



THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 577-2009

**SOUTHWEST RAPID TRANSIT CORRIDOR - STAGE 1: TRANSITWAY TUNNEL AT
CN RIVERS SUBDIVISION MILEAGE 1.38 & ASSOCIATED WORKS**

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PART B - BIDDING PROCEDURES

B1. CONTRACT TITLE

- B1.1 SOUTHWEST RAPID TRANSIT CORRIDOR - STAGE 1: TRANSITWAY TUNNEL AT CN RIVERS SUBDIVISION MILEAGE 1.38 & ASSOCIATED WORKS

B2. SUBMISSION DEADLINE

- B2.1 The Submission Deadline is 12:00 noon Winnipeg time, November 3, 2009.
- B2.2 Bids determined by the Manager of Materials to have been received later than the Submission Deadline will not be accepted and will be returned upon request.
- B2.3 The Contract Administrator or the Manager of Materials may extend the Submission Deadline by issuing an addendum at any time prior to the time and date specified in B2.1.

B3. SITE INVESTIGATION

- B3.1 Further to C3.1, the Contract Administrator or an authorized representative will be available at the Pumping Station Parking Lot, 395 Osborne Street from 9:00 a.m. to 10:00 a.m. on October 15, 2009 to provide Bidders access to the Site. No additional site visits on Railway property will be permitted without prior arrangements with the Contract Administrator.
- B3.2 The Bidder is required to complete CN's Contractor Orientation Training as outlined in Appendix 'C' prior to entering CN property for the Site investigation.
- B3.3 The Bidder shall not be entitled to rely on any information or interpretation received at the Site investigation unless that information or interpretation is the Bidder's direct observation, or is provided by the Contract Administrator in writing.

B4. BIDDERS' CONFERENCE

- B4.1 Further to C3.1, the Contract Administrator will hold a non-mandatory Bidders' conference at Caboto Centre, 1055 Wilkes Avenue, Winnipeg, MB, R3P 2L7 at 9:30 a.m. on Friday, October 16th, 2009.
- B4.2 The Bidder is advised that, at the Bidders' Conference:
- (a) A presentation related to the Tunnel design and Shoring design will be given at the non-mandatory pre-bid information meeting.
 - (b) Notes of presentations made at this meeting will be available at least two (2) Business Days prior to the Submission Deadline on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/bidopp.asp>.
 - (c) No information provided at this meeting or in the meeting notes is intended to change any provision of the Bid Opportunity. Any required changes arising from the meeting will be explicitly changed through addenda. Notify the Contract Administrator if anything at the meeting or in the notes from the meeting appears to warrant an addendum.
- B4.3 The Bidder shall not be entitled to rely on any information or interpretation received at the Bidders' Conference unless that information or interpretation is provided by the Contract Administrator in writing.

B5. ENQUIRIES

- B5.1 All enquiries shall be directed to the Contract Administrator identified in D4.1

- B5.2 If the Bidder finds errors, discrepancies or omissions in the Bid Opportunity, or is unsure of the meaning or intent of any provision therein, the Bidder shall notify the Contract Administrator of the error, discrepancy or omission, or request a clarification as to the meaning or intent of the provision at least five (5) Business Days prior to the Submission Deadline.
- B5.3 Responses to enquiries which, in the sole judgment of the Contract Administrator, require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator to all Bidders by issuing an addendum.
- B5.4 Responses to enquiries which, in the sole judgment of the Contract Administrator, do not require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator only to the Bidder who made the enquiry.
- B5.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B5 unless that response or interpretation is provided by the Contract Administrator in writing.

B6. ADDENDA

- B6.1 The Contract Administrator may, at any time prior to the Submission Deadline, issue addenda correcting errors, discrepancies or omissions in the Bid Opportunity, or clarifying the meaning or intent of any provision therein.
- B6.2 The Contract Administrator will issue each addendum at least two (2) Business Days prior to the Submission Deadline, or provide at least two (2) Business Days by extending the Submission Deadline.
- B6.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/bidopp.asp>
- B6.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Division website for addenda regularly and shortly before the Submission Deadline, as may be amended by addendum.
- B6.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 10 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B7. SUBSTITUTES

- B7.1 The Work is based on the Plant, Materials and methods specified in the Bid Opportunity.
- B7.2 Substitutions will not be allowed unless application has been made and prior approval has been granted by the Contract Administrator in writing.
- B7.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least five (5) Business Days prior to the Submission Deadline.
- B7.4 The Bidder shall ensure that any and all requests for approval of a substitute:
- (a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the Plant, Material or method as either an approved equal or alternative;
 - (b) identify any and all changes required in the applicable Work, and all changes to any other Work, which would become necessary to accommodate the substitute;
 - (c) identify any anticipated cost or time savings that may be associated with the substitute;
 - (d) certify that, in the case of a request for approval as an approved equal, the substitute will fully perform the functions called for by the general design, be of equal or superior substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with

the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance;

- (e) certify that, in the case of a request for approval as an approved alternative, the substitute will adequately perform the functions called for by the general design, be similar in substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance.

- B7.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his sole discretion grant approval for the use of a substitute as an “approved equal” or as an “approved alternative”, or may refuse to grant approval of the substitute.
- B7.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, only to the Bidder who requested approval of the substitute.
- B7.6.1 The Bidder requesting and obtaining the approval of a substitute shall be entirely responsible for disseminating information regarding the approval to any person or persons he wishes to inform.
- B7.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.
- B7.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative may base his Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B16.
- B7.9 No later claim by the Contractor for an addition to the Total Bid Price because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.
- B7.10 Notwithstanding B7.2 to B7.9, and in accordance with B8.6 deviations inconsistent with the Bid Opportunity document shall be evaluated in accordance with B16.1(a).

B8. BID COMPONENTS

- B8.1 The Bid shall consist of the following components:
 - (a) Form A: Bid;
 - (b) Form B: Prices;
- B8.2 Further to B8.1, the Bidder shall include the written correspondence from the Contract Administrator approving a substitute in accordance with B7.
- B8.3 All components of the Bid shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely, to constitute a responsive Bid.
- B8.4 The Bid shall be submitted enclosed and sealed in an envelope clearly marked with the Bid Opportunity number and the Bidder's name and address.
 - B8.4.1 Samples or other components of the Bid which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder's Bid.
- B8.5 Bidders are advised not to include any information/literature except as requested in accordance with B8.1.

B8.6 Bidders are advised that inclusion of terms and conditions inconsistent with the Bid Opportunity document, including the General Conditions, will be evaluated in accordance with B16.1(a).

B8.7 Bids submitted by facsimile transmission (fax) or internet electronic mail (e-mail) will not be accepted.

B8.8 Bids shall be submitted to:

The City of Winnipeg
Corporate Finance Department
Materials Management Division
185 King Street, Main Floor
Winnipeg MB R3B 1J1

B9. BID

B9.1 The Bidder shall complete Form A: Bid, making all required entries.

B9.2 Paragraph 2 of Form A: Bid shall be completed in accordance with the following requirements:

- (a) if the Bidder is a sole proprietor carrying on business in his own name, his name shall be inserted;
- (b) if the Bidder is a partnership, the full name of the partnership shall be inserted;
- (c) if the Bidder is a corporation, the full name of the corporation shall be inserted;
- (d) if the Bidder is carrying on business under a name other than his own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.

B9.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B9.2.

B9.3 In Paragraph 3 of Form A: Bid, the Bidder shall identify a contact person who is authorized to represent the Bidder for purposes of the Bid.

B9.4 Paragraph 12 of Form A: Bid shall be signed in accordance with the following requirements:

- (a) if the Bidder is a sole proprietor carrying on business in his own name, it shall be signed by the Bidder;
- (b) if the Bidder is a partnership, it shall be signed by the partner or partners who have authority to sign for the partnership;
- (c) if the Bidder is a corporation, it shall be signed by its duly authorized officer or officers and the corporate seal, if the corporation has one, should be affixed;
- (d) if the Bidder is carrying on business under a name other than his own, it shall be signed by the registered owner of the business name, or by the registered owner's authorized officials if the owner is a partnership or a corporation.

B9.4.1 The name and official capacity of all individuals signing Form A: Bid should be printed below such signatures.

B9.5 If a Bid is submitted jointly by two or more persons, the word "Bidder" shall mean each and all such persons, and the undertakings, covenants and obligations of such joint Bidders in the Bid and the Contract, when awarded, shall be both joint and several.

B10. PRICES

B10.1 The Bidder shall state a price in Canadian funds for each item of the Work identified on Form B: Prices.

B10.2 The quantities listed on Form B: Prices are to be considered approximate only. The City will use said quantities for the purpose of comparing Bids.

B10.3 The quantities for which payment will be made to the Contractor are to be determined by the Work actually performed and completed by the Contractor, to be measured as specified in the applicable Specifications.

B10.4 Prices from Non-Resident Bidders are subject to a Non-Resident Withholding Tax pursuant to the Income Tax Act (Canada).

B11. QUALIFICATION

B11.1 The Bidder shall:

- (a) undertake to be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba; and
- (b) be financially capable of carrying out the terms of the Contract; and
- (c) have all the necessary experience, capital, organization, and equipment to perform the Work in strict accordance with the terms and provisions of the Contract.

B11.2 The Bidder and any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:

- (a) be responsible and not be suspended, debarred or in default of any obligations to the City. A list of suspended or debarred individuals and companies is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/debar.stm>

B11.3 The Bidder and/or any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:

- (a) have successfully carried out work similar in nature, scope and value to the Work; and
- (b) be fully capable of performing the Work required to be in strict accordance with the terms and provisions of the Contract; and
- (c) have a written workplace safety and health program if required pursuant to The Workplace Safety and Health Act (Manitoba).

B11.4 Further to B11.3(c), the Bidder shall, within five (5) Business Days of a request by the Contract Administrator, provide proof satisfactory to the Contract Administrator that the Bidder/Subcontractor has a workplace safety and health program meeting the requirements of The Workplace Safety and Health Act (Manitoba), by providing:

- (a) a valid COR certification number under the Certificate of Recognition (COR) Program administered by the Manitoba Construction Safety Association or by the Manitoba Heavy Construction Association's Safety, Health and Environment Program; or
- (b) a report or letter to that effect from an independent reviewer acceptable to the City. (A list of acceptable reviewers and the review template are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>).

B11.5 The Bidder shall submit, within three (3) Business Days of a request by the Contract Administrator, proof satisfactory to the Contract Administrator of the qualifications of the Bidder and of any proposed Subcontractor.

B11.6 The Bidder shall provide, on the request of the Contract Administrator, full access to any of the Bidder's equipment and facilities to confirm, to the Contract Administrator's satisfaction, that the Bidder's equipment and facilities are adequate to perform the Work.

B12. BID SECURITY

B12.1 The Bidder shall provide bid security in the form of:

- B12.1.1 a bid bond, in the amount of at least ten percent (10%) of the Total Bid Price, and agreement to bond of a company registered to conduct the business of a surety in Manitoba, in the form included in the Bid Submission (Form G1: Bid Bond and Agreement to Bond); or
- B12.1.2 an irrevocable standby letter of credit, in the amount of at least ten percent (10%) of the Total Bid Price, and undertaking issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form included in the Bid Submission (Form G2: Irrevocable Standby Letter of Credit and Undertaking); or
- B12.1.3 a certified cheque or draft payable to "The City of Winnipeg", in the amount of at least fifty percent (50%) of the Total Bid Price, drawn on a bank or other financial institution registered to conduct business in Manitoba.
- (a) If the Bidder submits alternative bids, the bid security shall be in the amount of the specified percentage of the highest Total Bid Price submitted.
 - (b) All signatures on bid securities shall be original.
 - (c) The Bidder shall sign the Bid Bond.
 - (d) The Surety shall sign and affix its corporate seal on the Bid Bond and the Agreement to Bond.
- B12.2 The bid security of the successful Bidder and the next two lowest evaluated responsive and responsible Bidders will be released by the City when a Contract for the Work has been duly executed by the successful Bidder and the performance security furnished as provided herein. The bid securities of all other Bidders will be released when a Contract is awarded.
- B12.2.1 Where the bid security provided by the successful Bidder is in the form of a certified cheque or draft pursuant to B12.1.3, it will be deposited and retained by the City as the performance security and no further submission is required.
- B12.2.2 The City will not pay any interest on certified cheques or drafts furnished as bid security or subsequently retained as performance security.
- B12.3 The bid securities of all Bidders will be released by the City as soon as practicable following notification by the Contract Administrator to the Bidders that no award of Contract will be made pursuant to the Bid Opportunity.

B13. OPENING OF BIDS AND RELEASE OF INFORMATION

- B13.1 Bids will be opened publicly, after the Submission Deadline has elapsed, in the office of the Corporate Finance Department, Materials Management Division, or in such other office as may be designated by the Manager of Materials.
- (a) Bidders or their representatives may attend;
 - (b) Bids determined by the Manager of Materials, or his designate, to not include the bid security specified in B12 will not be read out.
- B13.2 Following the submission deadline, the names of the Bidders and their Total Bid Prices (unevaluated, and pending review and verification of conformance with requirements) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>
- B13.3 After award of Contract, the name(s) of the successful Bidder(s) and the Contract Amount(s) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>

B13.4 The Bidder is advised that any information contained in any Bid may be released if required by City policy or procedures, by The Freedom of Information and Protection of Privacy Act (Manitoba), by other authorities having jurisdiction, or by law.

B14. IRREVOCABLE BID

B14.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 11 of Form A: Bid.

B14.2 The acceptance by the City of any Bid shall not release the Bids of the next two lowest evaluated responsive Bidders and these Bidders shall be bound by their Bids on such Work until a Contract for the Work has been duly executed and the performance security furnished as herein provided, but any Bid shall be deemed to have lapsed unless accepted within the time period specified in Paragraph 11 of Form A: Bid.

B15. WITHDRAWAL OF BIDS

B15.1 A Bidder may withdraw his Bid without penalty by giving written notice to the Manager of Materials at any time prior to the Submission Deadline.

B15.1.1 Notwithstanding C23.3, the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.

B15.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid, and only such person, has authority to give notice of withdrawal.

B15.1.3 If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials will:

- (a) retain the Bid until after the Submission Deadline has elapsed;
- (b) open the Bid to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid; and
- (c) if the notice has been given by any one of the persons specified in B15.1.3(b), declare the Bid withdrawn.

B15.2 A Bidder who withdraws his Bid after the Submission Deadline but before his Bid has been released or has lapsed as provided for in B14.2 shall be liable for such damages as are imposed upon the Bidder by law and subject to such sanctions as the Chief Administrative Officer considers appropriate in the circumstances. The City, in such event, shall be entitled to all rights and remedies available to it at law, including the right to retain the Bidder's bid security.

B16. EVALUATION OF BIDS

B16.1 Award of the Contract shall be based on the following bid evaluation criteria:

- (a) compliance by the Bidder with the requirements of the Bid Opportunity, or acceptable deviation therefrom (pass/fail);
- (b) qualifications of the Bidder and the Subcontractors, if any, pursuant to B11 (pass/fail);
- (c) Total Bid Price;
- (d) economic analysis of any approved alternative pursuant to B7.

B16.2 Further to B16.1(a), the Award Authority may reject a Bid as being non-responsive if the Bid is incomplete, obscure or conditional, or contains additions, deletions, alterations or other irregularities. The Award Authority may reject all or any part of any Bid, or waive technical requirements or minor informalities or irregularities, if the interests of the City so require.

- B16.3 Further to B16.1(b), the Award Authority shall reject any Bid submitted by a Bidder who does not demonstrate, in his Bid or in other information required to be submitted, that he is responsible and qualified.
- B16.4 Further to B16.1(c), the Total Bid Price shall be the sum of the quantities multiplied by the unit prices for each item shown on Form B: Prices.
- B16.4.1 If there is any discrepancy between the Total Bid Price written in figures, the Total Bid Price written in words and the sum of the quantities multiplied by the unit prices for each item, the sum of the quantities multiplied by the unit prices for each item shall take precedence.
- B16.4.2 Further to B16.1(a), in the event that a unit price is not provided on Form B: Prices, the City will determine the unit price by dividing the Amount (extended price) by the approximate quantity, for the purposes of evaluation and payment.

B17. AWARD OF CONTRACT

- B17.1 The City will give notice of the award of the Contract or will give notice that no award will be made.
- B17.2 The City will have no obligation to award a Contract to a Bidder, even though one or all of the Bidders are determined to be responsible and qualified, and the Bids are determined to be responsive.
- B17.2.1 Without limiting the generality of B17.2, the City will have no obligation to award a Contract where:
- (a) the prices exceed the available City funds for the Work;
 - (b) the prices are materially in excess of the prices received for similar work in the past;
 - (c) the prices are materially in excess of the City's cost to perform the Work, or a significant portion thereof, with its own forces;
 - (d) only one Bid is received; or
 - (e) in the judgment of the Award Authority, the interests of the City would best be served by not awarding a Contract.
- B17.3 Where an award of Contract is made by the City, the award shall be made to the responsible and qualified Bidder submitting the lowest evaluated responsive Bid, in accordance with B16.
- B17.3.1 Following the award of contract, a Bidder will be provided with information related to the evaluation of his Bid upon written request to the Contract Administrator.

PART C - GENERAL CONDITIONS

C0. GENERAL CONDITIONS

- C0.1 The *General Conditions for Construction* (Revision 2006 12 15) are applicable to the Work of the Contract.
- C0.1.1 The *General Conditions for Construction* are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/gen_cond.stm
- C0.2 A reference in the Bid Opportunity to a section, clause or subclause with the prefix “**C**” designates a section, clause or subclause in the *General Conditions for Construction*.

PART D - SUPPLEMENTAL CONDITIONS

GENERAL

D1. GENERAL CONDITIONS

D1.1 In addition to the *General Conditions for Construction*, these Supplemental Conditions are applicable to the Work of the Contract.

D2. SCOPE OF WORK

D2.1 The Work to be done under the Contract consists of construction of a tunnel structure and associated works.

D2.2 The major components of the Work are as follows:

- (a) Gravity Sewers
- (b) Groundwater Depressurization
- (c) Excavation and Backfill
- (d) Demolition and Removals
- (e) Shoring
- (f) Dewatering
- (g) Site Work
- (h) Supplying and Driving Precast Concrete Piles
- (i) Structural Works (tunnel structure, retaining walls and other minor works)
- (j) Architectural Works (chain link fencing, paint, tile)
- (k) Electrical Works

D3. DEFINITIONS

D3.1 When used in this Bid Opportunity:

- (a) "**Contract #1**" means the Southwest Rapid Transit Corridor – Stage 1: Land Drainage Construction & Associated Works;
- (b) "**Contract #2**" means the Southwest Rapid Transit Corridor – Stage 1: Land Drainage Pumping Station & Associated Works;
- (c) "**Contract #3**" means the Southwest Rapid Transit Corridor – Stage 1: Transitway Construction, Donald/Harkness Reconstruction & Associated Works;
- (d) "**Contract #4**" means the Southwest Rapid Transit Corridor – Stage 1: Transitway Tunnel at CN Rivers Subdivision Mileage 1.38 & Associated Works;
- (e) "**Contract #5**" means the Southwest Rapid Transit Corridor – Stage 1: Osborne Station & Associated Works;
- (f) "**Contract #6**" means the Southwest Rapid Transit Corridor – Stage 1: Transitway Construction, Landscaping & Associated Works;
- (g) "**Southwest Rapid Transit Corridor – Stage 1**" means the overall project of the Southwest Rapid Transitway Corridor from Queen Elizabeth Way to Jubilee Avenue;
- (h) "**Stage 1**" in this Contract means the first half of construction for the north side of the Transitway Tunnel at CN Rivers Subdivision Mileage 1.38;
- (i) "**Stage 2**" in this Contract means the second half of construction for the south side of the Transitway Tunnel at CN Rivers Subdivision Mileage 1.38;

- (j) "**Stage 1 Track Detours**" means the first half of the track detour construction for the north side of the Transitway Tunnel at CN Rivers Subdivision;
- (k) "**Stage 2 Track Detours**" means the second half of the track detour construction for the south side Transitway Tunnel at CN Rivers Subdivision;
- (l) "**Stage 3 CN Track Relocation**" means the final track construction for the Transitway Tunnel at CN Rivers Subdivision.

D4. CONTRACT ADMINISTRATOR

D4.1 The Contract Administrator is Dillon Consulting Limited, represented by:

Dave Krahn, P.Eng.
Project Manager
200-895 Waverley Street
Winnipeg, Manitoba R3T 5P4
Telephone No. (204) 453-2301
Facsimile No. (204) 452-4412

D4.2 At the pre-construction meeting, Dave Krahn, P.Eng. will identify additional personnel representing the Contract Administrator and their respective roles and responsibilities for the Work.

D5. CONTRACTOR'S SUPERVISOR

D5.1 At the pre-construction meeting, the Contractor shall identify his designated supervisor and any additional personnel representing the Contractor and their respective roles and responsibilities for the Work.

D5.2 At least two (2) business days prior to the commencement of any Work on the Site, the Contractor shall provide the Contract Administrator with a phone number where the supervisor identified in D5.1 or an alternate can be contacted 24 hours a day to respond to an emergency.

D6. NOTICES

D6.1 Except as provided for in C23.2.2, all notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the Contractor shall be sent to the address or facsimile number identified by the Contractor in Paragraph 2 of Form A: Bid.

D6.2 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the City, except as expressly otherwise required in D6.3, D6.4 or elsewhere in the Contract, shall be sent to the attention of the Contract Administrator at the address or facsimile number identified in D4.1.

D6.3 Notwithstanding C21, all notices of appeal to the Chief Administrative Officer shall be sent to the attention of the Chief Financial Officer at the following address or facsimile number:

The City of Winnipeg
Chief Financial Officer
Administration Building, 3rd Floor
510 Main Street
Winnipeg MB R3B 1B9
Facsimile No.: (204) 949-1174

D6.4 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications required to be submitted or returned to the City Solicitor shall be sent to the following address or facsimile number:

The City of Winnipeg
Internal Services Department
Legal Services Division
Attn: City Solicitor
185 King Street, 3rd Floor
Winnipeg MB R3B 1J1
Facsimile No.: (204) 947-9155

D7. FURNISHING OF DOCUMENTS

- D7.1 Upon award of the Contract, the Contractor will be provided with five (5) complete sets of the Bid Opportunity. If the Contractor requires additional sets of the Bid Opportunity, they will be supplied to him at cost.

SUBMISSIONS

D8. AUTHORITY TO CARRY ON BUSINESS

- D8.1 The Contractor shall be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, or if the Contractor does not carry on business in Manitoba, in the jurisdiction where the Contractor does carry on business, throughout the term of the Contract, and shall provide the Contract Administrator with evidence thereof upon request.

D9. SAFE WORK PLAN

- D9.1 Provide the Contract Administrator with a Safe Work Plan at least five (5) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract.
- D9.2 The Safe Work Plan shall be prepared and submitted in the format shown in the City's template which is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/Safety/default.stm>
- D9.3 Notwithstanding Appendix C "CN Safety Requirements", the Contractor shall conform and operate in accordance with the Canadian National Railway Company (CN) "Safety Guidelines for Contractors".

D10. INSURANCE

- D10.1 The City shall provide and maintain the following Project Insurance Coverages:
- (a) Builder's Risk Insurance in the amount of one hundred percent (100%) of the total project cost.
 - (b) Wrap-Up Liability Insurance in an amount of no less than 10 million dollars (\$10,000,000.00).
 - (i) The Contractor shall be responsible for deductibles up to \$50,000.00 maximum of any one loss.
 - (ii) The City of Winnipeg will carry such insurance to cover all parties engaged in the Work in this Contract. Provision of this insurance by the City of Winnipeg is not intended in any way to relieve the Contractor from his obligations under the terms of the Contract. Specifically, losses relating to deductibles for insurance, as well as losses in excess of limits of coverage and any risk of loss that is not covered under the terms of the insurance provided by the City of Winnipeg remains with the Contractor.

- (iii) Wrap-Up Liability insurance shall be maintained from the date of commencement of the Work until one year from the date of Substantial Performance of the Work, after which, if Total Performance has not been met, the responsibility for payment of further insurance premiums shall transfer to the Contractor. The City may reduce any payment to the Contractor by the amount of such further insurance premiums.
- (iv) Liability coverage shall be provided for completed operations hazards from the date of Substantial Performance of the Work, as set out in the certificate of Substantial Performance of the Work, on an ongoing basis for a period of six (6) years following Substantial Performance of the Work.

D10.2 Responsibilities of the Contractor:

- (a) The Contractor shall provide and maintain automobile liability insurance for owned and non-owned automobiles used for or in connection with the Work in the amount of at least two million dollars (\$2,000,000.00).
- (b) The Contractor is responsible for insuring equipment and tools used on the Project that may be owned, rented, leased or borrowed.
 - (i) Premiums and deductibles shall be borne by the Contractor;
 - (ii) Policies shall be taken out with insurers licensed to and carrying on business in the Province of Manitoba;
 - (iii) The Contractor shall not cancel, or cause any such policy or policies to lapse without a minimum thirty (30) days prior written notice to the City;
 - (iv) The Contractor shall provide written notice to the City of Winnipeg of any material changes to their policies within thirty (30) days of the change taking effect;
 - (v) The Contractor shall provide the Contract Administrator with evidence of insurance at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than seven (7) Calendar Days from notification of the award of Contract and said insurance shall be in the form of a Certificate of Insurance and shall be in a form satisfactory to the City Solicitor.

D10.3 Responsibilities of Others, including payment of premiums and deductibles:

- (a) All sub-contractors, consultants and sub-consultants engaged for the Project are responsible to provide and maintain Automobile liability insurance for owned and non-owned automobiles used for or in connection with the Work in the amount of at least two million dollars (\$2,000,000.00);
- (b) All sub-contractors, consultants and sub-consultants engaged for the Project are responsible for insuring equipment and tools used on the Project that may be owned, rented, leased or borrowed.

D11. PERFORMANCE SECURITY

D11.1 Provide and maintain performance security until the expiration of the warranty period in the form of:

- (a) a performance bond of a company registered to conduct the business of a surety in Manitoba, in the form attached to these Supplemental Conditions (Form H1: Performance Bond), in the amount of fifty percent (50%) of the Contract Price; or
- (b) an irrevocable standby letter of credit issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form attached to these Supplemental Conditions (Form H2: Irrevocable Standby Letter of Credit), in the amount of fifty percent (50%) of the Contract Price; or
- (c) a certified cheque or draft payable to "The City of Winnipeg", drawn on a bank or other financial institution registered to conduct business in Manitoba, in the amount of fifty percent (50%) of the Contract Price.

D11.1.2 Where the performance security is in the form of a certified cheque or draft, it will be deposited by the City. The City will not pay any interest on certified cheques or drafts furnished as performance security.

