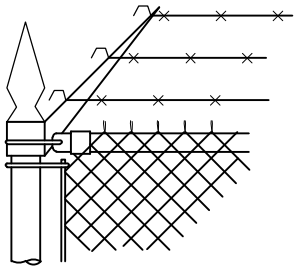
FENCING ON RETAINING WALLS

City of Saint John

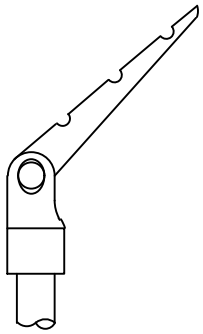
CHAIN LINK FENCE

DWN. BY J. GRANGER	DATE JAN. 2004	REV. No.		DWG. No. S045-325
CHECKED BY	SCALE N.T.S.	DATE		





CORNER POST
WITH BARBED ARM

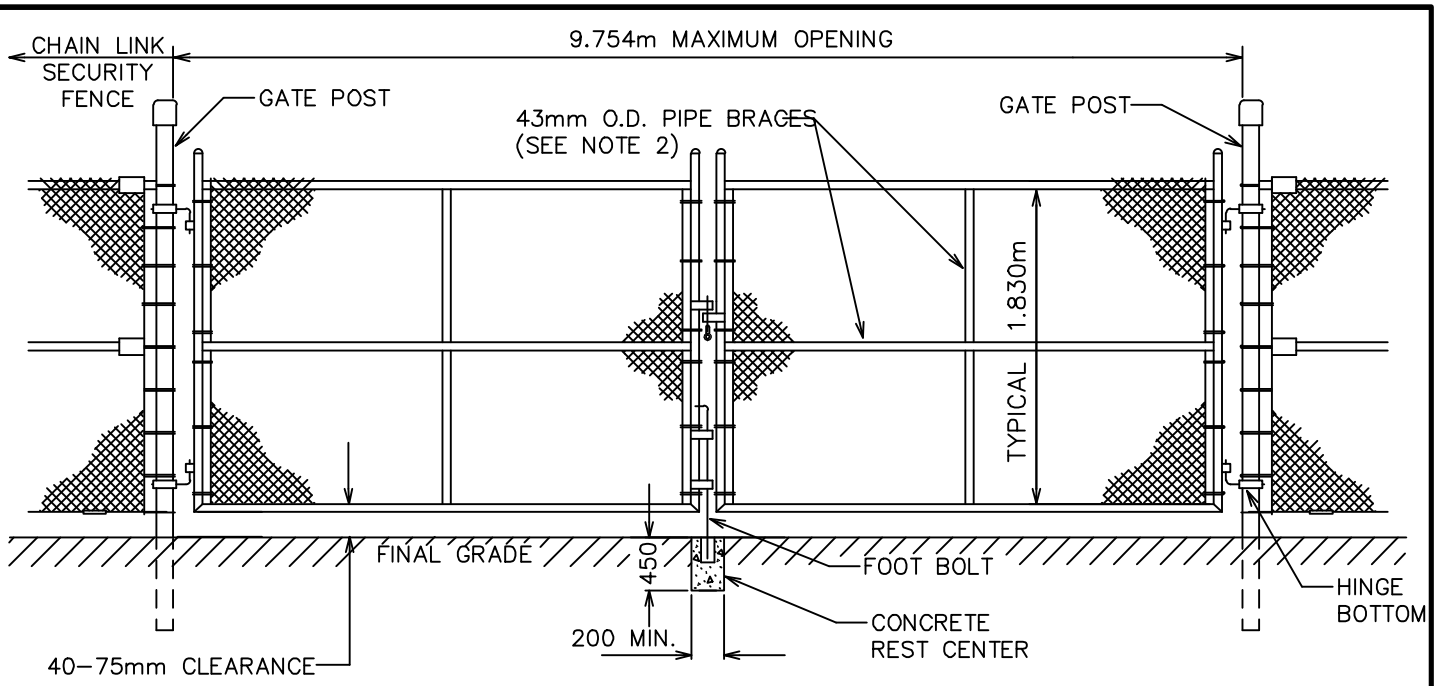


BARBED WIRE ARM

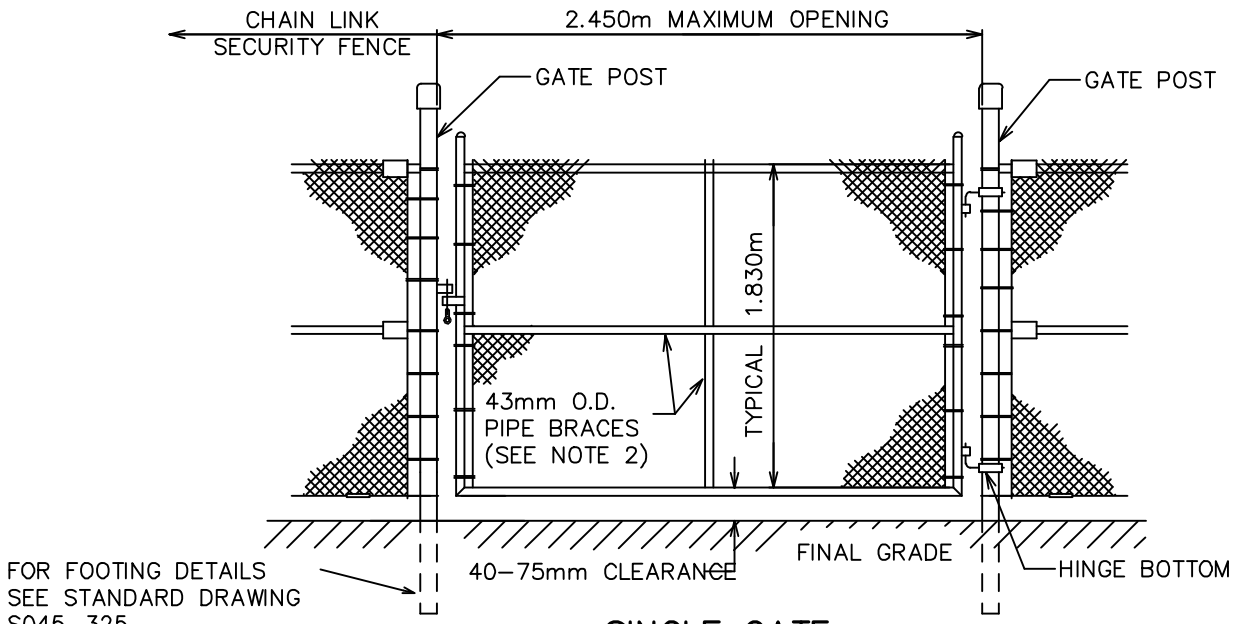
City of Saint John

INSTALLATION OF BARBED WIRE FOR CHAIN LINK FENCE

DWN. BY K.MORRIS	DATE JAN. 2004	REV. No.		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE		S045–326



DOUBLE GATE



SINGLE GATE

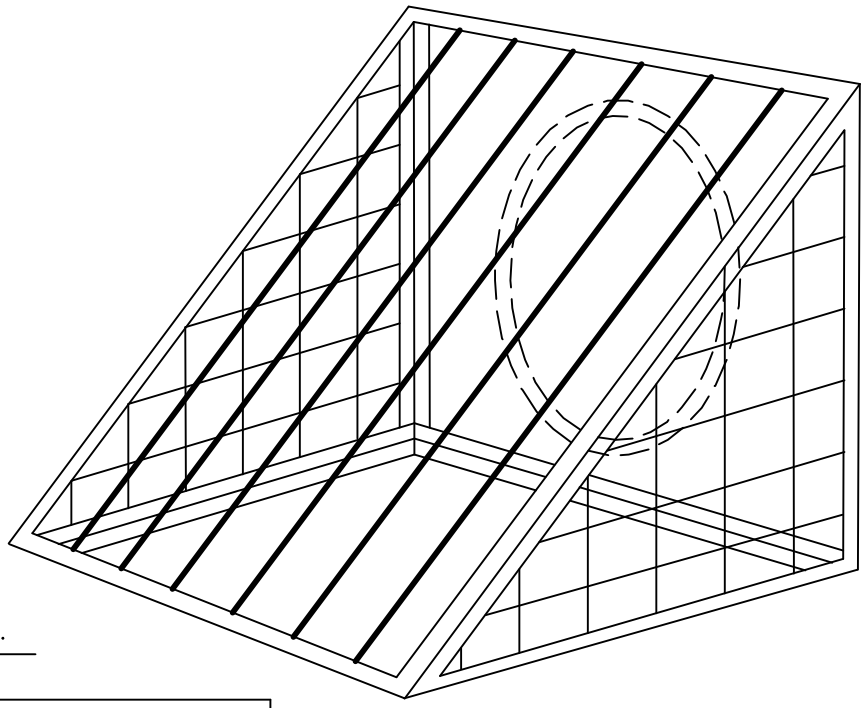
NOTES:

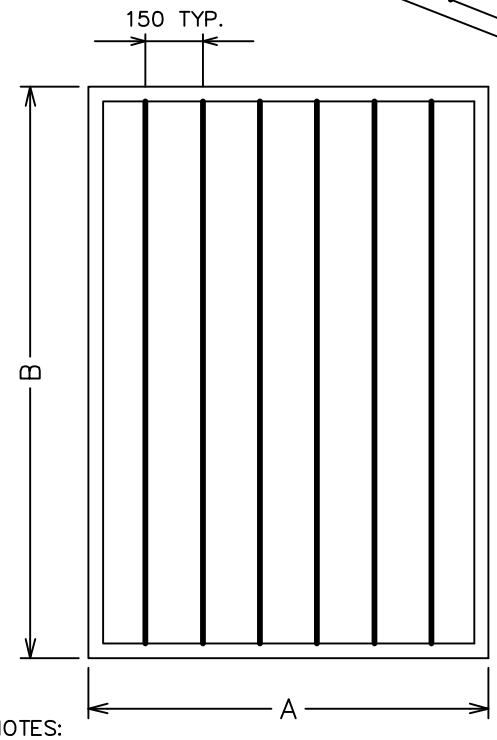
1. ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED
2. PIPE BRACES:
   GATES UP TO 1.8m WIDE – HORIZONTAL BRACE ONLY
   GATES GREATER THAN 1.8m – BOTH HORIZONTAL AND VERTICAL BRACES

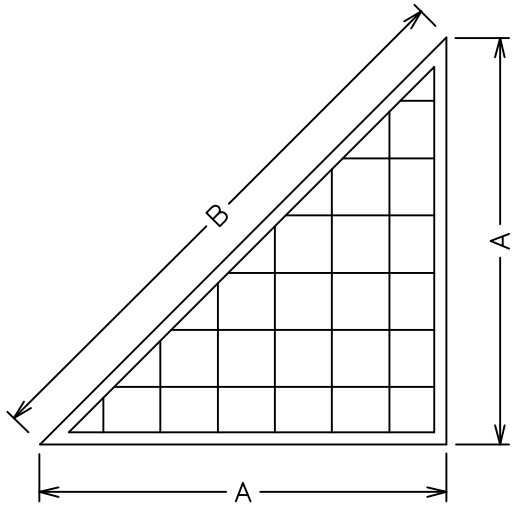
City of Saint John

CHAIN LINK SECURITY GATES

DWN. BY J. GRANGER	DATE JAN 2004	REV. No. 1		DWG. No. S045–327
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		







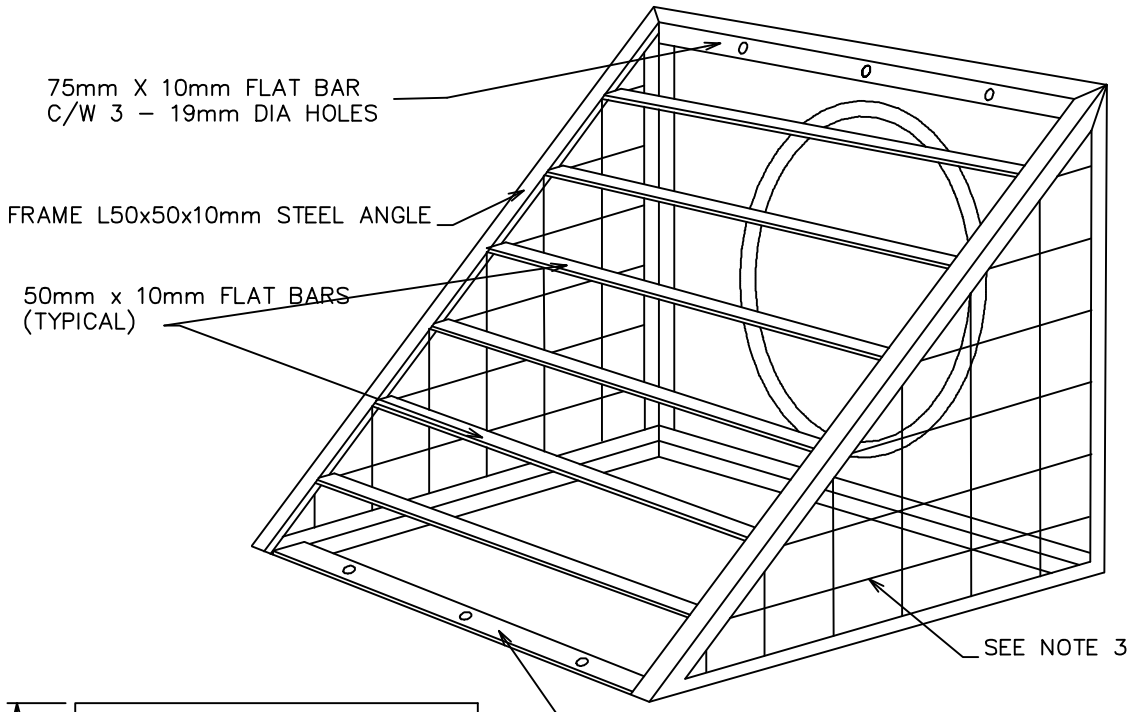
PIPE DIAMETER	DIMENSIONS	
	A	B
375–450	750	1060
600	900	1270
750	1050	1480
900	1200	1700
1050	1350	1910

