



THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 602-2018

EMPRESS STREET PROJECT, PAVEMENT RECONSTRUCTION, PORTAGE AVENUE TO ST. MATTHEWS AVENUE, EMPRESS OVERPASS REHABILITATION, ACCESSIBILITY RAMPS AND ASSOCIATED WORKS

Note to Bidders: Please be aware of revisions to B14.4

TABLE OF CONTENTS

PART A - BID SUBMISSION

Form A: Bid	1
Form B: Prices	4
Form G1: Bid Bond and Agreement to Bond	39
Form G2: Irrevocable Standby Letter of Credit and Undertaking	41

PART B - BIDDING PROCEDURES

B1. Contract Title	1
B2. Submission Deadline	1
B3. Enquiries	1
B4. Confidentiality	1
B5. Addenda	1
B6. Substitutes	2
B7. Bid Components	3
B8. Bid	3
B9. Prices	4
B10. Disclosure	4
B11. Conflict of Interest and Good Faith	5
B12. Qualification	6
B13. Bid Security	7
B14. Opening of Bids and Release of Information	8
B15. Irrevocable Bid	8
B16. Withdrawal of Bids	8
B17. Evaluation of Bids	9
B18. Award of Contract	9

PART C - GENERAL CONDITIONS

C0. General Conditions	1
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PART D - SUPPLEMENTAL CONDITIONS

General

D1. General Conditions	1
D2. Scope of Work	1
D3. Contract Administrator	4
D4. Contractor's Supervisor	4
D5. Ownership of Information, Confidentiality and Non Disclosure	4
D6. Notices	4
D7. Furnishing of Documents	5

Submissions

D8. Authority to Carry on Business	5
D9. Safe Work Plan	5
D10. Insurance	5
D11. Performance Security	6
D12. Subcontractor List	6
D13. Detailed Work Schedule	6

Schedule of Work

D14. Commencement	7
D15. Restricted Work Hours	7
D16. Work By Others	8
D17. Sequence of Work	8
D18. Critical Stages	9
D19. Substantial Performance	9
D20. Total Performance	9
D21. Liquidated Damages	9

D22. Scheduled Maintenance	10
Control of Work	
D23. Job Meetings	10
D24. Prime Contractor – The Workplace Safety and Health Act (Manitoba)	10
D25. The Workplace Safety and Health Act (Manitoba) – Qualifications	10
D26. Layout of Work	11
D27. Environmental Protection Plan	11
Measurement and Payment	
D28. Payment	18
Warranty	
D29. Warranty	19
Form H1: Performance Bond	20
Form H2: Irrevocable Standby Letter of Credit	22
Form J: Subcontractor List	24

PART E - SPECIFICATIONS

General	
E1. Applicable Specifications and Drawings	1
E2. Geotechnical and Structural Reports	7
E3. Office Facilities	7
E4. Contractor Parking	8
E5. Shop Drawings	8
E6. Protection Of Existing Trees	10
E7. Traffic Control	11
E8. Traffic Management	11
E9. Water Obtained From the City	12
E10. Surface Restorations	12
E11. Site Development	12
E12. Hydro-Excavation	14
E13. Conduit Installation	15
E14. Pre-Cast Concrete Traffic Barriers	16
E15. Remove and Salvage Existing Overhead Sign Structure	18
E16. Miscellaneous Removals	19
E17. Concrete Works	21
E18. Adjustment of Existing Manitoba Hydro Manholes	22
E19. Installation of Culverts	23
E20. Hydrant Relocation	25
E21. Green Bike Lane Treatment	25
E22. Construction of Rumble Strip	27
E23. Installation of Interlocking Paving Stones	27
E24. Supply and Install Rip Rap	28
E25. Rockfill Rib Construction	30
E26. Installation of Straw Wattles	33
E27. Erosion Control Blanket	34
E28. Installation of Silt Fence	37
E29. Tree Removal	38
E30. Crushed Granular and Concrete Rest Areas	39
E31. Site Furniture	41
E32. Tree and Shrub Planting	42
E33. Topsoil and Finish Grading	48
E34. Natural Seeding	51
E35. Salt Tolerant Grass Seeding	56
E36. Structural Excavation	57
E37. Structural Backfill	59
E38. Supplying and Placing Subsurface Drainage	61
E39. Turf Reinforcement Mat (TRM)	62
E40. Structural Concrete	66

E41. Self Compacting Concrete	90
E42. Supplying and Placing Reinforcing Steel	105
E43. Steel Strapping	110
E44. Supply, Fabrication and Erection Of Miscellaneous Metal	111
E45. Hot-Poured Rubberized Asphalt Waterproofing	120
E46. Riprap (Structural)	124
E47. Structural Removals	126
E48. Supply and Installation of Bearings	133
E49. Temporary Protection System	136
E50. Type 1 Anode - Distributed Galvanic Corrosion Control	138
E51. Type 2 Anode - Discrete Galvanic Protection System	141
E52. Drilling and Placing Dowels	144
E53. Self Consolidating Concrete Repairs	145
E54. Aluminum Pedestrian Handrail/Bicycle Rail	147
E55. Asphaltic Concrete Paving on Bridge	152
E56. Cellular Concrete Backfill	156
E57. Steel Bearing Piles	158
E58. Expansion Joints	162
E59. Rock-Socketed Caissons	170
E60. Precast Prestressed Concrete Slabs	174
E61. Modular Block Retaining Walls	188
E62. Slope Protection Paving	190
E63. Electrochemical Chloride Extraction (ECE)	192
E64. Penetrating Concrete Sealer	198

Appendix 'A' – Geotechnical Reports

Appendix 'B' – Empress Overpass Resistance Testing Report

Appendix 'C' – Property Acquisition Drawings

Appendix 'D' – Omand's Creek Hydraulic Report

Appendix 'E' – 1990 Bridge Rehabilitation Specifications

PART B - BIDDING PROCEDURES

B1. CONTRACT TITLE

- B1.1 Empress Street Project, Pavement Reconstruction, Portage Avenue to St. Matthews Avenue, Empress Overpass Rehabilitation, Accessibility Ramps and Associated Works

B2. SUBMISSION DEADLINE

- B2.1 The Submission Deadline is 12:00 noon Winnipeg time, October 12, 2018.
- 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. ENQUIRIES

- B3.1 All enquiries shall be directed to the Contract Administrator identified in D3.1.
- B3.2 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.
- B3.3 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.
- B3.4 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.
- B3.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B3 unless that response or interpretation is provided by the Contract Administrator in writing.

B4. CONFIDENTIALITY

- B4.1 Information provided to a Bidder by the City or acquired by a Bidder by way of further enquiries or through investigation is confidential. Such information shall not be used or disclosed in any way without the prior written authorization of the Contract Administrator. The use and disclosure of the confidential information shall not apply to information which:
- (a) was known to the Bidder before receipt hereof; or
 - (b) becomes publicly known other than through the Bidder; or
 - (c) is disclosed pursuant to the requirements of a governmental authority or judicial order.
- B4.2 The Bidder shall not make any statement of fact or opinion regarding any aspect of the Bid Opportunity to the media or any member of the public without the prior written authorization of the Contract Administrator.

B5. ADDENDA

- B5.1 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.

- B5.2 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.
- B5.3 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>
- B5.4 The Bidder is responsible for ensuring that he/she 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.
- B5.5 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.

B6. SUBSTITUTES

- B6.1 The Work is based on the Plant, Materials and methods specified in the Bid Opportunity.
- B6.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.
- B6.3 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.
- B6.4 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.
- B6.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his/her 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.
- B6.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, to the Bidder who requested approval of the substitute.
- B6.6.1 The Contract Administrator will issue an Addendum, disclosing the approved materials, equipment, methods and products to all potential Bidders. The Bidder requesting and obtaining the approval of a substitute shall be responsible for disseminating information regarding the approval to any person or persons he/she wishes to inform.
- B6.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.

- B6.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative may base his/her 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 B17.
- B6.9 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. BID COMPONENTS

- B7.1 The Bid shall consist of the following components:
- (a) Form A: Bid;
 - (b) Form B: Prices, hard copy;
 - (c) Bid Security
 - (i) Form G1: Bid Bond and Agreement to Bond, or
Form G2: Irrevocable Standby Letter of Credit and Undertaking, or
a certified cheque or draft;
- B7.2 Further to B7.1, the Bidder should include the written correspondence from the Contract Administrator approving a substitute in accordance with B6.
- B7.3 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.
- B7.4 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.
- B7.4.1 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.
- B7.4.2 A hard copy of Form B: Prices must be submitted with the Bid. If there is any discrepancy between the Adobe PDF version of Form B: Prices and the Microsoft Excel version of Form B: Prices, the PDF version shall take precedence.
- B7.5 Bidders are advised not to include any information/literature except as requested in accordance with B7.1.
- B7.6 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 B17.1(a).
- B7.7 Bids submitted by facsimile transmission (fax) or internet electronic mail (e-mail) will not be accepted.
- B7.8 Bids shall be submitted to:
- The City of Winnipeg
Corporate Finance Department
Materials Management Division
185 King Street, Main Floor
Winnipeg MB R3B 1J1

B8. BID

- B8.1 The Bidder shall complete Form A: Bid, making all required entries.

B8.2 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/her own name, his/her 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/her own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.

B8.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B8.2.

B8.3 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.

B8.4 Paragraph 13 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/her 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, shall be affixed;
- (d) if the Bidder is carrying on business under a name other than his/her 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.

B8.4.1 The name and official capacity of all individuals signing Form A: Bid should be printed below such signatures.

B8.5 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.

B9. PRICES

B9.1 The Bidder shall state a price in Canadian funds for each item of the Work identified on Form B: Prices.

B9.1.1 For the convenience of Bidders, and pursuant to B7.4.2 and B17.4.2, an electronic spreadsheet Form B: Prices in Microsoft Excel (.xls) format is available along with the Adobe PDF documents for this Bid Opportunity on the Bid Opportunities page at the Materials Management Division website at <http://www.winnipeg.ca/matmgt/>

B9.2 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.

B9.3 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.

B9.4 Payments to Non-Resident Contractors are subject to Non-Resident Withholding Tax pursuant to the Income Tax Act (Canada).

B10. DISCLOSURE

B10.1 Various Persons provided information or services with respect to this Work. In the City's opinion, this relationship or association does not create a conflict of interest because of this full

disclosure. Where applicable, additional material available as a result of contact with these Persons is listed below.

B10.2 The Persons are:

- (a) Borland Construction: discussed constructability of slope stabilization design;
- (b) Nelson River Construction: discussed constructability of slope stabilization design;
- (c) Vector Construction: discussed proposed galvanic corrosion control system.

B11. CONFLICT OF INTEREST AND GOOD FAITH

B11.1 Bidders, by responding to this Bid Opportunity, declare that no Conflict of Interest currently exists, or is reasonably expected to exist in the future.

B11.2 Conflict of Interest means any situation or circumstance where a Bidder or employee of the Bidder proposed for the Work has:

- (a) other commitments;
- (b) relationships;
- (c) financial interests; or
- (d) involvement in ongoing litigation;

that could or would be seen to:

- (i) exercise an improper influence over the objective, unbiased and impartial exercise of the independent judgment of the City with respect to the evaluation of Bids or award of the Contract; or
- (ii) compromise, impair or be incompatible with the effective performance of a Bidder's obligations under the Contract;
- (e) has contractual or other obligations to the City that could or would be seen to have been compromised or impaired as a result of its participation in the Bid Opportunity process or the Work; or
- (f) has knowledge of confidential information (other than confidential information disclosed by the City in the normal course of the Bid Opportunity process) of strategic and/or material relevance to the Bid Opportunity process or to the Work that is not available to other bidders and that could or would be seen to give that Bidder an unfair competitive advantage.

B11.3 In connection with its Bid, each entity identified in B11.2 shall:

- (a) avoid any perceived, potential or actual Conflict of Interest in relation to the procurement process and the Work;
- (b) upon discovering any perceived, potential or actual Conflict of Interest at any time during the Bid Opportunity process, promptly disclose a detailed description of the Conflict of Interest to the City in a written statement to the Contract Administrator; and
- (c) provide the City with the proposed means to avoid or mitigate, to the greatest extent practicable, any perceived, potential or actual Conflict of Interest and shall submit any additional information to the City that the City considers necessary to properly assess the perceived, potential or actual Conflict of Interest.

B11.4 Without limiting B11.3, the City may, in its sole discretion, waive any and all perceived, potential or actual Conflicts of Interest. The City's waiver may be based upon such terms and conditions as the City, in its sole discretion, requires to satisfy itself that the Conflict of Interest has been appropriately avoided or mitigated, including requiring the Bidder to put into place such policies, procedures, measures and other safeguards as may be required by and be acceptable to the City, in its sole discretion, to avoid or mitigate the impact of such Conflict of Interest.

B11.5 Without limiting B11.3, and in addition to all contractual or other rights or rights at law or in equity or legislation that may be available to the City, the City may, in its sole discretion:

- (a) disqualify a Bidder that fails to disclose a perceived, potential or actual Conflict of Interest of the Bidder or any of its employees proposed for the Work;
- (b) require the removal or replacement of any employees proposed for the Work that has a perceived, actual or potential Conflict of Interest that the City, in its sole discretion, determines cannot be avoided or mitigated;
- (c) disqualify a Bidder or employees proposed for the Work that fails to comply with any requirements prescribed by the City pursuant to B11.4 to avoid or mitigate a Conflict of Interest; and
- (d) disqualify a Bidder if the Bidder, or one of its employees proposed for the Work, has a perceived, potential or actual Conflict of Interest that, in the City's sole discretion, cannot be avoided or mitigated, or otherwise resolved.

B11.6 The final determination of whether a perceived, potential or actual Conflict of Interest exists shall be made by the City, in its sole discretion.

B12. QUALIFICATION

B12.1 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.

B12.2 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>

B12.3 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).

B12.4 Further to B12.3(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) Written confirmation of a safety and health certification meeting SAFE Work Manitoba's SAFE Work Certified Standard (e.g., COR™ and SECOR™) or
 - (i) a copy of their valid Manitoba COR certificate and Letter of Good Standing (or Manitoba equivalency) as issued under the Certificate of Recognition (COR) Program administered by the Construction Safety Association of Manitoba or by the Manitoba Heavy Construction Association's WORKSAFELY™ COR™ Program; or
 - (ii) a copy of their valid Manitoba SECOR™ certificate and Letter of Good Standing (or Manitoba equivalency) as issued under the Small Employer Certificate of Recognition Program (SECOR™) administered by the Construction Safety

Association of Manitoba or by the Manitoba Heavy Construction Association's
WORKSAFELY™ COR™ 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/>.)

B12.5 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.

B12.6 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.

B13. BID SECURITY

B13.1 The Bidder shall provide bid security in the form of:

- (a) 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
- (b) 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
- (c) 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.

B13.1.1 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.

B13.1.2 All signatures on bid securities shall be original.

B13.1.3 The Bidder shall sign the Bid Bond.

B13.1.4 The Surety shall sign and affix its corporate seal on the Bid Bond and the Agreement to Bond.

B13.2 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.

B13.2.1 Where the bid security provided by the successful Bidder is in the form of a certified cheque or draft pursuant to B13.1(c), it will be deposited and retained by the City as the performance security and no further submission is required.

B13.2.2 The City will not pay any interest on certified cheques or drafts furnished as bid security or subsequently retained as performance security.

B13.3 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.

B14. OPENING OF BIDS AND RELEASE OF INFORMATION

- B14.1 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.
- B14.1.1 Bidders or their representatives may attend.
- B14.1.2 Bids determined by the Manager of Materials, or his/her designate, to not include the bid security specified in B13 will not be read out.
- B14.2 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/>
- B14.3 After award of Contract, the name(s) of the successful Bidder(s), their address(es) 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/>
- B14.4 The Bidder is advised that any information contained in any Bid may be released if required by The Freedom of Information and Protection of Privacy Act (Manitoba), by other authorities having jurisdiction, or by law or by City policy or procedures (which may include access by members of City Council).
- B14.4.1 To the extent permitted, the City shall treat as confidential information, those aspects of a Bid Submission identified by the Bidder as such in accordance with and by reference to Part 2, Section 17 or Section 18 or Section 26 of The Freedom of Information and Protection of Privacy Act (Manitoba), as amended.

B15. IRREVOCABLE BID

- B15.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 11 of Form A: Bid.
- B15.2 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.

B16. WITHDRAWAL OF BIDS

- B16.1 A Bidder may withdraw his/her Bid without penalty by giving written notice to the Manager of Materials at any time prior to the Submission Deadline.
- B16.1.1 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.
- B16.1.2 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 13 of Form A: Bid, and only such person, has authority to give notice of withdrawal.
- B16.1.3 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 13 of Form A: Bid; and

- (c) if the notice has been given by any one of the persons specified in B16.1.3(b), declare the Bid withdrawn.

B16.2 A Bidder who withdraws his/her Bid after the Submission Deadline but before his/her Bid has been released or has lapsed as provided for in B15.2 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.

B17. EVALUATION OF BIDS

B17.1 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 B12 (pass/fail);
- (c) Total Bid Price;
- (d) economic analysis of any approved alternative pursuant to B6.

B17.2 Further to B17.1(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.

B17.3 Further to B17.1(b), the Award Authority shall reject any Bid submitted by a Bidder who does not demonstrate, in his/her Bid or in other information required to be submitted, that he/she is responsible and qualified.

B17.4 Further to B17.1(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.

B17.4.1 Further to B17.1(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.

B17.4.2 The electronic Form B: Prices and the formulas imbedded in that spreadsheet are only provided for the convenience of Bidders. The City makes no representations or warranties as to the correctness of the imbedded formulas. It is the Bidder's responsibility to ensure the extensions of the unit prices and the sum of Total Bid Price performed as a function of the formulas within the electronic Form B: Prices are correct.

B18. AWARD OF CONTRACT

B18.1 The City will give notice of the award of the Contract or will give notice that no award will be made.

B18.2 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.

B18.2.1 Without limiting the generality of B18.2, 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.

B18.3 The Work of this Contract is contingent upon Council approval of sufficient funding in the Capital Budget. If the Capital Budget approved by Council does not include sufficient funding for the Work, the City will have no obligation to award a Contract.

B18.4 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 B17.

B18.4.1 Following the award of contract, a Bidder will be provided with information related to the evaluation of his/her 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 shall consist of:

- (a) Roadworks
 - (i) St. John Ambulance Way from Portage Avenue to Empress Overpass
 - (ii) Empress Street East from Empress Overpass to Jack Blick Avenue
 - (iii) Empress Street from Jack Blick Avenue to St. Matthews Avenue
- (b) Active Transportation Facility
 - (i) St. John Ambulance Way from South of Portage Avenue to Empress Overpass
 - (ii) Empress Street East from Empress Overpass to Jack Blick Avenue
 - (iii) Empress Street from Jack Blick Avenue to St. Matthews Avenue
- (c) Landscaping Works
 - (i) Roadworks Areas
 - (ii) Omand's Creek Park
- (d) Slope Stabilization Works
 - (i) Assiniboine River Stabilization
 - (ii) Omand's Creek Stabilization south of Jack Blick Avenue
 - (iii) Omand's Creek Stabilization north of Jack Blick Avenue
- (e) Concrete Retaining Wall
 - (i) Empress Street south of St. Matthews Avenue
- (f) Bridge Rehabilitation Works
 - (i) Empress Overpass Superstructure and Substructure Rehabilitation Works
- (g) Accessibility Ramps
 - (i) North Accessibility Ramp
 - (ii) South Accessibility Ramp

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

- (a) Roadworks
 - (i) Removal of existing pavement and sidewalk;
 - (ii) Excavation;
 - (iii) Installation of subdrains;
 - (iv) Installation of catch basins and sewer service pipe;
 - (v) Installation of outfalls to Omand's Creek;
 - (vi) Compaction of sub-grade;
 - (vii) Placement of separation geotextile fabric;
 - (viii) Placement of sub-base and base course materials;
 - (ix) Adjustment of existing manholes and appurtenances;
 - (x) Construction of 230 mm plain dowelled concrete pavement (utilizing slip form paving equipment wherever possible);

- (xi) Construction of 200 mm reinforced concrete approaches;
 - (xii) Construction of various barrier curb types and heights;
 - (xiii) Construction of safety curb;
 - (xiv) Construction of 100 mm concrete sidewalk with paving stone bands;
 - (xv) Construction of F-shape barrier.
- (b) Active Transportation Facility
- (i) Excavation;
 - (ii) Placement of suitable site fill material;
 - (iii) Compaction of sub-grade;
 - (iv) Placement of separation geotextile fabric;
 - (v) Placement of sub-base and base course materials;
 - (vi) Construction of 100 mm concrete sidewalk;
 - (vii) Construction of splash strip;
 - (viii) Placement of Type 1A asphalt pavements (average thickness 100 mm) with rumble strip;
 - (ix) Line painting.
- (c) Landscaping Works
- (i) Placing topsoil;
 - (ii) Planting trees and shrubs;
 - (iii) Seeding (salt tolerant and native grasses);
 - (iv) Construction of concrete or granular rest areas and benches;
 - (v) Maintenance of landscaping works.
- (d) Slope Stabilization Works
- (i) Installation of silt fence;
 - (ii) Placing suitable site fill material for Assiniboine River toe berm;
 - (iii) Construction of rock fill ribs;
 - (iv) Installation of riprap;
 - (v) Installation of erosion control blanket.
- (e) Concrete Retaining Wall
- (i) Drive H-piles;
 - (ii) Construct reinforced concrete wall;
 - (iii) Backfill with lightweight concrete fill.
- (f) Bridge Rehabilitation Works
- (i) Demolition of existing concrete traffic barriers;
 - (ii) Partial depth concrete removals and installation of galvanic protection, additional reinforcement, concrete overlay, asphalt wearing surface complete with waterproofing membrane, new traffic barriers, and new bicycle rail over entire deck and approach slabs;
 - (iii) Localized removal of existing pedestrian rail and west curb for construction of north accessibility ramp;
 - (iv) Partial removal of existing expansion joints;
 - (v) Installation of new expansion joints;
 - (vi) Construction of new expansion slabs;
 - (vii) Partial demolition, installation of new reinforcement, and concrete placement of abutment back walls;
 - (viii) Concrete patch and crack repairs and installation of ECE on abutments, north and south piers, and centre pier cap;
 - (ix) Partial demolition and reconstruction of centre pier columns;

- (x) Repair of two bearing grout pads at south abutment.
 - (g) Accessibility Ramps- North Ramp
 - (i) Construction of rock-socketted caisson foundations;
 - (ii) Construction of cast-in-place reinforced concrete piers;
 - (iii) Construction of cast-in-place reinforced concrete pier diaphragms;
 - (iv) Fabrication, delivery, and installation of bearing pads;
 - (v) Fabrication, delivery, and erection of precast, prestressed slabs;
 - (vi) Construction of cast-in-place reinforced concrete slabs on grade;
 - (vii) Fabrication, delivery, and installation of pedestrian railing; and
 - (viii) Fabrication, delivery, and installation of expansion joints.
 - (h) Accessibility Ramps- South Ramp
 - (i) Excavation for construction of MSE retaining walls;
 - (ii) Design and construction of MSE retaining walls;
 - (iii) Partial demolition of existing curb and handrail on existing stair;
 - (iv) Construction of cast-in-place reinforced concrete slabs on grade;
 - (v) Construction of cast-in-place reinforced drainage channel;
 - (vi) Installation of steel drainage culvert under existing stairs by jacking or pushing;
 - (vii) Construction of grouted rip-rap pad for drainage;
 - (viii) Fabrication, delivery, and installation of pedestrian railing.
- D2.3 The City does not currently have permission to build the multi-use path on Canadian Pacific Railway right-of-way (Section G of Form B:Prices), but is anticipating acquiring it prior to the start of construction. This Section is contingent upon the City receiving permission to do this work.
- D2.3.1 Further to C7.1, if the required permission is not received, the City shall have the right to eliminate all or any portion of Section G of Form B:Prices, and the Contract Price will be reduced accordingly without penalty, claim for damages on the loss of anticipated profit on the Work so diminished, or any other grounds.
- D2.3.2 Further to C7.5, C7.5.1, and C7.6, a reduction in the Contract Price pursuant to D2.3.1 shall not be considered in calculating the aggregate reduction in the Contract Price for purposes of C7.5.
- D2.4 The Accessibility Ramps, identified in D2, will be contingent upon Council approval of sufficient funding in the Capital Budget. If the Capital Budget approved by Council does not include sufficient funding for the Work, the City shall have the right to eliminate all or any portion of the Accessibility Ramps, and the Contract Price will be reduced accordingly without penalty, claim for damages on the loss of anticipated profit on the Work so diminished, or any other grounds.
- D2.4.1 Further to C7.1, if the required funding is not received, the City shall have the right to eliminate all or any portion of the Accessibility Ramps, and the Contract Price will be reduced accordingly without penalty, claim for damages on the loss of anticipated profit on the Work so diminished, or any other grounds.
- D2.4.2 Further to C7.5, C7.5.1, and C7.6, a reduction in the Contract Price pursuant to D2.3.1 shall not be considered in calculating the aggregate reduction in the Contract Price for purposes of C7.5.