D11.2 If the bid security provided in his Bid was not a certified cheque or draft pursuant to B12.1.3, the Contractor shall provide the City Solicitor with the required performance security within seven (7) Calendar Days of notification of the award of the Contract by way of letter of intent and prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract.

D12. SUBCONTRACTOR LIST

D12.1 Provide the Contract Administrator with a complete list of the Subcontractors proposed for engagement (Form J: Subcontractor List) at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in the General Conditions for the return of the executed Contract.

D13. ENVIRONMENTAL PROTECTION PLAN

D13.1 Prior to commencing construction activities or delivery of materials to Site, submit an Environmental Protection Plan for review and approval by Contract Administrator. The Environmental Protection Plan shall present a comprehensive plan to address known or potential environmental issues which may be present during construction. Where applicable, the Environmental Protection Plan shall include sub-contractor activities. The submission of the Environmental Protection Plan to the Contract Administrator shall in no way relieve the Contractor of full responsibility for the success or failure of all environmental management practices and procedures.

D13.2 The Environmental Protection Plan shall address the following:

- (a) Name[s] of person[s] responsible for ensuring adherence to Environmental Protection Plan.
- (b) Name[s] and qualifications of person[s] responsible for manifesting hazardous waste to be removed from Site.
- (c) Name[s] and qualifications of person[s] responsible for training Site personnel.
- (d) Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- (e) Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including methods for protection of features including vegetation to be preserved within authorized Work areas.
- (f) Environmental Emergency Response: including procedures, instructions, and reporting in the event of unforeseen spill of regulated substance.
- (g) Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- (h) Hazardous materials and waste management plan outlining storage, transportation and disposal.
- (i) Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project Site.
- (j) Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

- (k) Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete wash or curing water, clean-up water, dewatering of ground water, hydrostatic test water, and water used in flushing of lines.
- (l) Monitor and report to ensure implementation of environmental protection measures.

D13.3 Fires

- (a) Fires and burning rubbish or waste materials on Site is not permitted.

D13.4 Disposal of Waste

- (a) Dispose all waste at licensed facilities or with licensed haulers.
- (b) The top 1.0 m of Site overburden is not to be removed from Site and is to be stockpiled along the Transitway roadway, East Boulevard, South of Brandon Avenue.
- (c) All waste disposal grounds receiving debris and construction waste from this project must be operated under the authority of a valid permit issued pursuant to MR 150 (latest edition) Waste Disposal Grounds Regulation under the Environment Act.
- (d) Dispose of all sewage and seepage from the on-site sanitary facilities in accordance with the Onsite Wastewater Management Systems Regulation MR 83/2003.
- (e) Do not bury waste materials on Site.
- (f) Do not dispose of solid or liquid wastes in drains or waterways.

D13.5 Hazardous Waste

D13.5.1 Definitions

- (a) Dangerous Goods: product, substance, or organism that is specifically listed or meets hazard criteria established in the Dangerous Goods Handling and Transportation Act or regulations including hazardous materials and wastes.
- (b) Hazardous Material: product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
- (c) Hazardous Waste: any hazardous material that is no longer used for its original purpose and that is intended for recycling, treatment or disposal.
- (d) Workplace Hazardous Materials Information System (WHMIS): a Canada-wide system designed to give employers and workers information about hazardous materials used in workplace. Under WHMIS, information on hazardous materials is provided on container labels, material safety data sheets (MSDS), and worker education programs. WHMIS is put into effect by combination of federal and provincial laws.

D13.5.2 Materials Management

- (a) Only bring on Site quantity of hazardous materials required to perform Work.
- (b) Maintain MSDSs in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.
- (c) Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

D13.5.3 Storage and Handling

- (a) Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
 - (i) Sign storage areas.
 - (ii) Store and handle flammable and combustible materials in accordance with current Manitoba and National Fire Code of Canada requirements.

- (iii) Do not transfer of flammable and combustible liquids in vicinity of open flames or heat-producing devices.
 - (iv) Do not use flammable liquids having flash point below 38 degrees C, such as naphtha or gasoline as solvents or cleaning agents.
 - (v) Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
 - (vi) Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- (b) Keep no more than 100 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.
- (i) Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.
 - (ii) Storage of quantities of flammable and combustible liquids exceeding 100 litres for Work purposes requires the written approval of the Contract Administrator
 - (iii) Fuel storage exceeding 100L shall be a minimum distance of 100 metres from any water body and in compliance with the requirements of the Storage and Handling of Petroleum Products and Allied Products Manitoba Regulation 188/2001 of the Dangerous Goods Handling and Transportation Act.
- (c) Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:
- (i) Store hazardous materials and wastes in closed and sealed containers.
 - (ii) Label containers of hazardous materials and wastes in accordance with WHMIS.
 - (iii) Store hazardous materials and wastes in containers compatible with that material or waste.
 - (iv) Segregate incompatible materials and wastes. Ensure that different hazardous materials or hazardous wastes are not mixed.
 - (v) Store hazardous materials and wastes in secure storage area with controlled access.
 - (vi) Maintain clear egress from storage area.
 - (vii) Store hazardous materials and wastes in location that will prevent them from spilling into environment.
 - (viii) Store products on spill trays or berms with 110% capacity.
 - (ix) Do not store within 30 meters of a waterway or drain
 - (x) Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
 - (xi) Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began and disposal occurred. Maintain tipping and other disposal receipts.
- (d) Report spills or accidents immediately:
- (i) to the Contract Administrator.
 - (ii) to Manitoba Conservations Accident Reporting Line at 204-944-4888 in accordance with Manitoba Regulation 439/87 of the Dangerous Goods and Transportation Act.
 - (iii) Submit a written spill report to the Contract Administrator outlining cause and proposed corrective action and Manitoba Conservation as required. Provide copies of reports submitted to Manitoba Conservation to the Contract Administrator.

D13.5.4 Transportation

- (a) Transport hazardous materials and wastes in accordance with the Manitoba Dangerous Goods Handling and Transportation Act.

- (i) Ensure that trained personnel handle, offer for transport, or transport dangerous goods.
- (ii) Use licensed carrier authorized by provincial authorities to accept subject material.
- (iii) Label container[s] with legible, visible safety marks as prescribed by federal and provincial regulations.
- (iv) Provide photocopy of shipping documents and waste manifests to the Contract Administrator.
- (v) Track receipt of completed manifest from consignee after shipping dangerous goods. Provide a photocopy of completed manifest to the Contract Administrator.
- (vi) Report discharge, emission, or escape of hazardous materials immediately to the Contract Administrator and appropriate provincial authority. Take measures to control release.

D13.5.5 Disposal

- (a) Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
 - (i) Recycle hazardous wastes for which there is approved, cost effective recycling process available.
 - (ii) Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
 - (iii) Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
 - (iv) Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

D13.5.6 Erosion and Sediment Control

- (a) Develop an erosion control plan to control negative impacts on water and air quality; plan should meet these objectives:
 - (i) Prevent loss of soil during construction by storm water run-off and wind erosion.
 - (ii) Protect against erosion from stockpiled topsoil aggregates.
 - (iii) Prevent sedimentation of the land drainage system and receiving streams with dust, particulate matter or eroded sediment.
- (b) Supply, install, maintain and remove (as applicable and when no longer required) effective sediment control barriers and erosion control before starting Work that may result in the deposit of sediment into a ditch or water body to avoid potential impacts to fish and fish habitat.
 - (i) Erosion and sediment control measures and installations include, as required, silt socks around storm drains, silt fence barriers, erosion control blanket, straw wattles, and geotextile fabric as appropriate.
 - (ii) Routinely inspect all erosion and sediment control measures and installations and immediately repair any deficiencies.

D13.5.7 Work to Adjacent Waterways

- (a) Do not operate construction equipment in waterways and, where possible, avoid operating equipment within 30 meters of the waterway.
- (b) Do not use waterway beds for borrow material.
- (c) Do not dump excavated fill, waste material or debris in ditches or waterway.
- (d) Design and construct temporary crossings to minimize erosion to waterways.
- (e) Dispose of excavated materials above the high water mark and 30 meters way from a watercourse.

D13.5.8 Drainage

- (a) Provide temporary drainage and pumping as necessary to keep excavations and Site free from water.
- (b) Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- (c) Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

D13.5.9 Reducing Site Disturbances

- (a) Do not disturb, in any way, the embankment slopes, roadway shoulders, and adjacent ground surfaces areas outside the limits of the construction areas including the approved lay down, staging and access unless written permission has been obtained from the Contract Administrator. Such written permission will be granted only if it can be shown that there is no alternative.
- (b) Minimize disturbance of any undeveloped areas on Site and maintain existing Site grading where indicated and where possible.
 - (i) Minimize stripping of topsoil and vegetation
 - (ii) Re-grade and plant vegetation on construction Site as soon as possible.
 - (iii) Avoid soil compaction where possible.

D13.5.10 Pollution Control

- (a) Maintain temporary erosion and pollution control features installed under this contract.
- (b) Maintain construction equipment in good working order. Control emissions from equipment.
- (c) Cover or wet down dry materials and stockpiled soils to prevent blowing dust and debris. Provide dust control for the construction Site, temporary and access roads.
- (d) Bring only clean fill, granular, rip rap and other similar construction materials to the project Site.

D14. WATER MANAGEMENT PLAN

D14.1 Provide the Contract Administrator with a water management plan at least five (5) Business Days prior to commencement of any Work on the Site but in no event later than the date specified in the General Conditions for the return of the executed Contract.

D14.2 The Water Management Plan shall be prepared and submitted in a format that clearly identifies how the Contractor will undertake dewatering activities at the Site during construction.

D14.3 The Water Management Plan shall include provisions for drawing down the water table sufficient to dewater the excavation to maintain dry conditions for construction of the tunnel. This will require the use of wells. The Water Management Plan shall be further updated or altered as dictated by Site conditions. The Water Management Plan shall remain in effect until all construction and backfill activities are completed.

- (a) Subject to the approval of the Contract Administrator, water with negligible suspended solids may be pumped into the LDS sewer.
- (b) For water containing suspended solids, provide alternative means to remove the water from the Site.
- (c) Formal approval for pumping water into the LDS sewer system must be obtained from the Contract Administrator in writing seven (7) days prior to commencement of pumping.

D15. TEMPERATURE MANAGEMENT PLAN

- D15.1 Provide the Contract Administrator with a Temperature Management Plan for all mass concrete at least five (5) Business Days prior to commencement of any Work on the Site but in no event later than the date specified in the General Conditions for the return of the executed Contract.
- D15.2 Mass concrete is defined as all structural concrete with a minimum thickness or dimension of 1.0 metres or more.
- D15.3 The Temperature Management Plan shall be prepared and submitted in a format that clearly identifies how the Contractor will undertake temperature management for the mass concrete pours at the Site during construction.
- D15.4 The Temperature Management Plan shall be prepared in accordance with the requirements of CSA A23.1 and shall include provisions for monitoring the temperature of the mass concrete pours and ambient temperature from time of placement until such time as management measures are no longer required.

SCHEDULE OF WORK

D16. DETAILED WORK SCHEDULE

- D16.1 Provide the Contract Administrator with a Detailed Work Schedule at least two (2) Business Days prior to commencement of any Work on the Site but in no event later than the date specified in the General Conditions for the return of the executed Contract.
- D16.2 The Detailed Work Schedule shall be provided in Gantt chart format and shall include all major tasks and milestones specified for the Work.
- D16.3 Update the Detailed Work Schedule to reflect actual progress on a regular basis. Update the schedule at least once per month and within one week before every Site meeting.
- D16.4 Provide a two and a half (2 ½) month continuous timeline in the construction schedule to allow a Railway Detour Contractor full access to the Site for Stage 2 – Track Detours.
- (a) The commencement date shall start no earlier than June 1, 2010 and shall end no later than October 30, 2010.
 - (b) Prior to the commencement date shown in D16.4(a), the Transitway Tunnel Works must be completed to a condition adequate for the Stage 2 - Track Detours to be installed. Except for Work inside the structure and possible architectural works, this would generally mean that the Works of Stage 1 are completed to the extent that no Work within 8 m of the northernmost tracks would yet have to take place. This would include the construction and backfilling of the east retaining wall and the west retaining wall where it is integral with the east retaining wall.
 - (c) Track detour Work will be tendered based on D16.4(a). The Contractor shall notify the Contract Administrator at least one (1) month prior to the two and a half (2 ½) month window he designates for the Stage 2 – Track Detour Works within the allowable range given in item D16.4(a) above.
 - (d) Assume that no Work or access inside the CN Rail property line can be completed during this timeline.
 - (e) Provide full access to the Site as required by the Railway Detour Contractor.
 - (f) After the track relocation Work has been tendered and the Railway Detour Contractor is in place, relaxations to item D16.4(d) may be negotiated directly with the Railway Detour Contractor.
 - (g) While the City and CN Rail have no objections to the relaxations described in item D16.4(f), the Railway Detour Contractor will have no obligation to accept any such relaxations and may insist on maintaining the assumption noted in item D16.4(d).

- D16.5 The Contractor shall install tiling from ceiling down approximately to one (1) course above concrete shoulder barrier, or as specified by the Contract Administrator. Tiling shall be installed prior to the commencement date of the Road Work Contract. The Road Work Contract is expected to be tendered in Spring, 2010 and completed by October, 2011.
- D16.6 Provide a two and a half (2 ½) month continuous timeline in the construction schedule to allow a Railway Track Relocation Contractor full access to the Site for Stage 3 – CN Track Relocation.
- (a) The commencement date shall start no earlier than July 1, 2011 and shall end no later than October 14, 2011.
 - (b) Prior to the commencement date shown in D16.6(a), the Transitway Tunnel Works must be completed to a condition adequate for the Stage 3 - Track Relocation to be installed. Except for Work inside the structure and possible architectural works, this would generally mean that the Works of Stage 2 are completed to the extent that no Work within 8 m of the tracks would yet have to take place. This would include the construction and backfilling of the west retaining wall and the east retaining wall where it is integral with the west retaining wall.
 - (c) Track relocation Work will be tendered based on D16.6(a). The Contractor shall notify the Contract Administrator at least two (2) months prior to the two and a half (2 ½) month window he designates for Stage 3 – CN Track Relocation within the allowable range given in item D16.6(a) above.
 - (d) Assume that no Work or access inside the CN Rail property line can be completed during this timeline.
 - (e) Provide full access to the Site as required by the Railway Relocation Contractor.
 - (f) After the track relocation Work has been tendered and the Railway Relocation Contractor is in place, relaxations to item D16.6(d) may be negotiated directly with the Railway Detour Contractor.
 - (g) While the City and CN Rail have no objections to the relaxations described in item D16.6(d) the Railway Relocation Contractor will have no obligation to accept any such relaxations and may insist on maintaining the assumption noted in item D16.6(d).

D17. COMMENCEMENT

- D17.1 The Contractor shall not commence any Work until he is in receipt of a letter of intent from the Award Authority authorizing the commencement of the Work.
- D17.2 Do not commence any Work on the Site until:
- (a) the Contract Administrator has confirmed receipt and approval of:
 - (i) evidence of authority to carry on business specified in D8;
 - (ii) evidence of the workers compensation coverage specified in C6.15;
 - (iii) the Safe Work Plan specified in D9;
 - (iv) evidence of the insurance specified in D10
 - (v) the performance security specified in D11;
 - (vi) the Subcontractor list specified in D12;
 - (vii) the Environmental Protection Plan specified in D13;
 - (viii) the Water Management Plan specified in D14;
 - (ix) the Temperature Management Plan specified in D15; and
 - (x) the Detailed Work Schedule specified in D16.
 - (b) the Contractor has attended a pre-construction meeting with the Contract Administrator, or the Contract Administrator has waived the requirement for a pre-construction meeting.
 - (c) The Contractor has provided proof of CN Contractor Safety Training for each individual proposed to Work on the Site. Contractor to contact Christina Cusson at (204) 231-7805 for CN Right of Entry and Safety Training requirements.

- (d) The Contractor has attended a Transit safety meeting to be arranged by Tony Dreolini at (204) 986-5574.

D17.3 The Contractor shall commence the Work on the Site within seven (7) Working Days of receipt of the letter of intent.

D17.4 The City intends to award this Contract by December 8, 2009.

D17.4.1 If the actual date of award is later than the intended date, the dates specified for Substantial Performance, Total Performance will be adjusted by the difference between the aforementioned intended and actual dates.

D18. WORK RESTRICTIONS

D18.1 The following Work restrictions may be limited by CN Flagman availability. See Specification E9.

D19. WORK BY OTHERS

D19.1 Work by others on or near the Site will include but not necessarily limited to:

- (a) Rogers Fiber Optics;
- (b) Bell Canada Fiber Optics;
- (c) Railway Detour Contractor;
- (d) Railway Relocation Contractor; and
- (e) Roadway Contractor.

D20. CRITICAL STAGES

D20.1 The Contractor shall achieve critical stages of the Work in accordance with the following requirements:

- (a) Critical Stage 1 Tunnel Works: The completion of Stage 1 Works sufficient, as described herein, for the commencement of Stage 2 – Track Detour by August 16, 2010. Refer to Section D16.4.
- (b) Critical Stage 2 Tunnel Works: The completion of Stage 2 Works sufficient, as described herein, for the commencement of Stage 3 – CN Track Relocation by August 15, 2011. Refer to Section D16.6.

D20.2 When the Contractor considers the Work associated with each critical stage to be completed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Completion. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be re-inspected.

D20.3 The date on which each critical stage has been accepted by the Contract Administrator as being completed to the requirements of the Contract is the date on which completion of each critical stage has been achieved.

D21. SUBSTANTIAL PERFORMANCE

D21.1 The Contractor shall achieve Substantial Performance by August 15, 2011.

D21.2 When the Contractor considers the Work to be substantially performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Substantial Performance. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be re-inspected.

D21.3 The date on which the Work has been certified by the Contract Administrator as being substantially performed to the requirements of the Contract through the issue of a certificate of Substantial Performance is the date on which Substantial Performance has been achieved.

D22. TOTAL PERFORMANCE

D22.1 The Contractor shall achieve Total Performance by August 31, 2011.

D22.2 When the Contractor or the Contract Administrator considers the Work to be totally performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Total Performance. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be re-inspected.

D22.3 The date on which the Work has been certified by the Contract Administrator as being totally performed to the requirements of the Contract through the issue of a certificate of Total Performance is the date on which Total Performance has been achieved.

D23. LIQUIDATED DAMAGES

D23.1 If the Contractor fails to complete the Critical Stage 1 Tunnel Works to the extent required to allow the Stage 2 – Track Detours to commence Work on or before August 16, 2010, the Contractor shall pay the City twenty five thousand five hundred dollars (\$25,500) per Calendar Day for each and every Calendar Day following that date during which such failure continues.

D23.2 If the Contractor fails to complete the critical Stage 2 Tunnel Works to the extent required to allow the Stage 3 – CN Track Relocation to commence Work on or before August 15, 2011, the Contractor shall pay the City twenty five thousand five hundred dollars (\$25,500) per Calendar Day for each and every Calendar Day following that date during which such failure continues.

D23.3 If the Contractor fails to achieve Total Performance in accordance with the Contract by the day fixed herein for Total Performance, the Contractor shall pay the City five thousand five hundred dollars (\$5,500) per Calendar Day for each and every Calendar Day following the day fixed herein for Total Performance during which such failure continues.

D23.4 The amount specified for liquidated damages in D23.1, D23.2, and D23.3 is based on a genuine pre-estimate of the City's damages in the event that the Contractor does not achieve each Critical Stage or Total Performance by the day fixed herein for same.

D23.5 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

D24. SCHEDULED MAINTENANCE

D24.1 The Contractor shall perform the following scheduled maintenance in the manner and within the time periods required by the Specifications:

(a) Water management as specified in D14.

D24.2 Determination of Substantial Performance and Total Performance shall be exclusive of scheduled maintenance identified herein. All scheduled maintenance shall be completed prior to the expiration of the warranty period. Where the scheduled maintenance cannot be completed during the warranty period, the warranty period shall be extended for such period of time as it takes the Contractor to complete the scheduled maintenance.

D25. CONTROL OF WORK

D25.1 Job Meetings

- D25.1.1 Regular weekly job meetings will be held at the Site. These meetings shall be attended by a minimum of one representative of the Contract Administrator, one representative of the City and one representative of the Contractor. Each representative shall be a responsible person capable of expressing the position of the Contract Administrator, the City and the Contractor respectively on any matter discussed at the meeting including the Work schedule and the need to make any revisions to the Work schedule. The progress of the Work will be reviewed at each of these meetings.
- D25.1.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings as deemed necessary.

D26. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA)

- D26.1 Further to C6.24, the Contractor shall be the Prime Contractor and shall serve as, and have the duties of the Prime Contractor in accordance with The Workplace Safety and Health Act (Manitoba).

D27. LAYOUT OF THE WORK

- D27.1 Further to C6, the Contract Administrator will provide the basic centrelines and an elevation of the works as shown on the Drawings.
- D27.2 The Contractor shall be responsible for the true and proper layout of the Work and for the correctness of the location, levels, dimensions, and alignment of all aspects of the Work. The Contractor shall provide all required instruments and competent personnel for performing all layouts.
- D27.3 Should any error appear or arise in location, levels, dimensions, and/or alignments during the course of the Work, the Contractor shall promptly rectify such errors to the satisfaction of the Contract Administrator, at his own expense.
- D27.4 The Contract Administrator shall be notified at least one (1) Working Day prior to any Work being commenced in order to have the option to check and review all elevations and layouts at his discretion.
- D27.5 The Contractor shall carefully protect and preserve all benchmarks, stakes, and other items used in giving the basic data supplied by the Contract Administrator. Any such benchmarks or stakes removed or destroyed by the Contractor, without the consent of the Contract Administrator, shall be replaced by the Contract Administrator at the expense of the Contractor.

MEASUREMENT AND PAYMENT

D28. PAYMENT

- D28.1 Further to C12, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.
- D28.2 Further to C12, payment shall be in accordance with the following payment schedule:
- D28.2.1 All portions of Work including those designated for lump sum payment, will be paid for on a monthly pro-rata basis as determined by the Contract Administrator in consultation with the Contractor provided the portion of the Work to be paid for has been permanently incorporated into the Works.

WARRANTY

D29. WARRANTY

D29.1 Notwithstanding C13.2, the warranty period shall begin on the date of Total Performance and shall expire two (2) years thereafter, except where longer warranty periods are specified in the respective Specification sections, unless extended pursuant to C13.2.1 or C13.2.2, in which case it shall expire when provided for thereunder.

D29.1.2 For the purpose of Performance Security, the warranty period shall be one (1) year.

D29.2 Notwithstanding C13.2, the Contract Administrator may permit the warranty period for a portion or portions of the Work to begin prior to the date of Total Performance if a portion of the Work cannot be completed because of unseasonable weather or other conditions reasonably beyond the control of the Contractor but that portion does not prevent the balance of the Work from being put to its intended use.

D29.3 In such case, the date specified by the Contract Administrator for the warranty period to begin shall be substituted for the date specified in C13.2 for the warranty period to begin.

FORM H1: PERFORMANCE BOND
(See D10)

KNOW ALL MEN BY THESE PRESENTS THAT

_____ ,
(hereinafter called the "Principal"), and

_____ ,
(hereinafter called the "Surety"), are held and firmly bound unto **THE CITY OF WINNIPEG** (hereinafter called the "Obligee"), in the sum of

_____ dollars (\$_____)

of lawful money of Canada to be paid to the Obligee, or its successors or assigns, for the payment of which sum the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS the Principal has entered into a written contract with the Obligee for

BID OPPORTUNITY NO. 577-2009

SOUTHWEST RAPID TRANSIT CORRIDOR - STAGE 1: TRANSITWAY TUNNEL AT CN RIVERS
SUBDIVISION MILEAGE 1.38 & ASSOCIATED WORKS

which is by reference made part hereof and is hereinafter referred to as the "Contract".

NOW THEREFORE the condition of the above obligation is such that if the Principal shall:

- (a) carry out and perform the Contract and every part thereof in the manner and within the times set forth in the Contract and in accordance with the terms and conditions specified in the Contract;
- (b) perform the Work in a good, proper, workmanlike manner;
- (c) make all the payments whether to the Obligee or to others as therein provided;
- (d) in every other respect comply with the conditions and perform the covenants contained in the Contract; and
- (e) indemnify and save harmless the Obligee against and from all loss, costs, damages, claims, and demands of every description as set forth in the Contract, and from all penalties, assessments, claims, actions for loss, damages or compensation whether arising under "The Workers Compensation Act", or any other Act or otherwise arising out of or in any way connected with the performance or non-performance of the Contract or any part thereof during the term of the Contract and the warranty period provided for therein;

THEN THIS OBLIGATION SHALL BE VOID, but otherwise shall remain in full force and effect. The Surety shall not, however, be liable for a greater sum than the sum specified above.

AND IT IS HEREBY DECLARED AND AGREED that the Surety shall be liable as Principal, and that nothing of any kind or matter whatsoever that will not discharge the Principal shall operate as a discharge or release of liability of the Surety, any law or usage relating to the liability of Sureties to the contrary notwithstanding.

IN WITNESS WHEREOF the Principal and Surety have signed and sealed this bond the

_____ day of _____, 20____ .

SIGNED AND SEALED
in the presence of:

(Witness as to Principal if no seal)

(Name of Principal)

Per: _____ (Seal)

Per: _____

(Name of Surety)

By: _____ (Seal)
(Attorney-in-Fact)

All demands for payment shall specifically state that they are drawn under this Standby Letter of Credit.

Subject to the condition hereinafter set forth, this Standby Letter of Credit will expire on

(Date)

It is a condition of this Standby Letter of Credit that it shall be deemed to be automatically extended from year to year without amendment from the present or any future expiry date, unless at least 30 days prior to the present or any future expiry date, we notify you in writing that we elect not to consider this Standby Letter of Credit to be renewable for any additional period.

This Standby Letter of Credit may not be revoked or amended without your prior written approval.

This credit is subject to the Uniform Customs and Practice for Documentary Credit (1993 Revision), International Chamber of Commerce Publication Number 500.