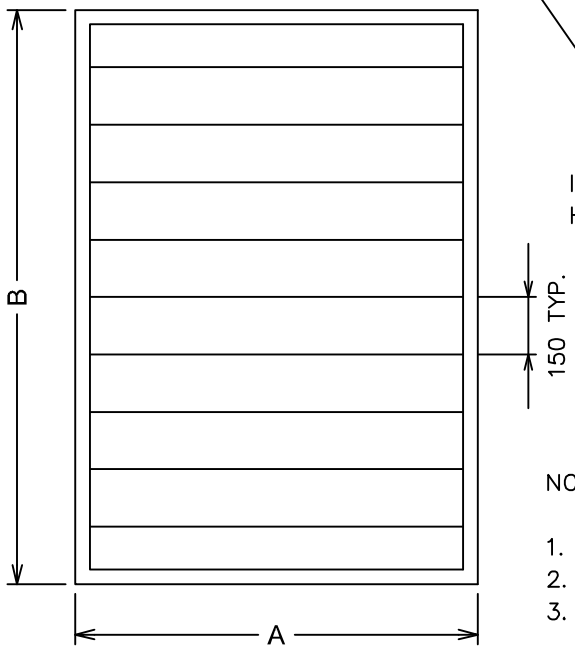
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL JOINTS TO BE FULLY WELDED
3. SIDES SHALL BE CONSTRUCTED OF 12.7mm ∅ ROUND BAR AT 150mm SPACING, EACH DIRECTION
4. USE 25mm ∅ ROUND BARS FOR FRONT SURFACE
5. FRAME CONSTRUCTED OF L50 X 50 X 10 STEEL ANGLE
6. GRATES SHALL BE SECURED TO HEADWALL. CONNECTION TO HEADWALL SHALL BE REMOVABLE FOR MAINTENANCE
7. NO GRATES ON CULVERTS GREATER THAN 1050 ∅ UNLESS REQUIRED BY ENGINEER

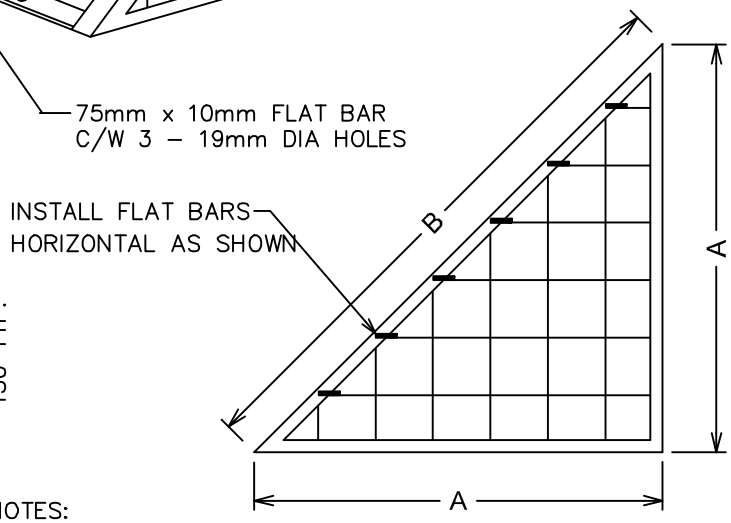
City of Saint John

CULVERT INLET GRATE

DWN. BY G.S.	DATE FEB. 2008	REV. No.		DWG. No. S045–328A
CHECKED BY	SCALE N.T.S.	DATE		







PIPE DIAMETER	DIMENSIONS	
	A	B
450	750	1060
600	900	1270
750	1050	1480
900	1200	1700
1050	1350	1910

NOTES:

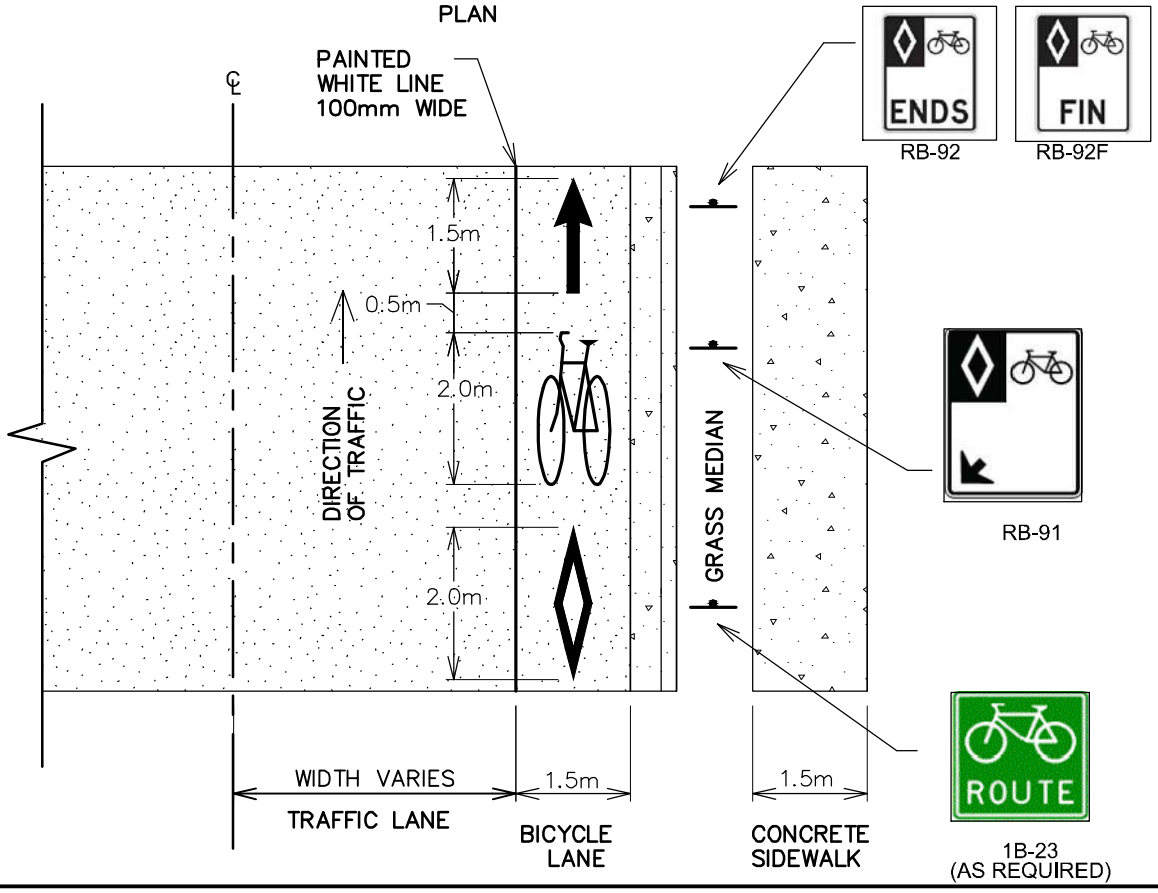
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL JOINTS TO BE FULLY WELDED
3. SIDES SHALL BE CONSTRUCTED OF 12.7mm Ø ROUND BAR AT 150mm SPACING, EACH DIRECTION
4. FRAME CONSTRUCTED OF L50 X 50 X 10 STEEL ANGLE
5. GRATES SHALL BE SECURED TO HEADWALL. CONNECTION TO HEADWALL SHALL BE REMOVABLE FOR MAINTENANCE CONNECTION SHALL BE BASED ON FIELD CONDITIONS
6. NO GRATES ON CULVERTS GREATER THAN 1050 Ø UNLESS REQUIRED BY ENGINEER
7. GRATE TO BE PAINTED WITH RED OXIDE PRIMER
8. THIS DRAWING IS INTENDED TO SHOW GENERAL SIZE AND CONFIGURATION. FINAL DESIGN OF GRATE SHALL CORRESPOND WITH HEADWALL CONSTRUCTION

City of Saint John

CULVERT OUTLET GRATE

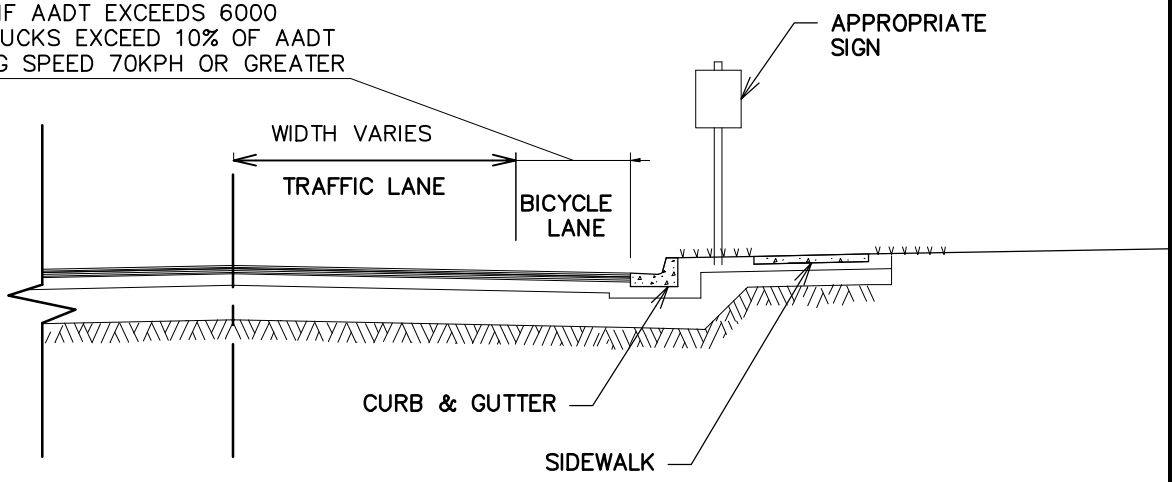
DWN. BY J. GRANGER	DATE FEB 2008	REV. No. 2		DWG. No.
CHECKED BY	SCALE N.T.S.	DATE JAN 2011		S045–328B

PLAN



1.5m TYPICAL
1.8m : IF GRADE EXCEEDS 6%
OR IF AADT EXCEEDS 6000
OR IF TRUCKS EXCEED 10% OF AADT
OR IF AVG SPEED 70KPH OR GREATER

CROSS–SECTION



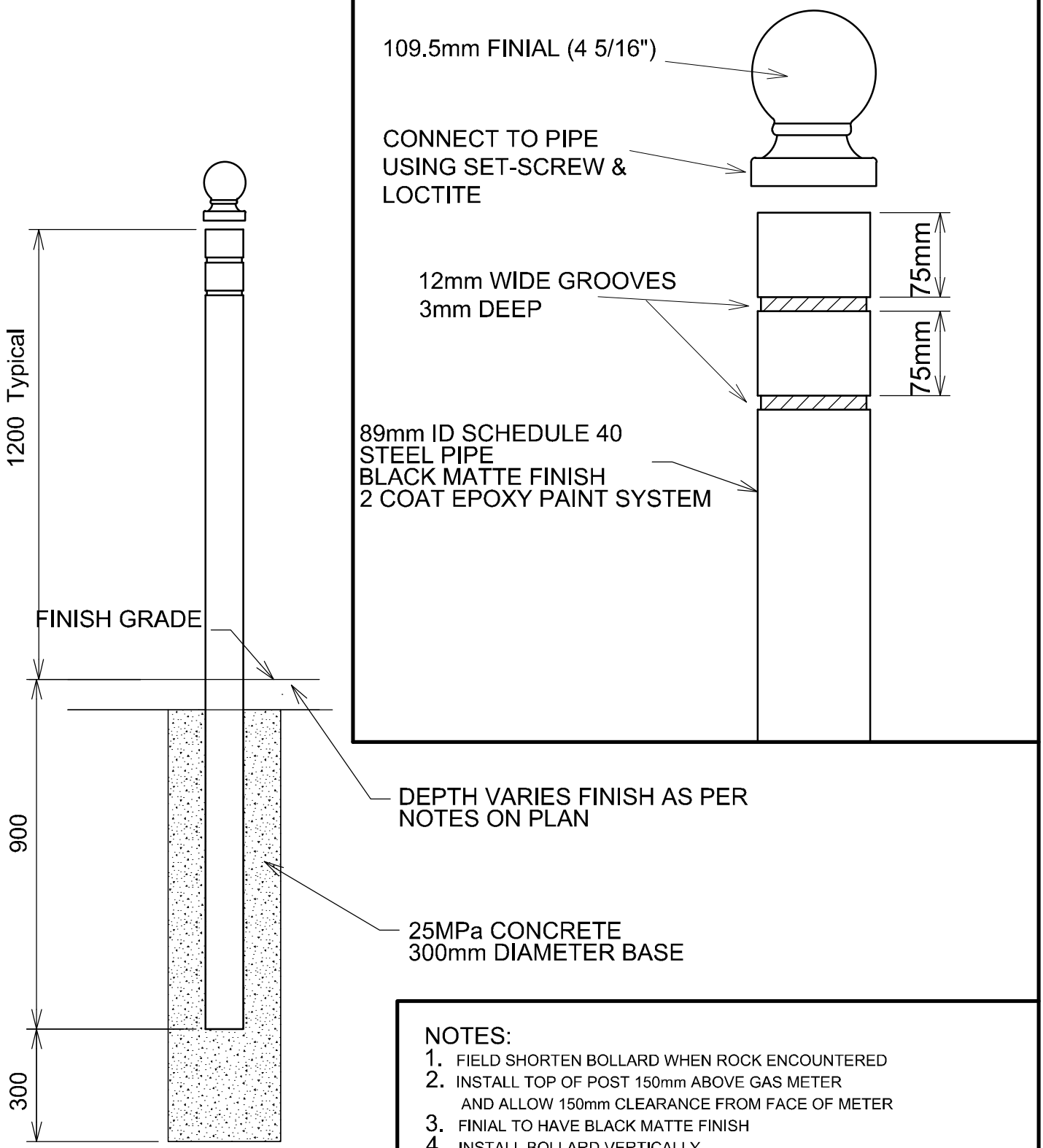
NOTES:

1. WIDTH OF GUTTER NOT TO BE INCLUDED AS PART OF BICYCLE LANE
2. REFER TO 'BIKEWAY TRAFFIC CONTROL GUIDELINES FOR CANADA' FOR SYMBOL DIMENSIONS, INTERSECTION DESIGN AND FREQUENCY OF PAINTED SYMBOLS
3. SIGNS TO BE PLACED AS PER TAC GUIDELINES AND AT THE ENGINEER'S DISCRETION
4. BIKE LANE CAN BE 2.0m WHERE AVAILABLE WIDTH EXISTS
5. MINIMUM SIGNAGE – START OF EACH BLOCK & 200m INTERVALS

City of Saint John

BICYCLE LANE DETAIL

DWN. BY M.A.M.	DATE JAN. 2007	REV. No. 1		DWG. No. S045–330
CHECKED BY	SCALE N.T.S.	DATE JAN 2009		



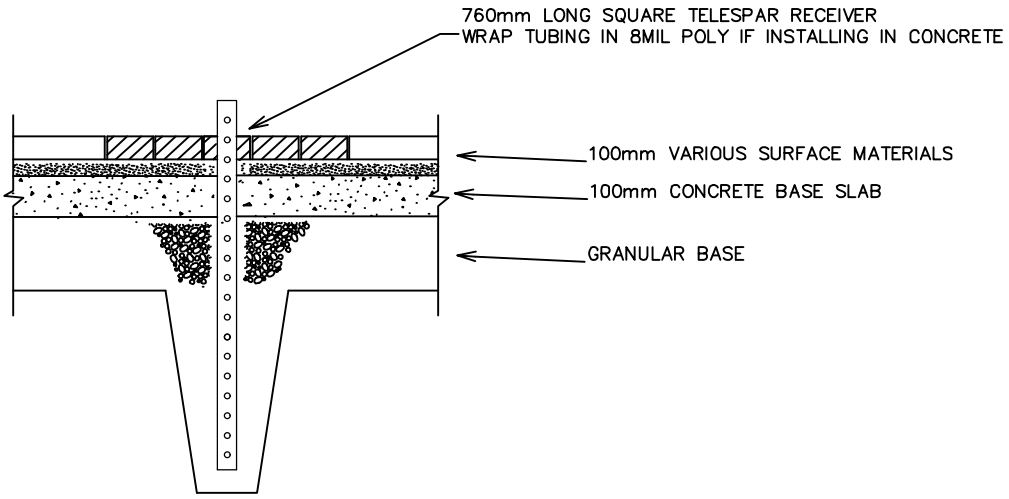
NOTES:

1. FIELD SHORTEN BOLLARD WHEN ROCK ENCOUNTERED
2. INSTALL TOP OF POST 150mm ABOVE GAS METER AND ALLOW 150mm CLEARANCE FROM FACE OF METER
3. FINIAL TO HAVE BLACK MATTE FINISH
4. INSTALL BOLLARD VERTICALLY
5. BOLLARD IS TO BE FILLED WITH 25 MPa CONCRETE

City of Saint John

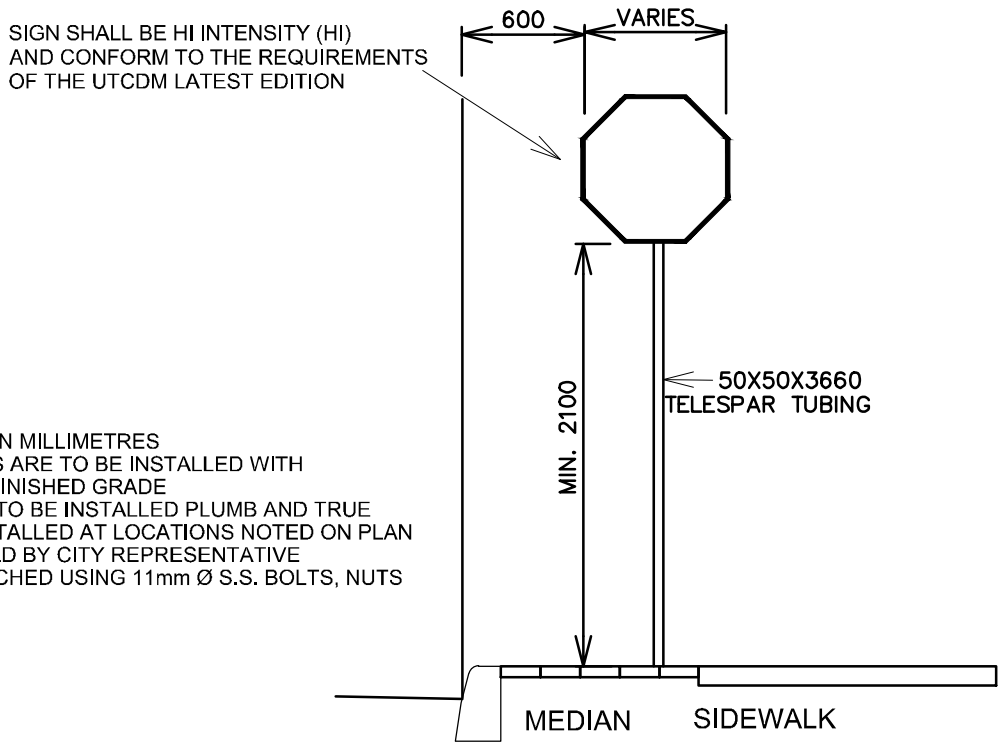
89mm I.D. STEEL HERITAGE STYLE BOLLARD

DWN. BY J Granger	DATE OCT 2008	REV. No. 2		DWG. No. S045-331
CHECKED BY	SCALE N.T.S.	DATE JAN 2010		



SIGN POST RECEIVER

(TELESPAR POST)



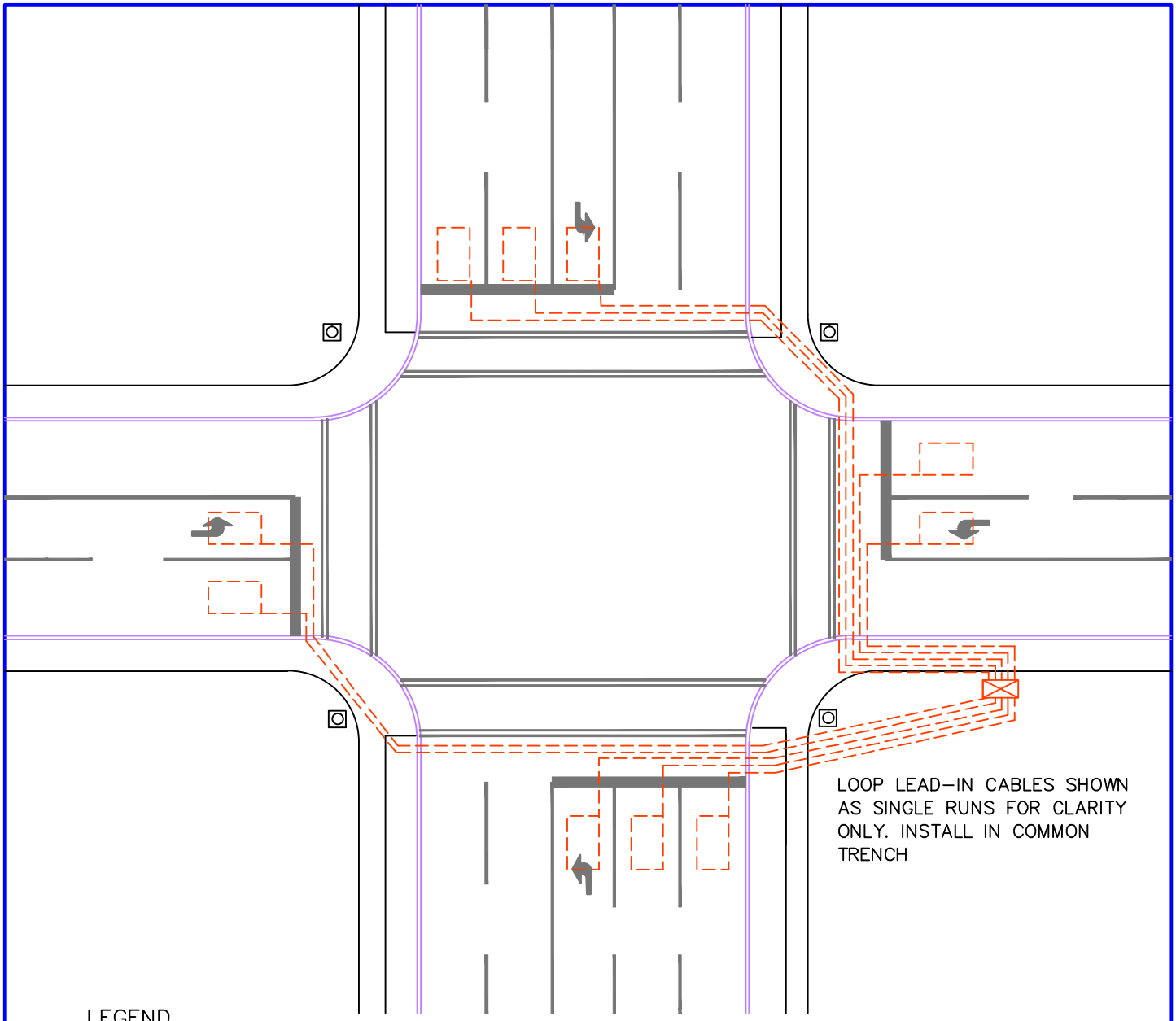
SIGN LOCATION
CROSS SECTION

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. SIGN POST RECEIVERS ARE TO BE INSTALLED WITH SINGLE HOLE ABOVE FINISHED GRADE
3. ALL BASE RECEIVERS TO BE INSTALLED PLUMB AND TRUE
4. RECEIVERS TO BE INSTALLED AT LOCATIONS NOTED ON PLAN OR AS MARKED IN FIELD BY CITY REPRESENTATIVE
5. SIGNS SHALL BE ATTACHED USING 11mm Ø S.S. BOLTS, NUTS AND FLAT WASHERS