D3. CONTRACT ADMINISTRATOR

D3.1 The Contract Administrator is Morrison Hershfield, represented by:

Wayne Jaworski, C.E.T.
Senior Project Manager

Telephone No. 204-977-8370

Email Address wjaworski@morrisonhershfield.com

D3.2 At the pre-construction meeting, Wayne Jaworski, C.E.T. will identify additional personnel representing the Contract Administrator and their respective roles and responsibilities for the Work.

D3.3 Bids Submissions must be submitted to the address in B7.

D4. CONTRACTOR'S SUPERVISOR

D4.1 At the pre-construction meeting, the Contractor shall identify his/her designated supervisor and any additional personnel representing the Contractor and their respective roles and responsibilities for the Work.

D4.2 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 D4.1 or an alternate can be contacted twenty-four (24) hours a day to respond to an emergency.

D5. OWNERSHIP OF INFORMATION, CONFIDENTIALITY AND NON DISCLOSURE

D5.1 The Contract, all deliverables produced or developed, and information provided to or acquired by the Contractor are the property of the City and shall not be appropriated for the Contractors own use, or for the use of any third party.

D5.2 The Contractor shall not make any public announcements or press releases regarding the Contract, without the prior written authorization of the Contract Administrator.

D5.3 The following shall be confidential and shall not be disclosed by the Contractor to the media or any member of the public without the prior written authorization of the Contract Administrator;

- (a) information provided to the Contractor by the City or acquired by the Contractor during the course of the Work;
- (b) the Contract, all deliverables produced or developed; and
- (c) any statement of fact or opinion regarding any aspect of the Contract.

D5.4 A Contractor who violates any provision of D5 may be determined to be in breach of Contract.

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 identified in D3.1.

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:

The City of Winnipeg
Attn: Chief Financial Officer
Office of the Chief Administrative Officer
Susan A. Thompson Building
2nd Floor, 510 Main Street
Winnipeg MB R3B 1B9

- 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 facsimile number:

The City of Winnipeg
Legal Services Department
Attn: Director of Legal Services
Facsimile No.: 204-947-9155

- D6.5 Bids Submissions must not be submitted to this facsimile number. Bids must be submitted in accordance with B7.**

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/her 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 The Contractor shall 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>

D10. INSURANCE

- D10.1 The Contractor shall provide and maintain the following insurance coverage:
- (a) commercial general liability insurance, in the amount of at least two million dollars (\$2,000,000.00) inclusive, with The City of Winnipeg added as an additional insured, with a cross-liability clause, such liability policy to also contain contractual liability, unlicensed motor vehicle liability, non-owned automobile liability, broad form property damage cover and products and completed operations, to remain in place at all times during the performance of the Work and throughout the warranty period;
 - (b) if applicable, Automobile Liability Insurance covering all motor vehicles, owned and operated and used or to be used by the Contractor directly or indirectly in the performance

of the Work. The Limit of Liability shall not be less than \$2,000,000 inclusive for loss or damage including personal injuries and death resulting from any one accident or occurrence;

- (c) an all risks Installation Floater carrying adequate limits to cover all machinery, equipment, supplies and/or materials intended to enter into and form part of any installation.

D10.2 Deductibles shall be borne by the Contractor.

D10.3 The Contractor shall provide the City Solicitor with a certificate(s) of insurance, in a form satisfactory to the City Solicitor, at least two (2) Business Days prior to the commencement of any Work but in no event later than the date specified in the C4.1 for the return of the executed Contract.

D10.4 The Contractor shall not cancel, materially alter, or cause each policy to lapse without providing at least thirty (30) Calendar Days prior written notice to the Contract Administrator.

D11. PERFORMANCE SECURITY

D11.1 The Contractor shall 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.

D11.1.1 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/her Bid was not a certified cheque or draft pursuant to B13.1(c), 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 and in no event later than the date specified in the C4.1 for the return of the executed Contract.

D12. SUBCONTRACTOR LIST

D12.1 The Contractor shall provide the Contract Administrator with a complete list of the Subcontractors whom the Contractor proposes to engage (Form J: Subcontractor List) at or prior to a pre-construction meeting, or 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 C4.1 for the return of the executed Contract.

D13. DETAILED WORK SCHEDULE

D13.1 The Contractor shall provide the Contract Administrator with a detailed work schedule 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.

D13.2 The detailed work schedule shall consist of the following:

- (a) a Gantt chart for the Work

acceptable to the Contract Administrator.

D13.3 Further to D13.2(a), the Gantt chart shall show the time on a weekly basis, required to carry out the Work of each trade, or specification division. The time shall be on the horizontal axis, and the type of trade shall be on the vertical axis.

SCHEDULE OF WORK

D14. COMMENCEMENT

D14.1 The Contractor shall not commence any Work until he/she is in receipt of a letter of intent from the Award Authority authorizing the commencement of the Work.

D14.2 The Contractor shall 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 twenty-four (24) hour emergency response phone number specified in D4.2.
 - (iv) the Safe Work Plan specified in D9;
 - (v) evidence of the insurance specified in D10;
 - (vi) the performance security specified in D11;
 - (vii) the subcontractor list specified in D12; and
 - (viii) the detailed work schedule specified in D13.
- (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.

D14.3 The Contractor shall commence the Work associated with the north Accessibility Ramp within seven (7) Working Days of receipt of the letter of intent.

D14.4 The Contractor shall not commence the construction of rockfill ribs before January 2, 2019, and shall commence the work on the Site no later than January 7, 2019, as directed by the Contract Administrator and weather permitting.

D14.5 The Contractor shall not commence roadworks or active transportation facility Work before May 21, 2019 unless permitted by the Contract Administrator.

D14.6 The Contractor shall not commence Work in areas which are currently privately owned until it has received written notification from the Contract Administrator. The following areas are currently privately owned and the City anticipates to acquire or receive permission to enter prior to the start of construction:

- (a) Sidewalk construction in the southwest corner of Empress Street and Maroons Road (see Drawing included in Appendix 'C');
- (b) St. John's Ambulance Way construction (see Drawing included in Appendix 'C');
- (c) Multi-use path construction along Canadian Pacific Railway right-of-way.

D14.7 The City intends to award this Contract by November 23, 2018.

D14.7.1 If the actual date of award is later than the intended date, the dates specified for Critical Stages, Substantial Performance, and Total Performance will be adjusted by the difference between the aforementioned intended and actual dates.

D15. RESTRICTED WORK HOURS

D15.1 Further to clause 3.10 of CW 1130, the Contractor shall require written permission forty-eight (48) hours in advance from the Contract Administrator for any work to be performed between

2000 hours and 0700 hours, or on Saturdays, Sundays, Statutory Holidays and or Civic Holidays.

D16. WORK BY OTHERS

D16.1 Work by others on or near the Site will include but not necessarily be limited to:

- (a) Traffic Signals- Removal, modification, and installation of new traffic signals plant;
- (b) Manitoba Hydro – Removal and installation of street lighting;
- (c) Manitoba Hydro, Gas Division – lowering and/ or rock wrapping of underground main and services as required;
- (d) MTS and Shaw – relocations, protection and adjustments as required;
- (e) City of Winnipeg Traffic Services – Erection and maintenance of temporary traffic control (see E7.), removal and installation of new traffic signage and line painting.
- (f) City of Winnipeg Geomatics Branch – various work on survey infrastructure.
- (g) City of Winnipeg Water & Waste- maintenance and inspection of water mains, sewers and other infrastructure within the project area.

D17. SEQUENCE OF WORK

D17.1 Further to C6.1, in general the sequence of work shall be as follows:

D17.1.1 Commencement in 2018 to Spring 2019:

- (a) Start construction of north accessibility ramp

D17.1.2 January 2019 to February 2019:

- (a) Tree removals and clearing and grubbing throughout the Site to be complete by April 1, 2019.
- (b) Rockfill Rib Construction
- (c) Soil Capping of Rockfill Ribs
- (d) Installation of Riprap
- (e) Erosion Control Blanket

D17.1.3 May 2019 to October 31, 2019:

- (a) Remove erosion control blanket and install landscaping on lower Omand's Creek bank (Rockfill rib area) and installation of silt fence
- (b) Roadworks (see staging Figures)
 - (i) Construct southbound lanes
 - (ii) Construct northbound lanes
 - (iii) Construct active transportation facilities
- (c) Overpass rehabilitation in coordination with roadworks (see staging Drawings)
- (d) Construction of south accessibility ramp
- (e) Assiniboine River toe berm
- (f) Concrete retaining wall along Omand's Creek near St. Matthews Avenue
- (g) Complete Boulevard Grading
- (h) Start landscaping

D17.1.4 Spring 2020 to Substantial Performance:

- (a) Finish landscaping
- (b) Install electrochemical chloride extraction

D18. CRITICAL STAGES

- D18.1 The Contractor shall achieve critical stages of the Work in accordance with the following requirements:
- (a) Construction of rockfill ribs, including soil capping and erosion control blanket shall be completed by February 15, 2019.
 - (b) Tree removals and clearing and grubbing throughout the Site to be completed by April 1, 2019.
 - (c) All roadworks and active transportation facilities shall be completed by October 31, 2019.
 - (d) Construction of all bridge rehabilitation and accessibility ramp works except electrochemical chloride extraction by November 15, 2019.
- D18.2 When the Contractor considers the Work associated with Critical Stages 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.
- D18.3 The date on which the Critical Stages Work has been accepted by the Contract Administrator as being completed to the requirements of the Contract is the date on which completion of Critical Stages have been achieved.

D19. SUBSTANTIAL PERFORMANCE

- D19.1 The Contractor shall achieve Substantial Performance by July 12, 2020.
- D19.2 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.
- D19.3 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.

D20. TOTAL PERFORMANCE

- D20.1 The Contractor shall achieve Total Performance by July 26, 2020.
- D20.2 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.
- D20.3 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.

D21. LIQUIDATED DAMAGES

- D21.1 If the Contractor fails to achieve Critical Stages, Substantial Performance or Total Performance in accordance with the Contract by the days fixed herein for same, the Contractor shall pay the City the following amounts per Calendar Day for each and every Calendar Day following the days fixed herein for same during which such failure continues:
- (a) Critical stage listed in D18.1(a)- three thousand five hundred dollars (\$3,500);

- (b) Critical stage listed in D18.1(b) – three thousand five hundred dollars (\$3,500);
- (c) Critical stage listed in D18.1(c) – seven thousand dollars (\$7,000);
- (d) Critical stage listed in D18.1(d) – seven thousand dollars (\$7,000);
- (e) Substantial Performance – one thousand five hundred dollars (\$1,500);
- (f) Total Performance – one thousand five hundred dollars (\$1,500).

D21.2 The amounts specified for liquidated damages in D21.1 are based on a genuine pre-estimate of the City's losses in the event that the Contractor does not achieve critical stages, Substantial Performance or Total Performance by the days fixed herein for same.

D21.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

D22. SCHEDULED MAINTENANCE

D22.1 The Contractor shall perform the following scheduled maintenance in the manner and within the time periods required by the Specifications:

- (a) Reflective crack maintenance during two year warranty period as specified in CW 3250;
- (b) Native grass plantings maintenance period and weed control as specified in E34;
- (c) Salt tolerant grass seeding maintenance period as specified in E35;
- (d) Tree Plantings maintenance period as specified in E32;
- (e) Electrochemical chloride extraction system operation and maintenance as specified in E63.5 .

D22.2 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.

CONTROL OF WORK

D23. JOB MEETINGS

D23.1 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.

D23.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings whenever he/she deems it necessary.

D24. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA)

D24.1 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).

D25. THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA) – QUALIFICATIONS

D25.1 Further to B12.4, the Contractor/Subcontractor must, throughout the term of the Contract, have a Workplace Safety and Health Program meeting the requirements of The Workplace Safety

and Health Act (Manitoba). At any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require updated proof of compliance, as set out in B12.4.

D26. LAYOUT OF WORK

- D26.1 Further to C6, the Contract Administrator shall layout work except Bridge Rehabilitation Works as defined in Clause D2.1(f) and Accessibility Ramps work as defined in Clause D2.1(g).
- D26.2 The Contractor shall be responsible for the true and proper laying out of all aspects of the Bridge Rehabilitation Works as defined in Clause D2.1(f) and Accessibility Ramps work as defined in Clause D2.1(g) and shall provide all required instruments and competent personnel for performing the layouts. The Contract Administrator will provide benchmarks for this work.
- D26.3 The Contract Administrator shall be notified at least one (1) Business Day prior to any Work being commenced in order to have the option to check and review all elevations and layouts at their discretion.
- D26.4 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 their own expense.
- D26.5 The Contractor shall carefully protect and preserve all benchmarks, stakes, and other items of 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.

D27. ENVIRONMENTAL PROTECTION PLAN

- D27.1 The Contractor shall plan and implement the Work of this Contract strictly in accordance with the requirements of the Environmental Protection Plan as herein specified.
- D27.2 The Contractor is advised that at least the following Acts, Regulations, and By-laws apply to the Work:
- (a) Federal
 - (i) Canadian Environmental Assessment Act (CEAA), 1992 c.37;
 - (ii) Canadian Environmental Protection Act;
 - (iii) Fisheries Act, 1985 c.F-14;
 - (iv) Transportation of Dangerous Goods Act and Regulations, c.34;
 - (v) Migratory Birds Convention Act and Regulations, c.22;
 - (vi) Species at Risk Act, c.29;
 - (vii) Transportation Association of Canada's Transportation Association of Canada National Guide to Erosion and Sediment Control on Roadway Projects, 2005;
 - (viii) Applicable Fisheries and Oceans Canada Operational Statements for Manitoba for Temporary Stream Crossings;
 - (ix) The Department of Fisheries and Oceans Freshwater Intake End-of-Pipe Fish Screen *Guidelines*, DFO 1995;
 - (x) Fisheries and Oceans Policy for the *Management of Fish Habitat* 1986;
 - (xi) Federal Policy on Wetland Conservation 1991;
 - (xii) Navigable Waters Best Practices; and
 - (xiii) Any other applicable Acts, Regulations, and By-laws.
 - (b) Provincial
 - (i) The Dangerous Goods Handling and Transportation Act, D12;
 - (ii) The Endangered Species Act, c.E111;
 - (iii) The Environment Act, c.E125;

- (iv) The Fire Prevention Act, c.F80;
 - (v) The Heritage Resources Act, c.H39.1;
 - (vi) The Noxious Weeds Act , c.N110;
 - (vii) The Nuisance Act, c.N120;
 - (viii) The Pesticides Regulation, M.R. 94/88R
 - (ix) The Public Health Act, c.P210;
 - (x) The Water Protection Act, c.W65;
 - (xi) The Workplace Safety and Health Act c.W210;
 - (xii) Current applicable Associated Regulations;
 - (xiii) The Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat, Manitoba National Resources, 1996.; and
 - (xiv) Any other applicable Acts, Regulations, and By-laws.
- (c) Municipal
- (i) The City of Winnipeg Neighbourhood Liveability By-law No. 1/2008;
 - (ii) The City of Winnipeg By-law No. 1573/77 and all amendments up to and including 7670/2000;
 - (iii) City of Winnipeg Best Management Practices for Activities In and Around the City's Waterways and Watercourses, City of Winnipeg 2005;
 - (iv) The City of Winnipeg Motor Vehicle Noise Policies and Guidelines;
 - (v) The City of Winnipeg By-law No. 2480/79 and all amendments up to and including 7976/2000;
 - (vi) The City of Winnipeg By-law No. 92/2010;
 - (vii) The City of Winnipeg By-law No. 5888/92; and
 - (viii) Any other applicable Acts, Regulations, and By-laws.
- D27.3 Applications for a City of Winnipeg Waterways permit, Manitoba Water Resources Authorization permit, and DFO Authorization permit are currently underway for this Work. The permits shall be provided to the Contractor when they are formally issued. The Contractor shall comply with the requirements outlined in the permits.
- D27.4 The Contractor is advised that the following environmental protection measures apply to the Work.
- (a) Materials Handling and Storage
- (i) Storage on construction materials shall be confined to the defined laydown areas as shown on the Drawings or at a location approved by the Contract Administrator.
 - (ii) Any construction staging and material stockpiles are to be well removed from the riverbank and located in an area as approved by the Contract Administrator so that riverbank stability is not compromised. Under no circumstances are construction supplies or materials to be stored or stockpiled close to or on the riverbank. In general, stockpile locations should be located no closer to the creek than the southbound lane of Empress Street, or as otherwise directed by the Contract Administrator.
 - (iii) Construction materials shall not be deposited or stored on or near watercourses unless written acceptance from the Contract Administrator is received in advance.
 - (iv) Construction materials and debris shall be tied down or secured if severe weather and high wind velocities are forecasted. Work shall be suspended during extreme high wind conditions.
 - (v) Construction materials and debris shall be prevented from entering watercourses. In the event that materials and/or debris inadvertently enter the land drainage system, the Contractor will be required to remove the material to an appropriate landfill or storage facility and restore the watercourse to its original condition.
- (b) Fuel Handling and Storage

- (i) The Contractor shall obtain all necessary permits from Manitoba Conservation and Water Stewardship for the handling and storage of fuel products and shall provide copies to the Contract Administrator.
 - (ii) All fuel handling and storage facilities shall comply with The Dangerous Goods and Transportation Act Storage and Handling of Petroleum Products Regulation and any local land use permits.
 - (iii) Fuels, lubricants, and other potentially hazardous materials as defined in The Dangerous Goods and Transportation Act shall be stored and handled within the approved storage areas.
 - (iv) The Contractor shall ensure that any temporary fuel storage areas established for construction of the project are contained by an impermeable dyke. Dykes shall be designed, constructed, and maintained to retain not less than 100% of the capacity of the total number of containers or 110% of the largest container, whichever is greatest. The dykes shall be constructed of clay or similar impervious material. If this type of material is not available, the dyke shall be constructed of locally available material and lined with high-density polyethylene (HDPE). Furthermore, the fuel storage area(s) shall be secured by a barrier such as a high fence and gate to prevent vandalism.
 - (v) The Contractor shall ensure that all fuel storage containers are inspected daily for leaks and spillage.
 - (vi) Products transferred from the fuel storage area(s) to specific Work Sites shall not exceed the daily usage requirement.
 - (vii) When servicing requires the drainage or pumping of fuels, lubricating oils or other fluids from equipment, a groundsheet of suitable material (such as HDPE) and size shall be spread on the ground to catch the fluid in the event of a leak or spill.
 - (viii) Washing, refueling, and servicing of machinery and storage of fuel and other materials for the machinery shall take place at least 100 metres from a watercourse to prevent deleterious substances from entering the water.
 - (ix) The area around storage sites and fuel lines shall be distinctly marked and kept clear of snow and debris to allow for routine inspection and leak detection.
 - (x) The deposit of deleterious substances into water frequented by fish is prohibited under the Fisheries Act, 1985. The Contractor shall take appropriate precautions to ensure that potentially deleterious substances (such as fuel, hydraulic fluids, oil, sediment, etc.) do not enter any water body.
 - (xi) A sufficient supply of materials, such as absorbent material and plastic oil booms, to clean up minor spills shall be stored nearby on Site. The Contractor shall ensure that additional material can be made available on short notice.
 - (xii) Machinery shall arrive on Site in a clean condition and shall be maintained to be free to fluid leaks.
 - (xiii) A sufficient supply of materials, such as absorbent material and plastic oil booms, to clean up minor spills shall be stored nearby on Site. The Contractor shall ensure that additional material can be made available upon short notice. Additionally, appropriate staff on Site shall be trained for proper handling of deleterious liquids (i.e. fueling) and trained in preventing and cleaning up minor spills.
- (c) Waste Handling and Disposal
- (i) The construction area shall be kept clean and orderly at all times during and at completion of construction.
 - (ii) At no time during construction shall personal or construction waste be permitted to accumulate for more than one day at any location on the construction Site, other than at a dedicated storage area as may be approved by the Contract Administrator.
 - (iii) The Contractor shall, during and at the completion of construction, clean-up the construction area and all resulting debris shall be deposited at a Waste Disposal Ground operating under the authority of Manitoba Regulation 150/91. Exceptions are liquid industrial and hazardous wastes which require special disposal methods (refer to Section 30.5D).