(Name of bank or financial institution)

Per: _____
(Authorized Signing Officer)

Per: _____
(Authorized Signing Officer)

PART E - SPECIFICATIONS

GENERAL

E1. APPLICABLE SPECIFICATIONS AND DRAWINGS

- E1.1 These Specifications shall apply to the Work.
- E1.2 *The City of Winnipeg Standard Construction Specifications* in its entirety, whether or not specifically listed on Form B: Prices, shall apply to the Work.
- E1.2.1 *The City of Winnipeg Standard Construction Specifications* is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/Spec/Default.stm>
- E1.2.2 The version in effect three (3) Business Days before the Submission Deadline shall apply.
- E1.2.3 Further to C2.4(d), Specifications included in the Bid Opportunity shall govern over *The City of Winnipeg Standard Construction Specifications*.
- E1.3 The following are applicable to the Work:

Specification No. Specification Title

DIVISION 26 – ELECTRICAL

26 00 05	Electrical Scope of Work
26 05 01	Electrical General Provisions
26 05 20	Wire and Box Connectors – 0-1000 V
26 05 21	Building Wires
26 05 28	Grounding – Secondary
26 05 31	Splitters, Junction, Pull Boxes and Cabinets
26 05 32	Outlet Boxes, Conduit Boxes and Fittings
26 05 34	Conduits, Conduit Fastening and Conduit Fittings
26 27 26	Wiring Devices
26 28 21	Moulded Case Circuit Breakers
26 28 23	Disconnect Switches – Fused and Non-Fused
26 29 01	Contactors
26 50 00	Luminaire Schedule – Short Format

<u>Consultant Drawing No.</u>	<u>City Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Size</u>
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GENERAL

C4-G100-T	U237-09-01	Cover Sheet	A1
C4-G101-T	U237-09-02	Index Sheet	A1
C4-G102-T	U237-09-03	Legend and Design Notes	A1
C4-G103-T	U237-09-04	Site Plan	A1
C4-G103A-T	U237-09-04A	Overall Staging Plan and Major Items of Work	A1
C4-G104-T	U237-09-05	General Arrangement	A1
C4-G105-T	U237-09-06	General Information	A1
C4-G106-T	U237-09-07	Typical Tunnel Section	A1
C4-G107-T	U237-09-08	Tunnel Geometry	A1
C4-G108-T	U237-09-09	Borehole Logs Sheet 1 of 2	A1
C4-G109-T	U237-09-10	Borehole Logs Sheet 2 of 2	A1
C4-G110-T	U237-09-11	Removals	A1

SHORING

C4-S1000-T	U237-09-12	Site Plan	A1
C4-S1001-T	U237-09-13	Stage 1 and 2 Plans	A1
C4-S1001A-T	U237-09-13A	General Notes	

C4-S1002-T	U237-09-14	Sections	A1
C4-S1003-T	U237-09-15	Cantilever Shoring Plan and Details	A1
C4-S1004-T	U237-09-16	Braced Shoring	A1
C4-S1005-T	U237-09-17	Braced Shoring Details Sheet 1 of 2	A1
C4-S1006-T	U237-09-18	Braced Shoring Details Sheet 2 of 2	A1
C4-S1007-T	U237-09-19	Stage 1 Interface Braced Shoring	A1
C4-S1008-T	U237-09-20	Stage 2 Interface Braced Shoring	A1
C4-S1009-T	U237-09-21	Structural Details Sheet 1 of 2	A1
C4-S1010-T	U237-09-22	Structural Details Sheet 2 of 2	A1

STRUCTURAL

C4-S1100-T	U237-09-23	Foundation Plan and Details	A1
C4-S1101-T	U237-09-24	Foundation Details	A1
C4-S1102-T	U237-09-25	Foundation Joint Details Sheet 1 of 2	A1
C4-S1103-T	U237-09-26	Foundation Joint Details Sheet 2 of 2	A1
C4-S1104-T	U237-09-27	Manhole and Catchbasin Details	A1
C4-S1105-T	U237-09-28	Tunnel Layout and Sections	A1
C4-S1106-T	U237-09-29	Roof Slab Details Sheet 1 of 2	A1
C4-S1107-T	U237-09-30	Roof Slab Details Sheet 2 of 2	A1
C4-S1108-T	U237-09-31	Roof Slab Sections	A1
C4-S1109-T	U237-09-32	Wall Details	A1
C4-S1110-T	U237-09-33	Wall Sections	A1
C4-S1111-T	U237-09-34	Shoring Blockout Details	A1
C4-S1112-T	U237-09-35	Headwall Details Sheet 1 of 2	A1
C4-S1113-T	U237-09-36	Headwall Details Sheet 2 of 2	A1
C4-S1114-T	U237-09-37	Staging Joint Details Sheet 1 of 2	A1
C4-S1115-T	U237-09-38	Staging Joint Details Sheet 2 of 2	A1
C4-S1116-T	U237-09-39	Construction Joint Details	A1
C4-S1117-T	U237-09-40	North Portal Area Details	A1
C4-S1118-T	U237-09-41	South Portal Area Details	A1
C4-S1119-T	U237-09-42	South Portal Light Pedestal Details	A1
C4-S1120-T	U237-09-43	North Retaining Walls	A1
C4-S1121-T	U237-09-44	South Retaining Walls	A1
C4-S1122-T	U237-09-45	North Wall Elevations	A1
C4-S1123-T	U237-09-46	South Wall Elevations	A1
C4-S1124-T	U237-09-47	Retaining Wall Cross-Sections	A1
C4-S1125-T	U237-09-48	Tunnel Retaining & Wall Transition Details	A1
C4-S1126-T	U237-09-49	Retaining Wall Details Sheet 1 of 2	A1
C4-S1127-T	U237-09-50	Retaining Wall Details Sheet 2 of 2	A1
C4-S1128-T	U237-09-51	Gravity Wall Details	A1
C4-S1129-T	U237-09-52	Gravity Wall Joint Details	A1
C4-S1130-T	U237-09-53	Miscellaneous Wall Details	A1
C4-S1131-T	U237-09-54	Approach Slab Layouts	A1
C4-S1132-T	U237-09-55	Approach Slab Details	A1

ELECTRICAL

C4-E1200-T	U237-09-56	Electrical Layout	A1
C4-E1201-T	U237-09-57	Electrical Details	A1

ARCHITECTURAL FINISHES

C4-S1300-T	U237-09-58	Architectural Details Plan	A1
C4-S1301-T	U237-09-59	Tile Pattern Layout West Wall	A1
C4-S1302-T	U237-09-60	Tile Pattern Layout East Wall	A1
C4-S1303-T	U237-09-61	Tiling Details	A1

CIVIL

C4-S3000-T	U237-09-62	Control Line Geometry 1	A1
C4-S3001-T	U237-09-63	Control Line Geometry 2	A1
C4-S3002-T	U237-09-64	Paving and Grading - Sta. 11+620 to 11+790	A1

C4-S3003-T	U237-09-65	Paving and Grading - Sta. 11+790 to 11+975	A1
C4-S3004-T	U237-09-66	Paving and Grading - Sta. 11+975 to 12+070	A1
C4-S3005-T	U237-09-67	Tunnel Profile	A1
C4-S3006-T	U237-09-68	Cross-Sections - Sta. 11+630 to 11+705.525	A1
C4-S3007-T	U237-09-69	Cross-Sections - Sta. 11+720 to 11+740	A1
C4-S3008-T	U237-09-70	Cross-Sections - Sta. 11+820 & Details	A1
C4-S3009-T	U237-09-71	Cross-Sections - Sta. 12+000 to 12+036	A1
C4-S3010-T	U237-09-72	Catch Basin Details	A1

UTILITIES

C4-U4000-T	U237-09-73	LDS – Plan & Profile, Sta. 1+000 to 1+230	A1
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E2. SOILS INVESTIGATION REPORT

- E2.1 Further to C3.1, test hole logs from the 2004 Klohn Crippen geotechnical report and from the 2009 AECOM investigations are provided in Appendix A and B respectively to aid the Contractor's evaluation of the existing soil conditions. The information presented is considered accurate at the locations and time of drilling as outlined in the Appendices. However, variations in soil conditions may exist between test holes and fluctuations in groundwater levels can be expected seasonally and may occur as a result of construction activities. The nature and extent of variations may not become evident until construction commences. The complete Klohn Crippen geotechnical report and AECOM investigation memo may be viewed at the Contract Administrator's Office upon request.

GENERAL REQUIREMENTS

E3. SHOP DRAWINGS

E3.1 Description

- E3.1.1 This Specification provides instructions for the preparation and submission of shop drawings.
- (a) The term 'shop drawings' means drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data, including Site erection drawings which are to be provided by the Contractor to illustrate details of a portion of the Work.
 - (b) Submit specified shop drawings to the Contract Administrator for review. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be show on all submissions for Contract Administrator review.

E3.2 Shop Drawings

- (a) Original drawings shall be prepared by Contractor, Subcontractor, supplier, distributor or manufacturer to illustrate appropriate portion of Work including fabrication, layout, setting or erection details as specified in appropriate sections.
- (b) Shop drawings for the following components shall bear the seal of a Professional Engineer registered in the province of Manitoba:
 - (i) Metal Fabrications
 - (ii) Shoring
 - (iii) Aluminum Fencing

E3.3 Contractor's Responsibilities

- (a) Review shop drawings, product data and samples prior to submission and stamp and sign drawings indicating conformance to the Contract requirements.
- (b) Verify:
 - (i) Field Measurements

- (ii) Field Construction Criteria
- (iii) Catalogue numbers and similar data
- (b) Coordinate each submission with requirements of Work and Contract Documents. Individual shop drawings will not be reviewed until all related drawings are available.
- (c) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.
- (d) Responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator's review of submission, unless Contract Administrator gives written acceptance of specified deviations.
- (e) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- (f) Make any corrections required by the Contract Administrator and resubmit the required number of corrected copies of Shop Drawings. Direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.
- (g) After Contract Administrator's review and return of copies, distribute copies to Subcontractors and others as appropriate.
- (h) Maintain one (1) complete set of reviewed shop drawings, filed by Specification Section Number, at the Site of the Work for use and reference of the Contract Administrator and Subcontractors.

E3.4 Submission Requirements

- (a) Schedule submissions at least fourteen (14) Calendar Days before dates reviewed submissions will be needed, and allow for a fourteen (14) Calendar Day period for review by the Contract Administrator of each individual submission and re-submission, unless noted otherwise in the Contract Documents.
- (b) Submit two (2) paper prints of shop drawings. The Contract Administrator will retain one (1) copy of all submittals and return one (1) copy to the Contractor.
- (c) Accompany submissions with transmittal letter containing:
 - (i) Date
 - (ii) Project title and Bid Opportunity number
 - (iii) Contractor's name and address
 - (iv) Number of each shop drawing, product data and sample submitted
 - (v) Specification Section, Title, Number and Clause
 - (vi) Drawing Number and Detail / Section Number
 - (vii) Other pertinent data
- (d) Submissions shall include:
 - (i) Date and revision dates.
 - (ii) Project title and Bid Opportunity number.
 - (iii) Name of:
 - Contractor
 - Subcontractor
 - Supplier
 - Manufacturer
 - Detailer (if applicable)
 - (iv) Identification of product or material.
 - (v) Relation to adjacent structure or materials.
 - (vi) Field dimensions, clearly identified as such.
 - (vii) Specification section name, number and clause number or drawing number and detail / section number.

- (viii) Applicable standards, such as CSA or CGSB numbers.
- (ix) Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

E3.5 Other Considerations

- (a) Fabrication, erection, installation or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent shop drawings and resubmit.
- (b) Material and equipment delivered to the Site of the Works will not be paid for at least until pertinent shop drawings have been submitted and reviewed.
- (c) Incomplete shop drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.
- (d) No delay or cost claims will be allowed that arise because of delays in submissions, re-submissions and review of shop drawings.

E4. OFFICE FACILITIES

E4.1 The Contractor shall supply office facilities with direct access to Stage 1, without the need to cross any active railway tracks, meeting the following requirements:

- (a) The field office shall be for the exclusive use of the Contract Administrator.
- (b) The office shall be conveniently located near the Site of the Work.
- (c) Contractor shall supply four (4) parking stalls in a proximity to the field office.
- (d) The office shall have a minimum floor area of 66 square metres, a height of 2.4 m with a minimum of four windows for cross ventilation and a door entrance with a suitable lock.
- (e) The office shall be suitable for all weather use. It shall be equipped with a heater and air conditioner so that the room temperature can be maintained between either 16-18°C or 24-25°C.
- (f) The office shall be adequately lighted with fluorescent fixtures and have a minimum of five wall outlets.
- (g) The office shall be equipped with internet hook up at five locations and one land line telephone.
- (h) The office shall be furnished with five desks, one drafting table, 2 tables each 3m X 1.2m, one stool, one four drawer legal size locking filing cabinet, and a minimum of 12 chairs.
- (i) The office shall be equipped with a water cooler and be constantly supplied so as never to run out.
- (j) A portable toilet shall be located near the field office. The toilet shall be continuously provided with sanitary hand cleaner and have a locking door and be for the exclusive use of the Contract Administrator and other personnel from the City. The portable toilet shall be appropriately heated in cold weather.
- (k) The field office and the portable toilet shall be cleaned on a weekly basis immediately prior to each Site meeting. The Contract Administrator may request additional cleaning when he deems it necessary.

E4.2 Once Stage 1 is completed, the field office facility will be relocated to have direct access to the Stage 2 site without the need to cross any active railway tracks. The Contract Administrator will advise the Contractor that he is ready to relocate. The Contractor shall:

- (a) Move the field office to have access to Stage 2 tunnel construction.
- (b) Equip the field office with the above requirements listed in E4.1.

E4.3 The Contractor shall be responsible for all installation and removal costs, all operating costs, and the general maintenance of the office facilities.

E4.4 The office facilities shall be provided from the date of the commencement of the Work to the date of Total Performance.

E4.5 No separate measurement or payment will be made for "Office Facilities"

E5. WATER USED BY CONTRACTOR

E5.1 Further to clause 3.7 of CW 1120-R1, the Contractor shall pay for all costs associated with obtaining water in accordance with the Waterworks By-law. Sewer charges will not be assessed for water obtained from a hydrant.

E6. SITE DEVELOPMENT AND RESTORATION

E6.1 Description

E6.1.1 This Specification shall cover aspects of the Site Development and Restoration Work, including removal, erection, and maintenance of temporary chain link fencing, snow clearing, access development, access maintenance and removal, and Site restoration.

E6.2 Materials

E6.2.1 Equipment

- (a) All equipment, implements, tools and facilities use shall be of a size and type as required to complete the Work in reasonable time, approved by the Contract Administrator. The Contractor shall keep all equipment in good Working order, and have sufficient standby equipment available at all times, as required.

E6.3 Construction Methods

E6.3.1 Site Inspection

- (a) Inspect Site with Contract Administrator and verify extent and location of items designated for removal, disposal, salvage and items to remain.

E6.3.2 Site and Construction Access

- (a) The Contractor shall be responsible to develop suitable Site access. This includes but is not limited to, temporary removal and reinstallation of chain link fencing, any landscaping and grading repairs, etc necessary to restore any Site and construction access areas to their pre-existing condition.

E6.3.3 Existing Chain Link Fencing

- (a) The existing fence around the property shall be reconstructed if damaged during construction. New fence materials used for the reconstruction shall be consistent with the existing fence.
- (b) The Contractor shall ensure that the existing gates are closed and locked at the end of each Work day.

E6.3.4 Environmental Regulations

- (a) The Contractor shall adhere to all relevant Federal and Provincial environmental regulations.

E6.3.5 Snow and Ice Removal

- (a) Snow cover shall be cleared from the construction Site prior to commencement of the Work. The methodology to clear the snow shall be subject to the approval of the Contract Administrator.

E6.3.6 General Site Cleanup and Restoration

- (a) On a daily basis maintain premises free from debris and waste material.

- (b) Maintain project Site and public properties free from accumulations of waste materials and rubbish.
- (c) Remove waste materials and rubbish from site.
- (d) Disposal of waste on Railway property by burial or burning shall not be permitted.
- (e) All areas of the construction Site shall be restored to a condition at least equivalent to its original condition prior to initiation of Work. This may include, but is not necessarily limited to the Contractor's lay down area and removal of all temporary fencing.

E6.4 Measurement and Payment

E6.4.1 Site Development and Restoration

- (a) The Site Development and Restoration will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Site Development and Restoration", performed in accordance with this Specification and accepted by the Contract Administrator.

E7. SITE SECURITY

- E7.1 During the project the Contractor shall be responsible for maintaining only authorized Site access 24 hours a day. Any existing security fencing, etc. that may be altered during construction will need to have an equivalent replacement. No separate measurement for payment shall be made for this work.

E8. TRAFFIC MANAGEMENT

E8.1 Further to D16:

E8.1.1 The Contractor shall schedule construction activities to meet the following:

- (a) Site access for railway traffic shall be maintained at all times.

E8.1.2 Ambulance and emergency vehicle access must be maintained at all times.

E9. COORDINATION OF CONSTRUCTION WITH CN RAIL

E9.1 General Requirements

E9.1.1 The Contractor shall be responsible to meet all Canadian National (CN), constraints, requirements, and safety measures.

E9.1.2 CN Safety Requirements are included in Appendix C.

E9.2 Flag Protection of Work

E9.2.1 The City of Winnipeg will be supplying one full-time Flagman for this project.

E9.2.2 Flagman's availability is 6 days per week for a maximum of 10 hours per day.

E10. ENCROACHMENT ON PRIVATE PROPERTY

E10.1 Further to Section 3.11 of CW 1130 of the General Requirements, the Contractor shall confine his Work to the public right-of-ways and construction easements at all times, except if he has received written permission from the property owner. The Contractor shall provide the Contract Administrator with a copy of any written permission he has received to enter onto private property.

E10.2 The Contractor's construction activities shall be confined to the minimum area necessary for undertaking the Work and he shall be responsible for all damage to private property resulting from his Work. Particular care shall be taken to assure not damage is done to building, fencing,

trees and plants, and provision shall be made to maintain full drainage for private properties during construction.

E11. DAMAGE TO EXISTING STRUCTURES AND PROPERTY

- E11.1 Further to Section 3.13 of CW 1130 of the General Requirements, special care shall be taken to avoid damage to existing adjacent structures and properties during the course of the Work.
- E11.2 Any damage cause by the Contractor or his Subcontractors to the adjacent structures or properties shall be promptly repaired by the Contractor at his own expense to the satisfaction of the Contract Administrator.

E12. PROTECTION OF EXISTING TREES

- E12.1 Take the following precautionary steps to prevent damage from construction activities to existing trees as shown on the Site Plan:
- (a) Do not stockpile materials and soil or park vehicles and equipment within 2 meters of trees.
 - (b) Trees identified to be at risk by the Contract Administrator are to be strapped with 19 x 89 x 2400 mm wood planks, or suitably protected as approved by the Contract Administrator.
 - (c) Excavation shall be performed in a manner that minimizes damage to the existing root systems. Where possible, excavation shall be carried out such that the edge of the excavation shall be a minimum of 20 times the trunk diameter from the closest edge of the trunk. Where roots must be cut to facilitate excavation, they shall be pruned neatly at the face of excavation.
 - (d) Operation of equipment within the drip line of the trees shall be kept to the minimum required to perform the Work required. Equipment shall not be parked, repaired, refuelled; construction materials shall not be stored, and earth materials shall not be stockpiled within the drip lines of trees. The drip line of a tree shall be considered to be the ground surface directly beneath the tips of its outermost branches. Ensure that the operations do not cause flooding or sediment deposition on areas where trees are located.
 - (e) Work on-site shall be carried out in such a manner so as to minimize damage to existing tree branches. If damage does occur, the damaged branches shall be neatly pruned.
- E12.2 All damage to existing trees caused by the Contractor's activities shall be repaired to the requirements and satisfaction of the Contract Administrator and the City Forester or his designate.
- E12.3 No separate measurement or payment will be made for the protection of trees.
- E12.4 Do not trim Elm trees between April 1 and July 31, inclusive.

E13. DEMOLITION AND REMOVALS

- E13.1 Description
- E13.1.1 The Work required under this section shall include, but not limited to the following:
- (a) Demolition and removal of existing buildings.
 - (b) Demolition and removal of partial existing MTS Call Centre Parking Lot.
 - (c) Demolition and removal of partial existing Pembina Dodge Parking Lot.
 - (d) Demolition and removal of partial existing Quintex Parking Lot.
 - (e) Demolition and removal of existing light standard pile foundations. Light standards to be relocated as directed by the Contract Administrator.

- E13.1.2 The Work required under this section shall include, but not limited to the following:
- (a) Protection of services to be maintained, demolition, disposal, and clean up of Work Site in anticipation of new Work. Limits of the contract are as shown in drawings.
 - (b) Remove and recycle existing light standards.
- E13.1.3 The area south of the railway tracks, formerly known as CN Fort Rouge Rail Yards once housed their maintenance shops and other utility buildings. The buildings have since been removed although some of the foundations still exist below grade. The pump station Contractor removed a substantial amount of these foundations however it is anticipated the Contractor may encounter further foundations within the contract limits. These foundations will be required to be removed to a minimum of 1.0m below excavation grade within the contract limits
- E13.1.4 The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as described hereinafter.
- E13.2 References
- E13.2.1 Removals are in accordance with Standard Construction Specifications:
- (a) CW 1110 - General Instructions
 - (b) CW 1120 – Existing Services, Utilities, and Structures.
 - (c) CW 3235 – Renewal of Existing Miscellaneous Concrete Slabs
 - (d) CW 3240 – Renewal of Existing Curbs
- E13.2.2 CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.
- E13.2.3 Manitoba Workplace Safety and Health Act, and all applicable National, Provincial, and Municipal regulations.
- E13.3 Protection
- E13.3.1 Prevent movement, settlement or damage of adjacent structures. Make good damage caused by demolition.
- E13.4 Execution
- E13.4.1 Inspection
- (a) Inspect Site with Contract Administrator and verify extent and location of items designated for removal, disposal, salvage and items to remain.
 - (b) Locate and protect utilities.
 - (c) Notify and obtain approval of Contract Administrator before starting demolition.
- E13.4.2 Preparation
- (a) Do not disrupt active or energized utilities.
- E13.4.3 Safety Code and Requirements
- (a) Unless otherwise specified, carry out demolition Work in accordance with the City of Winnipeg Safety Directives and Guidelines.
 - (b) Blasting operations shall not be permitted during demolition unless reviewed and approved by the Contract Administrator.
- E13.4.4 Demolition
- (a) Demolition structures to permit construction of new Work as indicated.
 - (b) At end of each day's Work, leave Work in safe condition so that no part is in danger of toppling or failing.

- (c) Do not sell or burn materials on Site.

E13.4.5 Disposal of Demolished Material

- (a) The Contractor shall be responsible for removal of debris and waste from the Work area to the location to an appropriate solid waste disposal area approved by the Contract Administrator.
- (b) Metal debris, which may include structural steel, miscellaneous inserts, and reinforcing steel, shall be removed from the Site and Disposed of by the Contractor.

E13.5 Measurement of Payment

E13.5.1 Demolition and Removals

- (a) Foundation Removal will be measured on a weight basis and paid for at the Contract Unit Price per tonne for "Foundation Removal". The weight paid will be the total number of tonnes of foundation material removed in accordance with this Specification, accepted and measured by the Contract Administrator. Disposal of the unsuitable material is considered incidental to this Work and will not be paid separately.
- (b) The Demolition and Removal will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for "Demolition and Removals", performed in accordance with this Specification and accepted by the Contract Administrator.
- (c) No payment shall be made for demolition beyond the limits specified, or those otherwise approved by the Contract Administrator. The separation, as necessary of embedded and structural steel shall be considered incidental to the Work. Removal of construction debris shall be considered incidental to the Work.

E14. MISCELLANEOUS SITE WORKS

E14.1 Description of Work

E14.1.1 The Work required under this section shall include, but not limited to the following:

- (a) Reconstruction of partial MTS Call Centre Parking Lot.
 - (i) This Specification covers the reconstruction of an existing asphalt pavement parking lot to the limits shown on the Contract Drawings and shall include but not limited to:
 - ◆ Removal and disposal of chain link security fence.
 - ◆ Removal and disposal of concrete garbage pad.
 - ◆ Removal and disposal of wood parking fence complete with block heater receptacles including the temporary termination of the power supply.
 - ◆ Removal, salvage, storage and reinstallation of parking fence.
 - ◆ Removal, salvage and storage of light standard and demolition of concrete base including the temporary termination of power supply.
 - ◆ Saw cutting, removal and disposal of existing base and sub-grade materials.
 - ◆ Sub-grade compaction.
 - ◆ Supply and placement of Limestone Base and Sub-Base materials.
 - ◆ Adjustment of existing manhole frame and cover including supply and placement of concrete risers.
 - ◆ Supply and placement of Asphalt Concrete Pavement.
 - ◆ Construction of pinned concrete.
 - ◆ Supply and application of painted parking lines.
 - ◆ Installation of wood parking fence complete with block heater receptacles and connection of power supply.

- (b) Reconstruction of partial Pembina Dodge Parking Lot.
- (i) This Specification covers the reconstruction of an existing asphalt pavement parking lot to the limits shown on the Contract Drawings and shall include but not limited to:
- ◆ Removal and disposal of chain link security fence.
 - ◆ Removal, salvage and storage of two light standards and demolition of concrete bases including temporary termination of the power supply.
 - ◆ Abandonment of an existing catch basin and lead.
 - ◆ Saw cutting, removal and disposal of existing base and sub-grade materials.
 - ◆ Sub-grade compaction.
 - ◆ Supply and placement of Limestone Base and Sub-Base materials.
 - ◆ Construction of two cast-in-place light base including installation of salvaged light standards and reconnection of the power supply.
 - ◆ Supply and placement of Asphalt Concrete Pavement.
- (c) Reconstruction of partial Quintex Parking Lot.
- (i) This Specification covers the reconstruction of an existing asphalt pavement parking lot to the limits shown on the Contract Drawings and shall include but not limited to:
- ◆ Removal and disposal of chain link security fence.
 - ◆ Saw cutting, removal and disposal of asphalt pavement parking lot.
 - ◆ Excavation removal and disposal of existing base and sub-grade materials.
 - ◆ Sub-grade compaction.
 - ◆ Supply and placement of Limestone Base and Sub-Base materials.
 - ◆ Supply and placement of Asphalt Concrete Pavement.
- (d) Relocation of light standards

E14.1.2 The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as described hereinafter.

E14.2 References

- E14.2.1 Parking lots to be supplied in accordance with Standard Construction Specifications:
- (a) CW 2130 – Gravity Sewers.
 - (b) CW 3110 – Sub-Grade, Sub-Base and Base Course Construction and E15 - Base Course and Sub-Base Material
 - (c) CW 3130 – Supply and Installation of Geotextile Fabric.
 - (d) CW 3210 – Adjustment of Pavement and Boulevard Structures
 - (e) CW 3310 – Portland Cement Concrete Pavement Works
 - (f) CW 3410 – Asphaltic Concrete Pavement Works.
 - (g) CW 3550 – Chain Link Fencing and E31- Removal and Replacement of Existing Chain Link Fence
 - (h) E16- Relocation of Light Standards
 - (i) E17 - Cast-In-Place Pile Foundation
 - (j) E32 – Painted Traffic Lines and Markings

E14.3 Measurement of Payment

E14.3.2 Miscellaneous Site Works

- (a) The Miscellaneous Site Works will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Miscellaneous Site Works", performed in accordance with this Specification and accepted by the Contract Administrator.
- (b) No payment shall be made for Works beyond the limits specified, or those otherwise approved by the Contract Administrator.