City of Saint John

SIGN POST DETAILS

DWN. BY D.B.	DATE MAY 2018	REV. No. 3		DWG. No. S045–332
CHECKED BY	SCALE N.T.S.	DATE MAY 2018		



LOOP LEAD–IN CABLES SHOWN AS SINGLE RUNS FOR CLARITY ONLY. INSTALL IN COMMON TRENCH

LEGEND

- BASE MOUNTED TRAFFIC POLE
- TRAFFIC CONTROLLER ASSEMBLY
- PREFORMED DETECTOR LOOP AND LOOP LEAD–IN CABLE

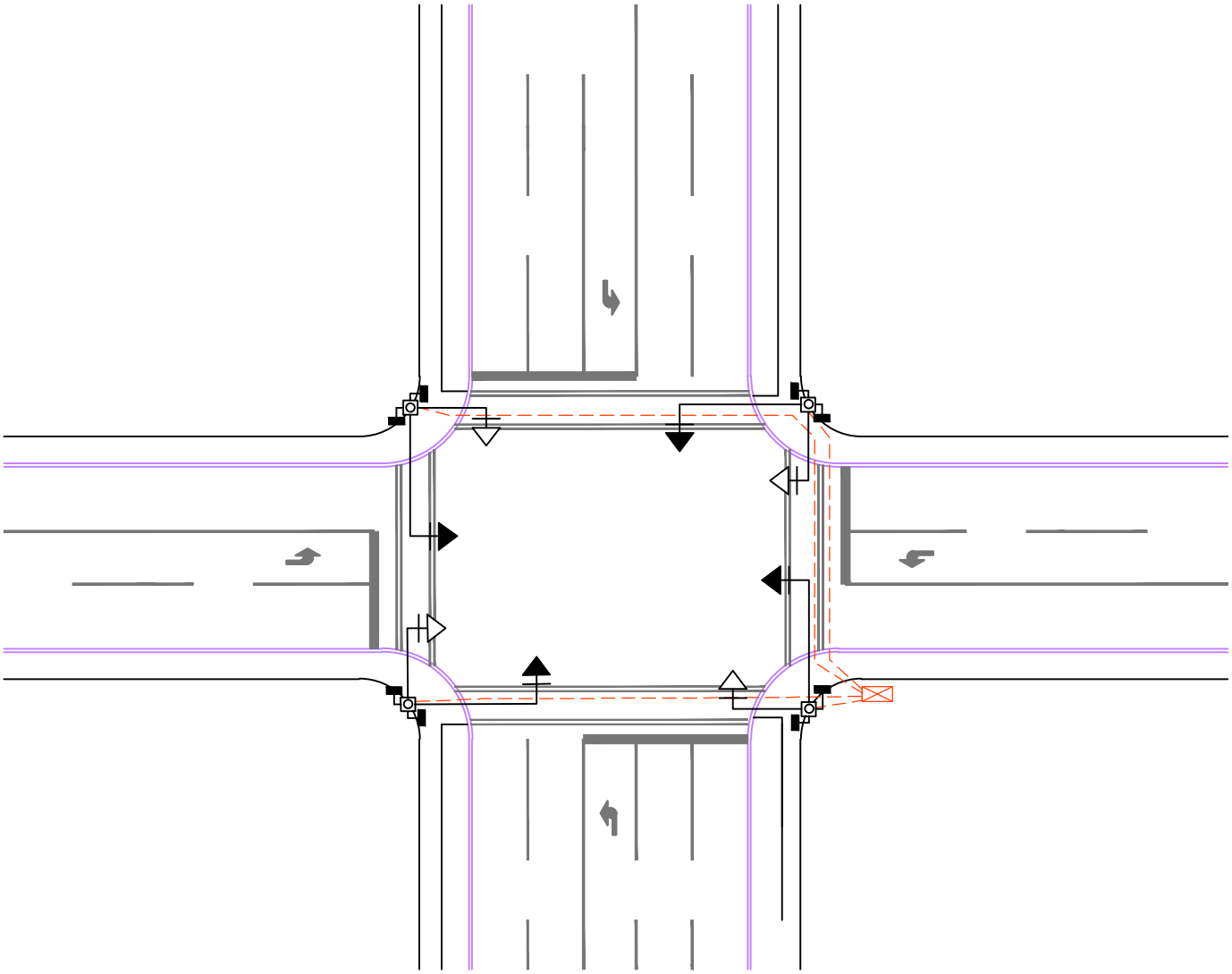
NOTES:

1. DETECTOR LOOP TO BE CENTRED IN LANE
2. LOOP DIMENSIONS ARE 1.8m x 6.0m. LOCATE LOOP 1.0m BEHIND STOP BAR
3. STOP BAR TO BE IDENTIFIED IN THE FIELD PRIOR TO LOOP INSTALLATION
4. LOOP LEAD–IN CABLE TO FOLLOW COMMON TRENCH WITH SIGNAL UNDERGROUND DUCT WHERE FEASIBLE (SEE S045–334)

City of Saint John

TYPICAL DETECTOR LOOP LAYOUT

DWN. BY	JGL	DATE	AUGUST 2013	REV. No.	1	DWG. No.	S045–333
CHECKED BY	DAK	SCALE	N.T.S.	DATE	AUGUST 2013		



LEGEND

- BASE MOUNTED TRAFFIC POLE
- PRIMARY TRAFFIC SIGNAL HEAD
- SECONDARY TRAFFIC SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD WITH MOUNTING BRACKET
- TRAFFIC CONTROLLER ASSEMBLY
- UNDERGROUND DUCT (2 @ 50mm AND 1 @ 32mm)

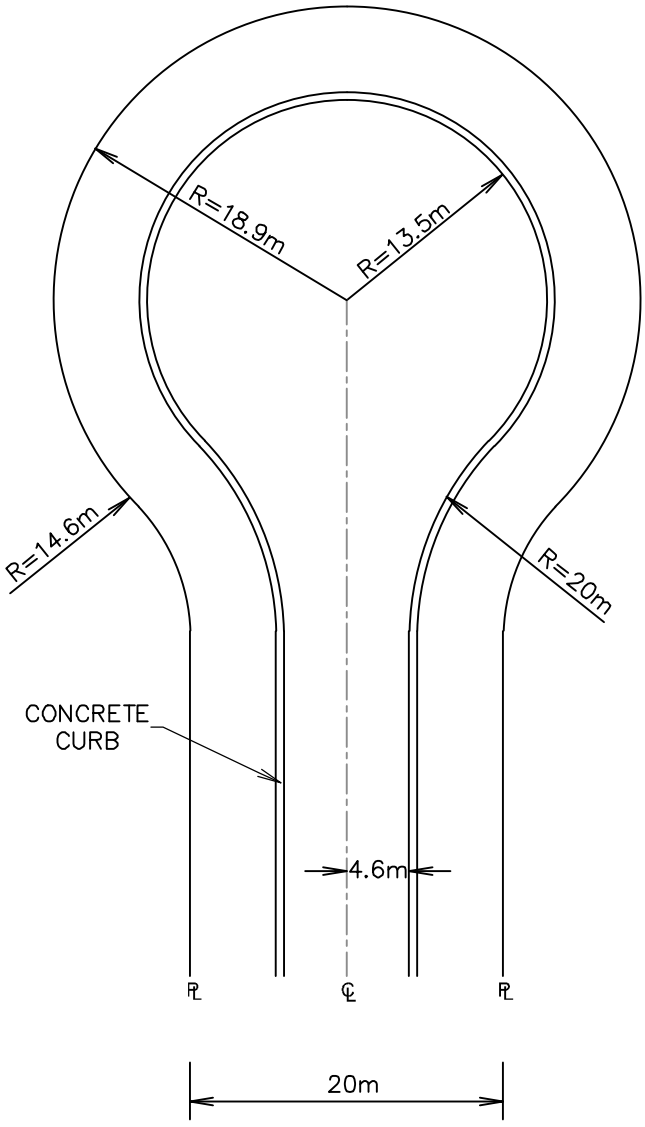
NOTES:

1) LOCATION OF ALL SIGNAL HEADS SHALL MEET MUTCDC CONE OF VISION REQUIREMENTS.
2) THIS DRAWING SHALL BE READ IN CONJUNCTION WITH S045–333 TO ENSURE CONDUIT PLACEMENT FOLLOWS A COMMON TRENCH WITH DETECTOR LOOPS

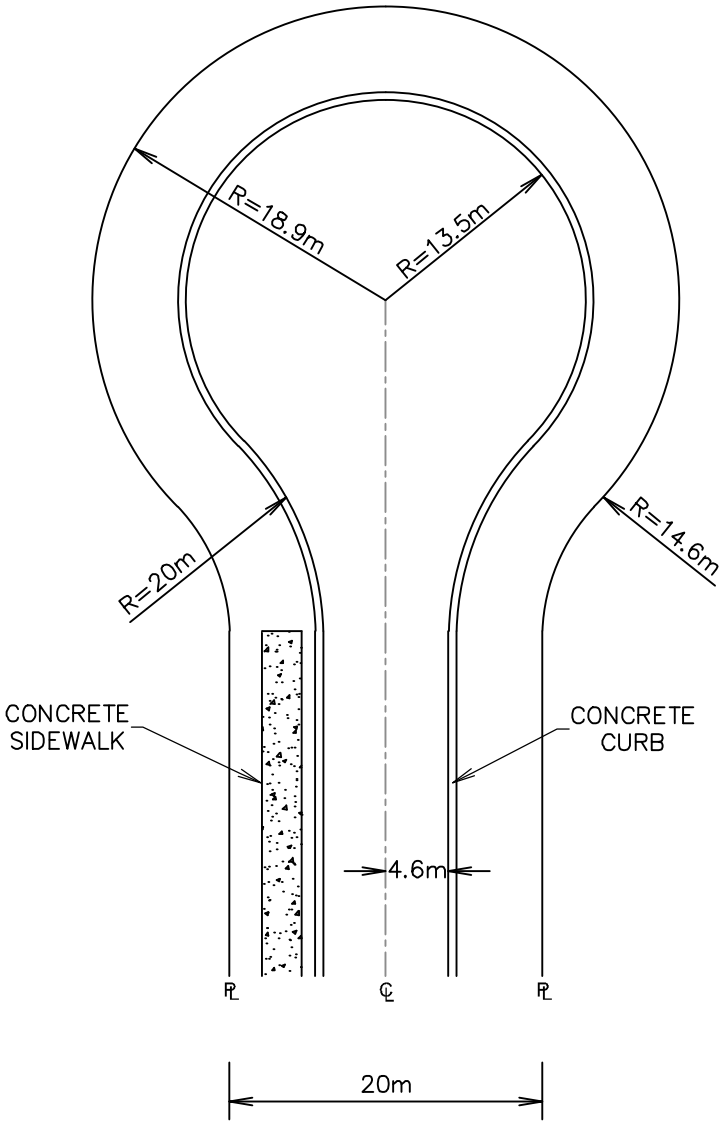
City of Saint John

TYPICAL SIGNAL LAYOUT FOR 2–WAY STREET WITH OPPOSING LEFT TURN LANES

DWN. BY	J.G.L	DATE	JULY 2013	REV. No.	1		DWG. No. S045–334
CHECKED BY	D.A.K	SCALE	N.T.S.	DATE	JULY 2013		



NO SIDEWALK,
CURB BOTH SIDES



SIDEWALK ONE SIDE,
CURB BOTH SIDES

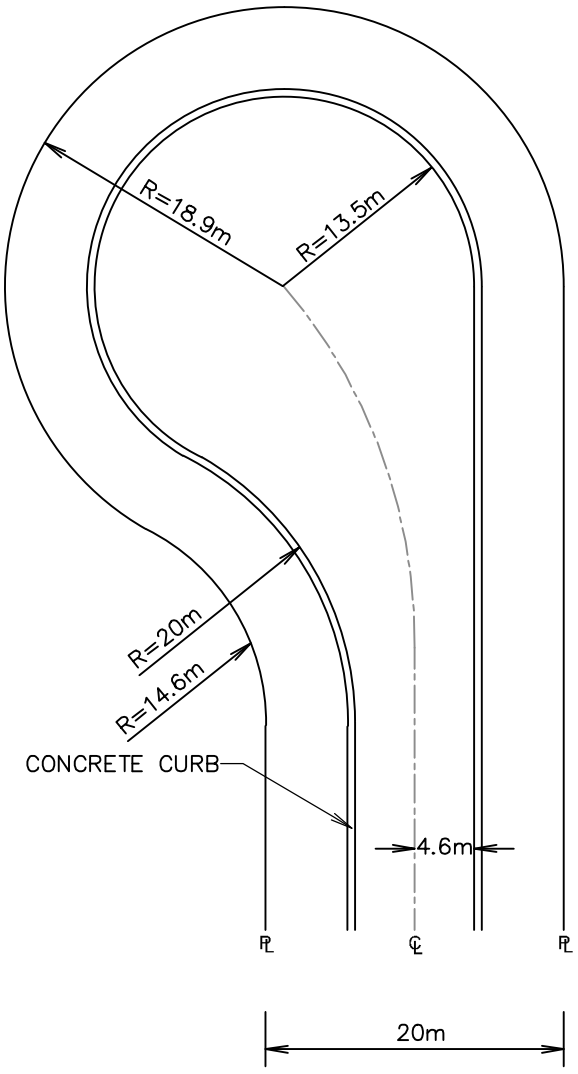
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB AND SIDEWALK DETAILS, SEE STANDARD DRAWINGS S045–309 TO S045–315 (AS APPLICABLE)
3. FOR STREET DETAILS SEE STANDARD DRAWING S045–300
4. NEW LOCAL STREETS ARE TO BE LOCATED INSIDE THE PRIMARY DEVELOPMENT AREA (P.D.A.)

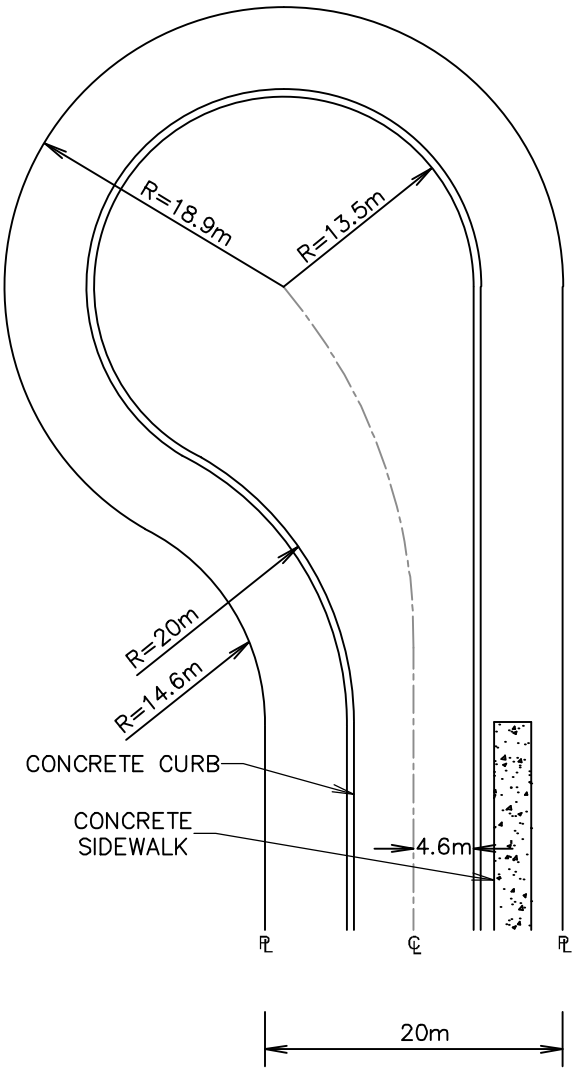
City of Saint John

TYPICAL CUL–DE–SAC LOCAL STREET (SYMMETRICAL – 20m R–O–W)

DWN. BY: D. BERUBE	DATE JAN. 2016	REV. No.		DWG. No. S045–335
CHECKED BY	SCALE N.T.S	DATE		



OFFSET LEFT,
NO SIDEWALK



OFFSET LEFT,
WITH SIDEWALK
ONE SIDE

NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB AND SIDEWALK DETAILS, SEE STANDARD DRAWINGS S045–309 TO S045–315 (AS APPLICABLE)
3. FOR STREET DETAILS SEE STANDARD DRAWING S045–300
4. NEW LOCAL STREETS ARE TO BE LOCATED INSIDE THE PRIMARY DEVELOPMENT AREA (P.D.A.)