- (iv) On Site volumes of sewage and/or septage will be removed on a weekly basis.
 - (v) The Contractor shall ensure sewage, septage, and other liquid wastes generated on Site are handled and disposed of by a certified disposal contractor.
 - (vi) Indiscriminate dumping, littering, or abandonment shall not take place.
 - (vii) No on-Site burning of waste is permitted.
 - (viii) Structurally unsuitable site excavation material will be removed by the Contractor.
 - (ix) Waste storage areas shall not be located so as to block natural drainage.
 - (x) Runoff from a waste storage area shall not be allowed to cause siltation of a watercourse.
 - (xi) Waste storage areas shall be left in a neat and finished appearance and/or restored to their original condition to the satisfaction of the Contract Administrator.
 - (xii) Equipment shall not be cleaned near watercourses; contaminated water from onshore cleaning operations shall not be permitted to enter watercourses.
 - (xiii) The Contractor shall notify and receive written approval from the Contract Administrator prior to discharge from any dewatered areas. The discharge will be released into a well-vegetated area, filter bag, settling basin, or storm sewer system to remove the suspended material and other deleterious substances from the discharge before it finds its way into any watercourse. Discharge from dewatering areas may require approved disposal via the sanitary sewer system or disposal truck in accordance with Construction Specifications, at the request of the Contract Administrator.
 - (xiv) Flows will be dissipated so that dewatering discharges minimize erosion at the discharge point.
- (d) Dangerous Goods/Hazardous Waste Handling and Disposal
- (i) Dangerous goods/hazardous waste are identified by, and shall be handled according to, The Dangerous Goods Handling and Transportation Act and Regulations.
 - (ii) The Contractor shall be familiar with The Dangerous Goods Handling and Transportation Act and Regulations.
 - (iii) The Contractor shall have on Site staff that is trained and certified in the handling of the dangerous/hazardous goods, when said dangerous/hazardous goods are being utilized on Site for the performance of the Work.
 - (iv) Different waste streams shall not be mixed.
 - (v) Disposal of dangerous goods/hazardous wastes shall be at approved hazardous waste facilities.
 - (vi) Liquid hydrocarbons shall not be stored or disposed of in earthen pits on Site.
 - (vii) Used oils shall be stored in appropriate drums or tankage until shipment to waste oil recycling centres, incinerators, or secure disposal facilities approved for such wastes.
 - (viii) Used oil filters shall be drained, placed in suitable storage containers, and buried or incinerated at approved hazardous waste treatment and disposal facilities.
 - (ix) Dangerous goods/hazardous waste storage areas shall be located at least 107 metres away from the edge of the water line for normal summer water levels and be dyked.
 - (x) Dangerous goods/hazardous waste storage areas shall not be located so as to block natural drainage.
 - (xi) Runoff from a dangerous goods/hazardous waste storage areas shall not be allowed to cause siltation of a watercourse.
 - (xii) Dangerous goods/hazardous waste storage areas shall be left in a neat and finished appearance and/or restored to their original condition to the satisfaction of the Contract Administrator.
- (e) Emergency Response

- (i) The Contractor shall ensure that due care and caution is taken to prevent spills.
- (ii) The Contractor shall report all major spills of petroleum products or other hazardous substances with significant impact on the environment and threat to human health and safety (as defined in Table 1 below) to Manitoba Environment, immediately after occurrence of the environmental accident, by calling the 24-hour emergency phone number (204) 945-4888.
- (iii) The Contractor shall designate a qualified supervisor as the on-Site emergency response coordinator for the project. The emergency response coordinator shall have the authority to redirect manpower in order to respond in the event of a spill.
- (iv) The following actions shall be taken by the person in charge of the spilled material or the first person(s) arriving at the scene of a hazardous material accident or the on-site emergency response coordinator:
 - (i) Notify emergency-response coordinator of the accident:
 - Identify exact location and time of accident;
 - Indicate injuries, if any;
 - Request assistance as required by magnitude of accident (Manitoba Environment 24-hour Spill Response Line (204) 945-4888, Police, Fire Department, Ambulance, company backup).
 - (ii) Attend to public safety:
 - Stop traffic, roadblock/cordon off the immediate danger area;
 - Eliminate ignition sources;
 - Initiate evacuation procedures if necessary.
 - (iii) Assess situation and gather information on the status of the situation, noting:
 - Personnel on Site;
 - Cause and effect of spill;
 - Estimated extent of damage;
 - Amount and type of material involved; and
 - Proximity to waterways, sewers, and manholes.
 - (iv) If safe to do so, try to stop the dispersion or flow of spill material
 - Approach from upwind;
 - Stop or reduce leak if safe to do so;
 - Dyke spill material with dry, inert absorbent material or dry clay soil or sand;
 - Prevent spill material from entering waterways and utilities by dyking;
 - Prevent spill material from entering manholes and other openings by covering with rubber spill mats or dyking; and
 - Resume any effective action to contain, clean up, or stop the flow of the spilled product.
 - (v) The emergency response coordinator shall ensure that all environmental accidents involving contaminants shall be documented and reported to Manitoba Environment according to The Dangerous goods Handling and Transportation Act Environmental Accident Report Regulation 439/87.
 - (vi) When dangerous goods are used on Site, materials for containment and cleanup of spill material (e.g. absorbent materials, plastic oil booms, and oversized recovery drums) shall be available on Site.
 - (vii) Minor spills of such substances that may be contained on land with no significant impact on the environment may be responded to within-house resources without formal notification to Manitoba Environment.
 - (viii) City Emergency response, 9-1-1, shall be used if other means are not available.

TABLE 1 SPILLS THAT MUST BE REPORTED TO MANITOBA SUSTAINABLE DEVELOPMENT AS ENVIRONMENTAL ACCIDENTS		
Classification	Hazard	Reportable quantity/level
1	Explosives	All
2.1	Compressed Gas (Flammable)	100 L*
2.2	Compressed Gas	100 L*
2.3	Compressed Gas (Toxic)	All
2.4	Compressed Gas (Corrosive)	All
3	Flammable Liquids	100 L
4	Flammable Solids	1 Kg
5.1 PG** I & II	Oxidizer	K kg or 1 L
PG** III	Oxidizer	50 kg or 50 L
5.2	Organic Peroxide	1 kg or 1 L
6.1 PG** I & II	Acute Toxic	1 kg or 1 L
PG** III	Acute Toxic	5 kg or 5 L
6.2	Infectious	All
7	Radioactive	Any discharge or radiation level exceeding 10 mSv/h at the package surface and 200 uSv/h at 1 m from the package surface
8	Corrosive	5 kg or 5 L
9.1	Miscellaneous (except PCB mixtures)	50 kg
9.2	PCB Mixtures	500 g
9.3	Aquatic Toxic	1 kg or 1 L
9.4	Wastes (chronic toxic)	5 kg or 5 L
* Container capacity (refers to container water capacity)		
** PG = Packing Group(s)		

(f) Noise and Vibration

- (i) Noise-generating activities shall be limited to the hours indicated in the City of Winnipeg Noise Bylaw, unless otherwise accepted in advance by the Contract Administrator. The activities will generally be restricted to 7:00 a.m. to 7:00 p.m. weekdays with written permission of the Contract Administrator and the City of Winnipeg for any afterhours or weekend work required for special cases. No extended or alternative working hours/dates will be permitted for pile driving activities.
- (ii) The Contractor shall be responsible for scheduling Work to avoid potential noise problems and/or employ noise reduction measures to reduce noise to acceptable limits. The Contractor shall also demonstrate to the Contract Administrator that Works to be performed during the night-time period, on Sundays, and Holidays as stated in the Licence shall not exceed the approved limit.
- (iii) The Contractor shall locate stationary noise generating equipment (i.e. generators) away from sensitive receptors and wildlife areas.
- (iv) Construction vehicles and equipment will adhere to posted speed limits.

(g) Dust and Emissions

- (i) Dust control practices implemented by the Contractor during construction shall include regular street cleaning and dampening of construction access roads and Work areas with water or approved chemicals at an adequate frequency to prevent the creation of dust.
- (ii) The Contractor shall minimize construction equipment idling times and turn off machinery, when feasible.
- (iii) Dust control practices implemented by the Contractor during construction will include regular street cleaning and dampening of construction access roads and Work areas with water or approved chemicals at an adequate frequency to prevent the creation of dust.

- (iv) Only water or chemicals approved by the Contract Administrator shall be used for dust control. The use of waste petroleum or petroleum by-products is not permitted.
 - (v) The Contractor shall ensure that trucks which are used to haul excavated material and backfill material to and from the Work Site utilize tarpaulin covers during transport to prevent material from falling onto the street and creating dust.
 - (vi) Stockpiled soils shall be covered with tarpaulin covers to prevent the creation of dust.
- (h) Erosion Control
- (i) The Contractor shall develop a sediment control plan prior to beginning construction in adherence to the Transportation Association of Canada National Guide to Erosion and Sediment Control on Roadway Projects, the City of Winnipeg's *Best Management Practices for Activities In and Around the City's Waterways and Watercourses*, and to the satisfaction of the Contract Administrator.
 - (ii) Exposure of soils shall be kept to a minimum practical amount, acceptable to the Contract Administrator. The cover of trees and undergrowth shall be preserved to the maximum extent possible.
 - (iii) Sediment control fencing, or other such erosion control structures, shall be employed wherever construction activity increases the potential for runoff to carry sediment into a drainage channel or other watercourse. The Contractor shall inspect all such structures daily during heavy construction activity in the areas of the structures and after a heavy rainfall to ensure their continued integrity.
 - (iv) All areas disturbed during construction shall be landscaped and revegetated with native and/or introduced plant species in order to restore and enhance the Site and to protect against soil erosion unless otherwise indicated.
 - (v) The disturbed surface shall be revegetated so as to create a dense root system in order to defend against soil erosion on the right-of-way and any other disturbed areas susceptible to erosion.
 - (vi) The loss of topsoil and the creation of excessive dust by wind during construction shall be prevented by the addition of temporary cover crop, water, or tackifier, if conditions so warrant.
 - (vii) The Contractor shall routinely inspect all erosion and sediment control structures and immediately carry out any necessary maintenance. Several inspections will be performed during rainy days.
 - (viii) Construction activities will be avoided during periods of high winds to prevent erosion and the creation of dust.
- (i) Runoff Control
- (i) Measures shall be undertaken to ensure that runoff containing suspended soil particles is minimized from entering the land drainage system and the Red River to the greatest extent possible, to the satisfaction of the Contract Administrator.
 - (ii) Areas that are heavily disturbed and vulnerable to erosion or gulying will be dyked to redirect surface runoff around the area prior to spring runoff.
 - (iii) Construction activities on erodible slopes shall be avoided during spring runoff and heavy rain fall events.
- (j) Fish
- (i) **Due to the presence of spawning fish species no instream works will occur between April 1 and June 15 of any given year.**
 - (ii) A buffer of vegetation will be maintained when working along waterways, where possible.
 - (iii) The duration of Work and amount of disturbance to the bed and banks of the waterbody will be minimized.
- (k) Wildlife

- (i) No clearing of trees, shrubs, or vegetation is permitted between May 1 and July 31 of any year to protect the nesting and breeding season for migratory birds and other wildlife, unless otherwise identified by a Project biologist.
 - (ii) No disruption, movement, or destruction shall occur to any migratory bird nests.
 - (iii) In the event that a species at risk or a nest is encountered during construction, all Work will cease in the immediate area, the site will be made safe, and the Contract Administrator shall be contacted for further direction.
- (l) Vegetation
- (i) Vegetation shall not be disturbed without written permission from the Contract Administrator.
 - (ii) The Contractor shall protect plants or trees which may be at risk of accidental damage. Such measures may include protective fencing or signage and shall be approved in advance by the Contract Administrator.
 - (iii) The Contractor will limit the removal of trees and snags (standing dead trees), surface disturbance, and vegetation clearing.
 - (iv) Herbicides and pesticides shall not be used adjacent to any surface watercourses unless otherwise approved by the Contract Administrator.
 - (v) Trees or shrubs shall not be felled into watercourses.
 - (vi) Areas where vegetation is removed during clearing, construction, and decommissioning activities, shall be revegetated as soon as possible in accordance with the landscaping plans forming part of the contract, or as directed by the Contract Administrator.
 - (vii) Trees damaged during construction activities shall be examined by bonded tree care professionals; viable trees damaged during construction activities shall be pruned according to good practice by bonded tree care professionals.
 - (viii) Damaged trees which are not viable shall be replaced at the expense of the Contractor.
- (m) Construction Traffic
- (i) Workforce parking shall be limited to the areas designated for such as detailed in the Contract Documents, or as otherwise may be directed by the Contract Administrator.
 - (ii) The Contractor shall adhere to the Standard Provisions of the Standard Construction Specifications, and of the Manual of Temporary Traffic Control on City Streets of The City of Winnipeg, Public Works Department.
 - (iii) The Contractor's laydown area, construction Site and access road shall be fenced and gated to secure the Site and materials and to discourage pedestrian entrance to construction area and to control any potential hazard to the public, particularly children.
 - (iv) For circumstances where the Contract Administrator has accepted Site access of special equipment or material, the Contractor shall provide adequate flagmen for traffic control in the vicinity of any public buildings.
- (n) Access
- (i) The Contractor shall maintain access to affected residential properties.
- (o) The Contractor shall provide or maintain general and off-street access to any affected business during construction.

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.

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 unless extended pursuant to C13.2.1 or C13.2.2, in which case it shall expire when provided for thereunder.
- D29.2 Notwithstanding C13.2 or D29.1, 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) 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.
- D29.2.1 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 D11)

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. 602-2018

Empress Street Project, Pavement Reconstruction, Portage Avenue to St. Matthews Avenue, Empress Overpass Rehabilitation, Accessibility Ramps and 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)

**FORM H2: IRREVOCABLE STANDBY LETTER OF CREDIT
(PERFORMANCE SECURITY)**
(See D11)

(Date)

The City of Winnipeg
Legal Services Department
185 King Street, 3rd Floor
Winnipeg MB R3B 1J1

RE: PERFORMANCE SECURITY – BID OPPORTUNITY NO. 602-2018

Empress Street Project, Pavement Reconstruction, Portage Avenue to St. Matthews Avenue,
Empress Overpass Rehabilitation, Accessibility Ramps and Associated Works

Pursuant to the request of and for the account of our customer,

(Name of Contractor)

(Address of Contractor)

WE HEREBY ESTABLISH in your favour our irrevocable Standby Letter of Credit for a sum not exceeding
in the aggregate

_____ Canadian dollars.

This Standby Letter of Credit may be drawn on by you at any time and from time to time upon written demand for payment made upon us by you. It is understood that we are obligated under this Standby Letter of Credit for the payment of monies only and we hereby agree that we shall honour your demand for payment without inquiring whether you have a right as between yourself and our customer to make such demand and without recognizing any claim of our customer or objection by the customer to payment by us.

The amount of this Standby Letter of Credit may be reduced from time to time only by amounts drawn upon it by you or by formal notice in writing given to us by you if you desire such reduction or are willing that it be made.

Partial drawings are permitted.

We engage with you that all demands for payment made within the terms and currency of this Standby Letter of Credit will be duly honoured if presented to us at:

(Address)

and we confirm and hereby undertake to ensure that all demands for payment will be duly honoured by us.

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 (2007 Revision), International Chamber of Commerce Publication Number 600.

(Name of bank or financial institution)

Per: _____
(Authorized Signing Officer)

Per: _____
(Authorized Signing Officer)

FORM J: SUBCONTRACTOR LIST
 (See D12)

Empress Street Project, Pavement Reconstruction, Portage Avenue to St. Matthews Avenue, Empress
 Overpass Rehabilitation, Accessibility Ramps and Associated Works

<u>Portion of the Work</u>	<u>Name</u>	<u>Address</u>
SURFACE WORKS		
<i>Supply of Materials:</i>		
Concrete		
Asphalt		
Base Course & Sub-base		
Geotextile		
Subdrains		
<i>Installation/ Placement:</i>		
Excavation		
Subdrains		
Concrete		
Asphalt		
Concrete Joint Sealing		
Reflective Crack Maintenance		
UNDERGROUND WORKS		
<i>Supply of Materials:</i>		
Catchbasins, Catchpits & Manholes		
Frames & Covers		
<i>Installation & Placement:</i>		
Catchbasins, Catchpits & Manholes		
Sewer Televising		
LANDSCAPING		
<i>Supply of Materials:</i>		
Trees & Shrubs		

FORM J: SUBCONTRACTOR LIST
 (See D12)

Empress Street Project, Pavement Reconstruction, Portage Avenue to St. Matthews Avenue, Empress
 Overpass Rehabilitation, Accessibility Ramps and Associated Works

<u>Portion of the Work</u>	<u>Name</u>	<u>Address</u>
Native Grass		
Salt Tolerant Seed		
Sod		
<i>Installation & Placement:</i>		
Tree Trimming and Removals		
Trees & Shrubs		
Seeding		
Sodding		
SLOPE STABILIZATION		
<i>Supply of Materials:</i>		
Rockfill		
Silt Fence		
Erosion Control Blanket		
<i>Installation & Placement:</i>		
Rockfill Ribs		
Silt Fence		
Erosion Control Blanket		
STRUCTURAL		
<i>Design:</i>		
Galvanic Anode System		
MSE Walls:		
Electrochemical Chloride Extraction		
<i>Supply of Materials:</i>		

FORM J: SUBCONTRACTOR LIST
 (See D12)

Empress Street Project, Pavement Reconstruction, Portage Avenue to St. Matthews Avenue, Empress
 Overpass Rehabilitation, Accessibility Ramps and Associated Works

<u>Portion of the Work</u>	<u>Name</u>	<u>Address</u>
Structural Concrete		
Plain Reinforcement		
ChromeX Reinforcement		
Stainless Steel Reinforcement		
Precast Prestressed Concrete Slabs		
Bearings		
Expansion Joints		
Aluminum Handrail		
MSE Walls		
Backfill		
Turf Mats		
Galvanic Anodes – Type 1		
Galvanic Anodes – Type 2		
Waterproofing Membrane		
Asphalt		
Cellular Concrete		
<i>Installation and Placement:</i>		
Structural Concrete		
Plain Reinforcement		
ChromeX Reinforcement		
Stainless Steel Reinforcement		
Precast Prestressed Concrete Slabs		
Bearings		
Expansion Joints		
Aluminum Handrail		
MSE Walls		
Backfill		

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:

<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
P-3494-0	Cover Sheet and Location Plan	A1
P-3494-1	Key Plan, Drawing List & Horizontal and Vertical Control	A1
P-3494-2	Horizontal Geometry- Empress Street East, Portage Ave. to Sta 0+390.000 EG	A1
P-3494-3	Horizontal Geometry- Empress Street East, Sta 0+390.000 EG to Sta 0+850.000 EG	A1
P-3494-4	Horizontal Geometry- Empress Street East, Sta 0+850.000 EG to Empress Street	A1
P-3494-5	Horizontal Geometry- Empress Street East, Empress Street East to Sta 0+940.000 WG	A1
P-3494-6	Horizontal Geometry- Empress Street East, Sta 0+940.000 WG to St Matthews Avenue	A1
P-3494-7	Paving- St. John Ambulance Way, Portage Ave. to Sta 0+200.000 EG	A1
P-3494-8	Paving- St. John Ambulance Way/ Empress Street East, Sta 0+200.000 EG to Sta 0+330.000 EG	A1
P-3494-9	Paving- Empress Street East, Sta 0+330.000 EG to Sta 0+460.000 EG	A1
P-3494-10	Paving- Empress Street East, Sta 0+460.000 EG to Sta 0+590.000 EG	A1
P-3494-11	Paving- Empress Street East, Sta 0+590.000 EG to Sta 0+720.000 EG	A1
P-3494-12	Paving- Empress Street East, Sta 0+720.000 EG to Sta 0+840.000 EG	A1
P-3494-13	Paving- Empress Street East, Sta 0+840.000 EG to Sta 0+960.000 EG	A1
P-3494-14	Paving- Empress Street East, Sta 0+960.000 EG to Sta 1+090.000 EG	A1
P-3494-15	Paving- Empress Street East, Sta 1+090.000 EG to Empress Street	A1

<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
P-3494-16	Paving- Empress Street, Sta 0+410.000 WG to Sta 0+540.000 WG	A1
P-3494-17	Paving- Empress Street, Sta 0+540.000 WG to Sta 0+670.000 WG	A1
P-3494-18	Paving- Empress Street, Sta 0+670.000 WG to Sta 0+800.000 WG	A1
P-3494-19	Paving- Empress Street, Sta 0+800.000 WG to Sta 0+920.000 WG	A1
P-3494-20	Paving- Empress Street, Sta 0+920.000 WG to Sta 1+040.000 WG	A1
P-3494-21	Paving- Empress Street, Sta 1+040.000 WG to St. Matthews Avenue	A1
P-3494-22	Grading- St. John Ambulance Way, Portage Ave. to Sta 0+200.000 EG	A1
P-3494-23	Grading- St. John Ambulance Way/ Empress Street East, Sta 0+200.000 EG to Sta 0+330.000 EG	A1
P-3494-24	Grading- Empress Street East, Sta 0+330.000 EG to Sta 0+460.000 EG	A1
P-3494-25	Grading- Empress Street East, Sta 0+460.000 EG to Sta 0+590.000 EG	A1
P-3494-26	Grading- Empress Street East, Sta 0+590.000 EG to Sta 0+720.000 EG	A1
P-3494-27	Grading- Empress Street East, Sta 0+720.000 EG to Sta 0+840.000 EG	A1
P-3494-28	Grading- Empress Street East, Sta 0+840.000 EG to Sta 0+960.000 EG	A1
P-3494-29	Grading- Empress Street East, Sta 0+960.000 EG to Sta 1+090.000 EG	A1
P-3494-30	Grading- Empress Street East, Sta 1+090.000 EG to Empress Street	A1
P-3494-31	Grading- Empress Street, Sta 0+410.000 WG to Sta 0+540.000 WG	A1
P-3494-32	Grading- Empress Street, Sta 0+540.000 WG to Sta 0+670.000 WG	A1
P-3494-33	Grading- Empress Street, Sta 0+670.000 WG to Sta 0+800.000 WG	A1
P-3494-34	Grading- Empress Street, Sta 0+800.000 WG to Sta 0+920.000 WG	A1
P-3494-35	Grading- Empress Street, Sta 0+920.000 WG to Sta 1+040.000 WG	A1
P-3494-36	Grading- Empress Street, Sta 1+040.000 WG to St. Matthews Avenue	A1
P-3494-37	Profiles- St. John Ambulance Way, Portage Ave. to Sta 0+200.000 EG	A1
P-3494-38	Profiles- St. John Ambulance Way/ Empress Street East, Sta 0+200.000 EG to Sta 0+330.000 EG	A1
P-3494-39	Profiles- Empress Street East, Sta 0+330.000 EG to Sta 0+460.000 EG	A1
P-3494-40	Profiles- Empress Street East, Sta 0+460.000 EG to Sta 0+590.000 EG- Southbound Lane	A1
P-3494-41	Profiles- Empress Street East, Sta 0+460.000 EG to Sta 0+590.000 EG- Northbound Lane	A1
P-3494-42	Profiles- Empress Street East, Sta 0+590.000 EG to Sta 0+691.283 EG- Southbound Lane	A1

<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
P-3494-43	Profiles- Empress Street East, Sta 0+590.000 EG to Sta 0+720 EG- Northbound Lane	A1
P-3494-44	Profiles- Empress Street East, Sta 0+720.000 EG to Sta 0+840 EG- Northbound Lane	A1
P-3494-45	Profiles- Empress Street East, Sta 0+840.000 EG to Sta 0+960 EG- Northbound Lane	A1
P-3494-46	Profiles- Empress Street East, Sta 0+960.000 EG to Sta 1+090 EG- Northbound Lane	A1
P-3494-47	Profiles- Empress Street East, Sta 1+090.000 EG to Empress Street- Northbound Lane	A1
P-3494-48	Profiles- Empress Street, Sta 0+410.000 WG to Sta 0+540.000 WG	A1
P-3494-49	Profiles- Empress Street, Sta 0+540.000 WG to Sta 0+670.000 WG	A1
P-3494-50	Profiles- Empress Street, Sta 0+670.000 WG to Sta 0+800.000 WG	A1
P-3494-51	Profiles- Empress Street, Sta 0+800.000 WG to Sta 0+920.000 WG	A1
P-3494-52	Profiles- Empress Street, Sta 0+920.000 WG to Sta 1+040.000 WG	A1
P-3494-53	Profiles- Empress Street, Sta 1+040.000 WG to St. Matthews Avenue	A1
P-3494-54	Profiles- Cycle Track, Portage Avenue to Sta 0+400 Track	A1
P-3494-55	Profiles- Cycle Track, Sta 0+400 Track to Sta 0+660 Track	A1
P-3494-56	Profiles- Cycle Track, Sta 0+660 Track to Sta 0+920 Track	A1
P-3494-57	Profiles- Cycle Track, Sta 0+920 Track to Sta 1+180 Track	A1
P-3494-58	Profiles- Cycle Track, Sta 1+180 Track to Sta 1+440 Track	A1
P-3494-59	Profiles- Cycle Track, Sta 1+440 Track to St. Matthews Avenue	A1
P-3494-60	Profiles- Multi-Use Path East of Hydro Substation, Sta 0+100.000 to Sta 0+226.423	A1
P-3494-61	Cross Sections- Sections 1,2,3, & 4 and Delineator Strip Detail	A1
P-3494-62	Cross Sections- Sections 5,6,7, & 8	A1
P-3494-63	Cross Sections- Sections 9,10, & 11	A1
P-3494-64	Cross Sections- Sections 12 & 13	A1
P-3494-65	Cross Sections- Sections 14 & 15	A1
P-3494-66	Cross Sections- Sections 16 & 17	A1
P-3494-67	Details- Various	A1
P-3494-68	Geotechnical- Plan and Sections, Portage Avenue to St. Matthews Avenue	A1
P-3494-69	Landscaping- St. John Ambulance Way, Portage Ave. to Sta 0+200.000 EG	A1