E15. BASE COURSE AND SUB-BASE MATERIAL

E15.1 Description

E15.1.1 General

- (a) This specification shall supplement the specification for Base Course and Sub-Base Material found in CW 3110.

E15.2 Materials

E15.2.1 Base Course and Sub-Base Materials

- (a) All material shall be Crushed Limestone supplied and installed in accordance with CW 3110.
- (b) Use of Recycled Concrete Pavement will not be permitted.

E15.3 Construction Methods

E15.3.1 As per CW 3110.

E15.4 Measurement of Payment

E15.4.2 Base Course and Sub-base Material

- (a) The Construction of Base Course and Sub-Base Material will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for the "Miscellaneous Site Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E16. RELOCATION OF LIGHT STANDARDS

E16.1 Description

E16.1.1 The Work required under this section shall include, but not limited to the following:

- (a) Relocation and reconnection of power to the light standards which includes and not limited to supply and installation of all necessary materials and labour required to make the lights functional.

E16.1.2 The Contractor shall inform the Contract Administrator, VIA, MTS Call Centre, and Pembina Dodge in writing two (2) weeks prior to construction taking place.

E16.1.3 The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as described hereinafter.

E16.2 Measurement of Payment

- (a) The Relocation of Light Standards will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Miscellaneous Site Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E17. CAST-IN-PLACE PILE FOUNDATION

E17.1 Description

- (a) The Work covered under this Item shall include all concreting operations related to construction of cast-in-place concrete pile foundations in accordance with this Specification and as shown on the Drawings.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.
- (c) This Specification does not apply to the temporary caissons for the Shoring.

E17.2 Materials

E17.2.1 General

- (a) The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

E17.2.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN3-A23.1-00.

E17.2.3 Testing and Approval

- (a) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.
- (b) All materials shall conform to CSA Standard CAN/CSA-A23.1-00.
- (c) All Testing of materials shall conform to CSA Standard CAN/CSA-23.2-00.

E17.2.4 Cement

- (a) Cement shall be Type HS, high-sulphate-resistant hydraulic cement, conforming to the requirements of CSA A3001-03.

E17.2.5 Supplementary Cementing Materials

- (a) Use of pozzolans, fly ash, or silica fume will not be permitted for use in structural concrete supplied under this Specification.

E17.2.6 Water

- (a) Water used for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

E17.2.7 Aggregate

- (a) The Contractor shall furnish in writing to the Contract Administrator, the location of the sources where aggregate will be obtained, in order that same may be inspected and tentatively approved by the Contract Administrator. Changes in the source of aggregate supply during the course of the Contract will not be permitted without notification in writing to and the expressed approval of the Contract Administrator.

Fine Aggregate

- (i) shall consist of sand having clean, hard, strong, durable, uncoated grains; free from injurious amounts of dust, soft or flaking particles, shale, alkali, organic matter, loam, or other deleterious substances.
- (ii) Fine aggregate shall be well-graded throughout and shall conform to the following grading requirements:

Gradation of Fine Aggregates	
Canadian Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve
10,000	100%
5,000	95% - 100%
2,500	80% - 100%
1,250	50% - 90%
630	25% - 65%
315	10% - 35%
160	2% - 10%
80	0% - 3%

- (iii) The fineness modulus of fine aggregate shall not be less than 2.2 nor more than 3.1 unless otherwise approved by the Contract Administrator.

Coarse Aggregate (20 mm Nominal)

- (iv) Standard course aggregate shall be used for cast-in-place concrete foundation required in this Specification.
- (v) Standard course aggregate shall consist of natural gravel, crushed stone, or other approved materials of similar characteristics, having clean, hard, strong, durable, uncoated particles, free from injurious amounts of soft, friable, thin, elongated, or laminated pieces, alkali, organic, or other deleterious matter. Course aggregate shall be well graded throughout and shall conform to the grading requirements shown in the following table:

Gradation of 20 mm Coarse Aggregate	
Canadian Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve
28,000	100%
20,000	90% - 100%
10,000	25% - 60%
5,000	0% - 10%
2,500	0% - 5%
80	0% - 1%

E17.2.8 Admixtures

- (a) No admixtures other than air-entraining agent shall be used without the written authorization of the Contract Administrator, unless otherwise specified in these Specifications. It shall be the Contractor's responsibility to ensure that any admixture is compatible with all other constituent materials.

E17.2.9 Reinforcing Steel

- (a) Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, and dowels.
- (b) All reinforcing steel shall conform to the requirements of CSA Standard G30.12, Grade 400 MPa, Billet-Steel Bars for Concrete Reinforcement. All reinforcing steel shall be new deformed billet steel bars. All bars, including ties, shall be hot-dip galvanized in accordance with CSA Standard G164 for a minimum net retention of 600 g/m². Reinforcing steel supply and installation will be incidental to construction of concrete pile foundation and no separate payment will be made.

E17.2.10 Anchor Bolts, Nuts, and Washers

- (a) Anchor bolts, nuts, and washers shall be in accordance with CSA Standard G40.21 Grade 300W, and shall be hot-dip galvanized full length in accordance with CSA G164 for a minimum net retention of 600 g/m², for the entire length of the anchor bolts. The threaded portion of the anchor bolts shall be 300 mm long. Anchor bolt

supply and installation will be incidental to construction of concrete pile foundation and no separate payment will be made.

E17.2.11 Anchor Bolt Templates

- (a) Anchor bolt templates shall be CSA G40.21 Grade 300W, minimum 10 mm thick, and will be incidental to construction of new concrete pile foundation and no separate payment will be made.
- (b) Anchor bolt templates are to be coordinated to suit existing light standard base plates.

E17.2.12 Miscellaneous Materials

- (a) Miscellaneous materials shall be of the type specified on the Drawings or approved by the Contract Administrator.

E17.3 Concrete Mix Design

- (a) Proportioning of fine aggregate, coarse aggregate, cement, water, and air entraining agent shall be such as yield concrete having the required strength and workability as follows:
 - (i) Minimum Compressive Strength at 28 days = 35 MPa
 - (ii) Maximum Water/Cement Ratio = 0.45
 - (iii) Minimum Cement Content = 340 kg/m³
 - (iv) Slump = 80 mm ± 30 mm
 - (v) Aggregate: 20 mm nominal
 - (vi) Air Content: 5.0 to 8.0 percent
 - (vii) Cement – Type HS, high sulphate-resistant

E17.4 Construction Methods

E17.4.1 Location and Alignment of Piles

- (a) Pile construction shall not commence until the Contractor has obtained clearance from the appropriate Utility Authorities.
- (b) Piles shall be placed in the positions shown on the Drawings and as directed by the Contract Administrator in the field.
- (c) The deviation of the axis of any finished pile shall not differ by more than 1 percent from the vertical.

E17.4.2 Buried Utilities

- (a) The Contractor shall exercise extreme caution when constructing the pile foundations in the vicinity of existing buried utilities. The Drawings show the approximate locations of existing buried utilities. The Contractor shall be responsible for obtaining the exact location of the buried utilities from the appropriate Utility Authorities prior to installing the piles.
- (b) The proposed locations of the pile foundations may be changed by the Contract Administrator if they interfere with the buried utilities.
- (c) The Contractor shall be responsible for all costs that may be incurred for repair/rectification of any damage caused to the existing buried utilities as a result of the Contractor's operations in constructing cast-in-place concrete piles, as determined by the Contract Administrator.

E17.4.3 Excavation

- (a) Excavations for piles shall be made with equipment designed to remove a core of the diameter shown on the Drawings.
- (b) Upon reaching the required elevation, the bottom of the excavation shall be cleaned as directed by the Contract Administrator in the field.

- (c) All excavated material from the piles shall be promptly hauled away from the Site to an approved disposal area as located by the Contractor.
- (d) Upon completion of the cleaning out of the bottom to the satisfaction of the Contract Administrator, the reinforcement and anchor bolts shall be set in place and the concrete poured immediately. Under no circumstances shall a hole be left to stand open after boring has been completed.
- (e) If any hole is condemned because of caving, it shall be filled with lean-mix concrete and a new hole bored as near as possible to the location shown on the Drawings. In locations where underground utilities have been exposed, the underground utilities shall be covered with clean sand to 300 mm above the utility. Payment will not be made for condemned piles.

E17.4.4 Sleeving

- (a) Timber or steel sleeving shall be used to temporarily line the bore to prevent bulging or caving of the walls and to protect men at work in the bore.
- (b) The sleeving shall be designed by the Contractor and constructed to resist all forces that may tend to distort it.
- (c) The sleeving shall be withdrawn as the concrete is placed in the bore. The sleeving shall extend at least 1 m below the top of the freshly deposited concrete at all times.
- (d) The clearance between the face of the bore hole and the sleeving shall not exceed 75 mm.

E17.4.5 Inspection of Bores

- (a) Concrete shall not be placed in a bore until the bore has been inspected and approved by the Contract Administrator.
- (b) The Contractor shall have available suitable light for the inspection of each bore throughout its entire length.
- (c) All improperly set sleeving, bore, or bottom shall be corrected to the satisfaction of the Contract Administrator.

E17.4.6 Placing Reinforcing Steel

- (a) Reinforcement shall be:
 - (i) placed in accordance with the details shown on the Drawings
 - (ii) rigidly fastened together, and
 - (iii) lowered into the bore intact before concrete is placed.
- (b) Spacers shall be utilized to properly locate the reinforcing steel cage in the bore.

E17.4.7 Placing Reinforced Concrete Barrier

- (a) Where the slip formed concrete barrier is located directly above the pile foundations for the light standard, at three (3) locations, the Work shall include:
 - (i) Sawcut and remove slip formed barrier at pile locations as shown on the Drawings.
 - (ii) Install Concrete Piles as described herein, as shown on the Drawings.
 - (iii) Extend Pile Reinforcing through top of cast-in-place concrete barrier as shown on the Drawings.
 - (iv) Place concrete barrier as shown on the Drawings.

E17.4.8 Placing Anchor Bolts

- (a) The anchor bolts shall be aligned with a steel template matching the bolt holes in the light standard base plate. The setting template shall be held in place by the top and bottom nuts of the anchor bolts. Extreme care shall be used in this operation. Placement of anchor bolts without the steel template will not be permitted.

- (b) The threaded portion of the anchor bolts projecting above the top surface of pile shall be coated with oil, before the concrete is poured, to minimize the fouling of threads splattered by concrete residue.

E17.4.9 Forms

- (a) For bored piles, the top of the piles shall be formed with tubular forms (Sonotube) to a minimum depth of 1000 mm below final grade.
- (b) The forms shall be sufficiently rigid to prevent lateral or vertical distortions from the loading environment to which they shall be subjected. Forms shall be set to the design grades, lines, and dimensions, as shown on the Drawings.

E17.4.10 Placing Concrete

- (a) Care shall be taken to ensure that anchor bolts are vertically aligned and that anchor bolts and conduits are properly positioned prior to placement of concrete.
- (b) Concrete shall not have a free fall of more than 2.0 m and shall be placed so that the aggregates will not separate or segregate. The slump of the concrete shall not exceed 110 mm. The concrete shall be vibrated throughout the entire length of the pile.
- (c) Concrete shall be placed to the elevations as shown on the Drawings. The top surface of the pile shall be finished smooth and even with a hand float.
- (d) The shaft shall be free of water prior to placing of concrete. Concrete shall not be placed in or through water unless authorized by the Contract Administrator. In the event that tremie concrete is allowed by the Contract Administrator, the concrete shall be placed as specified herein.

E17.4.11 Tremie Concrete

- (a) The shaft of the pile shall be pumped clear of water so that the bottom can be cleaned. Pumping shall then be stopped and water shall be allowed to come into the bore until a state of equilibrium is reached. Concrete shall then be placed by means of a tremie pipe. The tremie pipe shall have a suitable gate in the bottom to prevent water from entering the pipe. The bottom of the pipe shall be maintained below the surface of the freshly placed concrete. The pipe shall be capable of being raised or lowered quickly in order to control the flow of concrete.
- (b) Tremie concrete shall be poured up to a depth of 600 mm or as the Contract Administrator directs. Pumps shall then be lowered into the bore and the excess water pumped out. The laitance that forms on top of the tremie shall then be removed and the remainder of the concrete shall be placed in the dry.

E17.4.12 Protection of Newly Placed Concrete

- (a) Newly laid concrete threatened with damage by rain, snow, fog, or mist shall be protected with a tarpaulin or other approved means.

E17.4.13 Curing Concrete

- (a) The top of the freshly finished concrete piles shall be covered and kept moist by means of wet polyester blankets immediately following finishing operations and shall be maintained at above 10°C for at least seven (7) consecutive days thereafter.
- (b) After the finishing is completed, the surface shall be promptly covered with a minimum of a single layer of clean, damp polyester blanket.
- (c) Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping or running water, vibration, and mechanical shock. Concrete shall be protected from freezing until at least twenty-four hours after the end of the curing period.
- (d) Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3° in one hour or 20° in twenty-four hours.

E17.4.14 Form Removal

- (a) Forms shall not be removed for a period of at least 24 hours after the concrete has been placed. Removal of forms shall be done in a manner to avoid damage to, or spalling of, the concrete.
- (b) The minimum strength of concrete in place for safe removal of forms shall be 20 MPa.
- (c) Field-cured test specimens, representative of the in-place concrete being stripped, will be tested to verify the concrete strength.

E17.4.15 Patching of Formed Surfaces

- (a) Immediately after forms around top of pile have been removed, but before any repairing or surface finishing is started, the concrete surface shall be inspected by the Contract Administrator. Any repair of surface finishing started before this inspection may be rejected and required to be removed.
- (b) All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back fifty (50) mm from the surface before patching.
- (c) Minor surface defects caused by honeycomb, air pockets greater than 5 mm in diameter, and voids left by strutting, and tie holes shall be repaired by removing the defective concrete to sound concrete, dampening the area to be patched and then applying patching mortar. A slurry grout consisting of water and cement shall be well-brushed onto the area to be patched. When the slurry grout begins to lose the water sheen, the patching mortar shall be applied. It shall be struck-off slightly higher than the surface and left for one hour before final finishing to permit initial shrinkage of the patching mortar and it shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification, and the final colour shall match the surrounding concrete.

E17.4.16 Cold Weather Concreting

- (a) Protection of concrete shall be considered incidental to its placement. The temperature of the concrete shall be maintained at or above 10°C for a minimum of three (3) days or till the concrete has reached a minimum compressive strength of 20 MPa, by whatever means are necessary. Concrete damaged as a result of inadequate protection against weather conditions shall be removed and replaced by the Contractor at his own expense. Also, concrete allowed to freeze prior to the three (3) days will not be accepted for payment.

E17.5 Quality Control

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator, including all operations from the selection and production of materials, through to final acceptance of the Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works that are not in accordance with the requirements of this Specification.
- (b) The Contractor shall be responsible for making a thorough inspection of materials to be supplied under this Contract. All material shall be free of surface imperfections and other defects.

E17.6 Measurement and Payment

E17.6.1 Cast-in-Place Concrete Pile

- (a) Construction of Cast-In-Place Concrete Pile Foundations including supply and installation of anchor bolts and steel template will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for the "Cast-in-Place Concrete Piles",

performed in accordance with this Specification and accepted by the Contract Administrator.

E18. SEWERS

E18.1 Further to CW 2130 clause 3.3, Class B bedding shall be used.

E18.1.1 Class B bedding shall be as follows:

- (a) For C76 concrete sewer installation, the bedding and initial backfill material shall be sand.

E18.2 Manholes shall be installed during the installation of the sewer up to the underside elevation of the working slab. The manholes shall then be capped with a temporary plate and the excavations backfilled. Completion of the manhole installation shall take place after completion of the tunnel structure, or as directed by the Contract Administrator. No additional measurement or payment will be considered for the supply of the temporary plate or the sequencing of this Work.

E19. GROUNDWATER DEPRESSURIZATION

E19.1 Description

- (a) The Work shall consist of the installation, operation and decommissioning of a groundwater depressurization system to lower the groundwater pressure within the upper carbonate bedrock aquifer to protect against hydraulic fracturing, improve stability and prevent excessive seepage at the base of the excavations for the tunnel and associated works. Provide all supervision, labour, plant, materials and equipment for the following work:
 - (i) Supply and Installation of the required pumps, back-up pumps, drop piping, connections, control valves and flow meters.
 - (ii) Supply of additional appurtenances to complete the groundwater depressurization system, including but not necessarily limited to additional pump motor starters / disconnects, electrical connections, drop pipe, well seal, elbows, flow meters, control valves, discharge piping and energy dissipation mats.
 - (iii) Installation and commissioning of the complete groundwater depressurization system, including system performance verification testing.
 - (iv) Supply, installation and commissioning of a power supply and back-up power supply capable of providing a stable and continuous power supply to the system, including all equipment and materials to complete the electrical connection to the system.
 - (v) Operation and maintenance of the system for the duration of construction for all affected areas on a 24 hour per day basis.
 - (vi) Decommissioning of the pumping system at the end of construction.
 - (vii) Decommissioning and abandonment of the on-site pumping and observation wells at the completion of construction.

E19.2 References and Related Specifications

- (a) All reference standards shall be current issue or latest revision at the first date of tender advertisement.

E19.3 Submittals

- (a) Prior to the commencement of the work, submit a groundwater depressurization system plan detailing the proposed equipment, installation and operation methodology and including a detailed schedule for groundwater depressurization system operation.
- (b) Submit groundwater elevation and flow rate monitoring records to the Contract Administrator on a daily basis.

E19.4 Materials

E19.4.1 Existing Wells

- (a) Groundwater pumping wells currently on site consist of the following:
- (i) Well TW-1 consists of a nominal 125 mm diameter PVC casing installed to bedrock at a depth of 15.2 m followed by an open bedrock hole to a maximum well depth of 36.6 m. The well is located on the west side of the Site proximate to the Quintex Cleaners Building. Testing of the well indicates that it has a capacity of approximately 1.5 litres per second (lps). This well is intended to be utilized as part of the groundwater depressurization system.
 - (ii) Well TW-2 consists of a nominal 125 mm diameter PVC casing installed to a depth of 15.2 m below grade followed by an open bedrock hole to a maximum well depth of 34.4 m. The well is located on the east side of the Site proximate to the MTS building. Testing of the well indicates that it has a capacity of approximately 1.5 litres per second (lps). This well is intended to be utilized as part of the groundwater depressurization system.
 - (iii) The Owner will be installing and testing additional pumping wells intended to be used for the groundwater depressurization system. The wells will be installed after sufficient Site preparation has been completed to allow access for the drilling rig and service vehicle. The location of the wells will be determined in consultation with the Contractor and his proposed works. The following will be required:
 - ◆ The Contractor is to provide a minimum of one week notice of when the Site will be ready for the installation of the pumping wells. It is estimated that two weeks will be required to install and test the wells.
 - ◆ The wells will need to be located in close proximity to the tunnel. The layout of the tunnel, shoring, and other ancillary works will be required before the locations for the wells are selected. Prior to drilling, the Contractor will be required to approve all well locations relative to potential interference with his works.
 - ◆ Based on testing conducted to date, up to eight (8) additional wells will be installed consisting of a nominal 125 mm diameter PVC casing complete with open bedrock hole to a maximum hole depth of approximately 30.0 m below grade. Testing to date indicates that the design capacity for the wells will be approximately 1.5 lps. However, higher capacity wells (up to 7.6 lps) may be achieved. The wells will be installed in two phases in conjunction with Stage 1 and Stage 2 of the works.
 - ◆ The Contractor is required to provide access to the well locations for the drill rig and service vehicle, remove the drill cuttings upon completion of the well installation, and provide drainage for any water generated during the drilling and testing program.
- (b) Monitoring wells currently on site consist of the following:
- (i) Well TH-1 consists of a nominal 25 mm diameter PVC casing with a screen installed to a depth of 16.6 m below grade in the limestone bedrock. The well is located proximate to well TW-2. This well is intended to be utilized as part of the groundwater monitoring program.
 - (ii) Well TH-2 consists of a nominal 25 mm diameter PVC casing with a screen installed to a depth of 17.0 m below grade in the limestone bedrock. The well is located near the northern limit of the tunnel site. This well is intended to be utilized as part of the groundwater monitoring program.
 - (iii) Well AH03-06 consists of a nominal 25 mm diameter PVC casing with a screen installed to a depth of 12 to 15 m below grade in the till. The well is located proximate to the centre of the tunnel site. This well is intended to be utilized as part of the groundwater monitoring program if it is not directly within the

- excavation area. The well may need to be abandoned if it interferes with construction activities.
- (iv) Well AH03-08 consists of a nominal 25 mm diameter PVC casing with a screen installed to a depth of 12 to 15 m below grade in the till. The well is located proximate to the south part of the tunnel site. This well is intended to be utilized as part of the groundwater monitoring program if it is not directly within the excavation area. The well may need to be abandoned if it interferes with construction activities.
 - (v) Additional monitoring wells may be installed by the Owner and will become part of the groundwater monitoring program.

E19.4.2 Pumps

- (a) Provide pumps sized to the design capacity of each well. It is anticipated that the majority of the pumps will be in the 1.5 lps range but the provision of pumps with a capacity of up to 7.6 lps must be allowed for.

E19.4.3 Appurtenances Supplied By Contractor

- (a) Supply all other items to complete the system set-up to provide a fully functioning system. Items to be provided by the Contractor include but are not limited to:
 - (i) All electrical connections to the Contractor's power supply, including but not limited to the necessary disconnects and wire to suit the Contractor's set-up.
 - (ii) Discharge pipe sized to match the pump discharge outlet size and of sufficient length to discharge the water to the designated discharge point, including any culverts required to allow the discharge piping to pass beneath the construction access roads and working pads, and any required adaptors to complete the well head connection.
 - (iii) Energy dissipation mats for sediment / erosion control in case of surface discharge.
 - (iv) Additional appurtenances as required to complete the installation and provide a fully functioning system, including but not limited to additional pump drop pipes, well head elbows, control valves and flow meters sized for the flow range of the pump with a +/- 10 % accuracy.

E19.4.4 Power Supply

- (a) Supply continuous and stable hydroelectric or diesel generator electrical power. Size and configure the power supply to operate all pumps concurrently or independently as required. Provide back-up generator(s) capable of providing a continuous and stable power supply to the pumps.

E19.4.5 Bentonite / Cement Grout Backfill

- (a) Bentonite / Cement Grout backfill shall consist of Enviroplug Grout or approved equal in accordance with B6, normal Portland cement and potable water mixed in the following proportions:

Item	Mass	Ratio by Mass
Enviroplug Grout	50 kg	1.0
Normal Portland Cement	25 kg	0.5
Potable water: 125 Litres	125 kg	2.5

E19.5 Construction Methods

E19.5.1 General

- (a) The Owner will obtain the permit(s) required for groundwater withdrawal. Comply with the terms and conditions associated with these permits.
- (b) Provide access to the wells and groundwater depressurization system, including access for drill rigs and service vehicles.

- (c) Operate the full groundwater depressurization system continuously for at least 48 hours before initiation of excavation or installation of shoring systems in the affected areas. Increase this duration as required based on monitoring of field groundwater conditions.
- (d) The Contractor is advised that the Contract Administrator will oversee the installation, operation, monitoring, and decommissioning of the groundwater depressurization system and all associated works.
- (e) Maintain all pumping and monitoring wells within the construction area for the duration of the Work. Repair or replace any well damaged during the course of the Work.
- (f) Be responsible for damage to any groundwater depressurization or monitoring system components during construction activities. Repair or replace damaged components to the satisfaction of the Contract Administrator.
- (g) Wells may be installed in areas to be subsequently excavated. The Contractor will be required to protect the wells during the excavation process and cut down the well casings to the appropriate height for groundwater depressurization system installation and operation.

E19.5.2 Groundwater Depressurization System Installation

- (a) Supply and install pumps, drop pipes, well head connections, valves and flow meters as required to meet manufacturer's specifications and to provide a fully functioning system. Verify the design and sizing of the pumps including power supply requirements, drop piping and other appurtenances to be used within the overall groundwater depressurization system.
- (b) Supply and install all appurtenances related to electrical components, including but not limited to transformers, wiring, electrical disconnect and motor starter, to meet the submersible pump and motor manufacturers specifications within weatherproof enclosures. Configure the electrical system to allow pumps to be operated concurrently or independently as required.
- (c) Install discharge hoses from the well heads to the point of discharge. Discharge will be to an approved location determined by the Contractor.

E19.5.3 System Performance Verification Testing

- (a) Undertake groundwater depressurization system performance verification testing and monitoring following installation and commissioning of the groundwater depressurization system. This testing will involve simultaneous operation and monitoring of all system wells (or as directed by the Contract Administrator) for a minimum period of 48 hours.
- (b) Monitor flow rates and groundwater levels within the on-site pumping and monitoring wells during performance verification testing. The Contract Administrator shall additionally monitor instrumentation in the area relative to possible groundwater depressurization impacts to local domestic well users.

E19.5.4 Groundwater Depressurization System Operation

- (a) Notify the Contract Administrator at least 48 hours prior to any dewatering activities.
- (b) Operate and maintain the groundwater depressurization system on a 24 hour per day basis for the duration of construction that requires lowered groundwater levels.
- (c) The required discharge rate will depend on groundwater elevations at the time of construction and the elevation at the base of the excavation and will be specified by the Contract Administrator at the start of construction and revised periodically during construction based on the monitoring results provided and on the final depth of excavation required.
- (d) Monitor and record the flow rate at each pumping well once every hour. Measure and record ground water levels in the pumping wells once every 24 hours. Provide copies of the field data sheets to the Contract Administrator daily.

- (e) Monitor and record groundwater levels in all of the monitoring wells at the Site once every 24 hours. Provide copies of the field data sheets to the Contract Administrator daily.
- (f) The Contract Administrator will be monitoring the operation of the depressurization system throughout the duration of the Work. Cooperate and provide the Contract Administrator with assistance upon request.
- (g) Non-Operating Periods: The wells are equipped with well seals to prevent infiltration of surface water into the underlying bedrock aquifer or the discharge of groundwater from the wells. Ensure that these components are in place and maintained during non-operating periods. Remove and reinstall equipment if necessary during non-operation periods.
- (h) Do not make changes to the set-up or operation of the groundwater depressurization system without prior acceptance by the Contract Administrator. Where emergency changes are required to maintain the system in a fully functioning manner, take the appropriate action and then immediately advise the Contract Administrator of the actions taken and the reasons therefore. If requested by the Contract Administrator, provide a written report of the source of the problem, the actions taken to rectify the issue and the steps taken to ensure the problem does not recur.

E19.5.5 Groundwater Depressurization System Decommissioning

- (a) Remove all pumps, back-up pumps, drop piping, connections, control valves, flow meters, discharge hose, energy dissipation mats and other appurtenances.