City of Saint John

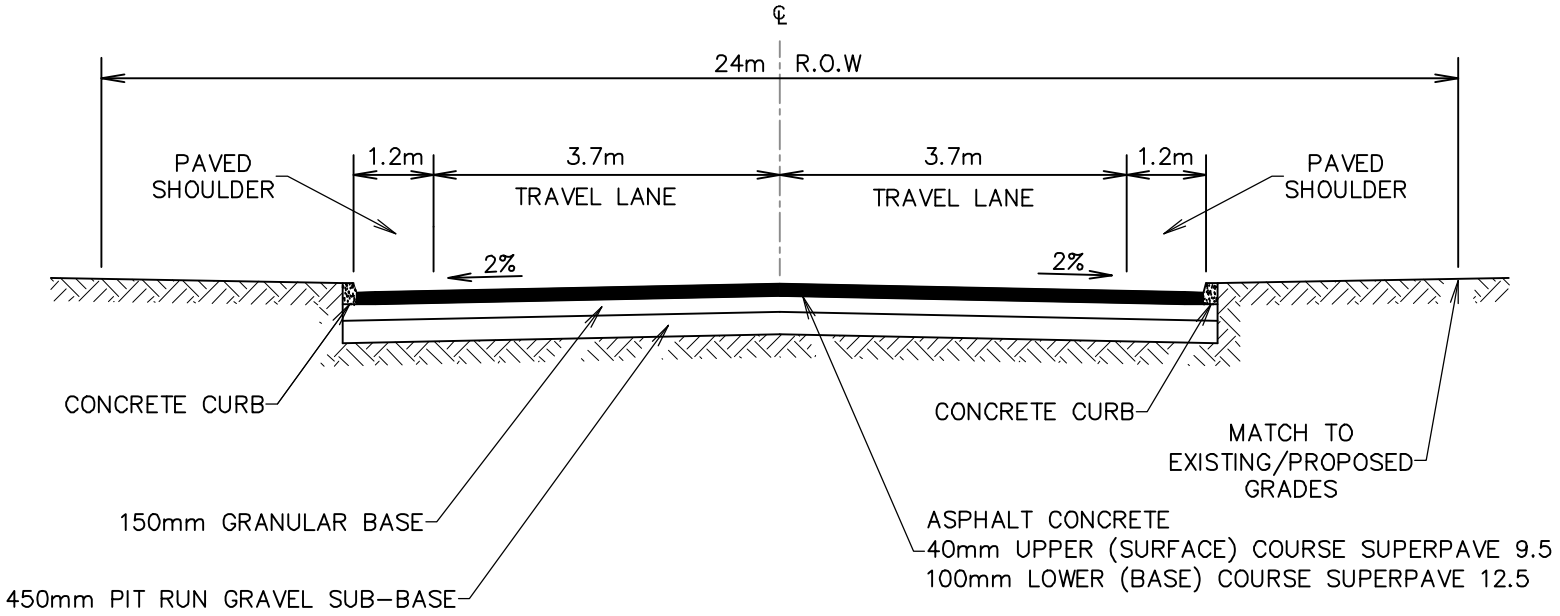
TYPICAL CUL–DE–SAC LOCAL STREET (OFFSET LEFT – 20m R–O–W)

DWN. BY: D. BERUBE	DATE JAN. 2016	REV. No.		DWG. No. S045–335A
CHECKED BY	SCALE N.T.S	DATE		

City of Saint John

CHECKED BY	DWN. BY: D. BERUBE
SCALE N.T.S	DATE JAN. 2016
DATE	REV. No.

TYPICAL CROSS SECTION
INDUSTRIAL ROAD – TYPE A



NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB DETAILS SEE STANDARD DRAWING S045–311
3. DESIGN ESAL'S: 3 TO < 10 MILLION
4. DESIGN TO BE BASED ON TAC'S GEOMETRIC DESIGN FOR CANADIAN ROADS FOR SITE SPECIFIC CONSIDERATIONS

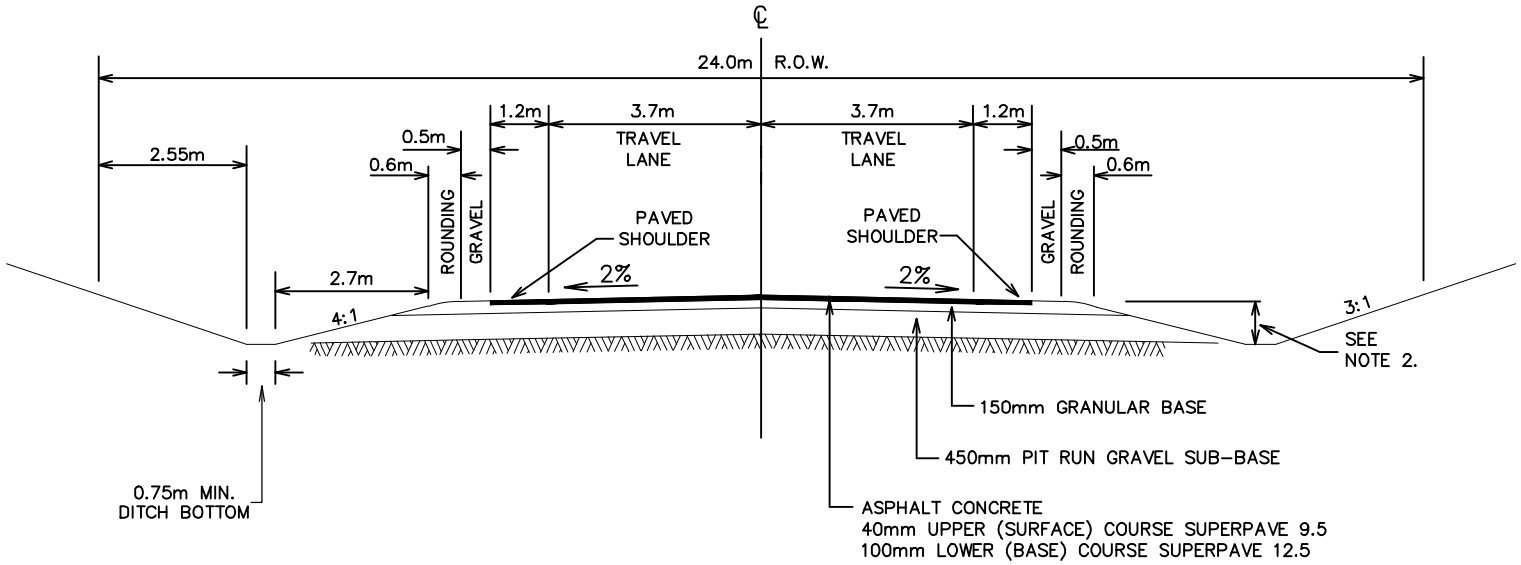
DWG. No. S045–337

City of Saint John

DWN. BY: D. BERUBE	DATE JAN. 2016	REV. No.
CHECKED BY	SCALE N.T.S	DATE

TYPICAL CROSS SECTION
INDUSTRIAL ROAD – TYPE B

DWG. No. S045-337A



NOTES:

1. DIMENSIONS ARE AS SHOWN
2. MINIMUM DEPTH FOR DITCHES IS 0.75m
3. DITCH BACKSLOPE TO MATCH PROPOSED/EXISTING ELEVATIONS
4. DESIGN ESAL'S: 3 TO < 10 MILLION
5. DESIGN TO BE BASED ON TAC'S GEOMETRIC DESIGN FOR CANADIAN ROADS FOR SITE SPECIFIC CONSIDERATIONS

NOTES:

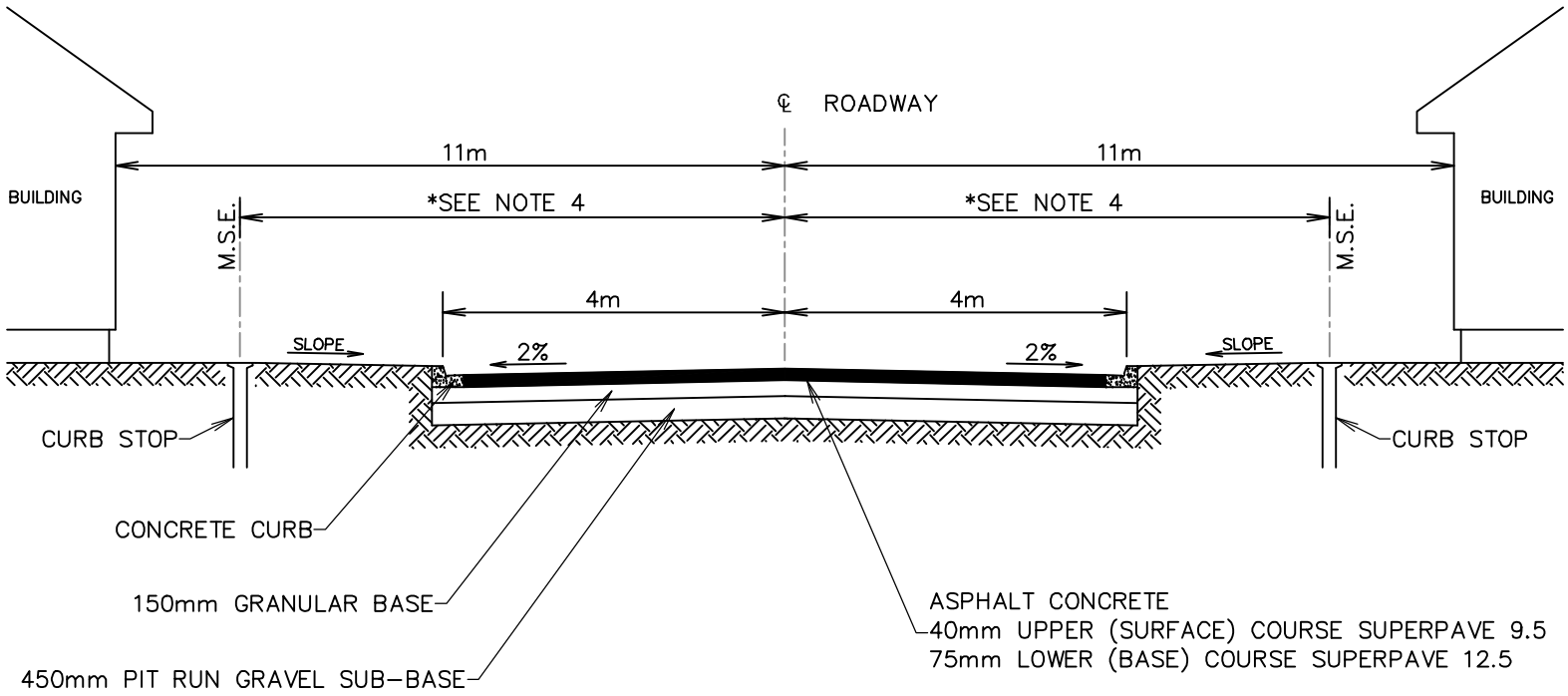
1. DIMENSIONS ARE AS SHOWN
2. MINIMUM 2% CROSSFALL ON ASPHALT WALKWAY, DIRECTION DEPENDANT ON DRAINAGE DESIGN
3. GRANULAR BASE TO BE MINIMUM 300mm DEPTH. DEPTH MAY BE INCREASED SUBJECT TO SUBGRADE CONDITIONS AT THE DIRECTION OF THE ENGINEER

City of Saint John

TYPICAL CROSS SECTION PEDESTRIAN WALKWAY/SHARED USE TRAIL

DWN. BY: D. BERUBE	DATE JAN. 2016	REV. No.		DWG. No. S045–338
CHECKED BY	SCALE N.T.S	DATE		

City of Saint John



NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB AND SIDEWALK DETAILS, SEE STANDARD DRAWINGS S045-309 TO S045-315 AS APPLICABLE
3. DESIGN ESAL'S: 0.3 TO < 3 MILLION
4. MUNICIPAL SERVICES EASEMENT (M.S.E.) LOCATION TO BE DETERMINED BASED ON DEPTH OF UNDERGROUND SERVICES AS PER CITY OF SAINT JOHN
5. NATURAL GAS UTILITIES ARE NOT PERMITTED WITHIN THE MUNICIPAL SERVICES EASEMENT
6. PRIVATE STREETS ARE THOROUGHFARES NOT OWNED BY THE CITY OF SAINT JOHN SERVING CLUSTER TOWNHOUSE DWELLINGS