<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
P-3494-70	Landscaping- St. John Ambulance Way/ Empress Street East, Sta 0+200.000 EG to Sta 0+330.000 EG	A1
P-3494-71	Landscaping- Empress Street East, Sta 0+330.000 EG to Sta 0+460.000 EG	A1
P-3494-72	Landscaping- Empress Street East, Sta 0+460.000 EG to Sta 0+590.000 EG	A1
P-3494-73	Landscaping- Empress Street East, Sta 0+590.000 EG to Sta 0+720.000 EG	A1
P-3494-74	Landscaping- Empress Street East, Sta 0+720.000 EG to Sta 0+840.000 EG	A1
P-3494-75	Landscaping- Empress Street East, Sta 0+840.000 EG to Sta 0+960.000 EG	A1
P-3494-76	Landscaping- Empress Street East, Sta 0+960.000 EG to Sta 1+090.000 EG	A1
P-3494-77	Landscaping- Empress Street East, Sta 1+090.000 EG to Empress Street	A1
P-3494-78	Landscaping- Empress Street, Sta 0+410.000 WG to Sta 0+540.000 WG	A1
P-3494-79	Landscaping- Empress Street, Sta 0+540.000 WG to Sta 0+670.000 WG	A1
P-3494-80	Landscaping- Empress Street, Sta 0+670.000 WG to Sta 0+800.000 WG	A1
P-3494-81	Landscaping- Empress Street, Sta 0+800.000 WG to Sta 0+920.000 WG	A1
P-3494-82	Landscaping- Empress Street, Sta 0+920.000 WG to Sta 1+040.000 WG	A1
P-3494-83	Landscaping- Empress Street, Sta 1+040.000 WG to St Matthews Avenue	A1
P-3494-84	Landscaping- Landscape Details & Plant Schedule	A1
P-3494-85	General Notes and Design Data	A1
P-3494-86	General Arrangement and Scope of Work	A1
P-3494-87	North and South Abutment Defect Map and Surface Repairs	A1
P-3494-88	South Pier Cap Defect Map and Surface Repairs	A1
P-3494-89	South Pier Columns Defect Map and Surface Repairs	A1
P-3494-90	Centre Pier Cap Defect Map and Surface Repairs	A1
P-3494-91	North Pier Cap Defect Map and Surface Repairs	A1
P-3494-92	North Pier Columns Defect Map and Surface Repairs	A1
P-3494-93	Centre Pier Rehabilitation 1	A1
P-3494-94	Centre Pier Rehabilitation 2	A1
P-3494-95	Centre Pier Rehabilitation 3	A1
P-3494-96	Centre Pier Rehabilitation 4	A1
P-3494-97	North and South Pier Rehabilitation	A1
P-3494-98	North and South Abutment Rehabilitation	A1
P-3494-99	Miscellaneous Repair Details	A1
P-3494-100	Type 1 Anode Installation Details	A1
P-3494-101	Construction Staging 1	A1
P-3494-102	Construction Staging 2	A1
P-3494-103	Existing Deck and Approach Slab Concrete Cover Readings	A1
P-3494-104	Concrete Removals	A1
P-3494-105	Deck Corrosion Protection Plan & Details	A1
P-3494-106	Structural Concrete	A1
P-3494-107	Structural Concrete and Reinforcing Details	A1
P-3494-108	Barrier Elevations and Joint Details	A1

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<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
P-3494-109	Asphalt Overlay	A1
P-3494-110	Expansion Joint Details	A1
P-3494-111	Expansion Joint Plate Details	A1
P-3494-112	Expansion Slab and Structural Roadway Slab	A1
P-3494-113	Bicycle Rail Details 1	A1
P-3494-114	Bicycle Rail Details 2	A1
P-3494-115	Bicycle Rail Details 3	A1
P-3494-116	Bill of Reinforcing	A1
P-3494-117	General Ramp Plan	A1
P-3494-118	Bore Hole Logs	A1
P-3494-119	Plan	A1
P-3494-120	Geometry	A1
P-3494-121	Elevations	A1
P-3494-122	Cross Sections 1	A1
P-3494-123	Cross Sections 2	A1
P-3494-124	Cross Sections 3	A1
P-3494-125	Cross Sections 4	A1
P-3494-126	Cross Sections 5	A1
P-3494-127	Concrete and Handrail Removals	A1
P-3494-128	Pedestrian Handrail Plan	A1
P-3494-129	Pedestrian Handrail Details 1	A1
P-3494-130	Pedestrian Handrail Details 2	A1
P-3494-131	Pedestrian Handrail Details 3	A1
P-3494-132	Pedestrian Handrail Details 4	A1
P-3494-133	Pedestrian Handrail Details 5	A1
P-3494-134	Pedestrian Handrail Details 6	A1
P-3494-135	Slab on Grade Reinforcement Plan	A1
P-3494-136	Slab on Grade Reinforcement Details	A1
P-3494-137	Drainage Channel Reinforcement Details	A1
P-3494-138	General Arrangement	A1
P-3494-139	Geometry	A1
P-3494-140	Foundation Details	A1
P-3494-141	Pier Details	A1
P-3494-142	Pile and Pier Reinforcement Details	A1
P-3494-143	Abutment and Diaphragm Details 1	A1
P-3494-144	Abutment and Diaphragm Reinforcement Details 1	A1
P-3494-145	Diaphragm Details 2	A1
P-3494-146	Diaphragm Reinforcement Details 2	A1
P-3494-147	Prestressed Slab Details	A1
P-3494-148	Prestressed Slab Reinforcement Details	A1
P-3494-149	Slab on Grade Reinforcement Details	A1
P-3494-150	Bearing Details	A1
P-3494-151	Expansion Joint Details 1	A1
P-3494-152	Expansion Joint Details 2	A1
P-3494-153	Expansion Joint Details 3	A1
P-3494-154	Pedestrian Handrail Plan	A1
P-3494-155	Pedestrian Handrail Details 1	A1
P-3494-156	Pedestrian Handrail Details 2	A1
P-3494-157	Pedestrian Handrail Details 3	A1
P-3494-158	Pedestrian Handrail Details 4	A1
P-3494-159	Drainage Details	A1
P-3494-160	General Arrangement	A1
P-3494-161	Cross Sections 1	A1
P-3494-162	Cross Sections 2	A1

<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
P-3494-163	Concrete and Reinforcing Details	A1
P-3494-164	Bicycle Rail Details 1	A1
P-3494-165	Bicycle Rail Details 2	A1
P-3494-166	Bill of Reinforcing 1	A1
S1	Staging- Stages 1, 2 & 3	11" x 17"
S2	Staging- Stages 4, 5 & 6	11" x 17"
S3	Staging- Stage 7	11" x 17"
S4	Staging- Stages 1, 2 & 3 Enlargement at Jack Blick Ave.	11" x 17"

E1.4 The following are applicable to the Work and provided for reference:

<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
B100-08-01	Empress Overpass Northbound Plan & Section	A1
B100-05-01	Concrete Bridge Deck Surface Sealing Plan & Section	A1
B100-05-02	Concrete Bridge Deck Surface Sealing Wearing Surface Details	A1
B-5072-1	Cover Sheet and Location Plan	A1
B-5072-2	Location of Existing Services and Centreline Profile	A1
B-5072-3	Deck Plan and Elevation of Structure	A1
B-5072-5	Abutment Details	A1
B-5072-6	Pier Details	A1
B-5072-8	Bearing Plate Layout & Details	A1
B-5072-9	Structural Steel Layout & Details	A1
B-5072-10	Expansion, Electrical, & Deck Details	A1
B-5072-11	Deck Reinforcing Layout	A1
B-5072-12	Guardrail & Stair Details	A1
B-5072-S1	Material For: Two Abutments	A1
B-5072-S2	Material For: Pier Beams Three Piers	A1
B-5072-S3	Material For: Deck, Curbs & Sidewalk	A1
B-5072-S4	Material For: Pier Columns & Footings 3 Piers	A1
B-5093-1	Cover Sheet, Design Data & Drawing List	A1
B-5093-2	General Arrangement and Scope of Work	A1
B-5093-3	Roadway Reconstruction Detour – Alternative A Complete Closure on Bridge	A1
B-5093-4	Portage Ave. Traffic Diversion Types	A1
B-5093-5	Temporary Noise and Protection Screen Requirements	A1
B-5093-6	General Elevation and Cross Sections	A1
B-5093-7	Plans Showing Limits of Demolition	A1
B-5093-8	Plans Showing Limits of New Works	A1
B-5093-9	Bearing Details	A1
B-5093-10	Diaphragm Details and Pier Cap Reinforcing	A1
B-5093-11	South Pier Exposed Concrete Surface Repairs	A1
B-5093-12	Center Pier Exposed Concrete Surface Repairs	A1
B-5093-13	North Pier Exposed Concrete Surface Repairs	A1
B-5093-14	Expansion Joint Details	A1
B-5093-15	Concrete & Reinforcing Details Approach Slabs and Sidewalks	A1

<u>Drawing No.</u>	<u>Drawing Name/Title</u>	<u>Drawing (Original) Sheet Size</u>
B-5093-16	Concrete and Reinforcing Details – Deck Slab	A1
B-5093-17	Concrete & Reinforcing Details Median and Should Traffic Barriers	A1
B-5093-18	Abutment Modifications and Backwall Reinforcing Details	A1
B-5093-19	Aluminum Pedestrian Handrail Details 1	A1
B-5093-20	Aluminum Pedestrian Handrail Details 2	A1
B-5093-21	Aluminum Traffic Barrier Rail Standard Details	A1
B-5093-22	Aluminum Pedestrian Handrails North and South Stairs	A1
B-5093-23	Reconstruction of Concrete Slope Paving and Approach Soil Stabilization	A1
B-5093-24	Reinforcing Steel Schedule Alternative A	A1
B-5093-25	Reinforcing Steel Schedule Alternative A	A1
B-5093-26	Roadway Reconstruction Plan and Profile	A1
B-5093-27	Roadway Reconstruction Details	A1
B-5093-28	Layout of Balance Aluminum Shoulder Barrier and Details	A1
B-5093-29	Balance Shoulder Barrier Standard Detail	A1
B-5093-30	Portage Avenue Median Reconstruction	A1
B-5093-31	Miscellaneous Details	A1
B-5093-32	Guardrail Energy Absorbing Terminal Standard Details	A1
B-5093-33	Guardrail Energy Absorbing Terminal Location Plan	A1

E2. GEOTECHNICAL AND STRUCTURAL REPORTS

- E2.1 Further to C3.1, the geotechnical reports are provided to aid the Contractor's evaluation of the pavement structure, existing soil conditions, and to aid the Contractor's evaluation of the rock socketed-caissons foundations. The geotechnical reports are contained in Appendix 'A'.
- E2.2 Further to C3.1, the report on the resistivity testing of the Empress Overpass substructure is provided to aid the Contractor's design of an Electrochemical Chloride Extraction system and methodology. The resistivity testing report is contained in Appendix 'B'.
- E2.3 Further to C3.1, the specifications used for the 1990 Empress Overpass rehabilitation project are provided to aid the Contractor's evaluation of the existing structure. The specifications are contained in Appendix 'E'.

E3. OFFICE FACILITIES

- E3.1 The Contractor shall supply office facilities meeting the following requirements:
- (a) The field office shall be for the exclusive use of the Contract Administrator.
 - (b) The building shall be conveniently located near the site of the Work.
 - (c) The building shall have a minimum floor area of 30 square metres, a height of 2.4m with two windows for cross ventilation and a door entrance with a suitable lock.
 - (d) The building shall be suitable for all weather use. It shall be equipped with an electric heater and air conditioner so that the room temperature can be maintained between either 16-18°C or 24-25°C.
 - (e) The building shall be adequately lighted with fluorescent fixtures and have a minimum of three wall outlets.
 - (f) The building shall be furnished with one desk, one drafting table, table 3m X 1.2m, one stool, one four drawer legal size filing cabinet, and a minimum of 15 chairs.

- (g) A portable toilet shall be located near the field office building. The toilet shall have a locking door and be for the exclusive use of the Contract Administrator and other personnel from the City.
- (h) The field office building 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/she deems it necessary.

E3.2 The Contractor shall be responsible for all installation and removal costs, all operating costs, and the general maintenance of the office facilities.

E3.3 The office facilities will be provided from the date of the commencement of the Work to the date of Total Performance.

E4. CONTRACTOR PARKING

E4.1 Parking of private work force vehicles within the work zone without prior written authorization from the Contract Administrator is prohibited. Requests to the Contract Administrator for private work force vehicle parking must include the reason for the request, the time frame of the request, description of any parking alternatives that were considered by the Contractor but not deemed feasible and a description of the specific location intended to accommodate the parking.

E5. SHOP DRAWINGS

E5.1 Description

- (a) This Specification provides instructions for the preparation and submission of Shop Drawings. 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) Further to C6.9, the Contractor shall arrange for the preparation of Shop Drawings required by the Contract, or as reasonably required by the Contract Administrator.
- (c) The Contractor shall submit to the Contract Administrator for review, all specified Shop Drawings. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be shown on all submissions for the Contract Administrator's review.

E5.2 Shop Drawings

- (a) Original drawings shall be prepared by the Contractor, to illustrate the appropriate portion of Work including fabrication, layout, setting, or erection details as specified in the appropriate sections.
- (b) Shop Drawings shall bear the seal of a Professional Engineer licensed to practice in the province of Manitoba.
- (c) Shop Drawings shall be prepared by the Contractor.

E5.3 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; and
 - (iii) Catalogue numbers and similar data.
- (c) Coordinate each submission with requirement of Work and Contract Documents. Individual Shop Drawings will not be reviewed until all related drawings are available.

- (d) Promptly submit Shop Drawings in an orderly sequence to prevent delay in the Work or the Work of other Contractors.
- (e) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.
- (f) 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.
- (g) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- (h) 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.
- (i) After Contract Administrator's review and return of copies, distribute copies to Subcontractors and others as appropriate.
- (j) 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.

E5.4 Submission Requirements

- (a) Allow for a ten (10) Business Day period for review by the Contract Administrator of each individual submission and re-submission, unless otherwise noted in the Contract Documents.
- (b) 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; and
 - (vii) Other pertinent data.
- (c) Submissions shall include:
 - (i) Date and revision dates; and
 - (ii) Project title and Bid Opportunity number.
- (d) Name of:
 - (i) Contract;
 - (ii) Subcontractor;
 - (iii) Supplier;
 - (iv) Manufacturer;
 - (v) Detailer (if applicable);
 - (vi) Identification of product or material;
 - (vii) Relation to adjacent structure or materials;
 - (viii) Field dimensions, clearly identified as such;
 - (ix) Specification section name, number, and clause number or drawing number and detail/section number;
 - (x) Applicable standard, such as CSA or CGSB numbers; and
 - (xi) Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

E5.5 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, resubmissions, and review of the Shop Drawings.

E6. PROTECTION OF EXISTING TREES

- E6.1 The Contractor shall take the following precautionary steps to prevent damage from construction activities to existing trees within the limits of the construction area:
- (a) All trees shall have a 3 m radius protective zone calculated from the circumference at the base of the trunk which will remain free of digging, trenching, grade changes, stock piling of materials and soil compaction, unless otherwise agreed to by the City and Contract Administrator throughout the duration of the Contract. Protective fencing around these areas is required.
 - (b) Trees within and immediately adjacent to proposed construction and those identified to be at risk by the Contract Administrator are to be strapped with 25 x 100 x 2400 mm wood planks, or suitably protected as approved by the Contract Administrator. Do not use nails or other fasteners that penetrate the tree trunk. The width and length of strapping may be reduced to suit the tree being 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 1.5 times the diameter (measured in inches) where 1 inch diameter equals 1 foot measured from the outside edge of the trunk of the tree at 6 inches above grade. Where roots must be cut to facilitate excavation, they shall be pruned neatly at the face of excavation. They must be properly trimmed with sharp tools to prevent crushing or being pulled by construction equipment. No paint is required. All exposed roots must be mulched until the excavated area is filled with clean earth to avoid exposure to sunlight and desiccation.
 - (d) Operation of equipment within the dripline 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 driplines of trees. The dripline of a tree shall be considered to be the ground surface directly beneath the tips of its outermost branches. The Contractor shall 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. Where damage to branches does occur, they shall be neatly pruned.
 - (f) Repair, replace and maintain tree protection materials during construction until the Project completion.
 - (g) Carefully remove safety fencing and strapping material without harming the tree as soon as the construction and restoration Work is complete.
- E6.2 The three trees along the north side of Portage Avenue near the North Accessibility Ramp are to be pruned as required for the construction and to provide a minimum 2.5 m clearance from the finished walking surface of the ramp. Pruning shall be kept to the minimum necessary and all reasonable steps shall be taken to prevent damage to these trees.
- E6.3 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/her designate.

- E6.4 No separate measurement or payment will be made for the protection of trees.
- E6.5 Except as required in clause E6.1, Elm trees shall not be pruned at any time between April 1 and July 31.

E7. TRAFFIC CONTROL

- E7.1 Further to clauses 3.6, 3.7 and 3.8 of CW 1130:
- (a) Where directed by the Contract Administrator, the Contractor shall construct and maintain temporary asphalt ramps to alleviate vertical pavement obstructions such as manholes and planing drop-offs to the satisfaction of the Contract Administrator. Payment shall be in accordance with CW3410.
 - (b) In accordance with the Manual of Temporary Traffic Control on City Streets (MTTC), the Contractor ("Construction Agency" in the manual) shall be responsible for placing, maintaining and removing the appropriate temporary traffic control devices as specified by the MTTC or by the Traffic Management Branch of the City of Winnipeg Public Works Department. The Contractor shall bear all costs associated with the placement of temporary traffic control devices by their own forces or subcontractor.
- E7.2 Notwithstanding E7.1, in accordance with the MTTC, the Contract Administrator shall make arrangements with the **Traffic Services Branch of the City of Winnipeg** to place, maintain, and remove all **regulatory signs** and traffic control devices authorized and/or required by the Traffic Management Branch in the following situations:
- (a) Parking restrictions,
 - (b) Stopping restrictions,
 - (c) Turn restrictions,
 - (d) Diamond lane removal,
 - (e) Full or directional closures on a Regional Street,
 - (f) Traffic routed across a median,
 - (g) Full or directional closure of a non-regional street where there is a requirement for regulatory signs (turn restrictions, bus stop relocations, etc.) to implement the closure.
 - (h) Approved Designated Construction Zones with a temporary posted speed limit reduction. Traffic Services will be responsible for placing all of the advance signs and 'Construction Ends' (TC-4) signs. The Contractor is still responsible for all other temporary traffic control including but not limited to barricades, barrels and tall cones.
- E7.2.1 An exception to E7.2 is the 'KEEP RIGHT/KEEP LEFT' sign (RB-25 / RB-25L) which shall be supplied, installed, and maintained by the Contractor at their own expense.
- E7.2.2 Further to E7.2, where the Contract Administrator has determined that the services of the Traffic Services Branch are required, the City shall bear the costs associated with the placement of temporary traffic control devices by the Traffic Services Branch of the City of Winnipeg in connection with the works undertaken by the Contractor.

E8. TRAFFIC MANAGEMENT

- E8.1 Further to clause 3.7 of CW 1130:
- (a) Single lane closures on intersecting and/or adjoining Regional Streets shall only be permitted during non-peak periods when required for construction activities when approved by the Traffic Management Branch. Storage/parking of materials, equipment or vehicles is not permitted on Regional Streets at any time unless approved by the Contract Administrator, in consultation with the Traffic Management Branch.
- E8.1.1 During rock fill rib construction, the Contractor will be allowed to close one northbound lane of Empress Street to traffic.

- E8.1.2 The Contractor shall follow the staging plan shown on the Drawings.
- E8.1.3 When no work is being performed on Site, non-essential lane closures will not be permitted.
- E8.1.4 Maintain a minimum of two lanes of traffic in each direction on Portage Avenue at all times during construction.
- E8.1.5 Flag persons may be necessary to maintain the flow of traffic during certain work operations.
- E8.1.6 Should the Contractor be unable to maintain pedestrian or vehicular access to a residence or business, he/she shall review the planned disruption with the business or residence and the Contract Administrator, and take reasonable measures to minimize the impact. The Contractor shall provide a minimum of 24 hours notification to the affected residence or business and the Contract Administrator, prior to disruption of access.
- E8.1.7 Pedestrian access must be maintained at all times.
- E8.1.8 Ambulance/emergency vehicle access must be maintained at all times.

E9. WATER OBTAINED FROM THE CITY

- E9.1 Further to clause 3.7 of CW 1120, the Contractor shall pay for all costs, including sewer charges, associated with obtaining water from the City in accordance with the Waterworks and Sewer By-laws.

E10. SURFACE RESTORATIONS

- E10.1 Further to clause 3.3 of CW 1130, when Total Performance is not achieved in the year the Contract is commenced, the Contractor shall temporarily repair any Work commenced and not completed to the satisfaction of the Contract Administrator. The Contractor shall maintain the temporary repairs in a safe condition as determined by the Contract Administrator until permanent repairs are completed. The Contractor shall bear all costs associated with temporary repairs and their maintenance.

E11. SITE DEVELOPMENT

DESCRIPTION

- E11.1 General
 - E11.1.1 This Specification shall cover the following site development items:
 - (a) Construction of temporary access ramps and working platforms to undertake work for slope stabilization;
 - (b) Removal of temporary access ramps and working platforms prior to spring flood.
 - E11.1.2 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.
 - E11.1.3 The Contractor shall be responsible to develop and maintain site access.
- E11.2 Submittals
 - E11.2.1 At least five (5) days prior to commencement of construction, the Contractor shall submit a Site Access Plan for acceptance by the Contract Administrator to facilitate installation of slope stabilization works (rockfill ribs, riprap and clay toe berm). The Site Access Plan shall include sufficient detail for the Contract Administrator to determine that the proposed access ramps and working platforms will be in accordance with these Specifications and will not adversely impact riverbank stability for the duration of the project. Acceptance of

the Site Access Plan shall not diminish the Contractor's responsibility for development and maintenance of site access, and adherence to the conditions of the City of Winnipeg Waterway Permit.