E19.5.6 Well Decommissioning

- (a) Decommission all pumping and observation wells at the end of construction.
- (b) For open bedrock holes, backfill the lower portion of the wells that extend into the carbonate bedrock aquifer with clean sand. Tremie backfill the remaining casing with bentonite / cement grout to ground surface. Cut the casing off a minimum of 1 meter below grade.
- (c) For screened monitoring wells, tremie backfill the entire length with bentonite / cement grout up to ground surface. Cut the casing off a minimum of 1 meter below grade.

E19.5.7 Construction Sequence

- (a) In order to minimize any potential impacts of pumping on nearby domestic wells, the construction sequence shall be such that the excavations for which depressurization is required are completed either simultaneously or within the shortest possible overall time frame. Coordinate and schedule the Work in a manner that minimizes the duration that groundwater depressurization is required.

E19.6 Quality Control / Quality Assurance

- (a) All materials supplied under this Specification will be subject to inspection and testing by the Contract Administrator or by a certified testing laboratory designated by the Contract Administrator.

E19.7 Measurement and Payment

E19.7.1 Groundwater Depressurization System Installation

- (a) The supply and installation of the groundwater depressurization system (including system performance verification testing) will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for "Groundwater Depressurization System Installation", performed in accordance with this Specification and accepted by the Contract Administrator.

E19.7.2 Groundwater Depressurization System Operation

- (a) Operation of the groundwater depressurization system will be measured on a daily basis and paid at the Contract Unit Price per day for "Groundwater Depressurization System Operation". The number of days paid will be the total number of days of

Groundwater Depressurization System Operation completed in accordance with this specification and accepted by the Contract Administrator.

E19.7.3 Groundwater Depressurization System Decommissioning

- (a) The groundwater depressurization system decommissioning will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for "Groundwater Depressurization System Decommissioning", performed in accordance with this Specification and accepted by the Contract Administrator.

E19.7.4 Groundwater Depressurization Well Decommissioning

- (a) Well decommissioning will be measured on a per well unit basis and paid for at the Contract Unit Price per well for "Groundwater Depressurization Well Decommissioning". The number of units paid will be the total number of wells decommissioned in accordance with this Specification and accepted by the Contract Administrator.

E20. TUNNEL APPROACH EXCAVATION AND GRADING

E20.1 Description

- E20.1.1 This Specification covers all excavation, preparation of sub-grade, placement of suitable site fill material, compaction and grading of all the areas not included in Specification E22 - Shoring, Excavation and Dewatering and as shown on the Contract Drawings. The Contractor shall coordinate his excavation with the Contract 6 Contractor.

E20.2 References

- E20.2.1 Removals are in accordance with Standard Construction Specifications:

- (a) CW 3110 – Sub-Grade, Sub-Base and Base Course Construction;
- (b) CW 3170 – Earthwork and Grading.

E20.3 Excavation and Grading

E20.3.1 Description

- (a) Excavation will be understood to include removal of all insitu material to the line and grade as shown on the Contract Drawings.
- (b) Excavation for areas to be filled higher than existing grade will include the removal of existing insitu materials to a depth of 150 mm prior to placement of suitable site materials.

E20.3.2 Construction Methods

- (a) Except as identified in Specification Section D13.4 and E20.3.2(b), all materials excavated from Stage 1 of the tunnel construction (approximate station 11+880 to north limit of construction) shall be removed, hauled and disposed of off-site to the satisfaction of the Contract Administrator. All material excavated from Stage 2 of the tunnel construction (approximate station 11+880 to south limit of construction) will be hauled and stock piled at a location within Fort Rouge Yards as designated by the Contract Administrator. The stock pile will be located between 1 km and 2 km from the tunnel site. Stock piled materials shall be evenly distributed along the south right of way of the proposed transit way for use by Contract 6 contractor.
- (b) Some excavated materials will be required on site to build up low areas, construct berms and backfill designated areas behind retaining walls. Excavated materials being used on site (suitable site fill material) shall be approved by the Contract Administrator prior to placement. Suitable site fill materials shall be placed in accordance with CW 3170.
- (c) Sub-grade Compaction will be performed on the sub-grade of all excavated areas with the exception of the tunnel approach side slopes.

- (d) Areas of the sub-grade determined to be unsuitable by the Contract Administrator shall be excavated beyond the design grade, hauled and disposed off site. The excavated material shall be replaced with suitable site material or crushed limestone sub-base material and compacted in accordance with CW 3110 and CW 3170 as directed by the Contract Administrator.

E20.4 Measurement and Payment

E20.4.1 Tunnel Approach Excavation and Grading

- (a) The Tunnel Approach Excavation and Grading will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Miscellaneous Site Works", performed in accordance with this Specification and accepted by the Contract Administrator.
- (b) Excavation beyond design grade will be measured on a volume basis and paid at the Contract Unit Price per cubic meter for "Excavation Beyond Design Grade". The volume to be paid for will be the total number of cubic metres of material excavated in accordance with this specification, accepted and measured by the Contract Administrator. The volume of excavation will be as measured by cross-sections in its original position and computed by the Contract Administrator.
- (c) Placement of suitable site material will be measured on a volume basis and paid at the Contract Unit Price per cubic meter for "Placing Suitable Site Sub-Base Material", in accordance with CW 3110.
- (d) Supply and Placement of crushed limestone sub-base material will be measured on a weight basis and paid at the Contract Unit Price per tonne for "Supply and Placement of Crushed Limestone Sub-Base Material", in accordance with CW 3110.

E21. STRUCTURE EXCAVATION PLAN AND MONITORING

E21.1 Description and Definitions

- (a) This Specification provides the minimum technical requirements that shall be adhered to in performing the excavation activities.
- (b) "Open Excavation" means a temporary unsupported excavation with side slopes cut at safe inclination.
- (c) "Supported Excavation" means a temporary excavation supported by an acceptable shoring system.
- (d) Geotechnical Report and the geotechnical design criteria may be viewed at the Contract Administrator's Office upon request.

E21.2 Submittals

- (a) Prepare and submit Shop Drawings for all excavation, shoring, work pads, access ramps and staging.
- (b) Prepare and submit a Structural Excavation and Shoring Safe Working Plan to the Contract Administrator a minimum of two (2) weeks prior to commencing Work on Site. This shall include an Excavation Staging Plan.

E21.3 Construction Methods

E21.3.1 Condition and Protection of Railway Tracks

- (a) The railway tracks at the boundary of the Work area are recently constructed detours to facilitate the proposed construction activities.
- (b) The track detours have a limited capacity to withstand excavations necessary for the proposed construction. Ensure that Work activities do not jeopardize the stability or impact the performance of the tracks.

- (c) The Contract Administrator will monitor the track displacement during construction and may require modifications to the construction sequence or introduce additional requirements to maintain acceptable track performance.

E21.3.2 Excavation Plan

- (a) One possible excavation plan is shown on the Drawings. Study the plan to confirm constructability and assess potential interference with other construction activities.
- (b) The edge of any excavation shall be at a distance not less than 5.0 meters from the centreline of the nearest railway track.
- (c) The maximum excavation depth shall not exceed 6.0 m for an open excavation and 10.0 m for a supported excavation.
- (d) Open excavations less than 3.0 m deep shall have side slopes cut at inclination not steeper than 2.5 horizontal to 1.0 vertical. Open excavations more than 3.0 m deep shall consist of a combination of two cut slopes separated by a minimum 4.0 m wide bench. Each cut slope shall not exceed 3.0 m depth and shall be cut at inclination not steeper than 3.0 horizontal to 1.0 vertical. Alternative geometries may be considered if Contractor demonstrates that factor of safety against slope instability for short term design condition is at least 1.30.
- (e) Do not stockpile material of any kind within 10.0 m from the edge of any excavation.
- (f) The shoring design includes a 20 kPa surcharge distributed over a 5.0 m wide strip along the sides of the excavation. The surcharge shall be positioned at minimum setback of 2.0 m from the excavation edge. This design assumption is intended to model surcharge from construction equipment. Ensure the surcharge does not exceed this value.
- (g) Excavations for supported excavations shall conform to the shoring design in as shown on the Drawings and shall proceed in stages that reduce the unsupported depth to the minimum necessary to facilitate the installation of support system members.
- (h) Coordinate the progress of the excavation with the groundwater depressurization Work and with the results of the monitoring program.
- (i) Protect cut slopes against surface water and rainfall and keep covered at all times by a protective layer of approved super duty tarp or geosynthetic product.

E21.4 Performance Monitoring

E21.4.3 Without limiting the Contractor's control over the Work and responsibilities as outlined in the General Conditions, certain aspects of the Work are critical to protect the stability of the excavation and existing infrastructure. The Contract Administrator will install geotechnical instrumentation on or in the vicinity of the Work area to monitor the performance during and after construction. This instrumentation may include piezometers, slope inclinometers, settlement points or any other instrumentation. Instrumentation locations will be determined by the Contract Administrator and communicated to the Contractor to minimize potential interference with construction activities.

E21.4.4 The instrumentation will be installed and monitored by the Contract Administrator during construction. Contractor is advised that it may be necessary to limit equipment movement in the vicinity of the monitoring work. The Contract Administrator will make every effort to coordinate the monitoring with the construction operations so as to minimize disruption of the Work.

E21.4.5 Take all necessary precautions to prevent damage to geotechnical instrumentation. Repair or replace to the satisfaction of the Contract Administrator instrumentation that becomes damaged or unreliable as a result of construction operations.

E21.4.6 It may become necessary during the Work to install additional geotechnical instrumentation. Cooperate and assist the Contract Administrator in the installation of this instrumentation. The Contract Administrator will make every effort to coordinate the

installation of additional instrumentation with the construction operations so as to minimize disruption of the Work.

E21.4.7 The Contract Administrator will review excavation progress and may revise construction sequencing and timing and / or introduce staging and waiting periods as required based on performance monitoring results.

E21.4.8 Ensure that all personnel understand and observe the requirements of E21.3 and E21.4. Prior to commencement of on-site work, the Contractor's superintendent, foremen and heavy equipment operators shall attend an orientation meeting that will outline restrictions for working on and around the tracks and excavations. The Contract Administrator reserves the right to have personnel removed from the Site for failure to comply with these restrictions.

E21.5 Measurement and Payment

- (a) Railway protection, development of the excavation plan and performance monitoring will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Shoring, Excavation and Dewatering", performed in accordance with this Specification and accepted by the Contract Administrator.

E22. SHORING, EXCAVATION AND DEWATERING

E22.1 Description

E22.1.1 The Work covered under this item shall include all operations relating to structural excavation, installation, and removal of shoring systems required to construct the tunnel and the retaining walls of the tunnel approaches including dewatering procedures for the duration of the construction period as specified herein.

E22.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, safe working plans, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of the Work as hereinafter specified.

E22.2 References and Building Codes

E22.2.1 All applicable sections of the National Building Code of Canada, the Manitoba Building Code and the American Railway Engineering and Maintenance-of-Way Association (AREMA) shall apply to the manufacture, installation, excavation and items and activities incidental to Work included in this Specification.

E22.3 Materials

E22.3.1 General

- (a) Be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

E22.3.2 Concrete

- (a) Concrete to be used in soldier pile caissons and working base shall be high early strength, with a minimum 28-day compressive strength of 30 MPa and nominal 20 mm coarse aggregate. Air entrainment is not required.

E22.3.3 Structural Steel

- (a) All structural steel shapes shall be minimum CSA G40.21 Grade 300W, HSS sections shall be minimum CSA G40.21 Grade 350W, and sheet piling shall be minimum Grade 45 ASTM A572 material.

E22.3.4 Timber Lagging

- (a) Timber lagging shall be species S-P-F, beams and stringers, grade no. 1 or better with an allowable bending stress of 6.6 MPa including all modification factors. The lagging thickness (horizontal dimension) shall be 150 mm minimum for the upper 2000 mm and 200 mm minimum for below 2000 mm depth. The vertical dimension of lagging shall be not less than 50 mm greater than the horizontal dimension.

E22.3.5 Foundation Replacement

- (a) Well graded crushed limestone, conforming to the following gradation:

CANADIAN METRIC SIEVE SIZE	PERCENT OF TOTAL DRY WEIGHT PASSING EACH SIEVE
50,000	100%
5,000	25% - 80%
80	5% - 18%

E22.4 Construction Methods

E22.4.6 General Staging and Construction Requirements

- (a) Construct the tunnel generally in accordance with the staging requirements identified on the Drawings.
- (b) Groundwater depressurization and construction dewatering systems shall be in place and complete with approved water disposal procedures prior to the commencement of any excavation or shoring operations.
- (c) Prepare and submit a Structural Excavation and Shoring Safe Working Plan to the Contract Administrator for review a minimum of two (2) weeks prior to the commencement of this work.
- (d) Prior to commencing excavation operations, install sediment control fencing or other such erosion control structures to prevent sediment-laden runoff from leaving the job Site and entering the City land drainage system. The sediment control fencing shall remain in place until all construction activities are complete.
- (e) Complete excavations in accordance with the specified procedures and to the elevations and dimensions shown on the Drawings or to adjusted elevations as directed by the Contract Administrator in order to obtain a firm, stable foundation.
- (f) Dewater excavations so that construction of the tunnel is completed in the dry. Keep the bottom of excavations free from excessive moisture or free-flowing water.
- (g) Undertake dewatering in accordance with the Water Management Plan as described in D14 and accepted by the Contract Administrator.
- (h) Handle, store and dispose of excavated materials in accordance with the Environmental Protection Plan as described in D13 and accepted by the Contract Administrator.

E22.4.7 Excavation Shoring Requirements

- (a) Excavation shoring requirements for sheet pile cofferdam, braced soldier pile and cantilever shoring are shown on the Drawings. Bidders shall submit tenders based on the designs shown on the bid documents.
- (b) Deviations from the specified shoring and excavation requirements and procedures during construction will only be considered after tender award for equivalent substitution of structural components only. Submit substitution requests to the Contract Administrator accompanied by a design statement sealed by a professional

engineer registered in the Province of Manitoba indicating that the substituted component has structural performance characteristics that are equal or superior to the specified component. Component substitutions will only be considered acceptable if approved in writing by the Contract Administrator.

E22.4.8 Foundation Replacement

- (a) Notify the Contract Administrator immediately if it appears that unsuitable material is present at the final base of excavation. Unsuitable material include soft spot, wet areas, frozen soil, organic material, fill soil, silt pockets, debris, etc,. The Contract Administrator will review the suitability of the foundation material and may specify replacement of the material.
- (b) If replacement is required, remove the specified depth of unsuitable material and replace with specified crushed granular material compacted to a minimum of ninety-five (95) percent standard Proctor Maximum Dry Density.
- (c) If the foundation is made unsuitable due to improper construction activities, the Contractor shall replace the affected area to the satisfaction of the Contract Administrator at Contractor's own cost.

E22.4.9 Protection of the Works

- (a) Be responsible for protection of the works during the duration of the Contract. This shall include but may not be limited to maintaining dewatering systems on completed works, providing fencing and security.

E22.5 Measurement and Payment

E22.5.1 Shoring, Excavation and Dewatering

- (a) The Structural excavation, shoring, dewatering and other associated works will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Shoring, Excavation and Dewatering", performed in accordance with this Specification and accepted by the Contract Administrator.
- (b) Foundation Replacement will be measured on a weight basis and paid at the Contract Unit Price per tonne for "Foundation Replacement". The weight paid will be the total number of tonnes of foundation replacement material placed and compacted in accordance with this Specification, accepted and measured by the Contract Administrator. Excavation and disposal of the unsuitable material is considered incidental to this Work and will not be paid separately.

E23. SUPPLYING AND DRIVING PRECAST CONCRETE PILES

E23.1 Description

E23.1.1 The Work shall consist of:

- (a) Supplying, handling, hauling, storing, aligning, and driving precast concrete piles;
- (b) Cutting off piles at the required elevations;
- (c) Pre-boring of piles, if applicable;
- (d) Splicing piles, if deemed necessary by the Contractor;
- (e) The quality control (QC) testing of all materials, and;
- (f) Building-up piles to the required elevations, where necessary.

E23.1.2 The Contractor shall be responsible for supplying piling of sufficient length to obtain the penetration and bearing value identified on the Drawings and in the Geotechnical Report. For the purpose of determining the length of piles required, the Contractor may, at his own expense, drive test piles, complete borings or make other such other investigations as deemed necessary.

E23.2 References and Related Specifications

E23.2.1 All references standards shall be current issue or latest revision at the first date of tender advertisement.

E23.2.2 References:

- (a) CSA A5, Portland Cement
- (b) CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete
- (c) CSA A362, Blended Hydraulic Cement
- (d) CAN/CSA A3001, Cementitious Materials for Use in Concrete
- (e) CAN/CSA A23.4/CSA A251, Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products
- (f) CSA G30.12, Billet-Steel Wire for Concrete Reinforcement
- (g) CSA G30.14, Deformed Steel Wire for Concrete Reinforcement
- (h) CSA G30.15, Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- (i) CSA G279, Steel for Pre-stressed Concrete Tendons
- (j) CAN/CSA G30.18, Billet-Steel Bars for Concrete Reinforcement
- (k) AASHTO/AWS D1.5M/D1.5 Bridge Welding Code
- (l) AASHTO T176, Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test Nineteenth Edition
- (m) ASTM C29, Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate
- (n) ASTM C40, Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
- (o) ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- (p) ASTM C70, Standard Test Method for Surface Moisture in Fine Aggregate
- (q) ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- (r) ASTM C117, Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
- (s) ASTM C127, Standard Test Method for density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- (t) ASTM C128, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- (u) ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- (v) ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- (w) ASTM C138, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Galvometric) of Concrete
- (x) ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete
- (y) ASTM C295, Standard Guide for Petrographic Examination of Aggregates for Concrete
- (z) ASTM C457, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
- (aa) ASTM C494, Standard Specification for Chemical Admixtures for Concrete

- (bb) ASTM C535, Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- (cc) ASTM C1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- (dd) ASTM C1064, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
- (ee) ASTM C1084, Standard Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete
- (ff) ASTM C1202, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- (gg) ASTM C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- (hh) ASTM C1583, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
- (ii) ASTM C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
- (jj) ASTM D75, Standard Practice for Sampling Aggregates
- (kk) ASTM D516, Standard Test Method for Sulfate Ion in Water
- (ll) ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- (mm) ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- (nn) ASTM D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
- (oo) ASTM D6928, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
- (pp) AASHTO/AWS D1.5M.D1.5, Bridge Welding Code
- (qq) AWS D1.1, Structural Welding Code - Steel

E23.3 Submittals

E23.3.1 The Contractor shall submit the following to the Contract Administrator:

- (a) Proof of certification to the Canadian Precast/Prestressed Concrete Institute (CPCI) Certification Program. The Manufacturer must meet requirements of CSA A23.4, including Appendices A and B, together PCI MNL-116 and 117 and CPCI certification requirements. The Manufacturer must be certified to Group B, Category B2 at the time of tender. Proof of this certification shall be provided to the Contract Administrator prior to award of the contract.
- (b) Concrete mix design that meets the minimum compressive strengths (f'_c and f'_ci) as shown on the Drawings shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba. Any changes to the concrete mix design shall be reviewed by the Contract Administrator prior to the Manufacturer implementing the change.
- (c) Stressing calculations shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba and include the following:
 - (i) Copies of the stressing sequence and strand elongation calculations as well as all data required for checking these calculations. Separate elongation calculations will be required for each significant variation in the Modulus of Elasticity of the strand.

- (ii) A calibration graph for each jack, calibrated not more than 6 months prior to stressing operation.
 - (iii) The proposed sequence of stressing and destressing operations.
 - (iv) The anchorage losses experienced by the Manufacturer under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation.
 - (v) A copy of the proposed "Record of Concrete Strength" and "Record of Pre-Tensioning" forms to be used by the Manufacturer.
- (d) Copies of the stress-strain curve for the prestressing steel.
- (e) Copies of all reports, including but not limited to: "Record of Concrete Strength" form, "Record of Pre-Tensioning" form and material quality control test results.
- (f) Details of the proposed pile driving system and Manufacturer's specifications and catalogue for the hammer(s) to be used to perform preconstruction wave equation analysis and determine the adequacy of the driving system and hammer(s) and the preliminary pile driving criteria. The results of the wave equation shall be the basis on which the Contract Administrator will determine if the proposed system is acceptable.
- (g) Detailed design notes and Shop Drawings for proposed splice connections that are sealed signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba (if applicable).
- (h) Proof of certification for the welders conducting the Work (if applicable). All welders shall satisfy one of the following requirements:
- (i) Welders qualified in accordance with the requirements of AASHTO/AWS D1.5M/D1.5
 - (ii) Valid Canadian Welding Bureau (CWB) Welding ticket, or
 - (iii) Valid "Welder's Licence" as issued by the Mechanical and Engineering Division, Department of Labour and Manpower, Province of Manitoba, with a minimum of 5 years of experience welding on steel structures.
- (i) Welding procedures specific to the Work (if applicable).

E23.4 Materials

E23.4.1 Concrete

- (a) Concrete in the piles shall have minimum compressive strengths (f'_c and f'_{ci}) as shown on the Drawings and meet the requirements of CSA A23.1, Exposure Class S-1 and Air Content Category 1 for hardened concrete.
- (i) Coarse Aggregate
 - ◆ The Maximum nominal size of coarse aggregate shall be 20 mm and meet the grading requirements of CSA A23.1, Table 11, Group I. Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances.
 - ◆ Tests of the coarse aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12, for concrete exposed to freezing and thawing.
 - (ii) Fine Aggregate
 - ◆ Fine aggregate shall meet the grading requirements of CSA A23.1, Table 10, FA1. Fine aggregate shall consist of sand, stone, screenings, and other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.

- ◆ Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12.

(iii) Admixtures

- ◆ Air-entraining admixtures shall conform to the requirements of ASTM C260.
- ◆ Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete.
- ◆ All admixtures shall be compatible with all other constituents. The additional of calcium chloride, accelerators and air-reducing agent will not be permitted, unless otherwise approved by the Contract Administrator.

(iv) Cementitious Materials

- ◆ Hydraulic cement shall be Type MS/MSb (moderate sulphate-resistant/blended high sulphate resistant) in accordance with CSA A23.1.

E23.4.2 Prestressing Strand

- (a) Prestressing strands shall be seven wire uncoated, low relaxation strand, conforming to CSA G279. They shall be in accordance with the size and ultimate strength as shown on the Drawings and the following:

(i) Tagging

- ◆ Size of strand, coil number, heat number and the mark of the Manufacturer shall be recorded on a tag attached securely to each reel. The tag shall also identify the strand with its own stress strain curve.

(ii) Stress-Strain Curves

- ◆ On stress-strain curve shall be provided by the Manufacturer for each reel.

(iii) Testing

- ◆ Should the Contract Administrator consider it necessary, approval of the prestressing strand, in addition to the requirements of CSA G279, shall be based on tests carried out by the Manufacturer at his expense in a testing laboratory satisfactory to the Contract Administrator. The Manufacturer shall test a minimum of three representative specimens of the strands to be used in the piles. The results of these tests shall be supplied to the Contract Administrator. The Contract Administrator may also require the Manufacturer to supply additional representative specimens for independent testing.
- ◆ Where the strand has rusted in storage, the use of such material will be subject to the approval of the Contract Administrator. The Contract Administrator, at his discretion, may require physical tests at the Manufacturer's expense in order to determine whether the material is suitable to be used in the piles.
- ◆ All strands that are contaminated by substances having a deleterious effect on the steel or concrete or on the bond strength of concrete to strand or, sustain physical damage, shall be replaced either by the Manufacturer at his expense or cleaned to the satisfaction of the Contract Administrator at the Manufacturer's expense.

E23.4.3 Reinforcement

- (a) Intermediate grade bars shall conform to the requirements of CSA G30.12, CSA G30.14 and CSA G30.15.
- (b) Reinforcing steel shall conform to the requirements of CAN/CSA G30.18 Grade 400W.

E23.4.4 Replacement of Damaged Materials

- (a) All material supplied by the Contractor that in the opinion of the Contract Administrator has been damaged or otherwise rendered unusable by improper storage or handling by the Contractor shall be replaced by the Contractor at his expense.

E23.4.5 Replacement or Repairing Damaged Piles

- (a) If piles are damaged due to the Contractor's handling operations, the Contractor shall, at his own expense, replace all damaged piles with piles that meet the requirements of this Specification and as shown on the Drawings.
- (b) All piles excessively spalled, crushed or broken in driving operations shall be replaced by the Contractor at his own expense unless, at the discretion of the Contract Administrator, the damage is so slight that the pile can be repaired properly by the Contractor at his own expense.

E23.4.6 Welding

- (a) Welding shall conform to the requirements of the Structural Welding Code - Steel of the American Welding Society AWS D1.1 and addendum and CSA W59 Welded Steel Construction.

E23.5 Construction Methods

E23.5.1 Identification

- (a) All piles will be marked on the side at one end clearly identifying the following information: the casting date, bed number and pile number, length and data pertaining to the manufacture of each pile.

E23.5.2 Fabrication

(a) Tolerances

- (i) The Contractor shall fabricate the precast concrete piles to the following tolerances:
 - ◆ total length: minimum variation shall be ± 3 mm per metre of length (or the greater of $L/500$ or 30 mm per CSA), whichever is less;
 - ◆ cross-section dimensions: -6 mm to +12 mm;
 - ◆ deviation from straight line: not more than 3mm/m of length to a maximum of 12 mm for full length;
 - ◆ head of pile: ± 10 mm/m from a right angle plane with surface irregularities ± 3 mm;
 - ◆ reinforcing steel cover: -3 mm to + 6 mm; and
 - ◆ spacing of spiral reinforcing: ± 12 mm.

(b) Stressing

- (i) The submission of the stressing calculations to the Contract Administrator shall in no way relieve the Manufacturer of the full responsibility for the success or failure of the stressing operations.
- (ii) Before the stressing operation begins, the Manufacturer shall have filled in on the approved "Record of Pre-Tensioning" form the calculated jack gauge reading, the required gross elongation (based on estimated anchorage losses), and the required net elongation for each strand. During stressing operations, the Manufacturer shall record the actual jack gauge reading, measured gross elongation, measured anchorage losses, and then calculate the actual net elongation for each strand.
- (iii) Tensioning shall be carried out so that the jack is coaxial with the tendon or strand. If the strands are tensioned individually, care shall be taken to ensure that unravelling of the strands does not take place.