TYPICAL CROSS SECTION PRIVATE STREET (CURBED)

DWN. BY: D. BERUBE	DATE JAN. 2016	REV. No.
CHECKED BY	SCALE N.T.S	DATE

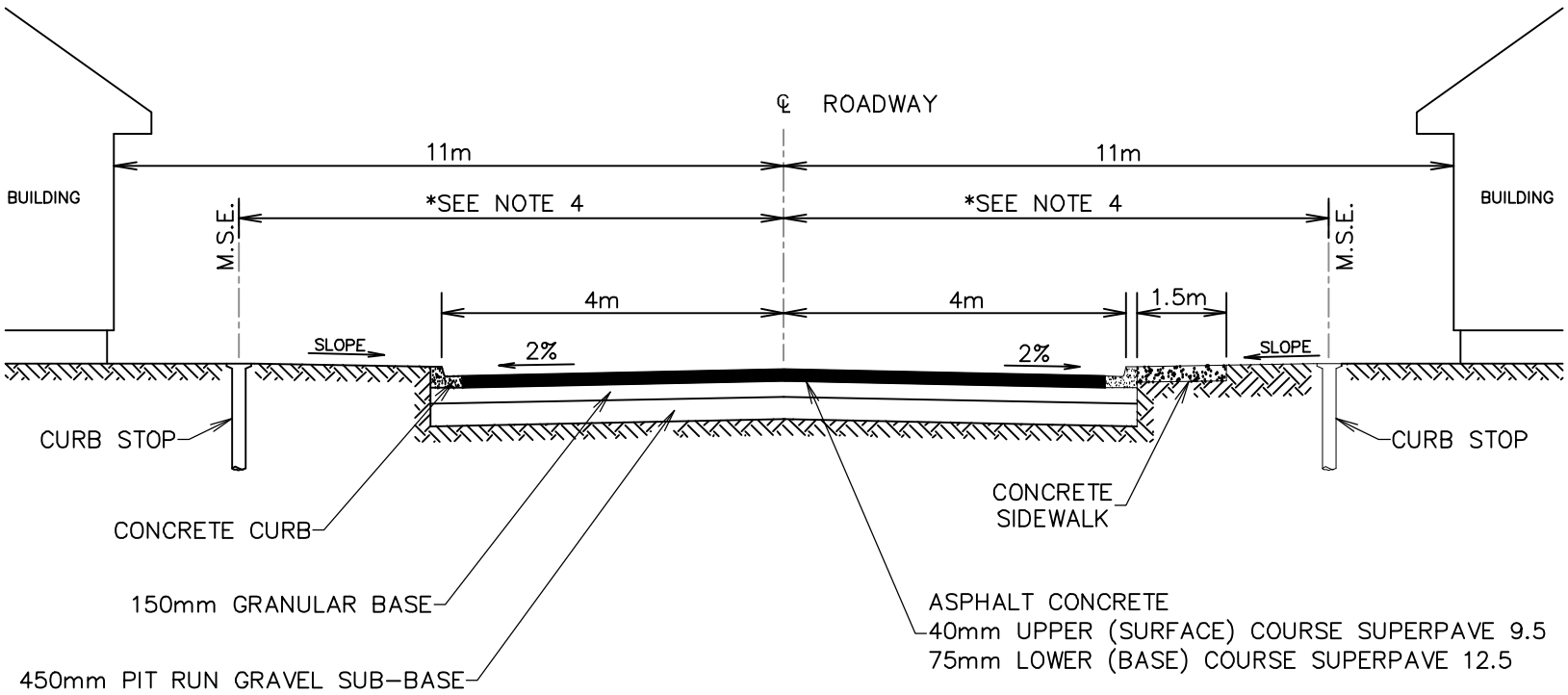
DWG. No. S045-341

City of Saint John

DWN. BY: D. BERUBE	DATE JAN. 2016	REV. No.
CHECKED BY	SCALE N.T.S	DATE

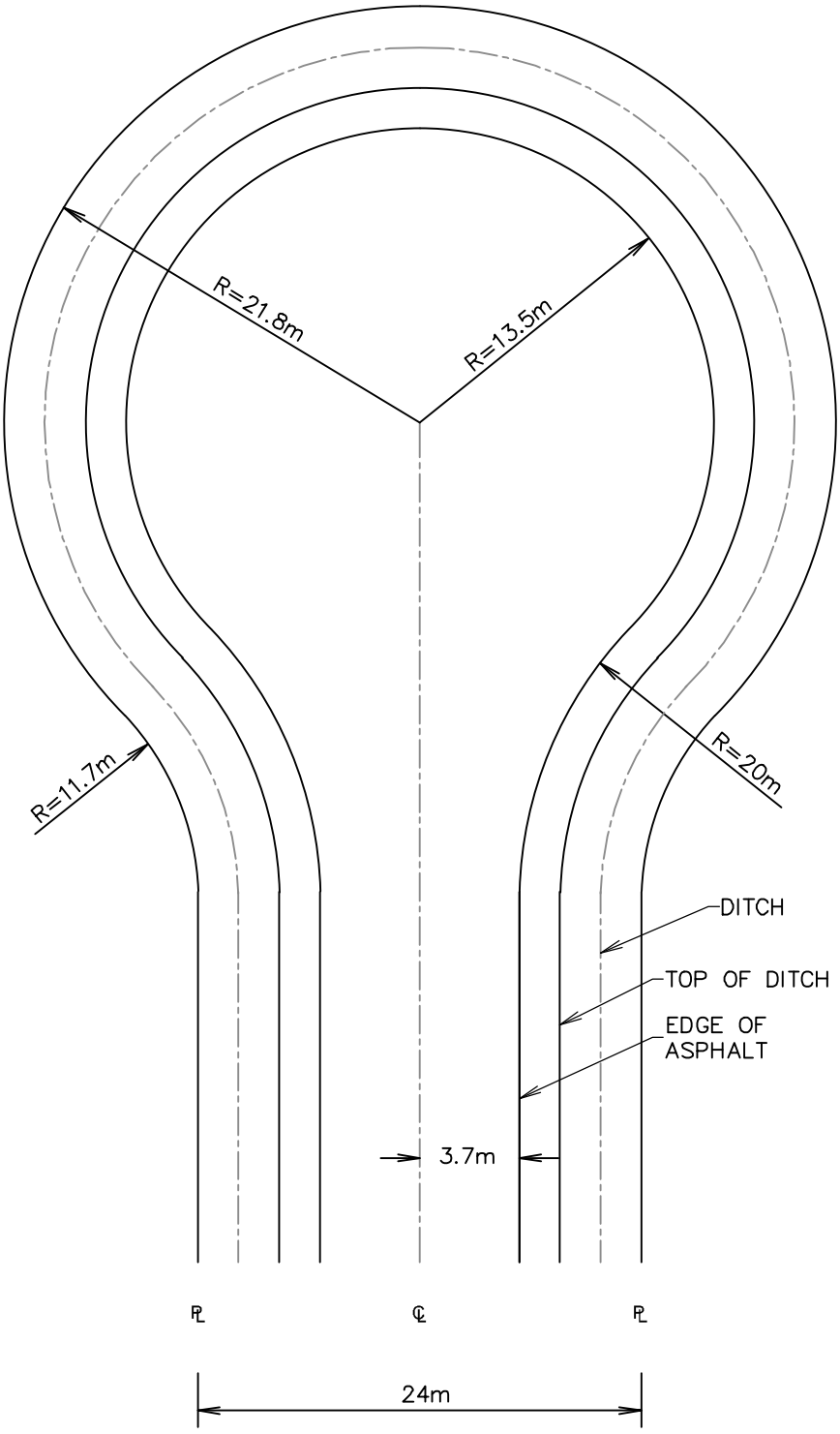
TYPICAL CROSS SECTION
PRIVATE STREET
(CURBED WITH SIDEWALK ON ONE SIDE)

DWG. No. S045-341A



NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR CURB AND SIDEWALK DETAILS, SEE STANDARD DRAWINGS S045-309 TO S045-315 (AS APPLICABLE)
3. DESIGN ESAL'S: 0.3 TO < 3 MILLION
4. MUNICIPAL SERVICES EASEMENT (M.S.E.) LOCATION TO BE DETERMINED BASED ON DEPTH OF UNDERGROUND SERVICES AS PER CITY OF SAINT JOHN
5. NATURAL GAS UTILITIES ARE NOT PERMITTED WITHIN THE MUNICIPAL SERVICES EASEMENT
6. PRIVATE STREETS ARE THOROUGHFARES NOT OWNED BY THE CITY OF SAINT JOHN SERVING CLUSTER TOWNHOUSE DWELLINGS



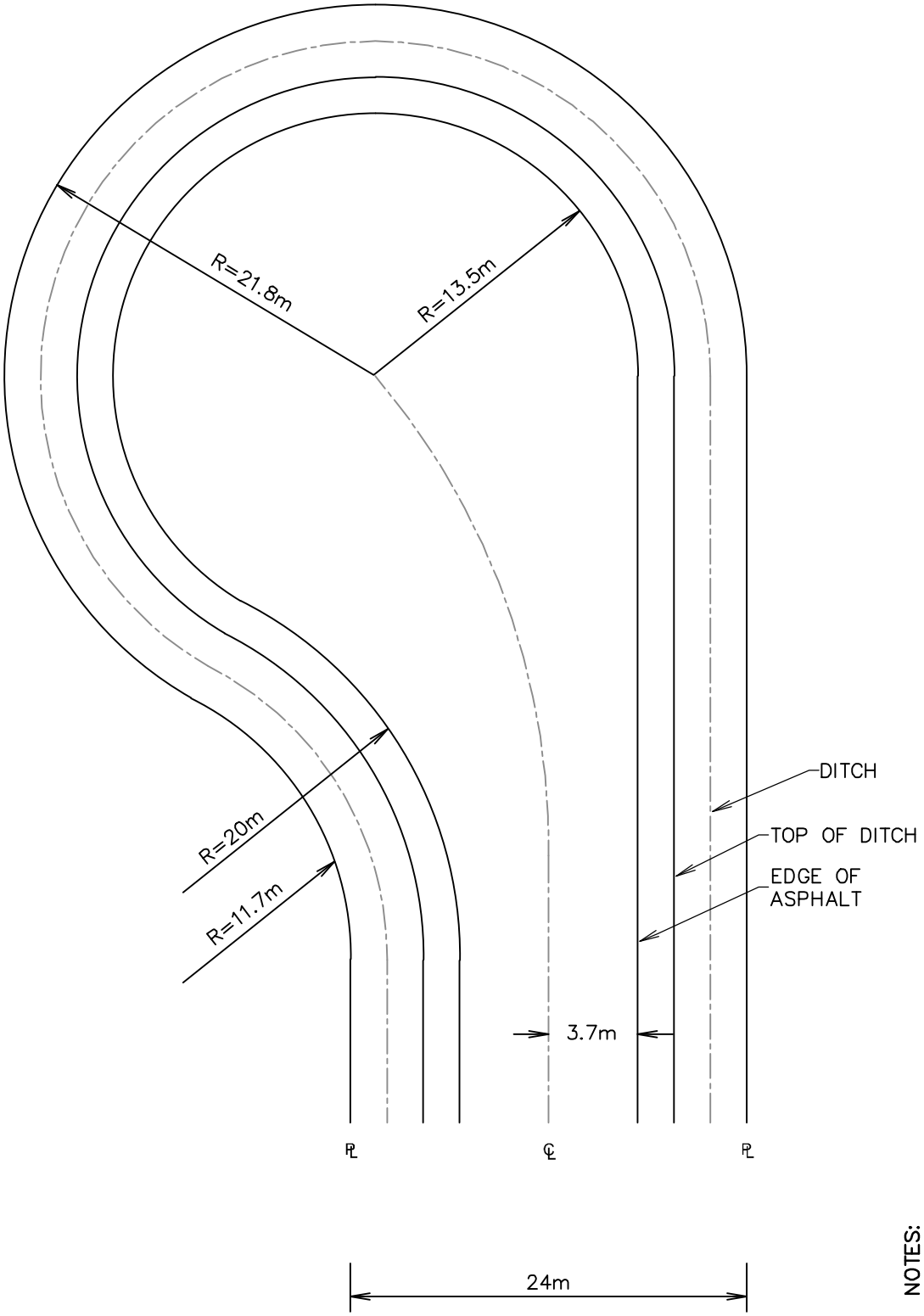
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR ROAD DETAILS SEE STANDARD DRAWING S045-304
3. NEW RURAL ROADS ARE TO BE LOCATED OUTSIDE THE PRIMARY DEVELOPMENT AREA (P.D.A.) OR ON LAND ZONED SUBURBAN RESIDENTIAL (RSS)

City of Saint John

TYPICAL CUL-DE-SAC RURAL ROAD (SYMMETRICAL – 24m R-O-W)