- E11.2.2 The Site Access Plan shall include a plan view layout, typical cross sections, and sequencing of any access ramps from the top of the bank area onto the banks and any working platforms.
- E11.2.3 As the work proceeds, any changes required to the temporary access deviating from the Site Access Plan shall be provided to the Contract Administrator for review and acceptance prior to modifying the access works.

MATERIALS

E11.3 Fills

- E11.3.1 The Contractor shall be responsible for supplying all fill or other materials that the Contractor may deem suitable for its operations, for construction and maintenance of access ramps and working platforms. Any native soil sub-excavated to offset imported fill or granular surfacing materials in order to achieve a balance of cut and fill shall be hauled and disposed either off-site or at an approved on-site stockpile location immediately following excavation.
- E11.3.2 Rockfill used for temporary access works may be accepted by the Contract Administrator for backfilling of rockfill ribs, if the materials satisfy the specifications for rockfill rib backfill.
- E11.3.3 Riprap used for temporary access works may be accepted by the Contract Administrator for placement as permanent riprap, if the materials satisfy the specifications for riprap.

CONSTRUCTION METHODS

E11.4 Site Access Development

- E11.4.1 The Contractor shall be responsible for developing and maintaining suitable site access. This includes but is not limited to temporary bridging over structures, temporary removal and reinstallation of safety fencing, and restoring the site prior to the spring flood.
- E11.4.2 The Contract Administrator may require that the Contractor retains a geotechnical engineer, at no cost to the City, to review the Site Access Plan and confirm the proposed access works will not adversely impact riverbank stability.
- E11.4.3 The Contractor's site access routes shall not require the removal of any trees or shrubs which are not shown on the Drawings to be removed.

E11.5 Waterways Permit for Temporary Access Works

- E11.5.1 The temporary access works will be included in the Work covered under the Waterways Permit for the project, to be obtained and paid for by the City. However, depending on the limits or grades proposed by the Contractor, the Contractor may be required to submit an application for a new or amended permit for their temporary works. Contact Kendall Thiessen, Riverbank Management Engineer (ph. 204-986-5159) for information regarding Waterways Permits.
- E11.5.2 The Contractor is responsible for obtaining and paying for all required permits and permissions that are necessary for site development, notwithstanding the original Waterway Permit for the Project paid for by the City described in E11.5.1, including an additional Waterways Permit (if required) from the City.

E11.6 Site Accesses

- E11.6.1 Tree protection, tree removals and clearing and grubbing shall be performed in accordance with E5, E29, and CW 3010 respectively.
- E11.6.2 Snow cover shall be cleared from the riverbank and hauled off-site prior to placement of the riprap, construction of the rockfill ribs, or construction of the clay toe berm. The

methodology to clear the snow may be subject to the acceptance of the Contract Administrator. Ice at the shoreline of the river or creek shall be broken and cleared before placement of riprap below ice level. Care shall be taken to ensure that the ice is removed, and does not become trapped below riprap.

E11.6.3 The Contractor shall erect and maintain a safety fence for the duration of the slope stabilization works, to restrict access to the Site. The fencing shall enclose the entire Site with appropriate gates or openings that are closed at the end of each work day. Appropriate signs shall be erected to warn all recreational users of the site that hazards exist. Fence construction on the riverbank shall consist of orange plastic safety fence with a minimum height of 1.2 metres supported by posts driven into the ground. The posts shall be sized and capable of maintaining the safety fence upright, regardless of conditions. The Contractor shall maintain the fences condition throughout the Work. Upon completion of the slope stabilization works, all fence materials shall be removed and disposed of off-site.

E11.6.4 Stockpiling

- (a) The rate at which materials are delivered to the Site shall be controlled to minimize stockpiling and handling.
- (b) The Contractor shall review his proposed stockpile locations with the Contract Administrator prior to establishing stockpiles of material. The Contract Administrator will review stockpile locations relative to overall bank stability.
- (c) No stockpiles shall remain on the working platforms overnight unless placed on top of backfilled ribs
- (d) Stockpiled material shall be handled and maintained in a manner that prevents contamination with other soils and materials, debris, snow or excess moisture. Contaminated material shall be removed and replaced at the Contractor's own expense.
- (e) Stockpiles shall be maintained to prevent release of fine grain sediments into the watercourse.

E11.6.5 The Contractor shall remove the access ramps and working platforms upon completion of slope stabilization works by regrading the riverbank to the grades shown on the Drawings. Placement and compaction of fill to restore areas of temporary excavation shall be done in accordance with CW 3170.

MEASUREMENT AND PAYMENT

E11.7 Site Access and Working Platforms

E11.7.1 There will be no separate measurement for the work associated with this Specification. Payment for construction, maintenance or removal of site access ramps and working platforms is to be included with the price for either "Construction of Rockfill Ribs", "Supply and Place Class 350 Riprap", or "Fill Material, Placing Suitable Site Material" associated with Assiniboine River Stabilization.

E12. HYDRO-EXCAVATION

DESCRIPTION

E12.1 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 excavated material by vacuum type means or equivalent method as approved by the Contract Administrator.

CONSTRUCTION METHODS

E12.2 Hydro-Removal of Earthen Material

- E12.2.1 The Contractor shall only be compensated for hydro-excavation undertaken with prior permission of the Contract Administrator.
- E12.2.2 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. Expose the buried utility by using a sweeping motion only, perpendicular to the locate markings, until the line is sighted. After sighting, the line shall not be contacted by spray or vacuum to avoid damage.
- E12.2.3 Maximum settings when excavating within 1 m of marked utilities will be 38°C (100°F) temperature and 10,342 kPa (1500 psi) pressure.
- E12.3 Recovery of Excavated Material
- E12.3.1 The recovery of excavated material shall be done using a vacuum type method, or other type method as approved by the Contract Administrator.
- E12.3.2 The recovery of material shall follow immediately behind the excavation, to avoid excavated areas from filling with excavated material.
- E12.3.3 The use of mechanical sweepers will not be allowed.
- E12.3.4 Dispose of material in accordance with Section 3.4 or CW 1130-R1.
- E12.4 Backfill of Hydro Excavated Material
- E12.4.1 The Contractor shall be responsible for the backfill of the hydro excavated hole upon acceptance of the Work described herein by the Contract Administrator.

MEASUREMENT AND PAYMENT

- E12.5 Hydro-Excavation
- E12.5.1 Hydro-Excavation of earthen material and its recovery and disposal as well as backfilling the hole will be measured on an hourly basis and paid for at 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 completed in accordance with this Specification, accepted and measured by the Contract Administrator.

E13. CONDUIT INSTALLATION

DESCRIPTION

- E13.1 This Specification shall cover the excavation, installation and backfill of utility-supplied conduits.

MATERIALS

- E13.2 Conduit will be supplied by the Utility. Material damaged or lost after it has been delivered shall be replaced and paid for by the Contractor with new material from the Utility.
- E13.3 The Contractor shall be responsible to furnish sand backfill material. The cost of furnishing materials shall be incorporated into the Unit Prices for the work.

CONSTRUCTION METHODS

- E13.4 The Contractor shall install conduit where shown on the Drawings or as directed by the Contract Administrator.
- E13.5 The Contractor shall furnish all materials and labour and supplies necessary for the completion and maintenance of grade and line of the conduit including water control if found to be necessary. The trench shall be graded to conform to the conduit so that the conduit rests firmly on a smooth surface throughout its length. All stones or other objects which, in the opinion of the Contract Administrator might damage the conduit shall be removed. Where the presence of rock or other condition prevent a satisfactory bed for the cables, 150 mm of well-tamped, clean

soil or ¼ down crushed limestone shall be placed in the bottom of the trench. In this case, the spoil bank from trenching operations shall not be allowed to fall into the trench or mix with the soil to be used in backfilling the trench. Loose debris or foreign matter and the spoil bank shall be placed so as not to hinder drainage, damage property, or obstruct traffic.

E13.6 Trenches shall be dug to such a depth that will provide a minimum cover of 750 mm from final grade in sodded areas and 1200 mm in roadways.

E13.7 The Contractor shall lay the conduit in the prepared excavation.

E13.8 Excavations shall be backfilled with clean sand and compacted in lifts of 150 mm.

MEASUREMENT AND PAYMENT

E13.9 Conduit Installation

E13.9.1 Conduit installation will be measured on a length basis. The length to be paid for shall be the total number of linear metres of trench excavated measured horizontally at grade regardless of the number of conduits placed in the trench. Conduit installation will be paid for at the Contract Unit Price for "Conduit Installation", which price shall be payment in full for performing all operations described in this Specification.

E14. PRE-CAST CONCRETE TRAFFIC BARRIERS

E14.1 Description

E14.1.1 This Specification covers the pick-up, installation, maintenance, and return of pre-cast concrete traffic barriers as indicated on the Drawings.

E14.1.2 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.

E14.2 Scope of Work

E14.2.1 The Work under this Specification shall involve:

- (a) Transporting (including loading) temporary precast concrete traffic barriers to project site and installation on site;
- (b) Removing from site and transporting (including unloading) temporary precast concrete traffic barriers;
- (c) Maintaining the precast concrete traffic barriers in position on site throughout the project as part of the overall work and traffic management plans (no additional payment for maintenance).

E14.3 Materials

E14.3.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall 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.

E14.3.2 Precast Concrete Barriers

- (a) The contractor shall arrange to pick-up, load, deliver, and upload the precast concrete barriers to the Site from the City of Winnipeg Bridge Yard at 960 Thomas Avenue and pick-up, load, deliver and unload the precast concrete barriers to the City of Winnipeg

Bridge Yard at 960 Thomas Avenue from Site by contacting Mike Terleski at 204-794-8510

E14.4 Equipment

E14.4.1 General

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

E14.5 Construction Methods

E14.5.1 Transporting Precast Concrete Barriers

- (a) The Contractor shall be responsible for the pickup and delivery of the pre-cast concrete barriers and all applicable components to the site. The Contractor shall supply equipment capable of lifting and loading the barriers at the City yard and safely transporting to, and unloading the barriers at the site. Any damage occurring to the barriers during loading, transporting and unloading shall be repaired at the Contractor's expense.
- (b) Prior to leaving the yard the Contractor's personnel shall inspect the barriers in conjunction with City personnel and note any obvious damage. The Contractor shall provide the Contract Administrator with a written description of any damage noted prior to transportation of the barriers.
- (c) The City will supply the contractor with all precast concrete barriers required for the project. These barriers will be available to the contractor as specified in this bid opportunity.
- (d) A minimum of twenty-four (24) hours' notice is required prior to pick up of the barriers. Once the barriers have reached the Site they shall be carefully unloaded, placed and assembled at the locations shown on the Drawings.

E14.5.2 Installation of Precast Concrete Barriers

- (a) Precast concrete barriers shall be installed in proper vertical and horizontal alignment and properly connected and terminated to the satisfaction of the Contract Administration.
- (b) Schedules for installing or removing the precast concrete barriers shall be approved by the Contract Administrator prior to any Work beginning on those items.

E14.5.3 Maintain and adjust temporary concrete barriers as required through the duration of the Project, the maintenance and adjustment to temporary precast concrete barriers shall be deemed incidental to the Work.

E14.5.4 Removal and Transportation of Precast Concrete Barriers

- (a) The Contractor shall be responsible for the removal and delivery of the precast concrete barriers and all applicable components from Site. The Contractor shall return all barriers to the City Bridge Yard. The Contractor shall supply all necessary equipment to unload and return the barriers to their designated locations within the City Bridge Yard. Any damage occurring to the barriers during loading, transporting, and unloading shall be repaired at the Contractor's expense. Any missing items or components originally supplied by the City shall be replaced at the Contractor's expense. Upon return of the barriers, the Contractor's personnel and City's personnel shall inspect and inventory the barriers and all applicable components.

E14.6 Quality Control

E14.6.1 Inspection

- (a) All workmanship and materials furnished and supplied under this Specification are subject to the close and systematic inspection by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.

- (b) 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.

E14.6.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times.

E14.7 Measurement and Payment

E14.7.1 Temporary Precast Concrete Traffic Barriers

- (a) Placing precast concrete traffic barriers will be measured on a unit basis. This Item of Work will be paid for at the Contract Unit Price per unit for "City Supplied Precast Concrete Traffic Barriers", which price shall be payable in full for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.
- (b) Payment for the precast concrete traffic barriers will be 50% of the unit price for each unit being placed to the satisfaction of the Contract Administrator and 50% of the unit price for each unit returned to the yard as accepted by the Contract Administrator.

E15. REMOVE AND SALVAGE EXISTING OVERHEAD SIGN STRUCTURE

DESCRIPTION

- E15.1 This Specification shall cover the removal and salvaging of the existing cantilever overhead sign structure on northbound Empress Street approaching St. Matthews Avenue.

CONSTRUCTION METHODS

E15.2 Remove and Salvage Existing Overhead Sign Structure

- E15.2.1 The Contractor shall submit a Removal Procedure Plan including details of traffic control to the Contract Administrator for review and approval. The Removal Procedure Plan shall be submitted at least five (5) days prior to starting his Work.
- E15.2.2 The Contractor shall never lift an overhead sign structure or member over traffic.
- E15.2.3 The Contractor shall remove the existing sign support carefully without damaging the existing anchor bolts or adjacent property.
- E15.2.4 All structures including hardware shall be delivered to the City of Winnipeg Bridge Storage Yard at 960 Thomas Avenue, Winnipeg, Manitoba. At the storage yard, the Contractor shall off-load the salvaged material with his own labour and equipment and place in the designated location indicated by the City Bridge Inspectors and as directed by the Contract Administrator.
- E15.2.5 The Contractor shall contact Mike Terleski (ph. (204) 794-8510) at the City of Winnipeg Bridge Operations to arrange for delivery.
- E15.2.6 Any damage to the structure or hardware that has not been identified prior to removal will be repaired or replaced by the City at the Contractor's expense.

MEASUREMENT AND PAYMENT

E15.3 Remove and Salvage Existing Overhead Sign Structure

- E15.3.1 Removal and salvage of existing overhead sign structures will be measured on a unit basis and paid for at the Contract Unit Price for "Remove and Salvage Existing Overhead Sign Structure". The number to be paid for will be the total number of structures removed, salvaged, delivered and unloaded in accordance with this Specification, accepted and measured by the Contract Administrator.

E16. MISCELLANEOUS REMOVALS

DESCRIPTION

E16.1 This Specification shall cover the miscellaneous removals listed below.

CONSTRUCTION METHODS

E16.2 Remove and Salvage Existing Crash Attenuation Unit

E16.2.1 The Contractor shall remove the existing crash attenuation shown on the Drawings.

E16.2.2 The crash attenuation unit including all hardware shall be delivered to the City of Winnipeg Bridge Storage Yard at 960 Thomas Avenue, Winnipeg, Manitoba. At the storage yard, the Contractor shall off-load the salvaged material with his own labour and equipment and place in the designated location indicated by the City Bridge Inspectors and as directed by the Contract Administrator.

E16.2.3 The Contractor shall contact Mike Terleski (ph. 204-794-8510) at the City of Winnipeg Bridge Operations to arrange for delivery.

E16.2.4 Any damage to the crash attenuation unit or hardware that has not been identified prior to removal will be repaired or replaced by the City at the Contractor's expense.

E16.3 Removal of Existing F-Shape Barrier

E16.3.1 Remove existing concrete F-shape barrier at locations as shown on the Drawings or as directed by the Contract Administrator.

E16.3.2 Ensure removal methods do not chip or damage any pavement or curbs which are to remain.

E16.3.3 Remove any barrier reinforcing steel included in the barrier.

E16.3.4 Dispose of removed barrier in accordance with Section 3.4 of CW 1130.

E16.4 Removal of Bollards

E16.4.1 Before commencement of any work, the Contractor shall consult with the Contract Administrator as to which bollards shall be removed.

E16.4.2 The Contractor shall remove all bollards designated for removal including any concrete bases to 1 metre below proposed grade. The Contractor shall load and haul all materials from the site and dispose of these materials in accordance with Section 3.4 of CW 1130.

E16.5 Removal of Pre-Cast Sidewalk Blocks

E16.5.1 Remove existing pre-cast concrete sidewalk blocks where shown on the Drawings or as directed by the Contract Administrator.

E16.5.2 Dispose of pre-cast concrete sidewalk blocks in accordance with Section 3.4 of CW 1130.

E16.6 Remove Post and Chain Fence

E16.6.1 Remove post and chain fence where shown on the Drawings or as directed by the Contract Administrator.

E16.6.2 Dispose of wood posts and chain in accordance with Section 3.4 of CW 1130.

E16.7 Remove Wood Plank Fence

E16.7.1 Remove wood plank fence where shown on the Drawings or as directed by the Contract Administrator.

E16.7.2 Dispose of wood posts and planks in accordance with Section 3.4 of CW 1130.

E16.8 Remove and Salvage Existing Limestone Planter Blocks

- E16.8.1 Contractor shall remove existing limestone planter blocks/ wall as required to facilitate asphalt path construction near the approach to the Omand's Creek path bridge as shown on the Drawings.
- E16.8.2 The limestone planter blocks shall be relocated on the Site to a location as directed by the Contract Administrator.
- E16.8.3 Any damage to the blocks that has not been identified prior to removal will be repaired or replaced by the City at the Contractor's expense.

MEASUREMENT AND PAYMENT

E16.9 Remove and Salvage Existing Crash Attenuation Unit

- E16.9.1 Remove and salvage existing crash attenuation unit will be measured on a unit basis and paid for at the Contract Unit Price for "Remove and Salvage Existing Crash Attenuation Unit". The number to be paid for will be the total number of units removed, salvaged, delivered and unloaded in accordance with this Specification, accepted and measured by the Contract Administrator.

E16.10 Removal of Existing F-Shape Barrier

- E16.10.1 Removal and disposal of F-Shape barrier will be measured on a length basis and paid for at the Contract Unit Price for "Removal of Existing F-Shape Barrier". The length to be paid for will be the total number of meters removed and disposed of in accordance with this Specification, accepted and measured by the Contract Administrator

E16.11 Removal of Bollards

- E16.11.1 Removal and disposal of bollards will be measured on a unit basis and paid for at the Contract Unit Price for "Removal of Bollards". The number to be paid for will be the total number of bollards removed and disposed of in accordance with this Specification, accepted and measured by the Contract Administrator.
- E16.11.2 No separate measurement or payment shall be made for the removal and disposal of any concrete bases

E16.12 Removal of Pre-Cast Sidewalk Blocks

- E16.12.1 Removal of pre-cast concrete sidewalk blocks will be measured on an area basis and paid for at the Contract Unit Price for "Removal of Pre-Cast Sidewalk Blocks". The area to be paid for will be the total number of square meters removed and disposed of in accordance with this Specification, accepted and measured by the Contract Administrator

E16.13 Remove Post and Chain Fence

- E16.13.1 Removal and disposal of post and chain fence will be measured on a length basis and paid for at the Contract Unit Price for "Remove Post and Chain Fence". The length to be paid for will be the total number of meters removed and disposed of in accordance with this Specification, accepted and measured by the Contract Administrator.

E16.14 Remove Wood Plank Fence

- E16.14.1 Removal and disposal of wood plank fence will be measured on a length basis and paid for at the Contract Unit Price for "Remove Wood Plank Fence". The length to be paid for will be the total number of meters removed and disposed of in accordance with this Specification, accepted and measured by the Contract Administrator.

E16.15 Remove and Salvage Existing Limestone Planter Blocks

- E16.15.1 Remove and salvage existing limestone planter blocks will not be measured. This item shall be paid for at the Contract Lump Sum Price for "Remove and Salvage Existing Limestone Planter Blocks", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials

and for performing all operations herein described and all other items incidental to the Work.

E17. CONCRETE WORKS

DESCRIPTION

- E17.1 This Specification shall supplement and amend CW 3310-R17 – “Portland Cement Concrete Pavement Works”.
- E17.2 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 an incidental to the satisfactory performance and completion of all work hereinafter specified.

MATERIALS

- E17.3 All materials shall be as specified in CW 3310-R17.

CONSTRUCTION METHODS

- E17.4 230 mm Plain-Dowelled Concrete
- E17.4.1 The Contractor shall utilize slip-form paving methods wherever possible, as determined by the Contract Administrator.
- E17.5 F-Shape Barriers
- E17.5.1 Single-sided and double-sided F-shape barriers shall be constructed to the dimensions and at the locations shown on the Drawings.
- E17.5.2 Reinforcing steel shall be installed as per the Drawings or as directed by the Contract Administrator.
- E17.5.3 Transition sections to or from F-shape barriers to other shapes shall be constructed to the dimensions and at the locations shown on the Drawings or as directed by the Contract Administrator.
- E17.6 Concrete Barrier Curb
- E17.6.1 The Contractor shall pour concrete barrier curb integrally with 230 mm plain-dowelled concrete pavement wherever possible, as determined by the Contract Administrator.
- E17.7 Monolithic Curb and Sidewalk for Asphalt Cycle Track
- E17.7.1 The Contractor shall construct the monolithic curb and sidewalk for asphalt cycle track to the dimensions and at the locations shown on the Drawings and in general conformance with CW 3310 for other types of monolithic curb and sidewalk.
- E17.7.2 The Contractor shall utilize slip-form paving methods wherever possible, as determined by the Contract Administrator.
- E17.8 Splash Curb for Asphalt Cycle Track
- E17.8.1 The Contractor shall construction the splash curb for asphalt cycle track to the dimensions and at the locations shown on the Drawings and in general conformance with CW 3310 for other types of splash curb.
- E17.8.2 The Contractor shall utilize slip-form paving methods wherever possible, as determined by the Contract Administrator.

MEASUREMENT AND PAYMENT

- E17.9 230 mm Plain-Dowelled Concrete

E17.9.1 Measurement and payment for 230 mm plain-dowelled concrete pavement will be in accordance with CW 3310-R17.

E17.10 F-Shape Barriers

E17.10.1 F-Shape barriers will be measured on a length basis and paid for at the Contract Unit Price for the "Items of Work" listed here below. The length to be paid for will be the total number of meters installed in accordance with this Specification, accepted and measured by the Contract Administrator.

Items of Work

Construction of F-Shape Barrier

- (i) Single-Sided
- (ii) Double-Sided (Median)

E17.10.2 Supply and installation of reinforcing steel shall not be measured and shall be considered incidental to "Construction of F-Shape Barrier".

E17.10.3 Transition section to or from F-shape barriers to other shapes shall be measured and paid for as "Construction of F-Shape Barrier".

E17.11 Concrete Barrier Curb

E17.11.1 Measurement and payment for integral concrete barrier curb will be in accordance with CW 3310-R17.

E17.12 Monolithic Curb and Sidewalk for Asphalt Cycle Track

E17.12.1 Monolithic curb and sidewalk for asphalt cycle track will be measured on a length basis and paid for at the Contract Unit Price for "Monolithic Curb and Sidewalk for Asphalt Cycle Track". The length to be paid for will be the total number of meters installed in accordance with this Specification, accepted and measured by the Contract Administrator.

E17.13 Splash Curb for Asphalt Cycle Track

E17.13.1 Splash curb for asphalt cycle track will be measured on a length basis and paid for at the Contract Unit Price for "Remove Post and Chain Fence". The length to be paid for will be the total number of meters installed in accordance with this Specification, accepted and measured by the Contract Administrator.

E18. ADJUSTMENT OF EXISTING MANITOBA HYDRO MANHOLES

DESCRIPTION

E18.1 This Specification shall cover the adjustment of existing Manitoba Hydro manholes.