- (iv) At no time shall the actual jack pressure vary from the pressure corresponding to the calculated gross elongation by more than 5 percent. If the required gross elongation is not obtained by stressing to this maximum allowable jack pressure at one end of the pile bed, it will be necessary to complete the stressing from the other end of the pile bed.
 - (v) The jack calibration shall be repeated at any given time that a gauging system indicates erratic results and at intervals not greater than 6 months during regular usage or not greater than 12 months for other conditions of use.
 - (vi) The Manufacturer shall have on hand a calibrated load cell that can be used to verify the actual load in the strand as a means of checking the elongation whenever the Contract Administrator considers it necessary.
 - (vii) A copy of the "Record of Pre-Tensioning" form shall be submitted to the Contract Administrator upon completion of the pre-tensioning of each pile run.
 - (viii) The transfer of the pre-tensioning force from the bulkheads to the piles shall not be carried out until the concrete has reached the minimum compressive strength as shown on the Drawings or as specified by the Contract Administrator. The cylinders used to determine this strength shall be cured under the same circumstances as the concrete of the piles in question.
 - (ix) Transfer of the pre-tensioning force shall be carried out by a method approved by the Contract Administrator. If the strands are to be cut, the destressing sequence shall be subject to approval by the Contract Administrator.
 - (x) All pre-tensioning strands shall be cut off flush with the end of the piles unless noted otherwise on the Drawings. The exposed ends of the pre-tensioning strands and a 50 mm strip of adjacent concrete shall be cleaned and painted unless noted otherwise on the Drawings. Cleaning shall be by abrasive blast to remove all dirt and residue that is not firmly bonded to the concrete surface. The surfaces shall be coated immediately with one thick coat of zinc-rich paint or other waterproofing material approved by the Contract Administrator. The paint shall be mixed thoroughly at the time of application and shall be worked into all voids in the pre-tensioning strands.
- (c) Reinforcement
- (i) Reinforcement shall be placed accurately in the positions shown on the Drawings, and shall be retained in such positions by means of bar accessories and wires so that the reinforcement shall not be moved out of alignment during or after the depositing of concrete.
 - (ii) Reinforcement shall be kept free of all foreign materials in order to ensure a positive bond between the concrete and reinforcement. The Manufacturer shall remove any material that has been deposited on the reinforcement before concrete is placed.
- (d) Depositing of Concrete
- (i) The temperature of the mixed concrete shall not be less than 10°C and not more than 25°C at the time of placing in the forms. Aggregates shall be heated to a temperature of not more than 65°C. The heating apparatus and the housing for the aggregates shall be sufficient to heat the aggregates uniformly without the possibility of the occurrence of hot spots which may burn the materials. The water shall be heated to a temperature of not more than 65°C.
 - (ii) Concrete shall be deposited carefully and vibrated so that it fills the forms completely and makes complete contact with all reinforcement, pre-stressing strands and any embedded materials.
 - (iii) Concrete shall be deposited at frequent locations within the forms so that there shall not be a necessity to move large quantities of concrete from place to place in the forms. The concrete shall be vibrated into place by methods that do not permit the constituent materials to segregate. The Manufacturer shall provide sufficient personnel to deposit and vibrate the concrete and shall ensure that each batch of concrete is vibrated properly into place as it is deposited.

- (iv) Buckets, chutes and other equipment used to deposit concrete in the forms shall be positioned as close to the top of the forms as possible to minimize the free fall of the concrete.
 - (v) Depositing of concrete shall be a single continuous complete operation so that each pile shall be monolithic without joints.
 - (vi) Before any concrete shall be deposited, the interior of the forms shall be cleaned of all chips, earth, shavings, sawdust, rubbish or other foreign substances.
- (e) Vibrating Concrete
- (i) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3,600 impulses per minute when operating under load. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place and to visibly affect the concrete over a radius of at least 450 mm from the vibrator when used in concrete having a 25 mm slump.
 - (ii) A sufficient number of vibrators shall be employed so that at the required rate of placement, vibration and complete compaction are obtained throughout the entire volume of each layer of the concrete. At least one extra vibrator shall be on hand for emergency use.
 - (iii) Internal vibrators shall be constantly moving vertically in the concrete and shall be applied at points uniformly spaced that are not farther apart than the radius over which the vibrator is visibly effective. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively but care shall be taken to avoid displacing or damaging the forms.
 - (iv) Vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete but shall not be continued so as to cause segregation or draw a pool of grout from the surrounding area.
 - (v) Care shall be exercised so as not to damage the prestressing strand in any way or transfer the vibration through the strand to concrete that has already been placed and has started to set.
- (f) Concrete Finish
- (i) Immediately after the removal of the forms, all defects in the concrete shall be repaired as directed by the Contract Administrator, provided the defects are not extensive enough to cause rejection of the piles. Should the top surface exhibit excessive laitance or "frothing", or any other deleterious effects, the Manufacturer shall repair the concrete to the satisfaction of the Contract Administrator.
 - (ii) Honeycomb, if any, shall be repaired as soon as the forms are taken off. When approved by the Contract Administrator, repairs shall be accomplished by: removing all aggregate that is loose or that is not bonded thoroughly to the surrounding concrete, washing the sound concrete with clean water, using a wire brush to remove any loose particles, applying an approved epoxy resin to the dried areas, and applying a cementitious mortar. The cementitious mortar shall have the same quality and mix as that used for the concrete. Patched areas shall be rubbed flush with the surrounding surface after the cementitious mortar has hardened.
 - (iii) All objectionable fins, projections, offsets, streaks, and other surface imperfections shall be removed totally to the Contract Administrator's satisfaction by approved means.
- (g) Curing
- (i) Concrete shall be either moist cured for a minimum of 72 hours from the time of casting or steam cured until the concrete has reached a strength (f'_{ci}) as shown on the Drawings or as specified by the Contract Administrator. Concrete may be radiant heat cured within an enclosure to retain concrete moisture. The 100% humidity must be maintained in the enclosure.

- (ii) If steam curing or radiant heat curing is used, it shall not be applied until after the initial set has taken place. Initial set will be considered to have taken place 4 hours after the completion of concrete placing. The cylinders used to determine the concrete strength shall be cured under the same conditions as the piles in question.
 - (iii) During steam curing, the rise in the ambient air temperature shall not exceed 20° C per hour to a maximum temperature of 70° C.
 - (iv) A thermocouple approved by the Contract Administrator shall be placed within the pile bed after placing of concrete is completed and the thermocouple shall not be removed until after steam curing has been completed. A graph showing the internal temperature plotted against the time of day shall be submitted to the Contract Administrator by the Manufacturer upon completion of the steam curing for each pile run and prior to any subsequent casting. The graph shall be properly identified as to the hour, day, month and year, as well as to the times of the completion of placing concrete, and of the start and completion of steam curing.
 - (v) Once curing has been completed, the temperature of the concrete shall not be allowed to fall at a rate exceeding 20° C per hour.
 - (vi) The Manufacturer shall not subject any pile to freezing temperatures before the pile has reached 85% of the design strength (f'c) as shown on the Drawings. The Manufacturer shall monitor the rate of cooling of the pile and avoid thermal shock from prematurely subjecting the pile to freezing temperatures.
- (h) Handling and Storage
- (i) Piling shall be handled, hauled and stored in a manner that avoids damage to the piling materials. Loading and unloading shall be by crane, loader or other appropriate hoisting equipment.
 - (ii) Precast concrete piles shall be lifted using the lifting hooks provided on the piles. Piles at all times shall be supported at yarding points only.
 - (iii) The Contractor, in handling or lifting the precast concrete piles, will not be permitted to drag them along the ground.
 - (iv) If any piles are damaged due to the Contractor's handling operations, the Contractor shall, at his own expense, replace all damaged piles with piles meeting the requirements of this Specification and as shown on the Drawings.
- (i) Location and Alignment
- (i) The piles shall be driven in the positions shown on the Drawings or as directed by the Contract Administrator. Piles shall be driven vertically unless shown otherwise on the Drawings, and shall not deviate more than 2 percent out of plumb. Batter piles shall be driven to the batter specified and shall not deviate more than 2 percent from the batter specified. Piles shall not be more than 75 mm off center measured at cut-off elevation.
 - (ii) Piles shall not be jacked or pulled into their final positions.
- (j) Driving Precast Concrete Piles
- (i) Precast concrete piles shall be driven to the depths and in accordance with the pile driving criteria indicated in the Geotechnical Report, on the Drawings or as directed by the Contract Administrator. The Contractor shall remove any surface and/or shallow depth obstruction(s) to obtain the required penetration of the pile.
 - (ii) Pile driving equipment to be used by the Contractor shall be of such capacity that the required bearing and penetration will be obtained without damage being done to the piles. Drop hammers will not be permitted for driving precast concrete piles. Pile driving shall be carried out using a diesel mechanical hammer only. Driving of all piles shall be continuous and without interruption until the pile has been driven to cut-off elevation or the refusal criteria has been met.

- (iii) Pile driver leads shall be used to support the piles while they are being driven and shall be braced to the supporting crane so as to hold the piles securely and accurately in the required position during driving. Leads shall be of sufficient length to be firmly supported on the ground. The use of hanging or swinging leads will not be allowed unless they can be held in a fixed position during the driving operations. Batter piles shall be driven with inclined leads.
 - (iv) The heads of precast concrete piles shall be protected by a cap of a design approved by the Contract Administrator. The cap shall be designed to hold the axis of the pile in line with the axis of the hammer. The bottom of the cap shall have a recess with a cushion of suitable material next to the pile head, and the top of the cap shall have a timber shock block.
 - (v) The Contractor shall drive all piling in the sequence as shown on the Drawings or specified by the Contract Administrator to minimize pile upheaval. If upheaval does occur, the Contractor shall re-drive the lifted piles to the specified elevations. The Contractor shall excavate material that has boiled up during pile driving operations. The elevation of all piles previously driven or redriven shall be confirmed to detect uplift. If uplift of 5 mm or more occurs in any pile, that pile shall be redriven to its original elevation and thereafter to the required final driving resistance. If cavities remain around the pile after drifting, the cavities should be filled with sand or other approved material to the satisfaction of the Contract Administrator.
 - (vi) The Contractor shall ensure the safety of all personnel during pile driving operations. In particular, overhead protection shall be provided for all personnel located adjacent to the pile driving lead and under the pile driving hammer. The overhead protection shall be designed and constructed so as to safely withstand forces from falling debris or other matter.
- (k) Pile Cut Off
- (i) The concrete at the top of the pile shall be chipped off neatly and perpendicular to the axis of the pile to the required elevation. The projecting steel reinforcing and prestressing strand, shall be left to act as anchorages into the concrete substructure units, either being bent down into the unit, if necessary, or cut off or leave at least 40 bar diameter lengths for the reinforcing steel and 1.0 metres for the prestressing strand projecting into the unit, or as detailed on the Drawings or directed by the Contract Administrator.
- (l) Piles Cut Off Too Low or Driven Too Low
- (i) A precast concrete pile, which at the discretion of the Contract Administrator, has had a detrimental amount of concrete broken off below the required cut-off elevation, shall be repaired by removing concrete until the entire end face of the pile is perpendicular to the longitudinal axis.
 - (ii) Where the top of such a pile is embedded in a footing or cap, the following procedures will apply:
 - ◆ For a cap that is exposed to view, the bottom surface of the cap shall be lowered by the distance that the lowest pile is below the required cut off elevation.
 - ◆ For an unexposed footing, an area 1.0 metre by 1.0 metre centered on the pile axis shall be lowered by the same distance that the pile is below the required cut off elevation.
 - (iii) The bottom surfaces of caps and footings shall be treated in the same manner as described above for cases where precast concrete piles have been driven below the required cut off elevations.
 - (iv) If extra reinforcing steel is required, it shall be supplied and placed by the Contractor at his expense as directed by the Contract Administrator in areas where a cap or footing has to be lowered.

(m) Splicing

- (i) The Contractor shall complete the Work in accordance with the welding procedures, Shop Drawings and the following:
- ◆ Before welding over previously deposited metal, the slag shall be cleaned off. This requirement shall apply to successive layers, successive beads, and to the cratered area when welding is resumed after any interruption.
 - ◆ Material to be welded shall be preheated in accordance with CSA W59.
 - ◆ The piles shall not have more than one splice per pile unless otherwise approved by the Contract Administrator. The location of the splice(s) shall be approved by the Contract Administrator.

E23.6 Quality Control/Quality Assurance

E23.6.1 Quality Control

- (a) Quality Control For the fabrication of the precast concrete piles, the Contractor shall be responsible for all quality control testing and shall complete the minimum testing requirements to the specified frequency and test procedure as described in Tables 1 and 2. All testing shall be completed by qualified personnel who are certified at the time of testing as ACI CSA-Based Concrete Field Testing Technician – Grade 1.

E23.6.2 Quality Assurance

- (a) The Contract Administrator, at his discretion, will complete random quality assurance testing on all materials incorporated into the structure. The Contractor shall allow the Contract Administrator unhindered access to the materials and shall assist the Contract Administrator in carrying out any sampling, testing or inspection at the plant or the site, including suitable access and storage.
- (b) All welds will be inspected visually by the Contract Administrator.

E23.6.3 Pile Driving Records

- (a) The Contractor and the Contract Administrator will keep an independent record of each and every pile driven. The records shall give the date, time, diameter, length, location, type, total depth of penetration, rate of penetration, number of blows per 300 mm, penetration of the last five blows, steam, air or diesel pressure and the kind and size of hammer used in driving. Any unusual phenomena shall be noted and recorded, especially if they indicate possible damage to the pile.
- (b) Energy output of driving equipment at the time of final set shall be carefully recorded by the Contractor, along with the final penetration readings, and reported immediately to the Contract Administrator. The required set per blow will be subject to acceptance by the Contract Administrator, showing regard to the specified driving equipment and piles permitted.

E23.7 Measurement and Payment

E23.7.1 Supplying and Driving Precast Concrete Piles

- (a) The Supplying and Driving Precast Concrete Piles will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for “Supplying and Driving Precast Concrete Piles”, performed in accordance with this Specification and accepted by the Contract Administrator.

**Table 1
 AGGREGATE**

TEST			MINIMUM FREQUENCY
AGGREGATE TESTING			
Sampling			One complete set of tests: <ul style="list-style-type: none"> • One per hour of production ⁽¹⁾ • Sampling as directed by the Contract Administrator ⁽²⁾ • One sample taken per lane every 500 m (minimum 3 sets of tests per day) ⁽³⁾
Gradation Analysis			
Soundness of Aggregate			
Density of Aggregate			
Standard Proctor			
Impurities/Deleterious Substances ⁽²⁾			
Alkali -Aggregate Reactivity ⁽²⁾			
Petrographic Analysis ⁽²⁾			
Sand Equivalent			
Coarse Aggregate Only:			
Crush Count			
Shale Content			
Flakiness Index			
Micro -Deval			
Dry-rodded Unit Weight			
LA Abrasion: Large -Size			One complete set of tests per material
LA Abrasion: Small -Size			
Relative Density and Absorption			
Base Course Mix Design			At the request of the Contractor
Potential for Alkali Aggregate Reactivity ⁽²⁾			As directed by the Contract Administrator
Fine Aggregate Only:			
Organic Impurities			
Surface Moisture			One test per material
Relative Density and Absorption			
Material Finer than 75µm			Test per sample

(1) For use as base course or backfill material
 (2) Concrete aggregate only
 (3) Bituminous pavement aggregate only

Table 2
CONCRETE

TEST			MINIMUM FREQUENCY
WATER TESTING			As directed by the Contract Administrator
MORTAR TESTING			
CEMENT TESTING			
Mill Certificate			
ADMIXTURES			
Air-Entraining			
Chemical			
MIX DESIGN			At the beginning of the project, repeated as many times necessary to develop a suitable concrete mix design
Proportioning			
Density of Plastic Concrete			
Batch Plant			MRMCA certification Calibrated within the last year.
Calibrated by Weights & Measures			
CONCRETE SAMPLING			One complete set of test for every 14m ³ of concrete placed, including slump, air content and temperature (every 10m ³ when Type 10, silica fume and fly ash is used)
Air Content			
Slump			
Temperature			
Cylinders			
Compressive Strength			
OTHER RELATED TESTING			As directed by the Contract Administrator
Core Compressive Strength			
Petrographic Analysis of Concrete			
Sulfate ion Content in Groundwater			
Bond Tests			
Cement Content			
Rapid Chloride Permeability			
Air-Void Parameters			

E24. SUPPLYING AND PLACING REINFORCING STEEL

E24.1 Description

E24.1.1 This Specification shall cover the supply, fabrication and placement of reinforcing steel.

E24.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E24.2 Materials

E24.2.1 General

- (a) Be responsible for the supply, safe storage and handling of all materials as set forth in this Specification.
- (b) Handle and store all materials in a careful and workmanlike manner to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with the latest edition of CSA Standard CAN3-A23.1, Storage of Materials, except as otherwise specified herein.

E24.2.2 Reinforcing Steel

- (a) Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, dowels and support bars.
- (b) All reinforcing steel shall conform to the requirements of CSA Standard G30.18, Billet-Steel Bars for Concrete Reinforcement, Grade 400W. All reinforcing steel shall be new deformed billet steel bars and shall be hot-dip galvanized.
- (c) Mechanical couplers shall be capable of developing the full strength of the coupled bars and shall be galvanized or otherwise protected against corrosion in a manner acceptable to the Contract Administrator.

E24.2.3 Galvanizing

- (a) Shop Applied:
 - (i) The galvanizing shall be shop applied and strictly in accordance with CSA Standard G164 to a minimum net retention of 600 g/m³.
 - (ii) Submit an original and three (3) copies of the coating applicator's notarized Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements.
 - (iii) Preclean reinforcing steel using acceptable methods to produce an acceptable surface for quality hot-dip galvanizing.
 - (iv) Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.
 - (v) The surface finish shall be continuous, adherent, as smooth and evenly distributed as possible, and free from any defect detrimental to the stated end use of the coated article.
 - (vi) Coating adhesion shall withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.
 - (vii) Sheared ends of bars shall be coated with a zinc-rich formulation before rusting occurs and before shipment to the job site.
 - (viii) Furthermore, no underlying cracking and other visible damage or deterioration of the hot-dip galvanizing as a result of handling or bending operations, or any other cause, shall be galvanize-coated with field-applied galvanizing touch-up material as specified hereinafter.

(b) Field Applied:

- (i) Field applied galvanized coating shall be brush applied Zinga, as supplied by Pacific Evergreen Industries Ltd., West Vancouver, BC, Canada, (802) 563-9280, or equal as accepted by the Contract Administrator.
- (ii) All field-applied galvanized coatings shall be applied in accordance with the manufacturer's recommendations and as directed by the Contract Administrator.
- (iii) The maximum area to be repaired in the field on a single repair shall be 5,000 mm². Any damaged article with a damaged area greater shall be rejected, removed, and replaced at the Contractor's expense.

E24.2.4 Bar Accessories

- (a) Bar accessories shall be of a type approved by the Contract Administrator. They shall be made from a non-rusting material, and shall not stain, blemish, or spall the concrete surface for the life of the concrete.
- (b) Bar accessories shall include bar chairs, spacers, clips, wire ties, wire (18 gauge minimum), or other similar devices that may be approved by the Contract Administrator.

E24.2.5 Reinforcing Steel Shop Drawings

- (a) Prepare and submit Shop Drawings in accordance with E3 for the supply, fabrication and placement of reinforcing steel. Shop drawings shall consist of bar bending details, bar lists, placing drawings and mass tabulations. Placing drawings shall indicate sizes, spacing, location and quantities of reinforcement. Prepare drawings in accordance with ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures. Detail lap lengths and bar development lengths to CAN3-A23.3 unless otherwise indicated.

E24.3 Construction Methods

E24.3.1 Fabrication of Reinforcing Steel

- (a) Fabricate reinforcing steel in accordance with CSA Standard G30.18 to the dimensions and shapes shown on the Drawings.

E24.3.2 Placing of Reinforcing Steel

- (a) Place reinforcing steel accurately in the position shown on the Drawings and retain in such position by means of a sufficient number of bar accessories so that the bars will not be moved out of alignment during or after the depositing of concrete. Intersecting bars size 20M or smaller shall be tied positively at a spacing not to exceed 300mm or the bar spacing, whichever is greater. Intersecting bars size 25M or larger shall be tied positively at a spacing not to exceed 600mm or the bar spacing, whichever is greater.
- (b) Reinforcing steel shall be free of all foreign material in order to ensure a positive bond between the concrete and steel. Remove any dried concrete which may have been deposited on the steel from previous concrete placement before additional concrete may be placed.
- (c) Splice reinforcing steel only as and where indicated on the Drawings. Obtain approval from the Contract Administrator for additional lap or mechanical splices. Do not use welded splices without the prior written approval of the Contract Administrator. If permitted, welded splices shall conform to CSA Standard W186.
- (d) Do not bend or straighten reinforcing steel in a manner that may damage the base metal or the galvanizing. Bars with bends not shown on the Drawings shall not be used. Heating of reinforcing steel will not be permitted without the prior approval of the Contract Administrator.
- (e) Following placement of galvanized-coated bars, all areas of damaged coating shall be repaired using approved touch-up coating material specified herein.

- (f) Provide a minimum of twenty-four (24) hours advance notice to the Contract Administrator to allow for inspection of the reinforcement prior to concrete placement.

E24.4 Quality Control

E24.4.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work. The Contract Administrator reserves the right to reject any materials or Works that are not in accordance with the requirements of this Specification, regardless of any previous inspection or approval.

E24.4.2 Access

- (a) Cooperate with the Contract Administrator and afford full access for inspection and quality control testing of reinforcing steel both at the Site and at any plant used for fabrication of the reinforcing steel.

E24.4.3 Quality Control Testing

- (a) Quality control testing may be used to determine the acceptability of the reinforcing steel supplied by the Contractor.
- (b) Provide samples of reinforcing steel as required for quality control tests and provide assistance, tools and equipment as may be required to facilitate such testing.

E24.5 Measurement and Payment

E24.5.1 Supply and Placing Reinforcing Steel

- (a) The Supplying and placing of reinforcing steel will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Structural Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E25. STRUCTURAL CONCRETE

E25.1 Description

E25.1.1 This Specification covers the preparation of Portland Cement Structural Concrete for, and all concreting operations related to, the construction of Portland Cement Structural Concrete Works as specified herein.

E25.1.2 The Work to be done by the Contractor under this Specification includes the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E25.2 Materials

E25.2.1 General

- (a) Be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

E25.2.2 Handling and Storage of Materials

- (a) Handle and store all materials in a careful and workmanlike manner and to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA-A23.1.

E25.2.3 Testing and Approval

- (a) All materials supplied under this Specification may be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.
- (b) All component materials shall be approved by the Contract Administrator at least seven (7) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials in whole or in part do not conform to the Specifications detailed herein or are found to be defective in manufacture or have become damaged in transit, storage, or handling operations, then such materials will be rejected by the Contract Administrator and shall be replaced by the Contractor at his own expense.

E25.2.4 Bonding Agents

- (a) Identify product(s) and submit product information to the Contract Administrator for review.

E25.2.5 Curing Compound

- (a) If permitted for use, curing compound shall be liquid membrane-forming and conform to the requirements of ASTM Standard C309 and the proposed standard ASTM P198. Rate of application shall be 1.5 times the rate required to meet the requirements of ASTM P198 for the texture of concrete to which the curing compound is being applied.
- (b) Curing compounds shall be resin-based and white-pigmented.
- (c) Do not using curing compound on surfaces to be tiled.

E25.2.6 Patching Mortar

- (a) Patching mortar shall be made of the same cementitious material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2 parts sand by damp loose volume. White Portland Cement shall be substituted for a part of the grey Portland Cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing.

E25.2.7 Non-Shrink Cementitious Grout

- (a) Non-shrink cementitious grout shall be CPD Cipadite E-500, Sika 212, Meadows CG-86 or approved equal in accordance with B6. The minimum compressive strength of the grout at 28 days shall be 40 MPa.

E25.2.8 Formwork

- (a) Formwork materials shall conform to CSA Standard A23.1, CSA S269.3 and American Concrete Publication SP4, "Formwork for Concrete".
- (b) No "stay-in-place" formwork or falsework is permitted.
- (c) Form sheeting plywood to be covered with form liner or to be directly in contact with soil shall be exterior Douglas Fir, concrete form grade, conforming to CSA Standard O121, a minimum of 20 mm thick.
- (d) Where form liner is not being used, form sheeting shall be Douglas Fir, overlay form liner type conforming to CSA Standard O121. Approved manufacturers are "Evans" and "C-Z".
- (e) Boards used for formwork shall be fully seasoned and free from defects such as knots, warps, cracks, etc., which may mark the concrete surface.
- (f) Do not leave formwork accessories in place within 50 mm of the surface following form removal. Items to be left in place must be made from a non-rusting material or galvanized steel and they shall not stain, blemish, or spall the concrete surface for the life of the concrete.

- (g) Forms for exposed concrete surfaces that do not require a form liner may be either new plywood or steel as authorized by the Contract Administrator.
- (h) Studding shall be spruce or pine and shall have such dimensions and spacing that they shall withstand distortion from all the forces to which the forms will be subjected. Minimum dimensions shall be 38mm x 140mm.
- (i) Walers shall be spruce or pine, with minimum dimensions of 89mm x 140mm.
- (j) All forms are incidental to these Works and must be removed by the Contractor once adequate strength and curing of the concrete has been achieved.

E25.2.9 Concrete

- (a) Be responsible for the design and performance of all concrete mixes supplied under this specification. Ready-mix concrete having the following minimum properties in accordance with CSA Standard A23.1 shall be used:
 - (i) Class of Exposure: C-1
 - (ii) Compressive Strength @ 28 days = 35 MPa
 - (iii) Maximum Water / Cementing Materials Ratio = 0.4
 - (iv) Air Content: Category 1 per Table 4 of CSA A23.1
- (b) Submit mix design for ready-mix concrete to the Contract Administrator at least two (2) weeks prior to start of concrete placing operations.
- (c) The workability of each concrete mix shall be consistent with the proposed placement methods.
- (d) Concrete temperature at discharge shall be between 15°C and 25°C unless otherwise noted. Concrete containing silica fume shall be at a temperature of between 10°C and 18°C at discharge unless otherwise approved by the Contract Administrator.
- (e) Concrete materials susceptible to frost damage shall be protected from freezing.

E25.2.10 Aggregates

- (a) All aggregates shall comply with CSA A23.1.
- (b) Be responsible for testing the fine and coarse aggregates to establish conformance to these specifications. Provide test results to the Contract Administrator.
- (c) Coarse Aggregate
 - (i) The maximum nominal size of coarse aggregate shall be selected to suit the Contractor's mix design but no larger than 35mm. Gradation shall be in accordance with CSA A23.1, Table 11, Group 1. The coarse aggregate shall satisfy the Standard Requirements specified in CSA A23.1, Table 12, "Concrete Exposed to Freezing and Thawing".
 - (ii) Coarse aggregate shall consist of crushed stone or gravel or a combination thereof having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances. Coarse aggregate shall be clean and free from alkali, organic or other deleterious matter and shall have a maximum absorption rate of 2.25%.
 - (iii) The aggregate retained on the 5 mm sieve shall consist of clean, hard, tough, durable, angular particles with a rough surface texture, and shall be free from organic material, adherent coatings of clay, clay balls, an excess of thin particles or any other extraneous material.
 - (iv) Coarse aggregate when tested for abrasion in accordance with ASTM C131 shall not have a loss greater than 30%.
- (d) Fine Aggregate
 - (i) Fine aggregate shall meet the grading requirements of CSA A23.1, Table 10, Gradation FA1.