DWN. BY: D. BERUBE	DATE FEB. 2016	REV. No.		DWG. No. S045-342
CHECKED BY	SCALE N.T.S	DATE		



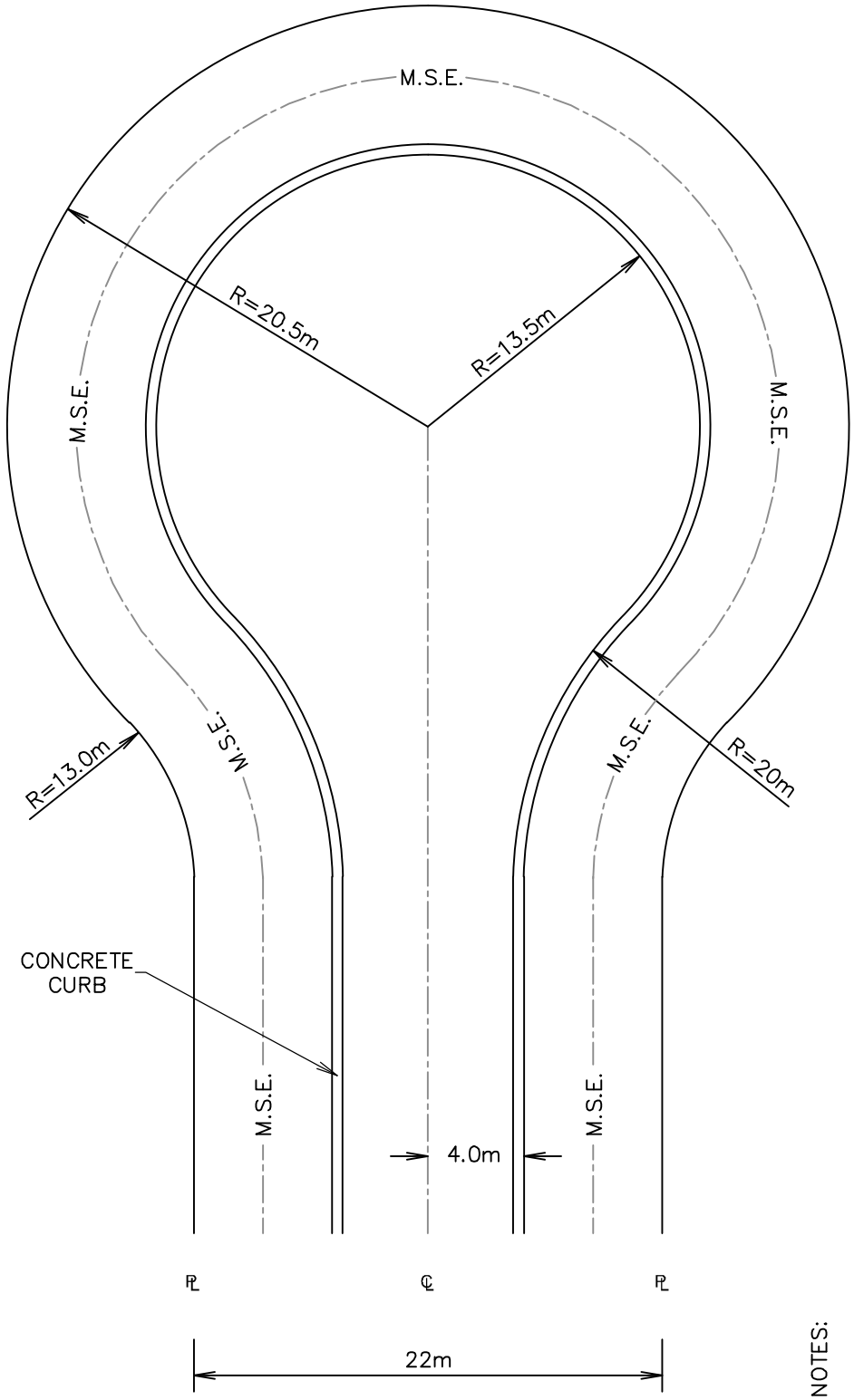
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR ROAD DETAILS SEE STANDARD DRAWING S045-304
3. NEW RURAL ROADS ARE TO BE LOCATED OUTSIDE THE PRIMARY DEVELOPMENT AREA (P.D.A.) OR ON LAND ZONED SUBURBAN RESIDENTIAL (RSS)

City of Saint John

TYPICAL CUL-DE-SAC RURAL ROAD (OFFSET LEFT – 24m R-O-W)

DWN. BY: D. BERUBE	DATE FEB. 2016	REV. No.		DWG. No. S045-342A
CHECKED BY	SCALE N.T.S	DATE		



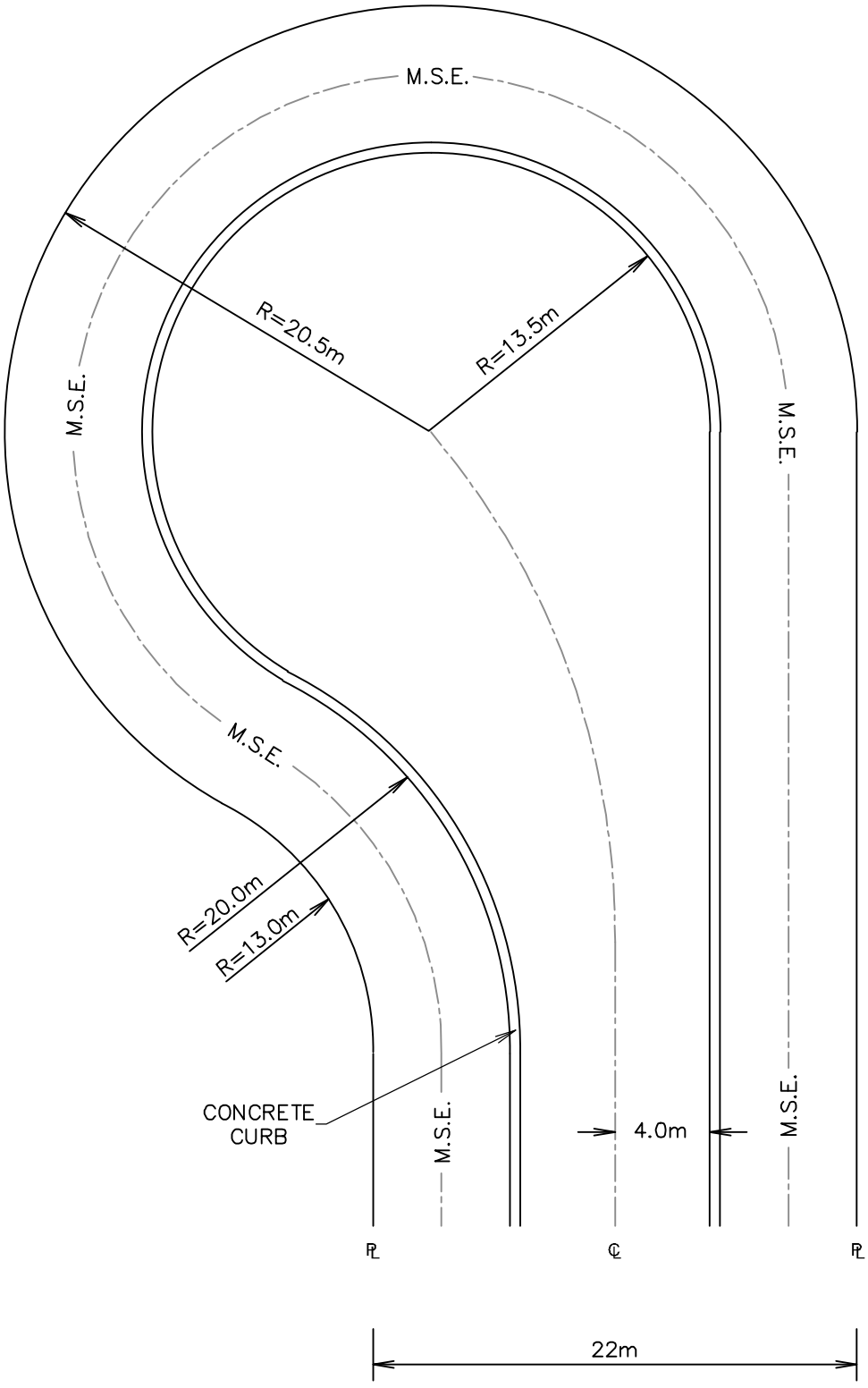
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR PRIVATE ROADWAY DETAILS SEE STANDARD DRAWING S045-341
3. MUNICIPAL SEVICES EASEMENT (M.S.E.) LOCATION TO BE DETERMINED BASED ON DEPTH OF UNDERGROUND SERVICES AS PER CITY OF SAINT JOHN
4. NATURAL GAS UTILITIES ARE NOT PERMITTED WITHIN THE MUNICIPAL SERVICES EASEMENT
5. PRIVATE STREETS ARE THOROUGHFARES NOT OWNED BY THE CITY OF SAINT JOHN SERVING CLUSTER TOWNHOUSE DWELLINGS

City of Saint John

TYPICAL CUL-DE-SAC PRIVATE STREET (SYMMETRICAL – 22m R-O-W)

DWN. BY: D. BERUBE	DATE FEB. 2016	REV. No.		DWG. No. S045-345
CHECKED BY	SCALE N.T.S	DATE		



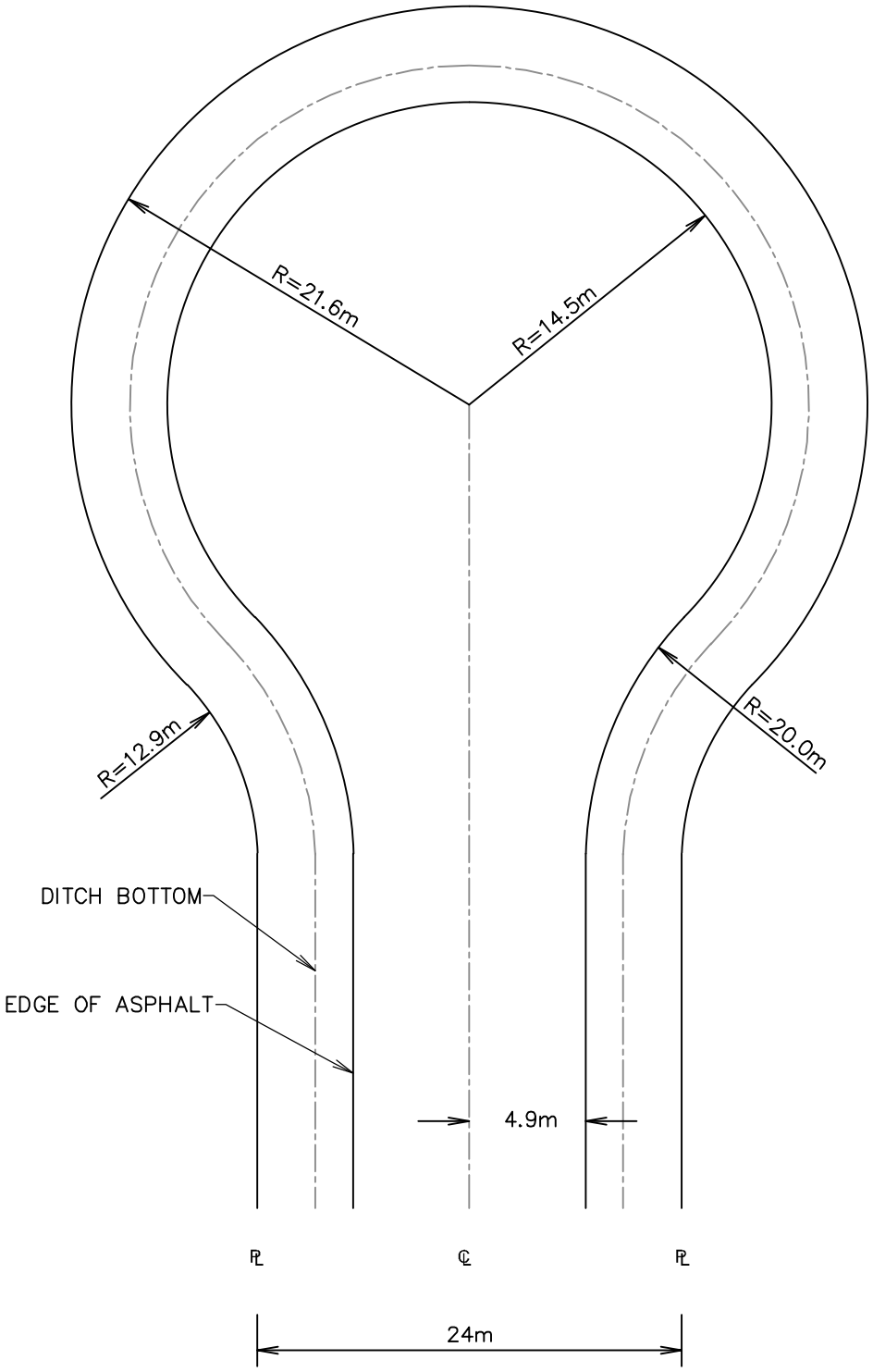
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR PRIVATE ROAD DETAILS SEE STANDARD DRAWING S045-341
3. MUNICIPAL SERVICES EASEMENT (M.S.E.) LOCATION TO BE DETERMINED BASED ON DEPTH OF UNDERGROUND SERVICES AS PER CITY OF SAINT JOHN
4. NATURAL GAS UTILITIES ARE NOT PERMITTED WITHIN THE MUNICIPAL SERVICES EASEMENT
5. PRIVATE STREETS ARE THOROUGHFARES NOT OWNED BY THE CITY OF SAINT JOHN SERVING CLUSTER TOWNHOUSE DWELLINGS

City of Saint John

TYPICAL CUL-DE-SAC PRIVATE STREET (OFFSET LEFT - 22m R-O-W)