MATERIALS

E18.2 All frames, covers and cast iron lifter rings shall be supplied by Manitoba Hydro.

E18.3 All concrete, and miscellaneous material shall be supplied by the Contractor in accordance with CW 3210.

CONSTRUCTION METHODS

E18.4 Responsibility of the Contractor

E18.4.1 Upon commencement of the Work, it shall be the responsibility of the Contractor to ensure that no materials are damaged as a result of his construction activities. Materials found damaged, missing or lost after the commencement of the Work shall be replaced or repaired by the Contractor at his own expense to the satisfaction of the Contract Administrator and Manitoba Hydro.

- E18.4.2 The Contractor shall be responsible for coordinating his work with Manitoba Hydro safety watch or inspection crews.
- E18.5 Adjustment of Existing Manitoba Hydro Manholes
- E18.5.1 Adjust existing Manitoba Hydro manhole frames at locations shown on the Drawings or as directed by the Contract Administrator.
- E18.5.2 Contractor to remove pavement without damaging the existing frame or roof/ structure.
- E18.5.3 Prevent construction material and debris from entering the manhole.
- E18.5.4 Remove existing grout and bricks without damaging precast concrete riser sections or flat top reducers.
- E18.5.5 Set frame to finished grade with bricks or as approved by the Contract Administrator.
- E18.5.6 Grout frame inside and out to make watertight. Remove excess grout from inside of manhole.
- E18.5.7 Install cast iron lifter ring as directed by the Contract Administrator.
- E18.5.8 Place and compact Class 2 backfill as required in accordance with CW 2030 and SD-002.
- E18.6 Cast-in-Place Concrete Risers
- E18.6.1 Contractor shall form and pour cast-in-place concrete risers on Manitoba Hydro manholes where shown on the Drawings to the height and dimensions required or as directed by the Contract Administrator.

MEASUREMENT AND PAYMENT

- E18.7 Adjustment of Existing Manitoba Hydro Manholes
- E18.7.1 Adjustment of existing Manitoba Hydro manholes will be measured on a unit basis and paid for at the Contract Unit Price for "Adjustment of Existing Manitoba Hydro Manholes". The number of units to be paid for will be the total number of existing Manitoba Hydro manhole frames adjusted, including installation of new covers and lifter rings, in accordance with this Specification, accepted and measured by the Contract Administrator.
- E18.8 Cast-in-Place Concrete Risers
- E18.8.1 Cast-in-place concrete risers for Manitoba Hydro manholes will be measured on a vertical metre basis and paid for at the Contract Unit Price for "Cast-in-Place Concrete Risers for Manitoba Hydro Manholes". The length to be paid for will be the total number of vertical metres of risers installed in accordance with this Specification, accepted and measured by the Contract Administrator.

E19. INSTALLATION OF CULVERTS

DESCRIPTION

- E19.1 General
- E19.1.1 This specification shall amend and supplement City of Winnipeg Standard Construction Specification CW 3610-R3 "Installation of Culverts", and shall cover supply and installation of culverts.
- E19.1.2 Referenced Standard Construction Specifications
- (a) CW 2030 – Excavation Bedding and Backfill
 - (b) CW 3610 – Installation of Culverts
- E19.1.3 Referenced Standard Detail
- (a) SD 002 – Standard Trench and Excavation Backfill Classes.

MATERIALS

E19.2 Bedding and Backfill

- E19.2.1 Bedding and initial backfill material shall consist of 20 mm limestone base, as specified in CW 2030, placed on a prepared subgrade and compacted to the thickness and density herein specified.

CONSTRUCTION METHODS

E19.3 Beveled Ends

- E19.3.1 Further to CW 3610, all CSP culvert ends shall be beveled as shown on the Drawings.

E19.4 Trenchless Installation

- E19.4.1 Where indicated on the Drawings, trenchless installation methods shall be used in accordance with CW 2130.

E19.5 Bedding and Backfill

- E19.5.1 The backfilling for corrugated steel pipe installed under proposed pavements and private approaches shall be Class 2 as shown in Standard Detail SD-002 and specified in CW 2030, except as noted below.
- E19.5.2 The following revisions for bedding and initial backfill apply to Class 2 and Class 4 backfill:
- (a) Limestone base material as previously specified shall be used for bedding and initial backfill as opposed to sand.
 - (b) A minimum thickness of 225 mm of compacted 20 mm limestone bedding shall be placed on the prepared subgrade. A 75 mm blanket of loose uniform bedding material shall then be placed on the compacted bedding to provide fill for the corrugations in the invert.
 - (c) The backfill material shall be placed in layers not exceeding 300 mm. Backfilling shall be carried out in such a manner as to obtain uniform compaction without soft spots. Compaction shall be 95% of the Standard Proctor Density.
 - (d) Manual placing and compaction of material shall be used to build up the backfill to encompass the lower part of the pipe. Backfill material shall be placed under the haunches by shovel and compacted firmly by power compaction ("jumping jack") equipment. Valleys of the corrugations and the area immediately next to the pipe must be compacted by hand operated methods. At no time shall heavy compaction equipment be brought closer than 1 m from the CSP.
 - (e) Backfill shall be so placed and mechanically compacted that the fill rises equally and simultaneously on both sides, including handwork next to the pipe. Layers shall be placed with equipment running parallel to the structure.
 - (f) When the fill on both sides of the pipe approaches the crown of the pipe, the same techniques of spreading shallow layers and compacting thoroughly shall be followed as the backfill covers the pipe. Light tamping equipment shall be used for the initial layers over the pipe.
 - (g) No distortion of the structure greater than 2% of the span or rise shall be allowed.
 - (h) No traffic of any sort shall be permitted over the structure until cover of a minimum depth of 300 mm is properly compacted in place. If the Contractor requires crossings by heavy construction equipment, a minimum of 1.2 m of compacted cover over a length of at least 7.3 m of the structure shall be provided at no extra cost to the City.
 - (i) All compaction equipment used shall be subject to the approval of the Contract Administrator.

MEASUREMENT AND PAYMENT

E19.6 Beveled Ends

- E19.6.1 There shall be no measurement or payment for beveled ends. Beveled ends shall be included in the payment for the supply and installation of CSP culverts.
- E19.6.2 The supply and installation of culverts will be measured and paid for in accordance with CW 3610.

E20. HYDRANT RELOCATION

DESCRIPTION

E20.1 General

- E20.1.1 This Specification amends CW 2110-R11, Watermains.

CONSTRUCTION METHODS

E20.2 Hydrant Relocation- Type A

- E20.2.1 CW 2110-R11, Section 3.21.3.1.2 shall be replaced with "Install a new hydrant (SD-006) in accordance with Section 3.8 at the location shown on the Drawings or as directed by the Contract Administrator."
- E20.2.2 Type A hydrant relocation shall include the installation of a watermain valve in accordance with Section 3.9.

MEASUREMENT AND PAYMENT

E20.3 Hydrant Relocation- Type A

- E20.3.1 Relocating hydrants will be measured on a unit basis and paid for at the Contract Unit Price for "Relocating Existing Hydrant- Type A (including new hydrant and valve)". Number of units to be paid for will be the total number of hydrants relocated in accordance with this Specification, accepted and measured by the Contract Administrator.
- E20.3.2 The following will be included in the price paid for "Relocating Existing Hydrant- Type A (including new hydrant and valve)":
- (a) Disposal of existing hydrant;
 - (b) Supply and installation of new hydrant (SD-006);
 - (c) Supply and installation of new valve;
 - (d) Up to 3.0 metres of new hydrant lead pipe measured from the connection to the existing hydrant lead.

E21. GREEN BIKE LANE TREATMENT

DESCRIPTION

E21.1 General

- E21.1.1 This Specification covers all operations relating to the supply and installation of green bike lane treatment at cycling corridor conflict points and longitudinal lane lines, as noted on the Drawings.
- E21.1.2 The Work to be done by the Contractor under this Specification shall include furnishing of all superintendence, overhead, labor, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

MATERIALS

- E21.2 Green Bike Lane Treatment**

E21.2.1 The Green Bike Lane Treatment shall be Cycle Grip MMAX by Ennis-Flint color to be EF Bike Lane Green, PumaTrack MMA Cold Applied Surface Treatment by HITEX International Group color to meet MUTCH requirements or equivalent, in accordance with B6 as approved by the Contract Administrator. A link to the manufacturer's specifications is provided:

- (a) Cycle Grip MMAX:
<https://www.ennisflintamericas.com/catalog/product/view/id/945/category/81>
- (b) PumaTrack MMA Cold Applied Surface Treatment:
https://www.hitexinternational.com/wp-content/uploads/2017/03/Hitex_PumaTrack_Website.pdf

SUBMITTALS

E21.3 Prior to construction the Contractor shall submit material data sheets for the proposed product to be supplied and installed to the Contract Administrator.

CONSTRUCTION METHODS

E21.4 Surface Preparation

E21.4.1 Surface Preparation to be in accordance with the Manufacturer's instructions.

E21.5 Masking

E21.5.1 Masking of the edges of all green bike lane treatment areas to be in accordance with Manufacturer's instructions.

E21.6 Paint Mixing

E21.6.1 Mix paint in accordance with Manufacturer's instructions.

E21.7 Installation of Green Bike Lane Treatment

E21.7.1 Install Green Bike Lane Treatment in accordance with Manufacturer's instructions.

E21.7.2 Any damage done to the Green Bike Lane Treatment prior to completion of each marking shall be rectified at the Contractor's expense.

MEASUREMENT AND PAYMENT

E21.8 Green Bike Lane Treatment- Intersection Treatment

E21.8.1 Supply and installation of green bike lane treatment for intersection treatments shall be measured on an area basis and will be paid for at the Contract Unit Price per square metre for "Supply and Installation of Green Bike Lane Treatment- Intersection Treatment" supplied and installed in accordance with this Specification and accepted and measured by the Contract Administrator.

- (a) No separate measurement will be made whether the treatment is being applied to asphalt pavement or to concrete pavement. The payment made shall cover either instance.

E21.9 Green Bike Lane Treatment- Longitudinal Lane Line

E21.9.1 Supply and installation of green bike lane treatment for longitudinal lane lines shall be measured on a length basis and will be paid for at the Contract Unit Price per linear metre for "Supply and Installation of Green Bike Lane Treatment- Longitudinal Lane Line" supplied and installed in accordance with this Specification and accepted and measured by the Contract Administrator.

- (a) No separate measurement will be made whether the treatment is being applied to asphalt pavement or to concrete pavement. The payment made shall cover either instance.

E22. CONSTRUCTION OF RUMBLE STRIP

DESCRIPTION

E22.1 General

- E22.1.1 This Specification shall cover the construction of rumble strips in asphalt pavement along active transportation facilities.
- E22.1.2 The Work to be done by the Contractor under this Specification shall include furnishing of all superintendence, overhead, labor, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

CONSTRUCTION METHODS

- E22.2 Construct rumble strips in asphalt pavement to the dimensions and at the locations shown on the Drawings or as directed by the Contract Administrator.
- E22.3 The Contractor shall grind the rumble strip with the specified dimensions into the asphalt pavement after it has been fully rolled and cooled.

MEASUREMENT AND PAYMENT

- E22.4 Rumble strips will be measured on a length basis and paid for at the Contract Unit Price for "Construction of Rumble Strip". The length to be paid for will be the total number of meters installed in accordance with this Specification, accepted and measured by the Contract Administrator.

E23. INSTALLATION OF INTERLOCKING PAVING STONES

DESCRIPTION

E23.1 General

- E23.1.1 This Specification shall cover the installation of interlocking paving stones on concrete sidewalk and lean concrete base.
- E23.1.2 Referenced Standard Construction Specifications
- (a) CW 3325 – Portland Cement Concrete Sidewalk
 - (b) CW 3335 – Installation of Interlocking Paving Stones on a Lean Concrete Base

MATERIALS

E23.2 Interlocking Paving Stones

- E23.2.1 Paving stones in island areas shall be Barkman Concrete Holland Stone Pavers (100 x 200). All pavers to be "Charcoal" in colour.
- E23.2.2 Paving stones for sidewalk bands shall be Barkman Concrete Holland Stone Pavers (200 x 200). All pavers to be "Charcoal" in colour.
- E23.2.3 Island areas shall be installed with Pattern #1 (45° herringbone pattern) with Border #1.
- E23.2.4 Paving stones shall conform to the requirements of CAN3-A231.2, Precast Concrete Pavers.
- E23.2.5 Further to CAN3-A231.2.6.1.1, where concrete pavers are shipped for installation before the pavers are twenty-eight (28) days old, the average compressive strength of these pavers at the time of delivery to the work site shall be not less than 40 MPa.

E23.3 Other Materials

- E23.3.1 Bedding sand shall be in accordance with CW 3335.

E23.3.2 Concrete sidewalk base to be in accordance with CW 3325.

CONSTRUCTION METHOD

E23.4 Installation of Paving Stones

E23.4.1 Sidewalk bands shall be installed on a 100 mm concrete sidewalk base which shall be constructed in accordance with CW 3325.

E23.4.2 Island areas shall be installed on lean concrete base in accordance with CW 3335.

E23.4.3 Install paving stones on concrete sidewalk with bedding sand in accordance with the Drawings and CW 3335.

MEASUREMENT OF PAYMENT

E23.5 Supply and Installation of Paving Stones

E23.5.1 Supply and installation of interlocking paving stones shall be measured on an area basis. The amount to be paid for shall be the total number of square metres of paving stones supplied and installed in accordance with this Specification and the Drawings and accepted by the Contract Administrator. Supply and Installation of Paving Stones shall be paid for at the Contract Unit Price for "Interlocking Paving Stones", which price shall be payment in full for the supply of all materials and for performing all operations required to complete the work as specified.

E23.5.2 No measurement or payment will be made for bedding sand. Bedding sand shall be included in the price paid for "Interlocking Paving Stones".

E23.6 100 mm Concrete Sidewalk Base

E23.6.1 Supply and installation of 100 mm concrete sidewalk base shall be measured and paid for in accordance with CW 3325.

E23.7 Lean Concrete Base

E23.7.1 Supply and installation of lean concrete base shall be measured and paid for in accordance with CW 3335.

E24. SUPPLY AND INSTALL RIP RAP

DESCRIPTION

E24.1.1 The Work covered under this item shall include all items relating to the supply and placement of rip rap material.

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 Work as hereinafter specified.

MATERIALS

E24.2 General

E24.2.1 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator. There shall be no charge for any materials taken by the Contract Administrator for testing purposes.

E24.2.2 The Contractor shall supply all materials incidental to these Works. All materials must be on hand prior to commencement of the Work.

E24.3 Geotextile

E24.3.1 The geotextile material shall be a nonwoven geotextile fabric, such as Geotex 801 or approved equal. The Contractor shall notify the Contract Administrator of the material to be supplied (5) days prior to construction for approval.

E24.4 Aggregate

E24.4.1 The rip rap material shall be 350 mm down rock manufactured from hard, durable quarried rock with the following requirements:

- (a) minimum bulk specific gravity of 2.6 (ASTM C127),
- (b) maximum Los Angeles abrasion loss of 35% (ASTM C131),
- (c) maximum soundness loss of 13% (ASTM C88),
- (d) maximum absorption of 2.5% (ASTM C127)
- (e) shall not include flat, elongated particles whose greatest dimension exceeds five times their least dimension,
- (f) shall have a gradation that conforms to the following:

Canadian Metric Sieve Size (mm)	Percent of Total Dry Weight Passing Sieve
350	100
200	15 - 50
100	0 - 15

E24.5 Acceptance of Material

E24.5.1 The Contractor shall submit the proposed supplier(s) and location of quarry sites, and arrange a site visit with the Contract Administrator at least ten (10) business days prior to the supply of riprap to the Site, to confirm that sufficient quantity of specified rock is available.

E24.5.2 The Contractor shall supply representative test results at least ten (10) business days prior to the supply of riprap to the Site, demonstrating that the material to be supplied is of adequate quality and gradation to satisfy the material specifications contained herein. The Contractor shall provide, at no additional cost, whatever facilities are required to assist the Contract Administrator in checking rip rap gradation during construction.

E24.5.3 Material deemed unacceptable by the Contract Administrator under these provisions shall be removed off-site at the Contractors expense.

CONSTRUCTION METHODS

E24.6 Site development shall be done in accordance with E11.

E24.7 Installation, handling and storage of geotextile fabric shall conform to the manufacturers recommendations and specifications, with the following additional requirements:

- (a) Geotextile fabric shall be installed on all ground surfaces beneath the rip rap as shown on the drawings.
- (b) The joints shall be overlapped 0.6 m in a shingle pattern, with the up-slope pieces overlapping the down-slope pieces and/or the up-stream pieces overlapping the down-stream pieces.
- (c) Stapling of the geotextile fabric to the ground surface shall conform to the manufactures recommendations and specifications.
- (d) The geotextile should be placed without wrinkles or folds.
- (e) Tears or other damage in the geotextile fabric shall be repaired at the Contractors expense with a piece of geotextile fabric extending 1.0 m in all directions beyond the damaged area placed over the damaged area.

- E24.8 Rip rap material shall be placed to the lines and grades shown on the Drawings. The upstream and downstream ends of the rip rap shall have smooth transitions to the existing bank as indicated on the drawings.
- E24.9 Rip rap material shall be placed such that the geotextile fabric is not dislodged or torn. Hand placing a portion of the rip rap material may be required to secure the geotextile in place prior to machine placing.
- E24.10 Rip rap material shall be placed in a manner such that larger pieces are uniformly distributed and smaller pieces fill the spaces between the larger pieces and shall be spread in a layer or layers of uniform thickness.
- E24.11 The location and size of temporary stockpiles shall be approved by the Contract Administrator to evaluate potential impacts on riverbank stability.
- E24.12 Care shall be taken to avoid the introduction of clay, silt, organic or other deleterious material into the rip rap material.

MEASUREMENT AND PAYMENT

- E24.13 Supply and placement of riprap shall be measured on a weight basis and paid for at the Contract Unit Price per tonne for "Supply and Place Class 350 Riprap" for the total number of tonnes measured by truck weight scale tickets as accepted by the Contract Administrator.
- E24.14 The Contractor is to supply all truck weight scale tickets to the Contract Administrator by the end of each work day.
- E24.15 Sub-excavation and disposal of excavated soil, supply and placement of geotextile, shaping the riprap bed, supplying, loading, hauling, and placing stone riprap shall be included in the price paid for "Supply and Place Class 350 Riprap".

E25. ROCKFILL RIB CONSTRUCTION

DESCRIPTION

- E25.1.1 The Work covered under this item shall include all items relating to the construction of Rockfill ribs along Empress Street/Omand's Creek as shown on the Drawings.
- E25.1.2 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 Work as hereinafter specified.
- E25.2 Scope of Work
- E25.2.1 The scope of this Work is not necessarily confined to the following, which is compiled as a general outline:
- (a) Excavation.
 - (b) Supply and placement of all backfill materials.
 - (c) Compaction of backfill materials.

MATERIALS

- E25.3 General
- E25.3.1 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator. There shall be no charge for any materials taken by the Contract Administrator for testing purposes.

E25.3.2 The Contractor shall supply all materials incidental to these Works. All materials must be on hand prior to commencement of the Work.

E25.4 Rockfill for Rockfill Ribs

E25.4.1 Backfill for Rockfill ribs shall consist of sound, dense, durable crushed limestone with the following requirements:

- (a) minimum bulk specific gravity of 2.6 (ASTM C127),
- (b) maximum Los Angeles abrasion loss of 35% (ASTM C131),
- (c) maximum soundness loss of 13% (ASTM C88),
- (d) maximum absorption of 2.5% (ASTM C127)
- (e) The material shall be free from organics, roots, silt, clay, snow, ice or any other deleterious material.
- (f) Gradation that conforms to the following:

Canadian Metric Sieve Size (mm)	Percent of Total Dry Weight Passing Sieve
100	97 – 100
25	30 – 50
0.08	0 - 8

E25.5 Acceptance of Material

E25.5.1 The Contractor shall supply a representative sample of rockfill to the Contract Administrator for approval at least ten (10) days prior to the commencement of construction. The Contract Administrator will advise the Contractor as to the size of the samples required. Additional testing of samples shall be undertaken in the event the initial sample does not meet specification requirements.

E25.5.2 The Contractor shall identify the supplier and location of the manufacturer of rockfill material and confirm that sufficient quantity of the specified material is available.

E25.5.3 The Contractor shall provide, at no additional cost, whatever facilities are required to assist the Contract Administrator in checking rockfill gradation during construction.

E25.5.4 Material deemed unacceptable by the Contract Administrator under these provisions shall be removed off-site at the Contractors expense.

CONSTRUCTION METHODS

E25.6 Site Development

E25.6.1 The Contractor shall develop the site in accordance with E11.

E25.7 Compaction Testing Program

E25.7.1 The Contractor shall carry out a Compaction Testing Program to facilitate quality control during construction. This program shall be carried out to demonstrate that the means, methods and techniques of compaction proposed by the Contractor are consistent with achieving the degree of compaction specified.

The Contractor shall provide all necessary labour, material and equipment necessary to carry out the compaction testing program. All testing shall be carried out in the presence of the Contract Administrator. Minimum requirements for the testing program will include:

- .1 The first Rockfill rib shall be used as a test trench. Additional test trenches (if required) shall be located immediately adjacent to completed test trenches. The

test trench shall be excavated to the lines and grades shown on the drawings and backfilled as noted herein.

- .2 Placement of the backfill material shall be in maximum lift thicknesses (prior to compaction) of 400 mm, if compacted using a hoe-pack. If a direct-insertion vibratory probe will be used for compaction, the trench may be backfilled in full prior to compaction. The equipment to be used and methods to backfill and compact the ribs shall be subject to review and acceptance by the Contractor Administrator.
- .3 Compaction of the backfill in the manner proposed for construction to achieve a maximum apparent field density. The degree of compaction will be determined by measurement of the volume of backfill material before and after compaction.
- .4 Such other testing as necessary to demonstrate that the Contractor's proposed means, method(s), techniques and equipment are consistent with achieving the specified degree of compaction during construction.

As a result of the Compaction Testing Program, the Contractor must establish the following:

- (i) the compaction equipment proposed for use
- (ii) the protocol for operations
- (iii) degree of compactive effort required

No construction of rockfill ribs shall commence until the Contractor has demonstrated through the Compaction Testing Program that the proposed methods of compaction will meet the specified requirement for each portion of the works. Acceptance of the Compaction Testing Program shall in no way relieve the Contractor from his contractual obligation of achieving the maximum apparent field density during construction.

E25.8 Excavation

- E25.8.1 The excavation for each rib shall be a width of 1.2 metres and shall extend to the lines and grades shown on the drawings. The excavation for side slopes shall be cut as near vertical as possible. Any deleterious or sloughed material at the base of the excavation or during backfilling shall be removed prior to further backfilling.
- E25.8.2 The Contractor is advised that the excavations required for rockfill ribs may not satisfy Workplace Health and Safety guidelines for safe excavation slopes to permit personnel working upslope of ribs, between ribs or in the excavation. The Contractor shall incorporate this consideration in their Safe Work Plan.
- E25.8.3 The Contractor shall maintain a dry excavation and will be required to take the necessary corrective actions to prevent water from entering or accumulating in the excavation.