- (ii) Fine aggregate shall consist of sand, stone, screenings, other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam, or other deleterious substances.
- (iii) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12.

E25.2.11 Cementing Materials

- (a) Cementing materials shall conform to the requirements of CSA A3001. Portland cement shall be Type HS (sulphate-resistant).
- (b) Silica Fume
 - (i) Silica fume shall not exceed 8% by mass of cement.
- (c) Fly Ash
 - (i) Fly ash shall be Type CI or Type F and shall not exceed 25% by mass of cement.
- (d) Store cementitious materials in a suitable weather-tight building that will protect these materials from dampness and other destructive agents. Cementitious materials that have been stored for a length of time resulting in the hardening or formation of lumps shall not be used in the Work.

E25.2.12 Admixtures

- (a) Air entraining admixtures shall conform to the requirements of ASTM C260.
- (b) Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete.
- (c) All admixtures shall be compatible with all other constituents. The addition of calcium chloride, accelerators and air-reducing agents will not be permitted unless otherwise approved by the Contract Administrator.
- (d) Use appropriate low range water reducing and/or superplasticizing admixtures in concrete containing silica fume. Approved retarders or set controlling admixtures may be used for concrete containing silica fume.

E25.2.13 Water

- (a) Water to be used for mixing and curing concrete or grout and saturating substrate shall conform to the requirements of CSA A23.1 and shall be free of oil, alkali, acidic, organic materials or deleterious substances.

E25.2.14 Concrete Supply

- (a) Concrete shall be proportioned, mixed, and delivered in accordance with the requirements of CSA A23.1, except that the transporting of ready mixed concrete in non-agitating equipment will not be permitted unless prior written approval is received from the Contract Administrator.
- (b) Unless otherwise directed by the Contract Administrator, the discharge of ready mixed concrete shall be completed within 120 minutes after the introduction of the mixing water to the cementing materials and aggregates.
- (c) Maintain all equipment used for handling and transporting concrete in clean condition and proper working order.

E25.2.15 Joint Sealant

- (a) Joint sealant shall be guaranteed non-staining flexible grey polyurethane applied in strict accordance with the manufacturer's instructions, including appropriate primers and backer rod. Approved products include: Vulkem 116 by Tremco, Sonolastic NP1 by BASF, RC-1 by Permapol and Sikaflex by Sika.

- E25.2.16 Expanding Sealant
- (a) Expanding sealant shall be a bentonite-based sealant that expands on contact with moisture. Volclay RX-101, SikaSwell S-2 or approved equal in accordance with B6.
- E25.2.17 Joint Filler
- (a) Joint filler shall be rot-proof, preformed, non-extruding, resilient, made with a bituminous fibre such as "Flexcell" and shall conform to the requirements of ASTM Standard D1751.
- E25.2.18 Expanding Joint Filler
- (a) Expanding joint filler shall be a polyurethane foam compressed to maximum 20 percent of its expanded width and be impregnated throughout with a latex modified asphalt. Emseal by Emseal Corporation or approved equal in accordance with B6 only. Installed in strict accordance with Manufacturer's instructions.
- E25.2.19 Waterproofing
- (a) Waterproofing membrane shall be one of the following systems or approved equal in accordance with B6.
 - (i) Bituthene 3000 as manufactured by Grace Construction Products.
 - (ii) Torchflex TP-250-FF as manufactured by IKO Industries.
 - (iii) Sopralene Flame 250 as manufactured by Soprema.
 - (iv) Bridge Deck Membrane as manufactured by Bridge Preservation.
 - (v) Two-component methyl methacrylate (MMA) resin membrane as manufactured by Stirling Lloyd.
 - (b) Waterstops and rubber strips are as specified on the Contract Drawings or approved equal in accordance with B6.
 - (c) Protection board shall be asphaltic panels of minimum thickness 3/8 in (10 mm) laid in two layers with staggered joints.
- E25.2.20 Miscellaneous Materials
- (a) Supply all miscellaneous materials as required to ensure the satisfactory completion of the concrete works.
- E25.3 Equipment
- E25.3.1 General
- (a) All equipment shall be of a type accepted by the Contract Administrator. The equipment shall be in good working order, kept free from hardened concrete or foreign materials, and shall be cleaned at frequent intervals.
 - (b) Maintain sufficient standby equipment available on short notice at all times.
- E25.3.2 Vibrators
- (a) Maintain sufficient numbers of internal concrete vibrators and experienced operators on-site to properly consolidate all concrete in accordance with ACI 309. The type and size of vibrators shall be appropriate for the particular application, the size of the pour, and the amount of reinforcing and shall conform to standard construction procedures.
 - (b) Use rubber coated vibrator for consolidating concrete.
 - (c) Maintain standby vibrators available at all times during the pour.
 - (d) Mechanical vibrators shall have a minimum speed of 7,000 rpm.
- E25.3.3 Miscellaneous Equipment
- (a) Provide all miscellaneous equipment as required to properly and thoroughly execute and complete all operations related to the supply and placement of structural concrete.

E25.4 Construction Methods

E25.4.1 Concrete Working Base

- (a) See Section E22.

E25.4.2 Formwork and Shoring

- (a) Formwork shall be designed, erected, braced, and maintained to safely support all vertical and lateral loads until such loads can be supported by the concrete.
- (b) Maximum spacing for studs and walers:
 - (i) studs - 450 mm centre to centre (based on 20mm plywood)
 - (ii) walers - 760 mm centre to centre
- (c) Forms shall be clean before use. Plywood and other wood surfaces shall be sealed against absorption of moisture from the concrete by a field-applied form coating or a factory-applied liner. Ensure that form coatings used on surfaces to be tiled are compatible with tiling application.
- (d) Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be a commercially manufactured type. The portion remaining within the concrete shall leave no metal within 50 mm of the surface when the concrete is exposed to view. Spreader cones on ties shall not exceed 25 mm in diameter.
- (e) All exposed edges shall be chamfered 25 mm unless otherwise noted on the Drawings.
- (f) Slots, recesses, chases, sleeves, inserts, bolts, hangers, and other items shall be formed or set in coordination and cooperation with the trade concerned. No openings shall be made in structural members that are not shown on the structural drawings without the prior approval of the Contract Administrator.
- (g) Shores shall be provided with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.
- (h) Mud sills of suitable size shall be provided beneath shores, bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlements during or after concreting. Shores must not be placed on frozen ground.
- (i) Brace shores horizontally in two directions and diagonally in the same two vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.
- (j) Design loads and lateral pressures are outlined in Part 3, Section 102 of "Recommended Practice for Concrete Formwork," (ACI 347). Additional design considerations concerning factors of safety for formwork elements and allowable settlements outlined in Section 103 of the above reference shall apply.
- (k) Formwork shall have sufficient strengths and rigidity so that the resultant finished concrete conforms to the shapes, lines and dimensions of the members shown on the Drawings.
- (l) Formwork shall be constructed to permit easy dismantling and stripping and such that removal will not damage the concrete. Provision shall be made in the formwork for shores to remain undisturbed during stripping where required.
- (m) Formwork shall be cambered where necessary to maintain the specified tolerances and to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and other construction loads.
- (n) Forms shall be sufficiently tight to prevent leakage of grout or cement paste.
- (o) Form panels shall be constructed so that the contact edges are kept flush and aligned.
- (p) Remove all form lumber, studding, etc. from the Site after the concrete has set, and leave the entire Site in a neat and clean condition.

- (q) Forms may be reused only if they are thoroughly cleaned and in good condition after being removed from the former portions of the Work. The Contract Administrator shall be the sole judge of form condition and suitability and his decision shall be final.

E25.4.3 Allowable Tolerances

- (a) In addition to tolerances defined in CSA A23.1 and CSA S6, concrete wall surfaces shall be constructed within tolerances required for application of the selected tiling system. Coordinate tolerance requirements with the tiling Contractor and be responsible for preparing a substrate that is suitable for tiling installation. Refer to E32 for Tiling plane tolerances.

E25.4.4 General Curing

- (a) The use of curing compound will not be allowed on concrete areas that are to receive additional concrete or waterproofing or tiling.
- (b) Unformed concrete surfaces and areas to receive additional concrete, waterproofing, or tiling shall be covered and kept moist by means of wet polyester blankets and 6 mil polyethylene for seven (7) consecutive days immediately following finishing operations or as otherwise approved by the Contract Administrator and shall be maintained at or above 10°C for at least fourteen (14) days after placement.
- (c) In lieu of curing blankets on formed surfaces, the forms may be kept on for up to 7 days provided that water is allowed to fully enter the space between the form and the concrete especially if the forms are slightly loosened in that period.
- (d) Exercise care to ensure that the polyester curing blanket is well drained and placed as soon as the surface will support it without deformation. Ensure that water from the polyester curing blankets does not run into areas where concrete placement and finishing operations are underway. If this occurs, concrete placement shall stop until the problem is corrected to satisfaction of the Contract Administrator.
- (e) If permitted for use, curing compounds shall be applied uniformly and by roller. Spraying of the compound will not be permitted.
- (f) Protect concrete from the harmful effects of sunshine, drying winds, surface dripping, running water, vibration and mechanical shock. Protect concrete from freezing until at least twenty-four hours after the end of the curing period.
- (g) Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3° in any one hour period or 20° in any twenty-four hour period.

E25.4.5 Placing Concrete

- (a) Notify the Contract Administrator at least twenty-four (24) hours prior to concrete placement so that an adequate inspection may be made of formwork, shoring, reinforcement and related works. Placement without required prior notification will not be allowed.
- (b) Equipment for mixing or conveying concrete shall be thoroughly flushed with clean water before and after each pour. Water used for this purpose shall be discharged outside the forms.
- (c) Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent segregation and a marked change in consistency.
- (d) Before depositing any concrete, all debris shall be removed from the space to be occupied by the concrete and any mortar splashed upon the reinforcement or forms shall be removed.
- (e) Placing of concrete shall be continuous. No concrete shall be placed against concrete that has sufficiently hardened to cause the formation of seams or "cold joints" within the section. If placing must be interrupted, construction joints shall be located where shown on the Drawings or as otherwise approved by the Contract Administrator.
- (f) Concrete shall be placed as near as possible to its final position. Rakes or mechanical vibrators shall not be used to transport concrete.

- (g) The maximum drop of free concrete into the forms shall not be greater than 1.5 m. Use rubber tubes or pouring ports spaced not more than 1.5 m vertically and 2.5 m horizontally to meet this requirement.
- (h) Concrete shall be consolidated by mechanical vibrators during and immediately after deposition so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into the corners of the forms; eliminating all air or stone pockets that may cause honeycombing, pitting or planes of weakness.
- (i) Vibrators shall be inserted systematically into the concrete at intervals such that the zones of influence of the vibrator overlap (generally 300 to 900 mm). Apply the vibrator at any point until the concrete is sufficiently compacted (5 to 15 seconds) but not long enough for segregation to occur. Maintain spare vibrators in working condition available on the Site during all placing operations.
- (j) Do not place concrete in rain or snow unless adequate protection is provided for formwork and concrete surfaces.

E25.4.6 Finishing of Unformed Surfaces

- (a) Screed unformed concrete surfaces by the sawing movement of a straight edge along wood or metal strips or form edges that have been accurately set at required elevations.
- (b) Screed all concrete surfaces as a first step in other finishing operations. Complete screeding immediately after the concrete has been vibrated.
- (c) After screeding, do not work the concrete further until ready for floating. Floating shall begin when the water sheen has disappeared. The surface shall then be consolidated with hand floats. Concrete surfaces after floating shall have a uniform, smooth, granular texture.

E25.4.7 Form Removal

- (a) Forms shall remain in place for a minimum of seven (7) days unless otherwise accepted by the Contract Administrator. Notify the Contract Administrator at least twenty-four (24) hours prior to any form removal and obtain approval prior to removing forms.
- (b) Forms shall remain in place until the concrete has reached a minimum strength of 25 MPa.
- (c) Field-cured test specimens that are representative of the in-place concrete being stripped shall be tested to verify the concrete strength before forms are stripped.

E25.4.8 Patching of Formed Surfaces

- (a) Immediately after forms have been removed, but before any repairing or surface finishing is started, the concrete surface shall be inspected by the Contract Administrator. Any repair or surface finishing started before this inspection may be rejected and required to be removed.
- (b) All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back fifty (50) mm from the surface before patching.
- (c) Minor surface defects caused by honeycomb, air pockets greater than 5 mm in diameter, voids left by strutting and tie holes shall be repaired by removing the defective concrete to sound concrete, dampening the area to be patched and then applying patching mortar. A slurry grout consisting of water and cement shall be thoroughly brushed onto the area to be patched. When the slurry grout begins to lose the water sheen, the patching mortar shall be applied. It shall be struck-off slightly higher than the adjacent surface and left for one hour before final finishing to permit initial shrinkage of the patching mortar and it shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification and the final colour shall match the surrounding concrete.

- (d) Remove all fins, projections, offsets, streaks and other surface imperfections by approved means and to the Contract Administrator's satisfaction. Cement washes of any kind shall not be used.
- (e) Concrete shall be cast against forms that will produce plane surfaces with no bulges, indentations, or protuberances other than those shown on the Drawings. The number of panel joints shall be kept to a minimum. Panels containing worn edges, patches, or other defects that will impair the texture of concrete surfaces shall not be used.

E25.4.9 Hot Weather Concreting

- (a) The requirements of this section shall be applied during hot weather, i.e. when air temperatures are above 25°C during placing.
- (b) Aggregate stockpiles may be cooled by water sprays and sun shades.
- (c) Ice may be substituted for a portion of the mixing water, providing it has melted by the time mixing is completed.
- (d) Form and conveying equipment shall be kept as cool as possible before concreting by shading them from the sun, painting their surfaces white and/or the use of water sprays.
- (e) Sun shades and wind breaks shall be used as required during placing and finishing.
- (f) Plan the Work so that concrete can be placed as quickly as possible to eliminate the possibility of cold joints from occurring at any location.
- (g) Curing shall follow immediately after the finishing operation.
- (h) When the air temperature is at or above 25°C, or when there is probability of its rising to 25°C during the placing period, facilities shall be provided for protection of the concrete in place from the effects of hot and/or drying weather conditions. Under severe drying conditions (as defined below) the formwork, reinforcement and concreting equipment shall be protected from the direct rays of the sun or cooled by fogging and evaporation.
- (i) The temperature of the concrete as placed shall be as low as practicable and in no case greater than that shown below for the indicated size of the concrete section:

Thickness of Section, mm	Temperature, °C	
	Minimum	Maximum
< 300	10	27
300 – 1000	10	27
>1000	5	25

- (j) Moderate Drying Conditions:
 - (i) When surface moisture evaporation exceeds 0.75 kg/m²/h, windbreaks shall be erected around the sides of the structural element.
- (k) Severe Drying Conditions:
 - (i) When surface moisture evaporation exceeds 1.0 kg/m²/h, additional measures shall be taken to prevent rapid loss of moisture from the surface of the concrete. Such additional measures shall consist of the following:
 - ◆ Erecting sunshades over the concrete during finishing and placing operations.
 - ◆ Lowering the concrete temperature.
 - ◆ Applying fog spray immediately after placement and before finishing. Care shall be taken to prevent accumulation of water that may reduce the quality of the cement paste.
 - ◆ Beginning the concrete curing immediately after trowelling.

- (l) The nomograph contained in Figure D1 of Appendix D to CSA A23.1 shall be used to estimate surface moisture evaporation rates.

E25.4.10 Cold Weather Concreting

- (a) The requirements of this section shall be applied to all concreting operations during cold weather; i.e. if the temperature is expected to fall below 5°C at any time during placing or curing.
- (b) Supplementary equipment as listed below shall be at the Site if concrete is likely to be placed in cold weather.
- (c) Formwork and reinforcing steel shall be heated to at least 5°C before concrete is placed.
- (d) The temperature of the concrete shall be maintained at not less than 10°C for seven days, 15°C for five days or 20°C for three days after placing. In addition, the concrete shall be kept above freezing for at least seven days and until the concrete has reached 75% of the specified 28-day compressive strength (as determined from compressive strength tests for specimens secured under the same conditions as the concrete works in question).
- (e) The temperature of the concrete at the time of placement shall be within the range specified in CSA Standard A23.1 for the thickness of the section being placed.
- (f) Aggregates may be heated to a temperature of no more than 55°C. Water may be heated to a temperature of no more than 65°C.
- (g) When the mean daily temperature may fall below 5°C, complete hoarding of the Work together with supplementary heat shall be provided.
- (h) When the ambient temperature is below -15°C, the hoarding shall be constructed so as to allow the concrete to be placed without the hoarding having to be opened. If the mixing is done outside of the hoarding, the concrete shall be placed by means of hoppers installed through the hoarding. The hoppers shall be plugged when not in use.
- (i) When the ambient temperature is at or above -15°C, the Contractor will be permitted to open small portions of the hoarding for a limited time to facilitate the placing of the concrete.
- (j) Before depositing any concrete, demonstrate that enough heating equipment is available to keep the air temperature surrounding the forms within the specified range. This shall be accomplished by bringing the temperature inside of the hoarding to the specified 20°C at least 12 hours prior to the start of the concrete placing.
- (k) Supply all required heating apparatus and the necessary fuel. When dry heat is used, a means of maintaining atmospheric moisture shall be provided. The relative humidity within the heated enclosure shall be maintained at a minimum of 40 percent during concrete placing and finishing operations. Following finishing operations, exposed concrete surfaces shall be protected from excessive drying by applying curing compound, covering the surfaces with polyethylene, or providing water curing.
- (l) Sufficient standby heating equipment must be available to allow for any sudden drop in outside temperatures and any breakdowns that may occur in the equipment.
- (m) Combustion-type heaters may be used if their exhaust gases are vented outside the enclosures and not allowed to come into contact with concrete surfaces. Fire extinguishers must be readily at hand wherever combustion-type heaters are used.
- (n) Maintain a curing record of each concrete pour. The curing record shall include: date and location of the pour, mean daily temperature, hoarding relative humidity, temperatures above and below the concrete surface at several points, and notes regarding the type of heating, enclosure, unusual weather conditions, etc. These records shall be available for inspection by the Contract Administrator daily.

E25.4.11 Construction Joints

- (a) Construction joints shall be located only where shown on the Drawings or as otherwise approved in writing by the Contract Administrator. Construction joints shall be at right angles to the direction of the main reinforcing steel. All reinforcing steel shall be continuous across the joints. Bevelled shear keys, as shown on the Drawings or approved by the Contract Administrator, shall be provided at all joints.
- (b) The face of joints shall be cleaned of all laitance and dirt after which cementitious grout or an approved bonding agent shall be applied. Forms shall be retightened, and all reinforcing steel shall be thoroughly cleaned at the joint prior to concreting.

E25.4.12 Waterproofing Membrane

- (a) Perform all of the operations involved in waterproofing in sequential order, such that there are no delays between individual operations except those necessary to meet the requirements of these specifications.
- (b) Give the Contract Administrator forty-eight (48) hours notice prior to commencing any waterproofing operations.
- (c) Concrete to be waterproofed shall be completely surface dry and cured at least 14 days before application waterproofing can commence.
- (d) Completely sandblast or shotblast the existing surface of the concrete to expose sound, laitance-free concrete. Remove all dirt and debris leaving a prepared surface satisfactory for waterproofing. Do not commence waterproofing until the Contract Administrator has accepted all preparation work.
- (e) Immediately prior to the waterproofing application, air blast the concrete surface to remove all dust and any other foreign material.
- (f) Pay special attention to waterproofing over construction joints, cracks and grouted openings. Butyl rubber membrane material wide enough to extend 150 mm on either side of the joint or crack shall be fixed in place over all cracks, construction joints and grouted openings prior to waterproofing application.
- (g) Provide rubber membrane reinforcement at corners and at laps between membrane sections placed at different times as shown on the Drawings.
- (h) Install the selected membrane system in strict accordance with the manufacturer's recommendations.
- (i) Require a representative from the manufacturer to attend the Site at time of initial waterproofing application. The manufacturer's representative shall certify in writing to the Contract Administrator that the surface preparation and installation methods being followed are acceptable.

E25.4.13 Clean Up

- (a) Maintain the Sites of Work in a tidy condition and free from the accumulation of waste and debris.

E25.5 Quality Control

E25.5.1 Inspection

- (a) All workmanship and materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator, including all operations, from the selection and production of the Work, through to final acceptance of the specified Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works which are not in accordance with the requirements of this Specification.

E25.5.2 Access

- (a) The Contract Administrator shall be afforded full access for the inspection and control of testing of concrete and constituent materials, both at the Site of Work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification.

E25.5.3 Materials

- (a) All materials supplied under this Specification shall be subject to testing and approval by the Contract Administrator.

E25.5.4 Concrete Quality

- (a) Quality control tests will be used to determine the acceptability of the concrete supplied by the Contractor.
- (b) The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for quality control tests and provide such assistance and use of tools and construction equipment as is required.
- (c) The frequency and number of concrete quality control tests will be in accordance with the requirements of CSA Standard CAN/CSA-A23.1.
- (d) Compressive strength tests on specimens cured under the same conditions as the concrete works will be made to check the strength of the in-place concrete and the adequacy of curing. Backfilling or subsequent concreting operations will not be allowed until the in-place concrete has achieved a compressive strength of 25 MPa.

E25.5.5 Corrective Action

- (a) If the results of the tests indicate that the concrete is not of the specified quality, the Contract Administrator shall have the right to implement additional testing, as required, to further evaluate the concrete at the Contractor's expense.
- (b) The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Contract Administrator.

E25.6 Measurement and Payment

E25.6.1 Structural Concrete

- (a) The Structural Concrete will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for the "Structural Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E26. SUBDRAIN SYSTEMS

E26.1 Description

E26.1.1 This Specification shall cover the supply and installation of the subdrain pipe and wall drain systems located along the tunnel substructure and retaining walls.

E26.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of the superintendence, overhead, Labour materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

E26.2 Material

E26.2.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in the Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

E26.2.2 Drain Pipes, Fittings, and Accessories

- (a) Drain pipes, fittings, and other accessories and appurtenances for the tunnel substructure drain pipe system, shall conform to the requirements of the City of Winnipeg Standard Construction Specification CW 3610 and requirements of the latest revision of CSA G401.93, for Corrugated Steel Pipe (CSP). Corrugated steel pipe shall be perforated aluminized Type 2, 1.6 mm gauge, diameter as shown on the Contract Drawings.
- (b) All other drain pipes, fittings, and other accessories and appurtenances shall conform to the requirement of Standard Construction Specification CW 2310 and CW 2131.

E26.2.3 Filter Fabric

- (a) Filter fabric shall either Mirafi P600X Woven by Dominion Textile Inc. or Typar Style 3607 by Dupont Company or equal as accepted by the Contract Administrator, and shall conform to the requirements of Standard Construction Specification CW 3616.

E26.2.4 Wall Drain

- (a) Wall Drain shall be Miradrain 6000 by Mirafi, Nilex DN50 or equal as accepted by the Contract Administrator. Mastic adhesive shall be as recommended by the wall drain manufacturer.

E26.2.5 Prefabricated Drainage Composites

- (a) Prefabricated drainage composites shall be Miradrain 6000 complete with filter fabric by Mirafi or equal as accepted by the Contract Administrator. Mastic adhesive shall be as recommended by the prefabricated drainage composite manufacturer.

E26.3 Equipment

- E26.3.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E26.4 Construction Methods

E26.4.1 Subdrain Piping System

- (a) Install a perforated drain pipe system along both the tunnel walls and behind retaining walls. The supply and installation of this drain pipe system shall include the drain pipe, all required fittings, drain pipe backfill materials, and the filter fabric.
- (b) The drain pipe shall be laid to the line and grade shown on the Contract Drawings or as directed by the Contract Administrator with the separate sections securely jointed together by means of tightly drawn coupling bands. Drain pipe of the round or elongated type shall have the outside laps of circumferential joints in each pipe section of the upstream end and longitudinal lap seams at the sides of the pipe.

E26.4.2 Wall Drain System

- (a) Install a wall drain system to the vertical surface of the tunnel side walls and retaining walls. This involves the installation of the prefabricated drainage composite to the vertical surfaces.

E26.5 Measurement and Payment

E26.5.3 Subdrain Systems

- (a) The Subdrain Systems will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for the "Structural Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E27. BACKFILL

E27.1 Description

- E27.1.1 This Specification shall cover all operations related to supply, placement and compaction of backfill materials as herein specified.
- E27.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all works as hereinafter specified.
- E27.1.3 The backfill works included in this Specification includes all necessary backfill not included in other sections of the Works. For purposes of this Contract, backfill includes fill.

E27.2 Materials

E27.2.1 General

- (a) Be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E27.2.2 Suitable Site Backfill

- (a) Suitable Site backfill material shall be of a type approved by the Contract Administrator.

E27.2.3 Granular Backfill

- (a) Granular backfill material shall be sound, free from organic material, and meet the following gradation requirements:

Canadian Metric Sieve Size	Percent Total Dry Weight Passing
50,000	100%
20,000	75%-100%
5,000	45%-85%
2,500	35%-55%
315	15%-35%
160	5%-20%
80	0%-7%

- (b) In lieu of the above granular backfill, crushed limestone of 50 mm maximum aggregate size conforming to CW 3110-R10 may be used.

E27.2.4 Crushed Limestone Base Course Material

- (a) Crushed limestone base course material shall be supplied in accordance with City of Winnipeg Specification CW 3110-R10, maximum 20 mm size.

E27.2.5 Free Draining Granular Backfill Material

- (a) Free draining granular backfill shall consist of hard crushed stone, free from organic material meeting the following gradation requirements:

Canadian Metric Sieve Size	Percent Total Dry Weight Passing
40,000	95%-100%
20,000	35%-70%
10,000	10%-30%
5,000	0%-5%

- (b) In addition to the above granular material, the drainage material specified in Section 5.2 of CW 3120 may also be used.

E27.2.6 Clay Borrow Material

- (a) Clay borrow material shall be of a type approved by the Contract Administrator.

E27.3 Construction Methods

E27.3.1 Clay Seal

- (a) Material used for the construction of the clay seals shall be highly plastic clay (exhibiting putty-like properties with considerable strength when dry). Material with very high swelling potential such as bentonite clays will not be permitted.
- (b) Contract Administrator is to inspect Clay Seal prior to backfilling.
- (c) When the proposed material characteristics for the clay seals are in question, the Contract Administrator may require the Contractor to classify the material using Test Method ASTM D2487 – Classification of Soils for Engineering Purposes.
- (d) Material shall be a minimum Plasticity Index of 40.