DWN. BY: D. BERUBE	DATE FEB. 2016	REV. No.		DWG. No. S045-345A
CHECKED BY	SCALE N.T.S	DATE		



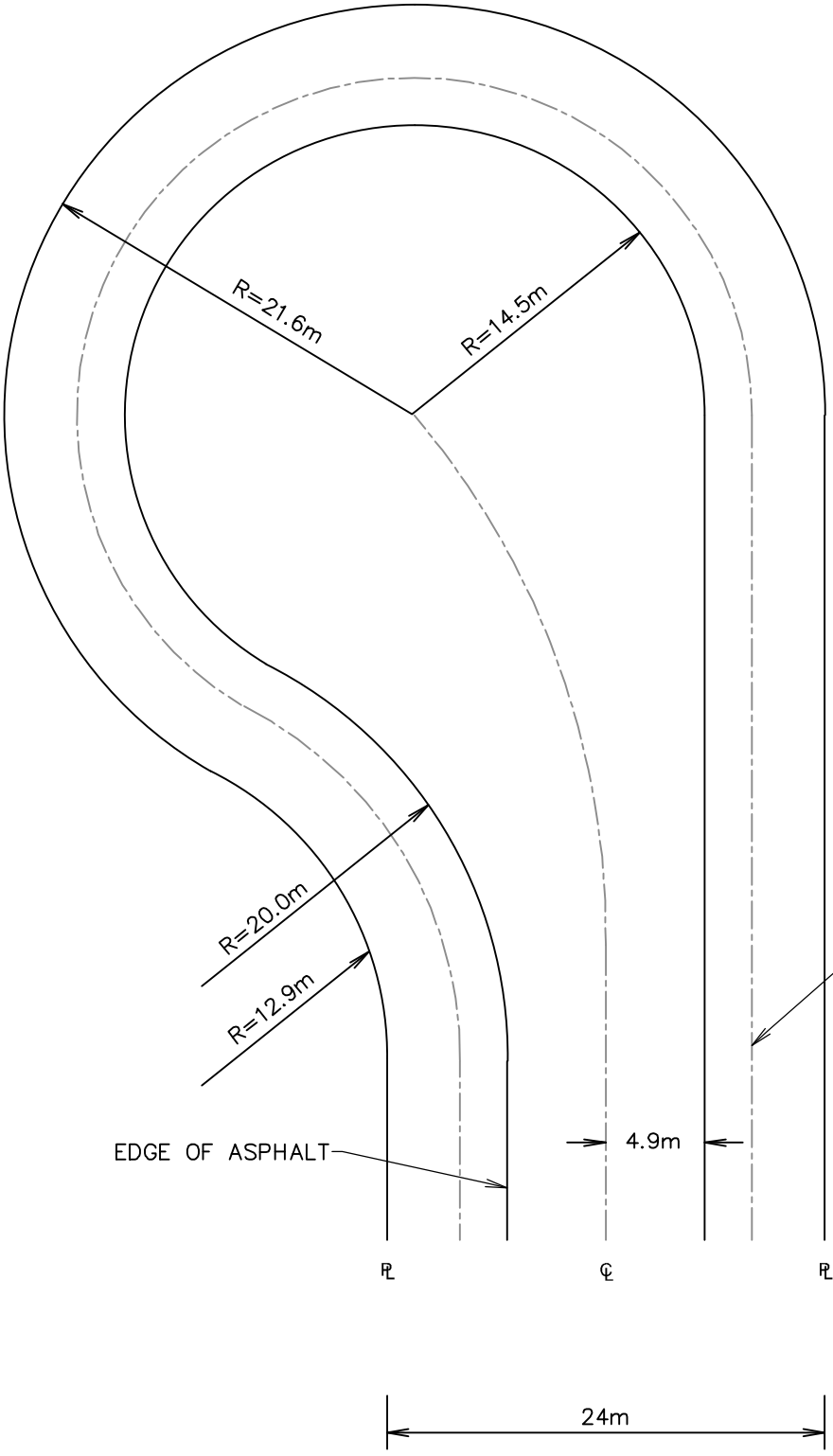
NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR INDUSTRIAL ROAD DETAILS SEE STANDARD DRAWING S045-337A
3. DITCH BACKSLOPE TO MATCH PROPOSED/EXISTING ELEVATIONS

City of Saint John

TYPICAL CUL-DE-SAC INDUSTRIAL ROAD (SYMMETRICAL - 24m R-O-W)

DWN. BY: D. BERUBE	DATE FEB. 2016	REV. No.		DWG. No. S045-346
CHECKED BY	SCALE N.T.S	DATE		



NOTES:

1. DIMENSIONS ARE AS SHOWN
2. FOR INDUSTRIAL ROAD DETAILS SEE STANDARD DRAWING S045-337A
3. DITCH BACKSLOPE TO MATCH PROPOSED/EXISTING ELEVATIONS

City of Saint John

TYPICAL CUL-DE-SAC INDUSTRIAL ROAD (OFFSET LEFT - 24m R-O-W)

DWN. BY: D. BERUBE	DATE FEB. 2016	REV. No.		DWG. No. S045-346A
CHECKED BY	SCALE N.T.S	DATE		

LINE TYPES	PIPING COLOUR	COLOUR CODE
WATER LINES		
Raw	Olive Green	311-5 Pea Soup
Settled or Clarified	Aqua	155-5 Aquamarine
Finished or Potable	Dark Blue	7064 Regal Blue/Safety Blue
CHEMICAL LINES		
Alum or Primary Coagulant	Orange	7221 Blaze Orange/Safety Orange
Caustic	Yellow with Green Band	7306 Safety Yellow, 7013 Ivy Green
Chlorine and Solution	Yellow	7306 Safety Yellow
Fluoride	Light Blue with Red Band	252-3 Flemish Blue, 7172 Brilliant Red/Safety Red
Polymers or Coagulant Aids	Orange with Green Band	7221 Blaze Orange/Safety Orange, 7013 Ivy Green
Soda Ash	Light Green with Orange Band	7401 Safety Green, 7221 Blaze Orange/Safety Orange
Ozone	Yellow with Orange Band	7306 Safety Yellow, 7221 Blaze Orange/Safety Orange
WASTEWATER LINES		
Backwash Waste	Light Brown	4489 Tulip Wood
Sludge	Dark Brown	7616 Walnut
Sewer (Sanitary or Other)	Dark Grey	506-6 Cannon Gray
OTHER		
Compressed Air	Dark Green	7013 Ivy Green
Gas (Natural/Propane)	Yellow with Black Band	7306 Safety Yellow, Gloss Black
Fuel	Red	7172 Brilliant Red/Safety Red
Other Lines	Light Grey	506-4 Steel City

ALL PIPES SHALL BE LABELED IN ACCORDANCE WITH ASME / ANSI A13.1-2007 "SCHEME FOR THE IDENTIFICATION OF PIPING SYSTEMS", OR MORE RECENT REVISION

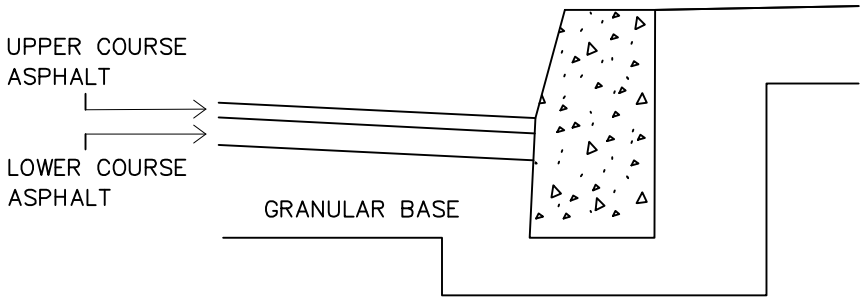
LABELS SHALL CONFORM TO THE CORRECT SIZE, BACKGROUND COLOR, LETTERING COLOR AND PLACEMENT THE NAME OF THE LIQUID OR GAS AND ARROWS INDICATING THE DIRECTION OF FLOW SHALL BE DISPLAYED ON THE PIPE UTILIZING COMMERCIALLY AVAILABLE PREFABRICATED STICKERS

ALL COLORS CODES REFER TO PITTSBURGH PAINTS STOCK. USE APPROVED COLOR MATCH EQUAL. WHEN COLOR BANDS ARE SPECIFIED, THE BAND WIDTH IS TO BE 150mm AT APPROXIMATELY 750mm INTERVALS. BAND WIDTHS TO BE 50mm ON PIPES 150mm DIA OR SMALLER

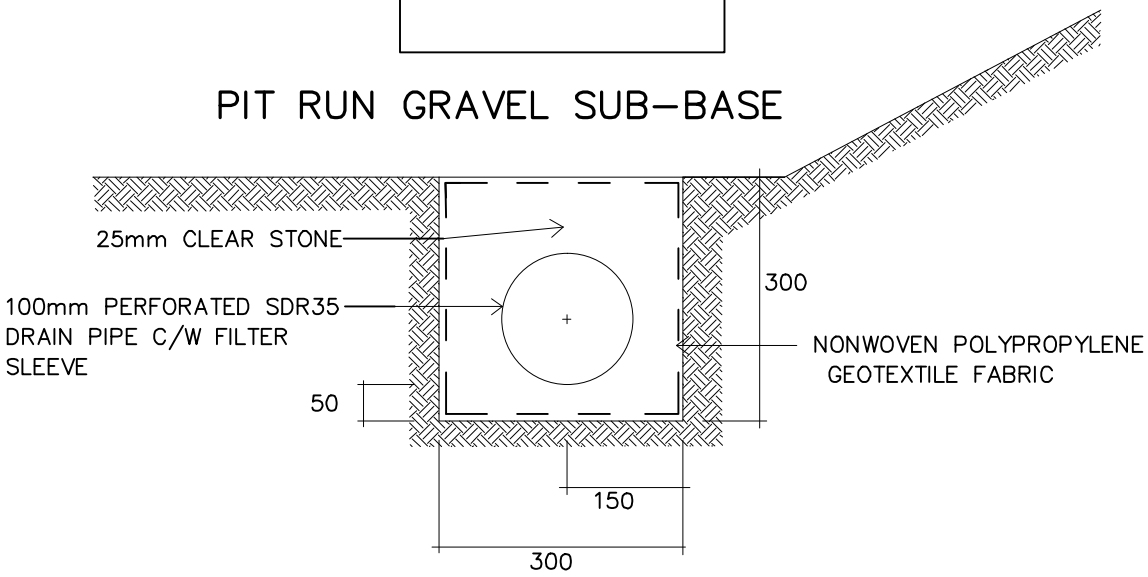
City of Saint John

STANDARD COLOUR CHART FOR INDUSTRIAL PIPING

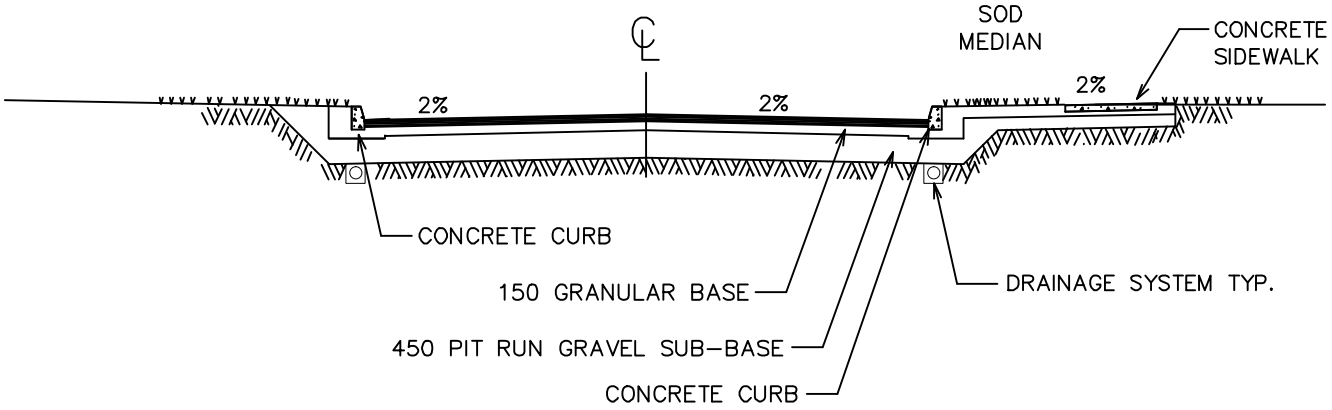
DWN. BY J. GRANGER	DATE JAN 2009	REV. No.		DWG. No. S045–401
CHECKED BY	SCALE	DATE		



PIT RUN GRAVEL SUB–BASE



TYPICAL SUBDRAINS



NOTES:

1. DIMENSIONS ARE IN MILLIMETERES
2. FOR CURB AND SIDEWALK DETAILS SEE STANDARD DRAWINGS S045–309 TO S045–315
3. SUBDRAINS TO BE USED AS DIRECTED BY ENGINEER
4. DRAINAGE SYSTEM CONNECTION AT EVERY CATCH BASIN
5. GRADE OF PERFORATED PIPE TO MATCH ROADWAY GRADE

City of Saint John

TYPICAL STREET CROSS SECTION WITH SUBDRAIN

DWN. BY J. DAIGLE	DATE FEB. 2012	REV. No. 1		DWG. No. S045–402
CHECKED BY	SCALE N.T.S	DATE FEB. 2012		