E25.9 Backfilling and Compaction

- E25.9.1 Backfilling of each rockfill rib shall commence immediately after excavation has been completed and shall not be left open. Excavation of adjacent ribs will not be permitted until backfilling of the excavated rib is complete.
- E25.9.2 Care shall be taken to prevent contamination of the crushed limestone backfill. Should contamination of the backfill occur, the affected backfill shall be removed and disposed as directed by the Contract Administrator.
- E25.9.3 The Contractor shall monitor his compaction operations during construction to ensure the compaction methods selected based on the Compaction Testing Program are consistently achieving the specified results.
- E25.9.4 The Contractor shall advise the Contract Administrator of any modifications to his proposed methods that are required if the required degree of compaction is not being achieved.

MEASUREMENT AND PAYMENT

E25.10 Site Development

E25.10.1 Site development shall be included in the price paid for "Construction of Rockfill Ribs" in accordance with E11.

E25.11 Compaction Testing program

E25.11.1 The Compaction Testing Program shall be included in the price paid for "Construction of Rockfill Ribs".

E25.12 Construction of Rockfill Rib

E25.12.1 Rockfill rib construction shall be measured on a weight basis and paid for at the Contract Unit Price per tonne for "Construction of Rockfill Ribs" for the total number of tonnes of backfill measured by truck weight scale tickets, constructed in accordance with this specification as accepted by the Contract Administrator.

- (i) The Contractor is to supply all truck weight scale tickets to the Contract Administrator by the end of each work day.
- (ii) Excavation, loading, hauling and disposal of the excavated soil shall be included in the price paid for "Construction of Rockfill Ribs".
- (iii) The backfill used in the compaction testing program shall be included in the quantity for payment.
- (iv) Soil capping otop of the rockfill ribs will not be measured. All costs associated with the soil capping shall be included in the price paid for "Construction of Rockfill Ribs".

E26. INSTALLATION OF STRAW WATTLES

DESCRIPTION

E26.1 Straw wattles are required to be installed as erosion control measures to mitigate any deleterious materials from entering the land drainage system or waterways. At a minimum, these locations will include the perimeter of all riprap located at ditch catchbasins, subdrain outfalls, and ditch bottom pads.

MATERIALS

E26.2 The straw wattles shall be Stenlog or other biodegradable straw wattles.

CONSTRUCTION METHODS

E26.3 Install 300mm straw wattle sediment control material in accordance with the manufacturer's specifications around all riprap areas related to drainage inlets and outlets, and catchbasins within seeded areas. Install 225 mm straw wattle on downward slope of all trees planted on slopes steeper than 4:1.

E26.4 Install straw wattles so that no gaps exist between the soil and the bottom of the wattle, and the ends of adjacent wattles are overlapped 150mm minimum to prevent water and sediment passing. Achieve a tight seal between the wattle segments.

E26.5 Dogleg terminal ends of straw wattle up the slope to prevent channeling of sedimentation.

E26.6 Use 300mm wooden stakes to fasten straw wattle to the soil. Place stakes on each side of the straw wattle, lying across the natural fibre twine, spaced 1200mm on centre. Leave 30 to 50 mm of wood stake exposed above the wattle.

E26.7 Avoid damage to wattles. Damaged areas of wattles should be cut and tied off, then treated as terminal ends.

E26.8 At the direction of the Contract Administrator, the straw wattle shall be removed after seeding has established and before the end of the Warranty Period.

MEASUREMENT AND PAYMENT

E26.9 Installation of straw wattles will be measured on a length basis and paid for at the Contract Unit Price for "Installation of Straw Wattle". The length to be paid for will be the total number of linear metres of straw wattles installed in accordance with this Specification, accepted and measured by the Contract Administrator.

E27. EROSION CONTROL BLANKET

E27.1.1 Description

- (a) This Specification shall cover the supply, installation, and maintenance of erosion control blanket (ECB), as herein specified.
- (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.

E27.1.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ASTM D1117 – Standard Guide for Evaluating Nonwoven Fabrics;
 - (ii) ASTM D1388 – Standard Test Method for Stiffness of Fabrics;
 - (iii) ASTM D6525 – Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products;
 - (iv) ASTM 6818 – Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products; and
 - (v) Erosion Control Technology Council (ECTC) Guidelines.

E27.1.3 Scope of Work

- (a) The Work under this Specification shall include the following items, to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator:
 - (i) Supplying and installing erosion control blanket on disturbed slopes and channel banks above riprap limits;
 - (ii) Supplying and temporarily installing erosion control blanket to protect disturbed slopes where sodding and permanent vegetation/restoration is eventually to take place; and
 - (iii) Complying with all requirements outlined in D27, "Environmental Protection Plan".

E27.2 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material.

E27.3 Materials

E27.3.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.

- (b) The Contractor shall 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.

E27.3.2 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.

E27.3.3 Erosion Control Blanket

- (a) Erosion Control Blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut blanket with a functional longevity of up to 24 months. Suitable products include SC 150 Extended Term manufactured by North American Green, or approved equivalent in accordance with B6, "Substitutes".
- (b) The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat.
- (c) The blanket shall be covered on the topside with heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and a maximum 159 mm x 159 mm mesh and on the bottom side with a lightweight photodegradable polypropylene netting with a maximum 127 mm x 127 mm mesh. The blanket shall be sewn together on 381mm centres (maximum) with degradable thread.
- (d) ECB shall have the following properties:
 - (i) Matrix 70% Straw Fibre (0.19kg/m²) and 30% Coconut Fibre (0.08kg/ m²);
 - (ii) Netting top side heavyweight photodegradable with UV additives (1.47kg/100m²);
 - (iii) Bottom side lightweight photodegradable minimum netting weight (0.73 kg/100m²); and
 - (iv) Degradable thread.
- (e) Staples used to secure EBC shall be biodegradable and as recommended by the Manufacturer.

E27.4 Equipment

E27.4.1 General

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

E27.5 Construction Methods

E27.5.1 General

- (a) ECB shall be placed on all disturbed and exposed slopes for which revegetation is required.
- (b) Locations of ECB will be confirmed on site with the Contract Administrator.

E27.5.2 ECB Installation

- (b) The blanket shall be rolled out in the direction of the water flow.
- (c) The upper edges of the blanket on the side slopes and the edges at the terminal ends of the installation shall be placed in a 150 mm x 150 mm trench.
- (d) The upper edges shall be stapled at 1 000 mm intervals and the terminal edges shall be stapled at 300 mm intervals within the trench. The trench shall be then be backfilled and compacted. The side and end seams shall be overlapped edge over edge (shingle style) with an overlap of 150 mm. The side seams shall be stapled at 1000 mm intervals and the end seams shall be stapled at 300 mm intervals.
- (e) At 10 m intervals, the Contractor shall place a double row of staggered staples to secure the blankets. The staples shall be spaced 100 mm apart. The remainder of the blanket

shall be stapled at a rate of four staples per m². The blanket may have to be trimmed to size to conform to the area to be covered.

- (f) Transverse joints and end seams in the ECB shall have a minimum overlap of 150 mm and secured with 200 mm staples a maximum of 300 mm apart.
- (g) Should the Contract Administrator determine that the Contractor has not installed the ECB properly or has damaged the blankets from construction activities resulting in sediment releases beyond the Work area; the Contractor shall retrieve all sediment that has left the construction area, to the fullest extent possible, at his own cost. As a minimum, the Contractor shall remove all deltas and sediment deposited in drainage ways and regrade the areas where sediment removal results in exposed soil. The removal and restoration shall take place within five (5) working days of discovery unless precluded by legal, regulatory, or physical access restraints. If precluded, removal and restoration must take place within five (5) working days of obtaining access. The Contractor is responsible for contacting all local, regional, provincial, and federal authorities before working in surface waters and for obtaining applicable permits. The Contractor's restoration Work to restore property outside of the designated Work area shall be at his own cost.

E27.5.3 Complying with Environmental Protection Requirements

- (a) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into waterways from areas disturbed as a result of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D27, "Environmental Protection Plan".
- (b) The Contractor shall monitor his work and implement appropriate sediment control measures as site conditions warrant. Such measures may include installation of silt fences, straw bales, or other measures as required in the event that there is runoff from the site.
- (c) The Contractor shall monitor, maintain, repair all sediment control measures until vegetation has re-established in restored areas and there no longer is a potential for sediment releases due to construction.
- (d) Disturbed areas shall be restored. Erosion control blankets, as approved by the Contract Administrator, shall be used to control potential erosion of areas where vegetation has been damaged, up until permanent vegetation has been reestablished.

E27.6 Quality Control

E27.6.1 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.

E27.7 Measurement and Payment

E27.7.1 Erosion Control Blanket

- (a) Supplying and installing erosion control blanket shall be paid for at the Contract Unit Price per square meter for "Supply and Install Erosion Control Blanket", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. The area to be paid for shall be the total area of ECB supplied and installed as noted on the Drawings, confirmed by survey, and as measured and accepted by the Contract Administrator.

E28. INSTALLATION OF SILT FENCE

DESCRIPTION

- E28.1 This specification covers the supply, erection, maintenance and removal of temporary silt fencing at the locations shown on the Drawings to control runoff and minimize the release of detrimental silt loading to watercourses.
- E28.2 The Scope of the work included in this specification is as follows:
 - (a) Supply and Install temporary silt fencing at the locations as indicated on the Drawings or as determined by the Contract Administrator, prior to undertaking any other activities on the Site where silt fencing is required.
 - (b) Maintain the silt fencing in serviceable condition throughout the entire duration of activities at the Site where silt fencing is required, including final restoration and clean-up of the construction Site.
 - (c) Remove the silt fencing and restore the area where the fencing was installed, without further disturbing the area and without releasing any deleterious substances to the adjacent watercourse.

MATERIALS

E28.3 Fence Posts

E28.3.1 Fence posts shall be 100 mm diameter untreated wood posts or 50 mm diameter steel.

E28.4 Filter Fabric

E28.4.1 Filter Fabric shall be woven geotextile material specifically designed for a silt fence application, meeting the following minimum requirements:

Property	Test Method	Value
Grab Tensile Strength	ASTM D 4632	0.55 kN
Grab Tensile Elongation	ASTM D 4632	15%
Mullen Burst	ASTM D 4786	2060 kPa
Puncture	ASTM D 4833	0285 kN

Property	Test Method	Value
Trapezoid Tear	ASTM D 4533	0285 kN
UV Resistance	ASTM D 435	580% @ 500 hrs.
Apparent Opening Size	ASTM D 4751	0.60 mm
Flow Rate	ASTM D 4491	405 L/min/m ²

Acceptable Product: "Amoco 2130 Silt Fence Fabric" or approved equal in accordance with B7.

E28.5 Wire Mesh

E28.5.1 Wire mesh shall be galvanized or plain metal with wire gauge = 3.0 mm, wire spacing @ 150 mm o/c.

E28.6 Fencing Material Fasteners

E28.6.1 Staples or wire ties of sufficient strength and spacing to withstand 500 N (100 lbf) pull test at any point on the wire mesh.

CONSTRUCTION METHODS

- E28.7 Ensure that no deleterious substances are discharged into the adjacent watercourse at any time during construction activities.
- E28.8 Silt Fence Installation
- E28.8.1 Excavate 150 x 150 anchor trench along alignment of silt fence as indicated. Note that riprap may be present in areas of anchor trench installation.
- E28.8.2 Ensure that fence posts are firmly driven into undisturbed soil, or are completely and firmly backfilled if installed via auger methods. Attach wire mesh as support backing for silt fence filter fabric with fasteners. Attach silt fence filter fabric on top of wire mesh in similar fashion. Overlap any fence seams (wire mesh or filter fabric) by 450 mm minimum. Ensure that wire mesh and filter fabric are installed on the upslope side of the post and are fully laid in anchor trench as shown
- E28.8.3 Install and compact impermeable excavated materials into anchor trench and slope as indicated. Compact to 95% of maximum dry density (ASTM D-698).
- E28.9 Silt Fence Maintenance
- E28.9.1 Inspect silt fence daily, prior to starting any other construction activities. If fence posts are found loose or not upright, repair in accordance with installation procedure as specified. If silt fence is found to be loose or torn, repair or replace as necessary to comply with this Specification.
- E28.9.2 If silt deposition at the fence is 300 mm or more in depth, carefully remove and dispose of silt offsite without disturbing silt fence.
- E28.10 Silt Fence Removal
- E28.10.1 The silt fence shall remain in place until permanent vegetation cover has been effectively introduced on all disturbed areas.
- E28.10.2 Upon authorization of the Contract Administrator, remove all fence posts, wire mesh, fabric, and fasteners from Site.
- E28.10.3 Restore area disturbed without releasing any deleterious substances to the adjacent watercourse.

MEASUREMENT AND PAYMENT

- E28.11 Silt Fence
- E28.11.1 The supply, placement, maintenance and removal of silt fence shall be measured on a length basis and paid for at the Contract Unit Price per lineal metre for "Silt Fence". The length to be paid for shall be the total number of metres supplied and placed in accordance with this Specification, accepted and measured by the Contract Administrator. Payment of silt fence shall be in accordance with the following payment Schedule:
- (a) Sixty percent (60%) of the Contract Unit Price per lineal metre for "Silt Fence" shall be paid following supply and installation.
 - (b) Forty percent (40%) of the Contract Unit Price per lineal metre for "Silt Fence" shall be paid following final removal.
- E28.11.2 Removal of accumulated sediment from the silt fence is considered incidental to the Work and no separate measurement or payment will be made.

E29. TREE REMOVAL

- E29.1 Description

E29.1.1 This Specification shall supplement CW3010 – Clearing and Grubbing and cover the removal of individual trees outside of the designated “Clearing and Grubbing” areas designated for removal by the Contract Administrator. The Work 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.

E29.2 Construction Methods

E29.2.1 Tree Removal

- (a) Before commencement of any work, the Contractor shall consult with the Contract Administrator as to which trees and/ or shrubs shall be removed. All other trees and shrubs shall be protected against damage from all construction activity in accordance with E5. Protection of Existing Trees.
- (b) All trees designated for removal shall be removed no later than April 1, 2019.
- (c) Trees to be removed are to be felled so as to land within the limits of the works. The Contractor shall take all precautions to prevent damage to traffic, structures, pole lines, adjacent property and to trees and shrubs designated to be saved, and he shall be liable for any damages occurring in the performance of this work.
- (d) The Contractor shall cut down all trees and shrubs designated for removal and grub out all stumps and roots. The Contractor shall load and haul all trees, stumps, roots, logs, brush, rubbish and all other surface litter from the site and dispose of these materials at dumps located by the Contractor and approved by the Contract Administrator.

E29.3 Measurement and Payment

E29.3.1 Measurement for payment shall be based on the Diameter at Breast Height (D.B.H.) measured at 145 cm above ground level on trees with single trunks. On trees with double or multiple trunks the following rules shall apply:

- (a) Where a single diameter measurement is possible above ground, the measurement will be made at a point just below the junction of the trunks where the total tree diameter is not influenced by the junction or the basal flare;
- (b) Where a single diameter measurement above ground is not possible, then the total tree diameter will be based on the D.B.H. (measured at 145 cm above ground level) of the largest trunk plus $\frac{1}{2}$ the D.B.H. of each subsequent trunks;
- (c) Situations regarding the measurement of any tree not falling into one of the above categories must be referred to the Contract Administrator immediately for a decision prior to removal

E29.3.2 Removal of Trees will be paid for at the Contract Unit Price for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for removing and disposing all tree materials and for completing all operations herein described and all other items incidental to the work included in this Specification.

Items of Work:

Tree Removal

- (a) 0 to 10 cm diameter
- (b) 11 to 30 cm diameter
- (c) Over 30 cm diameter

E30. CRUSHED GRANULAR AND CONCRETE REST AREAS

E30.1 Description

E30.1.1 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 as shown on the Drawings and as hereinafter specified, including, but not necessarily confined to the following:

- (a) Supply and installation of granular base course, surface course materials, concrete and geotextile, for pathway rest areas as indicated on the Drawings;

E30.2 Material

E30.2.1 All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.

E30.2.2 Granular Base Course

- (a) Granular base course material for the rest areas shall consist of 150 mm of 20 mm down crushed limestone and shall conform to CW3110 for crushed limestone base course material.

E30.2.3 Surface Course for Granular Rest Area

- (a) Granular surface course material for the granular pathway rest area shall consist of 25.4 mm of 6 mm crushed fines/ toppings crushed limestone.

E30.2.4 Geotextile Fabric

- (a) Geotextile fabric shall be in accordance with CW3130.

E30.2.5 Concrete

- (a) Concrete for bench footing and rest area surfacing shall be supplied as per CW3310 and CW3325.

E30.3 Construction Methods

E30.3.1 Construction method shall conform to Specification CW 3110 "Sub-Grade, Sub-Base and Base Course Construction".

E30.3.2 Contractor shall visit the Site and verify all data and dimensions and report any errors, omissions or discrepancies to the Contract Administrator prior to any installation.

E30.3.3 Contractor shall be responsible for interpretation of grades and protection of stakes. Layout to be approved by Contract Administrator prior to construction.

E30.3.4 Sub-Grade

- (a) Prepare compacted sub-grade to the lines and grades as shown on Drawings. Contract Administrator to review sub-grade preparation prior to placement of granular base.

E30.3.5 Granular Base

- (a) Geotextile fabric to be placed between subgrade and granular base as per CW3130;
- (b) Place granular base material to the lines and grades as shown on Drawings. Extend base minimum 150mm beyond width of surface course;
- (c) Compact material to a minimum of 100 percent Standard Proctor Density.

E30.3.6 Granular Surface Course

- (a) Place granular surface course material to the lines and grades as shown on Drawings;
- (b) Compact material to a minimum of 100 percent Standard Proctor Density.

E30.3.7 Concrete

- (a) Concrete for bench footing and rest area surfacing shall be installed as per the drawings and in accordance with CW3325. Bench footings shall be level.

E30.4 Method of Measurement

E30.4.1 Granular and Concrete Rest Areas shall be measured on a square meter basis. The total area to be paid for shall be the total number of square meters of each rest area installed in accordance with this Specification and the Drawings, and as acceptable to the Contract Administrator.

E30.5 Basis of Payment

E30.5.1 Payment for granular and concrete rest areas shall be paid for at the Contract Unit Prices for the "Items of Work" listed below. This price shall be payment in full for supplying all labour, equipment and materials, and performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

Item of Work:

- (a) Granular Rest Area
- (b) Concrete Rest Area (including bench footings)

E31. SITE FURNITURE

E31.1 Description

E31.1.1 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 as shown on the Drawings and as hereinafter specified, including, but not necessarily confined to the following:

- (a) Delivery and Installation of Benches;

E31.2 Materials

E31.2.1 All materials supplied under this specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.

E31.2.2 Bench shall be supplied by the City of Winnipeg FOB Central manufacturing facility. Bench shall be Tache Style Backed Bench Composite with Arms, as per SCD-121A, Product #52501085, **Black Powder Coated**, or substitute approved in accordance with B6.

E31.2.3 Contact for Benches:

City of Winnipeg
CPS order desk: pwd-cps-orderdesk@winnipeg.ca
960 Thomas Avenue

E31.3 Method of Measurement

E31.3.1 Site Furniture shall be measured on a per unit basis. The total unit to be paid for shall be the total number of units installed in accordance with this Specification and the Drawings, and as acceptable to the Contract Administrator.

E31.4 Basis of Payment

E31.4.1 Payment for shall be paid for at the Contract Unit Prices for the "Items of Work" listed below. This price shall be payment in full for supplying all labour, equipment and materials, and performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

Item of Work:

- (a) Tache Bench

E32. TREE AND SHRUB PLANTING

E32.1 Description

E32.1.1 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 as shown on the Drawings and as hereinafter specified, including, but not necessarily confined to the following:

(a) Supply and Installation of trees and shrubs.

E32.1.2 Reference

(a) Install trees work in accordance with the Canadian Standards for Nursery Stock Current Edition, published by the Canadian Nursery Trades Association, except where specified otherwise.

E32.1.3 Source Quality Control

- (a) All plant material shall be randomly inspected at the source upon request of the Contract Administrator.
- (b) Trees are to be grown in nurseries under proper cultural practices as recommended by the Canadian Nursery Trades Association.
- (c) Only those trees that have been grown for at least the four (4) previous years in local Manitoba nurseries located in an Agriculture Canada Plant Hardiness Zone designation of 2(a or b) or 3(a or b) and within a 250 kilometre radius of Winnipeg, will be accepted. Trees that have grown in plant hardiness zones 1 and 4 or greater will be rejected.

E32.1.4 Maintenance

- (a) The Contractor shall be responsible for the maintenance of the trees for a period of two (2) years from the date of Total Performance. Any areas planted after September 15th, the maintenance period will commence on May 15th of the following year or such date as mutually agreed upon by all parties.
- (b) Water to ensure soil moisture conditions for optimum growth and health of plant material. Ensure watering techniques do not cause erosion.
- (c) Reform damaged watering saucers.
- (d) Remove weeds bi-monthly.
- (e) Replace or re-spread damaged, missing or disturbed mulch.
- (f) For non-mulched areas, cultivate monthly to keep top layer of soil friable.
- (g) If required to control insects, fungus and disease, use appropriate control methods in accordance with Federal, Provincial and Municipal regulations. Obtain product approval from Contract Administrator prior to application.
- (h) Apply fertilizer as directed by manufacturer's specifications.
- (i) Remove dead, broken or hazardous branches from plant material.
- (j) Keep trunk protection and tree supports in proper repair and adjustment.
- (k) Remove trunk protection and tree supports on all trees and level watering saucers in mown areas at end of warranty period.
- (l) Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.
- (m) Submit monthly written reports to Contract Administrator identifying:
 - (i) Maintenance work carried out.
 - (ii) Development and condition of plant material.

- (iii) Preventative or corrective measures required which are outside Contractor's responsibility.

E32.1.5 Warranty

- (a) The Contractor shall, at his/her expense, warrant the Work against any and all defects or deficiencies resulting from insect infestation, disease and mechanical damage due to improper handling, installation or maintenance, for a period of two (2) years from the date of the Total Performance. Nursery stock damaged by vandalism or reasons beyond the control of the Contractor shall be replaced by the client.
- (b) End-of-Warranty inspection will be conducted by the Contract Administrator.
- (c) The Contract Administrator reserves the right to request material replacement or extend the Contractor's Maintenance responsibilities for an additional two (2) years if, at the end of the Warranty Period, leaf development and growth are not sufficient to ensure future survival of the plant material.

E32.1.6 Replacements

- (a) During the Maintenance Period, the Contractor shall remove from Site any plant material that has died or failed to grow satisfactorily as determined by the Contract Administrator and replace as per Specifications within a maximum ten (10) day period from notification.
- (b) Defective plants shall be replaced within three (3) days of notification to the Contractor.
- (c) The Contractor shall extend Maintenance and Warranty on replacement tree for a period equal to the original Maintenance and Warranty Periods.
- (d) The Contractor shall continue such replacement, Maintenance and Warranty until tree is acceptable.

E32.2 Materials

E32.2.1 Planting Soil

- (a) Planting Soil shall consist of black top soil, a fertile friable natural loam containing by volume not less than 4% and no more than 25% of organic matter for clay loams, and not less than 2% and no more than 25% for sandy loams, with an acidity value ranging from pH 6.0 to 8.0, a salinity rating shall be less than -4.0mm hos/cm on saturated paste test and it shall be capable of sustaining vigorous plant growth. Topsoil is to be free of any mixture of subsoil, clay lumps and free of stones and other extraneous matter. It is not to contain couch or crab grass rhizomes.