E27.3.2 Structure Backfill

- (a) All backfill within the CN right-of-way is to be unfrozen free draining granular backfill placed on unfrozen base. Outside of the CN right of way, granular backfill only shall also be used within the specific limits shown on the Drawings. Other backfill may be used outside of the areas designated as granular. Place the backfill in accordance with the preparation of sub-base in Specification CW3110-R10, in layers not exceeding 150 mm in compacted thickness and to 95% and 98% Maximum Standard Proctor Density as specified on the Contract Drawings.
- (b) Place the backfill to elevations as shown on the Drawings.

E27.4 Measurement and Payment

E27.4.1 Backfill

- (a) The Backfill will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for “Structural Works”, performed in accordance with this Specification and accepted by the Contract Administrator.

E28. STRUCTURAL STEEL

E28.1 Description

E28.1.2 This Specification covers all operations related to the supply and installation of structural steel in accordance with this Specification and as shown on the Drawings.

E28.1.3 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all works as hereinafter specified.

E28.2 Materials

E28.2.1 Fabricators

- (a) Fabricators must have extensive demonstrated experience in producing similar structural steel and shall be fully approved by the Canadian Welding Bureau (CWB) in accordance with Division 1 of CSA Standard W47.1.

E28.2.2 Structural Steel

- (a) Structural steel shall be in accordance with CSA G40.21 Grade 350W. Provide certified mill test reports for all material.

E28.2.3 Fasteners

- (a) Bolts shall be galvanized and shall be in accordance with ASTM A325.
- (b) Stud shear connectors shall conform to the chemical requirements of ASTM Standard A 108, Grades 1015, 1018 or 1020. In addition they shall meet the mechanical properties specified in AWS D1.5, Table 7.1 for Type B studs. Provide certified mill test reports for the stud material.

E28.2.4 Hot-Dip Galvanizing

- (a) Structural steel under this Specification shall be hot-dip galvanized.
- (b) Hot-dip galvanizing shall be in accordance with CSA G164 for a minimum net retention of 600 g/m².

E28.2.5 Galvanizing Touch-up and Field-Applied Galvanizing

- (a) Field-applied galvanizing, to touch-up damaged hot-dip galvanizing on-site and to galvanize field welds, shall be done with self-fluxing, low temperature, zinc-based alloy rods in accordance with ASTM A780 "Repair of Damaged Hot-Dip Galvanized Coatings."
 - (i) Galvalloy by Metalloy Products Company, Welco Gal-Viz Galvanizing Alloy by Thermocote Welco or approved equal in accordance with B6.

E28.3 Construction Methods

E28.3.1 Shop Drawings

- (a) Submit Shop Drawings showing full details of all steel fabrications.

E28.3.2 Fabrication

- (a) All fabrication shall be carried out in accordance with this Specification, Contract Drawings, and approved Shop Drawings.
- (b) The punching of identification marks on the members will not be allowed.
- (c) Any damage to members during fabrication shall be drawn to the attention of the Contract Administrator in order that the Contract Administrator may approve remedial measures.
- (d) Dimensions and fabrication details that control the field matching of parts shall receive very careful attention in order to avoid field adjustment.
- (e) All portions of the Work shall be neatly finished. Shearing, cutting, clipping, and machining shall be done neatly and accurately. Finished members shall be true to line, free from twists, bends, sharp corners, and edges.
- (f) Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting.
- (g) All holes shall be provided by drilling not burning. All holes shall be free of burrs and rough edges. All welds shall be minimum 6 mm all around fillet welds unless noted otherwise on the Drawings. All welds shall be ground smooth prior to hot-dip galvanizing.

- (h) All vertical and horizontal edges of fabricated items shall be ground to 6 mm radius.

E28.3.3 Welding

- (a) Welding shall be in accordance with CSA W59, "Welded Steel Construction." All seams shall be continuously welded and free from any slag or splatter. All seam welds shall be ground smooth and flush with the adjacent surface prior to hot-dip galvanizing or field galvanizing touch-up.
- (b) Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal. The low hydrogen covering and flux shall be protected and stored as specified by AWS Standard D1.5. Flux cored welding or use of cored filler wires in the submerged arc process or shielding gas process are not considered as conforming to low hydrogen practice and will not be permitted.
- (c) Submerged Arc Welding (SAW) is allowed for all flat and horizontal position welds. All flange and web butt joints shall be made by an approved semi or fully automatic submerged arc process. All web to flange fillet welds shall be made by an approved fully automatic submerged arc process.
- (d) Shielded Metal Arc Welding (SMAW) is allowed for girder vertical stiffener to flange fillet welds and for other miscellaneous components not listed above.
- (e) Metal Core Arc Welding (MCAW) process utilizing low hydrogen consumables with AWS designation of H4 is allowed for vertical stiffeners and for other miscellaneous components not listed above.
- (f) Field application of metal core arc welding is not allowed.
- (g) Weld areas must be clean, free of mill scale, dirt, grease, and other contaminants prior to welding.
- (h) Tack and temporary welds will not be allowed unless they are to be incorporated in the final weld.
- (i) Tack welds, where allowed, shall be of a minimum length of four times the nominal size of the weld and length shall not exceed 15 times the weld size, and shall be subject to the same quality requirements as the final welds. Cracked tack welds shall be completely removed prior to welding over.
- (j) Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. They shall be tack welded only to that portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs are to be removed by flame cutting, not by breaking off.

E28.3.4 Surface Preparation and Cleaning

- (a) Surface preparation and cleaning of materials prior to hot-dip galvanizing shall be in accordance with CSA G164 and SSPC Specification SP6, "Commercial Blast Cleaning." All welding and provision of holes is to be completed prior to surface preparation and cleaning, except where shown on the Drawings.
- (b) The sandblasting and cleaning shall be done in the shop.
- (c) After the fabricated materials have been sandblasted and cleaned, the Contract Administrator will carry out a visual inspection of the materials in the shop before they are shipped to the galvanizing plant.

E28.3.5 Hot-Dip Galvanizing

- (a) The hot-dip galvanizing plant shall be a Regular Member of the American Galvanizers Association Inc. and certified to CSA G164.
- (b) Adequate venting and drainage holes shall be provided in enclosed sections for hot-dip galvanizing. The galvanizing facility shall be consulted regarding the size and location of these holes. Holes shall be provided by drilling not burning.

- (c) The galvanizing coating on the outside surfaces of all steel items shall be smooth and free of blisters, lumpiness, and runs.
- (d) Minor defects in the galvanizing coating shall be repaired by field touch-up galvanizing in accordance with this Specification. The Contract Administrator shall be consulted before repairs are made. Use of cold applied spray-on galvanizing will not be permitted and will be cause for rejection.
- (e) Other defects and contaminants in the galvanizing coating, such as heavy dross protrusions, flux inclusions, and ash inclusions shall be grounds for rejection of the galvanizing coating system.
- (f) Verify the thickness of galvanized coatings and provide documentation of this verification to the Contract Administrator.
- (g) Store items on timber blocking after hot-dip galvanizing.

E28.3.6 Field-Applied Touch-up Galvanizing.

- (a) Any areas of damaged galvanizing on miscellaneous steel items shall receive field-applied touch-up galvanizing.
- (b) Surfaces to receive touch-up galvanizing shall be cleaned using a wire brush, a light grinding action, or mild blasting to remove loose scale, rust, paint, grease, dirt, or other contaminants. Preheat the surface to 315°C and wire brush the surface during preheating. Rub the cleaned preheated area with the repair stick to deposit an evenly distributed layer of zinc alloy. Spread the alloy with a wire brush, spatula, or similar tool. Care shall be taken to not overheat surfaces beyond 400°C and to not apply direct flame to the alloy rods.

E28.3.7 Installation

- (a) The structural steel shall be carefully handled so that no parts will be bent, broken, or otherwise damaged. Hammering, which will injure or distort the member, is not permitted. Report to the Contract Administrator any failure of members to come properly together before taking any corrective measures.
- (b) Except where shown on the Drawings, field welding will not be permitted unless approved by the Contract Administrator.

E28.4 Measurement and Payment

E28.4.1 Structural Steel

- (a) The Structural Steel will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Structural Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E29. HYDRO EXCAVATION

E29.1 Description

E29.1.1 General

- (a) This specification shall cover the removal of earthen material immediately adjacent to underground utilities infrastructure by means of high pressure water spray, and the recovery of evacuated material by vacuum type means or equivalent method as approved by the Contract Administrator.

E29.2 Equipment

- E29.2.1** Hydro Excavation unit shall be capable of maintaining a minimum working pressure of 10,000 psi, at a rate of flow of 10 to 12 gallons per minute. Unit should be adjustable, so as to provide adequate pressure to remove earthen material identified by the Contract Administrator.

E29.2.2 Spray head shall be equipped with a rotating type nozzle, in order to provide a wider path of cut.

E29.3 Construction

E29.3.1 Hydro-Removal of Earthen Material

(a) Earthen material adjacent to utility entity shall be sprayed with high pressure water so as to remove all such material identified by the Contract Administrator.

E29.3.2 Recovery of Excavated Material

(a) The recovery of excavated material shall be done using vacuum type method, or other type method as approved by the Contract Administrator.

(b) The recovery of material shall follow immediately behind the excavation, to avoid excavated areas from filling with excavated material.

(c) The use of mechanical sweepers will not be allowed.

(d) Depose of material in accordance with Section 3.4 of CW-1130.

E29.3.3 Backfill of Hydro Excavated Hole

(a) The Contractor shall be responsible for the backfill of the hydro excavated hole upon completion of the Work described herein, to the approval of the Contract Administrator.

E29.4 Measurement and Payment

E29.4.1 Hydro Excavation

(a) Hydro Excavation of earthen material will be measured on an hourly basis and paid for the Contract Unit Price per hour for "Hydro Excavation". The hours to be paid for will be the total number of hours of Hydro Excavation in accordance with this specification, accepted and measured by the Contract Administrator. Travel to and from the Site will not be accounted for in the payment of this item.

E30. VERIFICATION OF WEIGHTS

E30.1 All Material which is paid for on a weight basis shall be weighed on a scale certified by Consumer & Corporate Affairs, Canada.

E30.1.1 All weight tickets shall have the gross weight and the time and date of weighing printed by an approved electro/mechanical printer coupled to the scale.

E30.1.2 The tare weight and net weight may either be hand written or machine printed. All weights, scales and procedures shall be subject to inspection and verification by the Contract Administrator. Such inspection and verification may include, but shall not be limited to:

(a) Checking Contractor's scales for Consumer & Corporate Affairs certification seals;

(b) Observing weighing procedures;

(c) Random checking of either gross or tare weights by having such trucks or truck/trailer(s) combinations as the Contract Administrator shall select weighed at the nearest available certified scale;

(d) Checking tare weights shown on delivery tickets against a current tare.

E30.2 The Contractor shall ensure that each truck or truck/trailer(s) combination delivering Material which is paid for on a weight basis carries a tare not more than one (1) month old.

E30.2.1 The tare shall be obtained by weighing the truck or truck/trailer(s) combination on a certified scale and shall show:

(a) Upon which scale the truck or truck/trailers(s) combination as weighed;

(b) The mechanically printed tare weight;

- (c) The license number(s) of the truck and trailer(s);
- (d) The time and date of weighing.

E31. REMOVAL AND REPLACEMENT OF EXISTING CHAIN LINK FENCE

E31.1 Description

E31.1.1 General

- (a) This specification covers the removal of existing chain fencing, and installation of chain link fencing as located on the Contract Drawings.
- (b) Reference Standard Construction Specifications CW 3550 – Chain Link Fencing.
- (c) All new materials as per CW 3550.

E31.2 Construction Methods

E31.2.1 General

- (a) New fence construction as per detail in Contract Drawings and as per CW 3550.

E31.2.2 Removal of Existing Chain Link Fencing

- (a) Remove existing chain link fencing and dispose off-site.
- (b) Remove any concrete piles/bases within 0.3 metres of the ground surface. Backfill holes with soil.

E31.3 Measurement and Payment

E31.3.1 Removal and Replacement of Existing Chain Link Fence

- (a) The Removal and Replacement of Existing Chain Link Fence will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for “Site Development and Restoration”, performed in accordance with this Specification and accepted by the Contract Administrator.

E32. REPLACEMENT OF EXISTING WOOD FENCE

E32.1 Description

E32.1.2 This specification shall cover:

- (a) The supply and installation of timber post and rail fencing as shown on the Contract Drawings and as specified herein including compacted granular foundation.

E32.2 Products

E32.2.1 Lumber identified by a grade stamp of an agent certified by the Canadian Lumber Accreditation Board.

E32.2.2 Pressure treated wood is to be guaranteed for 10 years against rot, decay, insect attack, splitting, warping, or breaking. Fences are to be guaranteed against defects in materials and workmanship for a period of 12 months from the date of Substantial Performance of the Contract. The Contractor is not responsible for acceptable wear through usage of acts of vandalism.

E32.2.3 All wood for fences shall be No. 2 or better wolmanized pressure treated pine, spruce or fir; no wane, bark, checking, or splitting permitted. Colour as specified.

E32.2.4 All hardware is as follows:

- (a) Nails, spikes, and screws are hot dipped galvanized, size indicated on drawings, or specified.
- (b) Bolts are galvanized, 12 mm in diameter unless otherwise specified, complete with nuts and washers.

- (c) Galvanizing shall be to CSA G164-M1981; use galvanized.
- (d) Joist hangers are a minimum 1.0 mm thick sheet steel galvanized coating.
- (e) Fasteners indicated on the Contract Drawings or as specified by the Contract Administrator (no substitutes).

E32.2.5 Wood preservative is surface applied wood preservative; coloured, or copper naphthenate or 5% pentoachlorophenol solution, water repellent preservative.

E32.2.6 Granular material to be crushed limestone, 10 mm diameter containing down size material with degree of fines.

E32.3 Construction Methods

E32.3.1 Timber Post and Rail Fence Installation

- (a) All workmanship and all materials furnished and supplied under this specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through the final acceptance of the specified Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or Work which are not in accordance with the requirements of this Specification.
- (b) The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Contract Administrator.
- (c) The contract Administrator shall be afforded full access for the inspection and control testing of materials, both at the Site and at any plant or borrow pit used for the supply of the materials to determine whether the material is being supplied in accordance with this specification.
- (d) All lumber shall be neatly cut for a proper fit. All cuts shall be treated with preservation before being secured.
- (e) Fences to be constructed to the lines, grades, and specifications as shown in the Contract Drawings or as specified herein. Establish final grades and elevations for fences after regarding of Site. In the event that asphalt paving is to be carried on in the location of the fencing, the paving shall precede the fence construction.
- (f) The Contractor shall stake out the post locations as located on the Contract Drawings. Prior to drilling holes, all underground services shall be protected. Fence support posts shall be set true in line and elevations.
- (g) Factory treated end of post shall always be placed down in excavated hole prior to backfilling, under no circumstance shall a cut end of a post be placed down into and excavated hole. Treat all cuts or cut tops with preservative prior to any other lumber being secured to the post. Install posts plumb and level to the lines and grades required by the Work. Nail outside rails to posts. Secure all pickets to the rails. After all pickets are installed, install inside rails between posts and finish by installing cap over fence top.
- (h) Backfill hole excavations with crushed limestone, compacting the material by tamping with a blunt pole or rod. Material shall be compacted in layers not exceeding 150 mm. Top of fill to be overfilled so that the fill has convex appearance, sloping away from the post.
- (i) All wood shall be even and neat and shall provide a solid finished product suitable for the purposes intended.
- (j) Install spanning members with crown edge up.
- (k) Treat all cut, trimmed, or drilled with liberal application of preservative before installation. Apply preservative by dipping or by brushing to completely saturate and maintain wet film on surface minimum of 3 minute soak.

E32.4 Measurement and Payment

E32.4.2 Wood Fence

- (a) The Wood Fence will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Site Development and Restoration", performed in accordance with this Specification and accepted by the Contract Administrator.

E33. CHAIN LINK FENCING

E33.1 Description

- E33.1.1 The Work covered under this item shall include all operations relating to supply and installation of new chain link fencing on the tunnel structure and as specified herein.
- E33.1.2 The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of the Work as hereinafter specified.

E33.2 Materials

E33.2.1 Base Plate and Anchors

- (a) The base plate shall be fabricated and installed in accordance with the details provided on the Drawings. The base plate shall be hot-dip galvanized.
- (b) Either cast-in-place anchor bolts or drilled anchors may be used.
- (c) Anchor bolts shall be fabricated from steel with a minimum yield stress of 350 MPa. Bolts shall be galvanized in accordance with CSA Standard G164. Supply anchor bolts complete with nuts and washers.
- (d) Anchors shall be Hilti HVU adhesive anchors c/w stainless steel threaded HAS rods, nuts and washers.

E33.2.2 Chain Link Fence

- (a) Chain link fencing to be supplied in accordance with CW 3550-R2
- (b) Further to CW 3550-R2, 43 O.D. bottom rails shall be used.
- (c) Further to CW 3550-R2, 43 O.D. mid rails shall be required if Chain Link Fence is 1.8m or taller.

E33.3 Construction Methods

E33.3.1 Shop Drawings

- (a) Submit shop drawings showing the arrangement and details of all fencing. Posts shall be spaced uniformly at spacing as required by design, but not to exceed 2.4 meters.

E33.3.2 Base Plates and Anchors

- (a) Install anchors in accordance with Manufacturer's specifications.
- (b) Mount fence posts on shims and ensure correct vertical alignment.
- (c) Grout below base plates as shown on the Drawings.

E33.3.3 Chain Link Fence

- (a) Install new chain link fence to the limits shown on the Drawings in accordance with CW 3550-R2.

E33.4 Measurement and Payment

E33.4.1 Chain Link Fencing

- (a) The Chain Link Fencing will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Architectural Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E34. TILE

E34.1 Description

- E34.1.1 This specification covers the supply and installation of porcelain tile on concrete walls including custom water jet cut logos.

E34.2 Shop Drawings

- E34.2.1 Submit shop drawings showing details of all tile installation Work including location of all expansion and control joints, logos, tile colour arrangement, wall construction joints and other construction details.

E34.3 Materials

- E34.3.1 Porcelain tile to be Casalgrande Padana as supplied by Julian Tile , contact Wendy Scott (204) 632-8453, in the following styles, colours and sizes

- (a) Unicolore, Granitogres -Nero 30x30
- (b) Unicolore, Granitogres -Violet 20x20
- (c) Unicolore, Granitogres -Violet 30x30
- (d) Unicolore, Granitogres - Blu Forte 20x20
- (e) Unicolore, Granitogres - Blu Forte 30x30
- (f) Unicolore, Granitogres - Bianco Assoluto 20x20
- (g) Unicolore, Granitogres - Bianco Assoluto 30x30
- (h) Caleidoscopio, Monopadana - Rosso Selenio 20x20
- (i) Caleidoscopio, Monopadana - Rosso Selenio 30x30
- (j) 3mm thick Heogin Stainless Steel Straight Edger Trim, depth to match grout and tile. The Contractor is to supply a sample for approval by the Contract Administrator.

- E34.3.2 Tile setting mortar shall be either Kerabond / Keralastic System or Granirapid System, both manufactured by Mapei Inc.

- E34.3.3 Grout shall be white Kerapoxy as manufactured by Mapei Inc.

- E34.3.4 Contractor to supply tile for complete wall, including area to be installed by others. Deliver tile for bottom row of tiling to City of Winnipeg as per E34.3.5.

- E34.3.5 The Contractor is to supply an additional 1% by area of each type of tile for future maintenance to the City of Winnipeg. Tile to be packaged, labelled, delivered, and off-loaded to The City of Winnipeg Bridge Yard. Contact the Contract Administrator prior to delivery to ensure storage location is prepared for product.

E34.4 Construction Methods

E34.4.1 Preparation

- (a) Prepare surface as per mortar manufacturer's specifications. As a minimum, lightly sandblast the concrete surface to remove laitance or form release agent.
- (b) Surface preparation is to include the area of the bottom course of tile that is to be done under a subsequent contract.

E34.4.2 Tile Installation

- (a) Concrete shall be at least 28 days of age and have a surface measured moisture content of less than 5% before tile installation can start. Confirm moisture content through non-destructive testing at a maximum spacing of 5 meters in each direction. Submit test results to the Contract Administrator for review at least five (5) days prior to start of work. Plane tolerances of wall to be $\pm 6\text{mm}$ in 3m.
- (b) Maintain minimum 5 degrees Celsius ambient and substrate temperature. Do not install in freezing temperatures. Cover and protect if temperatures drop below 5 degrees Celsius.
- (c) Set out overall pattern of tile ensuring colour scheme is consistent with design drawings.
- (d) Determine location of all water jet cut logos. Contract Administrator to approve location of logos prior to start of tile installation.
- (e) Determine location of horizontal and vertical movement and control joints.
- (f) Cut tiles as required to fit pattern.
- (g) Cut edges of tiles are not to be exposed on edges of tile area.
- (h) Ensure tiles are square and plumb to layout.
- (i) Grout lines to be approximately 3mm (1/8") wide.
- (j) Mix and apply mortar as per manufacturer's specifications to achieve minimum 95% mortar to wall contact. Do not spread more mortar than can be covered before the mortar begins to set.
- (k) Back butter and set tiles firmly into mortar to ensure minimum 95% tile to mortar contact and a flush surface across tiles.
- (l) Install movement joints to meet the most current Terrazzo, Tile and Marble Association of Canada (TTMAC) guide.
- (m) Do not cover any substrate expansion or control joints with mortar or tiles.
- (n) Protect tile Work with Heogin Stainless Steel Straight Edger Trim along both edges of wall expansion joints.
- (o) Joint widths shall match the joint widths in the Concrete substrate.

E34.4.3 Logos

- (a) Water jet cut logos to be cut off-site at an approved facility. Logo design will be provided in CAD format by Contract Administrator. Completed logo to be inspected at cutting facility prior to transport to Site and prior to fabrication of remaining logos. Notify the Contract Administrator when the first logo is complete and ready for inspection. Allow five (5) Business Days for inspection.
- (b) Transport logos to Site as a unit.

E34.4.4 Grouting

- (a) Grout tiles as per grout manufacturer's specifications. Clean all tile surfaces after grouting.
- (b) Apply grout between tiles after allowing tiles to reach firm set.
- (c) Grout lines on the top of the retaining wall must be worked to slope down to the sides so that there will be no standing water on horizontal surfaces.

E34.5 Measurement and Payment

E34.5.1 Tile

- (a) The Tiling will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Architectural Works", performed in accordance with this Specification and accepted by the Contract Administrator.

E35. PAINTED TRAFFIC LINES AND MARKINGS

E35.1 Description

E35.1.1 This Specification covers the line painting of the parking stalls for:

- (a) MTS Call Centre Parking Lot.
- (b) Pembina Dodge Parking Lot.
- (c) Quintex Parking Lot.

E35.2 References

- (a) CGSB1-GP-12C-[68], Standard Paint Colours.
- (b) CGSB-GP-74M-[79], Paint, Traffic, Alkyd.CW.

E35.3 Materials

E35.3.1 Paint

- (a) To CGSB1-GP-74M, Alkyd Traffic Paint.
- (b) Colour – to CGSB1-GP-12C, Yellow 505-308.

E35.4 Construction Methods

E35.4.1 General

- (a) Line layout as detailed in Contract Drawings or as directed by the Contract Administrator.

E35.5 Equipment Requirements

E35.5.1 Paint applicator to be an approved pressure type mobile distributor capable of applying paint in single lines, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, to dimensions as indicated, and to have positive shut-off.

E35.6 Application

- (a) Pavement surface shall be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials.
- (b) Pavement markings shall be laid out by Contractor based on the Contract Drawings.
- (c) Unless otherwise approved by the Contract Administrator, apply paint only when air temperature is above 10°C, wind speed is less than 40km/h and no rain is forecast within the next 4 hours.
- (d) Apply traffic paint evenly at rate of 3m²/L.
- (e) Do not thin paint unless approved by the Contract Administrator.
- (f) Paint lines to be of uniform colour and density with sharp edges.
- (g) Protect pavement markings until dry.

E35.7 Measurement and Payment

E35.7.1 Painted Traffic Lines and Markings

- (a) The Painted Traffic Lines and Markings will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for “Site Development and Restoration”, performed in accordance with this Specification and accepted by the Contract Administrator.

E36. PAINTING OF TUNNEL CEILING

E36.1 Description

- E36.1.1 This Specification shall cover the supply and application of paint to all surfaces of the tunnel ceiling.
- E36.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory performance and completion of all Work hereinafter specified.
- E36.1.3 Submittals
- (a) Sample of each paint type applied to substrate for approval of colour.
 - (b) Provide product data on specified product, describing physical characteristics and maintenance instructions.

E36.2 Materials

E36.2.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

E36.2.2 Handling and Storage of Materials

- (a) All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with the requirements of the manufacturer.

E36.2.3 Paint Type

- (a) Concrete cleaner: Devoe Devprep 88 Heavy Duty Cleaner Cat. #788T0000.
- (b) Concrete primer / sealer: Rain Guard Surface-Seal II Clear Primer.
- (c) Concrete paint: Rain Guard Color-Lok High Performance Masonry Stain in white.
- (d) Stucco Paint: Decra-Flex 1130 Elastomeric Coating System, satin sheen in white.
- (e) Metal Primer: Devoe Devguard 4160 Alkyd Structural Primer in white.
- (f) Metal Paint: Devoe Devguard 4336DTM Urethane- Alkyd Semi-gloss Enamel in white.
- (g) Accessories and Application Equipment: As per manufacturer's specifications for each product.

E36.3 Construction Methods

E36.3.1 General

- (a) All Work shall be carried out by personnel skilled in this type of operation and all works shall be subject to acceptance by the Contract Administrator.
- (b) Mask all existing lighting and appurtenances identified by the Contract Administrator.
- (c) Painting to be done during appropriate weather conditions.
- (d) Contractor to clean concrete surface with concrete cleaner as per manufacturer's specifications.
- (e) Contractor to apply one coat of concrete primer / sealer over concrete.
- (f) Contractor to apply two coats of concrete paint over primer / sealer.
- (g) Contractor to apply one coat of metal primer to all metal surfaces following cleaning.
- (h) Contractor to apply two coats of metal paint over metal primer.

E36.3.2 Quality Control

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the Work. The Contractor shall be wholly responsible for the control of all operation incidental thereto notwithstanding any inspection or acceptance that may have been previously given.
- (b) The Contract Administrator reserves the right reject any materials or works, which are not in accordance with the requirements of this Specification.

E36.4 Measurement and Payment

E36.4.1 Painting of Tunnel Ceiling

- (a) The Painting will not be measured. This Item of Work will be paid for in the Contract Lump Sum Price for "Architectural Works", performed in accordance with this Specification and accepted by the Contract Administrator.