E32.2.2 Mulch

- (a) Enviro Mulch shall be Natural Colour, free of leaves, branches and other extraneous matter. The recommended mulch shall consist of chips not less than 15mm not larger than 75 mm in size and not more than 20 mm thick.
- (b) All other tree pit and planting area unspecific to be covered with Enviro Mulch free of leaves, branches and other extraneous matter. The recommended mulch shall consist of chips not less than 15mm not larger than 75 mm in size and not more than 20mm thick.
- (c) Contact for Enviro Mulch:
 - St. Boniface Pallet Company
 - 220 Panet Road
 - Winnipeg. MB R2J 0S3
 - Telephone No. (204) 233-0383
 - Facsimile No. (204) 233-6633
 - E-mail: info@stbpallet.com

E32.2.3 Miscellaneous Materials

- (a) Water shall be potable and free of minerals which may be detrimental to plant growth.

- (b) Stakes shall be metal T-Bar, steel, 40 x 40 x 5 x 2440 mm.
- (c) Guying ties shall Arbour Tie®
- (d) Trunk Protection shall be 600 mm weeping tile.
- (e) Fertilizer shall be a slow release formulation of low nitrogen and high phosphorus e.g. 10-50-12. Apply quantities at rates stated by product manufacturer.
- (f) Root Ball Burlap shall be 150 g Hessian burlap, biodegradable.
- (g) Wire Baskets shall be horticultural accepted product designed to carry the weight and to contain a burlap-covered root ball. Minimum diameter basket size is to conform to the same minimum diameter of the tree root ball for the respective minimum tree caliper sizes.

E32.2.4 Plant Material

- (a) Nomenclature of specified trees is to conform to the International Code of Nomenclature for Cultivated Plants and is to be in accordance with the approved scientific names given in the latest edition of the Standardized Plant Names.
- (b) Trees are to be characteristically developed for their species and structurally sound, well branched, healthy and vigorous and densely foliated when in leaf. The tree is to have a healthy, well developed, fibrous root system which may be verified through a testing procedure that destructively samples one or more randomly selected root balls.
- (c) Trees are to have been root pruned regularly, but not later than one growing season prior to arrival on Site. The Contractor may be required to furnish documentation to the client on their root-pruning program. Trees in excess of 75mm caliper are to have been half root pruned during each of two successive growing seasons, the latter at least, one growing season prior to arrival on Site.
- (d) All parts of the trees, especially the lower branches, are to be moist and show live, green cambium tissue when cut.
- (e) Trees are to have only one, sturdy, reasonably straight and vertical trunk, and a well-balanced crown with fully developed leader.
- (f) Trees are to be free of disease, insect infestation, rodent damage, sun scald, frost cracks, abrasions, unhealed scars, scars exceeding 5cm in diameter, major forks or crooks in the trunk, broken branches, or angled leaders. Trees having the above defects will not be accepted by the Contract Administrator.
- (g) Trees having a leader which has developed at a sharp angle to the trunk as a result of pruning or trunk damage will not be accepted.
- (h) Trees exhibiting suppressed, weakly developed branches due to competition from other closely spaced trees in the nursery will not be accepted. Trees exhibiting dead branches will not be accepted.
- (i) Any tree that has come out of dormant stage and is too far advanced will not be accepted unless prior approval obtained. Approval is required for any tree which has been held in cold storage.
- (j) Balled and burlapped trees in excess of a 3m height must have been dug with large firm ball. Roots in root balls must be comprised of 75% fibrous and feeder root systems. Secure root balls with burlap, heavy twine and rope. For trees 75mm or more in caliper, wrap ball in double layer of burlap and drum lace with minimum 10mm diameter rope. Protect root balls against sudden changes in temperature and exposure to heavy rainfall.
- (k) Tree spade dug trees are to be dug with mechanized digging equipment with hydraulic spade. Lift root ball from hole, place in wire basket designed for purpose and lined with burlap. Tie basket to ball with heavy rope. Take care not to injure trunk of tree with wire basket ties or rope.

- (l) Source (harvest) Sandbar Willow (*Salix exigua*) locally from donor site conditions that best approximate install site conditions. Approved donor site locations to be provided by the Contract Administrator.
 - (i) Willows must be sourced and installed while in a dormant state.
 - (ii) Willow Cuttings shall be cut to a length of no less than 1500mm (5 feet). Willow Cuttings shall be approximately 20 – 40mm in diameter.
 - (iii) Cut ends of Willow Cuttings must be sealed with pruning paint immediately following removal from the Donor Site to prevent desiccation unless Cuttings are being installed (planted) within 4 hours of harvesting.
- (m) Minimize storage time of Willow Cuttings if temporary storage is required.
 - (i) Store in temperatures of roughly 0 to 3°C in moist conditions until the time of installation in order to maintain dormancy and prevent desiccation of plant material. Stored Cuttings must not be exposed to extreme weather conditions. Store Cuttings in a secure location to prevent damage by animals during storage.
- (n) Use of collected or native trees is not permitted except for Sandbar Willow.

E32.2.5 Tree Quantity and Size

- (a) Trees are to be planted at the quantities and caliper listed on the Plant Lists which are shown on the drawings. Any variation from the specified quantity is to be clearly identified on the Schedule of Prices. Any variations to species, size or caliper of specified trees will require a request for approval from the Contract Administrator.
- (b) Any changes in planting locations will be determined on-site by the Contract Administrator.
- (c) The Contractor shall supply trees as indicated in the Schedule of Prices and PLANT LISTS.
- (d) Trees are to conform to the measurements specified in the on drawing PLANT LISTS, except that trees larger than specified may be used if approved by the Contract Administrator.
- (e) Trees are to be measured when the branches are in their normal position. Height dimensions specified are to refer to the main body of the tree and not from branch tip to root base. Where trees have been measured by caliper or diameter, reference is to be made to the diameter of the trunk measured 15cm above the ground as the tree stands in the nursery prior to lifting. Caliper of tree shall be appropriately designed on a permanently fixed tag on one of the branches.

E32.2.6 Shipment and Pre-Planting Care

- (a) Coordinate shipping of trees and excavation of holes to ensure minimum time lapse between digging and planting.
- (b) Tie branches of trees securely, and protect trees against abrasion, exposure and extreme temperature change during transit. Avoid binding of trees with rope or wire which would damage bark, break branches or destroy natural shape of tree. Give full support to root ball of trees during lifting.
- (c) Cover tree foliage with tarpaulin, and protect bare roots by means of dampened straw, peat moss, saw dust or other acceptable material to prevent loss of moisture during transit and storage.
- (d) Remove broken and damaged roots with sharp pruning shears. Make clean cuts, and cover cuts over 10mm diameter with a tree wound dressing.
- (e) Keep roots moist and protected from sun and wind. Heel-in trees which cannot be planted immediately in shaded areas and water well.

E32.3 Construction Methods

E32.3.1 Workmanship

- (a) All areas and locations provided for planting shall be staked out or painted on Site by the Contractor according to layout shown on the Drawings. Excavation shall not proceed until the layout has been inspected and approved by the Contract Administrator. Excavation shall not be undertaken until all underground utilities have been located and protected.
- (b) Coordinate operations. Keep Site clean and planting holes drained. Immediately remove soil or debris spilled onto street pavement, grass or sidewalk.

E32.3.2 Planting Time

- (a) Plant deciduous trees during dormant period before buds have broken. Trees noted for spring planting only, must be planted in dormant period.
- (b) Plant only under conditions that are conducive to health and physical conditions of trees.
- (c) Provide planting schedule to Contract Administrator. Extending planting operations over long period using limited crew will not be accepted.
- (d) The Contractor must obtain all above and below ground clearances from all the utilities as well as the appropriate District Operations Branch in a timely manner so as not to jeopardize the schedule of the complete tree planting Contract.

E32.3.3 Excavation

- (a) Tree Pit to be dug with back hoe.
- (b) Excavate tree pits as indicated by stakes or paint marks.
- (c) Protect bottom of excavations against freezing.
- (d) Remove water which enters excavations prior to planting. Ensure source of water is not ground water and notify Contract Administrator.
- (e) Upon excavation of the planting bed, the excavation shall be backfilled with a topsoil mixture to a depth to permit adequate installation and stabilization of the plant material. Topsoil shall be placed in accordance with City of Winnipeg Standard Construction Specification CW 3540 to a 300 mm depth.
- (f) Willow Cuttings will be placed into the ground into prepared Willow installation "Divots" as shown on the Drawings.
- (g) The Divot shall be created using an auger or a 'stinger' tool; capable of creating a 1370 mm (roughly 4.5 feet) deep x 100 mm (4 inches) wide hole into which Willow Cutting will be placed.

E32.3.4 Installation

- (a) Planting shall be done during periods of suitable weather conditions and in accordance with locally accepted practice.
- (b) Trees are to be planted within forty eight (48) hours of excavation from the nursery.
- (c) No tree pit is to be left open at the end of the Contractor's Work Day. Planting program is to be planned to ensure that all approved trees delivered to the Site at designated planting locations are installed and thoroughly watered the same day as delivery.
- (d) With balled and burlapped root balls and root balls in wire baskets, burlap shall be loosened and cut away from the top 1/3 without disturbing root ball. Wire shall be cut away and removed from the top 1/3 of the root ball. Burlap or rope shall not be pulled from under root ball. Non-biodegradable wrapping shall be removed.
- (e) After inserting the tree and tamping the root system with topsoil in lifts of 150mm, water shall be poured in until the pit is thoroughly soaked. Filling of the hole shall then be completed and the fill-in soil shall be packed firmly around the roots, leaving a concave surface for convenient watering. After filling, the planting shall be watered at frequent intervals.

- (f) Each tree is to have an earth saucer at its base having a diameter as large as the excavation with a 10 cm lip formed at the perimeter of the saucer to retain water.
- (g) All nursery stock shall be set plumb in the centre of pits and at levels as shown on the planting details after settlement has taken place.
- (h) Nursery stock shall be faced to give the best appearance or relationship to adjacent structure and to the approval of the Contract Administrator. Trees shall be placed equal to depth they were originally growing in nursery.
- (i) Where feasible, install Willow cuttings within 24 hours of harvesting.
- (j) Prior to Willow placement into the Divot, make a fresh cut at the bottom (larger) end of the cutting immediately prior to placement into the Divot. Make the cut at roughly a 45° angle. Install cutting within one half hour of making this fresh cut. (Do not respray this fresh cut at the bottom of the Cuttings).
- (k) Willow Cuttings are to be installed into the Divot leaving roughly 100 - 150mm of the cutting above ground.
- (l) Backfill Topsoil into the Divot after Willows have been placed in the Divot. Ensure that there are no voids in the Topsoil as it is back filled to the top of the Divot.

E32.3.5 Supply and Installation of Mulch

- (a) Contractor to supply and install mulch in tree pit and tree trenches as indicated on the Drawings. Mulch supplied shall cover entire trench to a consistent depth of 100 mm.

E32.3.6 Fertilizing

- (a) When planting is completed, give surface of planting saucer dressing of fertilizer meeting the requirements of Specification. Mix fertilizer thoroughly with top layer of planting soil and water in well.

E32.3.7 Trunk Protection

- (a) Install trunk protection on trees as indicated.
- (b) Install trunk protection prior to installation of tree supports when used.

E32.3.8 Pruning

- (a) The Contractor shall provide a licensed Manitoba Certified Arborist for each work crew or work site.
- (b) Employ clean sharp tools and make cuts flush with branch collars. Remove dead and injured branches.

E32.3.9 Watering

- (a) Trees are to be watered during the planting procedure as described previously, and once a week thereafter, or more frequently if required, during the growing season.
- (b) A complete record is to be kept of each series of waterings for all planted trees noting: 1) location, and 2) date of watering. This record shall be sent bi-weekly to the Contract Administrator.
- (c) Apply 40 litres of water per 25mm caliper per application using deep root feeder or low/pressure nozzle and hose. The water stream must not gouge out a hole in the soil and mulch.

E32.4 Method of Measurement

- E32.4.1 Installation of trees and shrubs shall be measured on a unit basis. The amount to be paid for shall be the total number of each type of trees and shrubs supplied and installed in accordance with this Specification and the Drawings, and as acceptable to the Contract Administrator. Two year maintenance and Enviro Mulch is considered incidental to the supply and installation of all plant material.

E32.5 Basis of Payment

E32.5.1 Payment for Installation of trees and shrubs shall be paid for at the Contract Unit Prices for the "Items of Work" listed below. This price shall be payment in full for supplying all labour, equipment and materials, and performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

Item of Work:

- (a) Deciduous Trees
- (b) Deciduous Shrubs
- (c) Willow Whips

E33. TOPSOIL AND FINISH GRADING

E33.1 Description

E33.1.1 The Work to be done by the Contractor under this Specification shall supplement CW3450 and 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 as shown on the Drawings and as specified hereinafter.

E33.1.2 Related Specifications

- (a) Tree Planting
- (b) Natural Seeding

E33.2 Provide submittals in accordance with Specifications.

E33.3 Quality control submittals:

- (a) Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in General Instructions.
- (b) Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

E33.4 Further to CW 3540 this specification is for the preparation of in situ soil, supply and placement of topsoil and finish grading for naturalization, seeded, and sodded areas.

E33.5 Following approval of removals and rough grading work the Contractor is to fracture the existing soil with approved tilling machinery, add top soil and till into existing soil. Fracturing plan and procedures are to follow method as approved by the City of Winnipeg.

E33.6 Topsoil

- (a) All topsoil required shall consist of a clay-textured or loam-textured dark topsoil, a fertile, friable material neither of heavy clay nor of very light sandy nature containing by volume, a minimum of four (4%) percent for clay loams and two (2%) percent for sandy loams to a maximum twenty-five (25%) percent organic matter (peat, rotted manure or composted material) and capable of sustaining vigorous plant growth. Soil shall be free of roots and stones over 30 mm in diameter or subsoil clay lumps over 30 mm in diameter.
 - (i) Upon delivery or thirty (30) days following delivery, salinity ratings shall be less than 4.0 mmhos/cm. The pH range shall be between 6.5 and 7.5.
 - (ii) Topsoil shall be free of residual chemical properties originating from past herbicide applications or other forms of contamination which can potentially negatively affect the growth and successful establishment of planted material as specified.
 - (iii) Topsoil shall not contain the roots or rhizomes of quack grass (*Elymus repens*), smooth brome (*Bromus inermis*), Canada thistle (*Cirsium arvense*), sweet clover spp. (*Melilotus officinale* or *M. alba*), dandelion (*Taraxacum officinale*) or other undesirable weed species.

E33.7 Organic Soil Amendments

- (a) Topsoil:
 - (i) In accordance with CW3540 and E33.6.
- (b) Peatmoss:
 - (i) Derived from partially decomposed species of Sphagnum mosses.
 - (ii) Elastic and homogeneous, brown to black in colour.
 - (iii) Free from Wood and deleterious material which could inhibit growth; Debris and stones over 12.5 mm diameter.
 - (iv) Shredded particle minimum size: 5 mm.
- (c) Organic matter: compost Category A in accordance with CCME PN1340; unprocessed organic matter such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- (d) Inorganic Soil Amendments
 - (i) Fertilizer: In accordance with the Canada Fertilizers Act and Fertilizers Regulations; compatible with the seed mix and soil conditions.
 - (ii) Fertility: major soil nutrients present in following amounts:
 - (i) Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
 - (ii) Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
 - (iii) Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
 - (iv) Calcium, magnesium, sulfur and micro nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - (iii) pH value: 6.5 to 8.0.
- (e) Sand: washed coarse silica sand, medium to course textured.
- (f) Limestone:
 - (i) Ground agricultural limestone.
 - (ii) Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.

E33.8 Temporary Erosion And Sedimentation Control

- (a) Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, whichever is more stringent.
- (b) Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- (c) Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

E33.9 Stripping and stockpiling of soils to be used for natural grass seeding

- (a) Soils shall not be stripped if they are too wet or too dry as determined by the Contract Administrator.
- (b) Begin topsoil stripping of areas after brush, weeds and grasses have been cleared and removed from site.
- (c) If existing topsoil contains established perennial noxious weed species or the perennial grassy weeds quackgrass (*E. repens*) or smooth brome (*B. enermis*), treat area with non-selective herbicide during the active growing season, a minimum of 10 days prior to stripping. Alternatively, provide minimum of 1 year of pre-plant weed control designed to eliminate persistent perennial weed species. Do not seed permanent cover until the site is free of primary and secondary noxious weeds and persistent perennial grassy weeds.

- (d) Strip topsoil to depths as indicated by core test samples to avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.
- (e) Stockpile in locations that are protected from traffic or where they will be protected from erosion, compaction, and contamination from wind-blown weed seed. Stockpile height not to exceed 1.5 m
- (f) If topsoil is expected to remain stockpiled for more than three (3) weeks during the growing season (May – October), seed the stockpile with an annual cover crop such as oats or barley by broadcast-harrow seeding method.

E33.10 Preparation of Existing Grade

- (a) Verify that grades are correct.
- (b) If discrepancies occur, notify the Contract Administrator and do not commence work until instructed.
- (c) Ensure positive drainage by grading soil to eliminate uneven areas and low spots.
- (d) Remove debris, roots, branches, stones and other deleterious materials in excess of 12.5 mm diameter.
 - (i) Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - (ii) Remove debris in excess of 12.5 mm which protrudes from soil surface.
 - (iii) Dispose of removed material off site.
- (e) Cultivate entire area which will receive topsoil to minimum depth of 150 mm.
 - (i) Cross cultivate (minimum of two perpendicular passes) those areas where equipment used for hauling and spreading has compacted soil.

E33.11 Placing and Spreading of Topsoil

- (a) Place stockpiled topsoil after subgrade meets conditions of E33.10 and has been accepted by Contract Administrator
- (b) Spread stockpiled topsoil in a uniform layer at a minimum depth of 150 mm.
- (c) If necessary, supplement stockpiled topsoil with suitable imported soil to CW3540 in order to achieve minimum 150 mm depth.
- (d) Integrate topsoil/organic soil amendments to a depth of 200-250 mm, taking care not to bury topsoil when blending with decompacted subgrade.

E33.12 Soil Amendments

- (a) Stockpiled soils that do not meet the requirements of this specification must be amended in order to achieve the minimum conditions.

E33.13 Finish Grading

- (a) Grade to eliminate rough spots and low areas and ensure positive drainage.
 - (i) Prepare loose friable bed by means of cultivation and subsequent raking.
- (b) Consolidate topsoil to required bulk density using approved equipment.
- (c) Leave surfaces smooth, uniform and firm against deep (> ½”) foot-printing.

E33.14 Acceptance

- (a) Contractor to provide soil tests confirming soil quality adheres to specified criteria. If amendments are required, contractor is to provide follow up soil tests to ensure soil has been amended sufficiently.
- (b) Contract Administrator will inspect topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

E33.15 Cleaning

- (a) Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers

E33.16 Measurement and Payment

E33.16.1 Topsoil and Finish Grading is considered incidental to Tree Planting and Natural Seeding work. No payment will be made for Topsoil and Finish Grading.

E34. NATURAL SEEDING

E34.1 GENERAL

E34.1.1 The work to be done by the Contractor under this Specification shall include the supply, installation, labour, equipment, tools and all other things necessary for and incidental to the satisfactory performance and completion of all work shown in the drawings and as hereinafter specified, including, but not necessarily confined to the following:

- (a) Site preparation (Growth Media Preparation)
- (b) Supply and install topsoil
- (c) Weed control
- (d) Erosion control
- (e) Supply and install grass seed
 - (i) Cover crop of Common Oats to be seeded in immediately following placement of topsoil
 - (ii) Cover crop of Winter wheat (*Triticum aestivum*) or fall rye (*Secale cereale*) to be seeded in if late in the year.
 - (iii) Natural Areas Seed Mix to be seeded in spring, consisting of the following pre-mixed grass species: (if after July 1st, only cover cropping will be acceptable until following year)

SALT TOLERANT GRASS MIX - SPECIES	
Chewing's Fescue	Northern Wheatgrass
Creeping Red Fescue	Side-Oats Grama
Fult's Alkali Grass	Slender Wheatgrass
Hard Fescue	Western Wheatgrass
Perennial Ryegrass	Little Bluestem

- (iv) Natural Area / Omand's Creek Seed Mix to consist of the following pre-mixed grass species:

OMAND'S CREEK BANK GRASS MIX - SPECIES	
Western Wheatgrass	Tufted Hairgrass
Slender Wheatgrass	Rough Hair Grass
Fowl Bluegrass	Switch Grass
Canada Wildrye	Cordgrass
Virginia Wildrye	

- (v) Natural Area / Assiniboine Riverbank Seed Mix to consist of the following pre-mixed grass species:

ASSINIBOINE RIVERBANK GRASS MIX - SPECIES	
Big Bluestem	Indian Grass
Canada Wildrye	Fowl Bluegrass

Kentucky Bluegrass	Purple Prairie Clover
Rough Hairgrass	Slender Wheatgrass
Switchgrass	Tufted Hairgrass
Virginia Wildrye	Western Wheatgrass

- (vi) Planting rate information will be supplied by the Contract Administrator prior to seeding.

E34.1.2 The Contractor shall ensure coordination with other site works including but not limited to asphalt and concrete surfacing as well as grading and other planting works.

E34.1.3 The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be subject to inspection and testing by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for inspection and testing purposes.

E34.1.4 Submittals

- (a) Detailed work schedule
- (b) Weed control plan
- (c) Erosion control plan (including cover crop management approach)
- (d) Salt Tolerant and Natural Areas grass establishment plan
- (e) Herbicide applicator's license
- (f) Soil analysis report from accredited soil testing lab.
- (g) Seed bag tags

E34.2 Materials

E34.2.1 Topsoil

- (a) In accordance with E33.6.

E34.2.2 Topsoil Testing

- (a) The Contractor shall inform the Contract Administrator of the proposed Topsoil source. The Contract Administrator reserves the right to reject topsoil not conforming to the requirements of this Specification.
- (b) The Contractor will submit Topsoil samples for review and approval by the Contract Administrator. Topsoil will be subject to tests for nitrate, phosphate, potassium, sulphate, pH, electrical conductivity, and organic matter content by an accredited soil testing laboratory.

E34.2.3 Erosion Control

- (a) Annual and perennial vegetation once established (>80% ground cover); residual dead biomass left after termination of annual cover crop vegetation.
- (b) In accordance with E27.

E34.2.4 Seed

- (a) "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.
- (b) Annual cover crop seed will be regionally appropriate and will be accompanied by an up-to-date seed analysis report. The Contract Administrator will review and approve the Contractor selected cover crop seed prior to seeding.
- (c) Salt Tolerant and Natural Areas Seed Mix consists of a pre-blended, grass-based seed mix developed by the Contract Administrator on a pure live seed per square metre basis.
 - (i) The Contractor will order seed mixes supplied by The Contract Administrator, pick up and deliver them to the work site.

- (ii) The seed will be packaged in 25 kilogram labelled bags. The Contractor must supply all equipment and labour required to transport seed.
- (d) Storage for seed shall be in cool dry location. The Contractor shall provide secure, weather and rodent proof storage for the seed prior to planting.
- (e) Any seed lost or damaged while stored shall be replaced by The Contractor and will be considered incidental to the contract.

E34.3 Method of Construction

E34.3.1 Growth Media Preparation

E34.3.2 Subsoil

- (a) The subsoil shall be graded in accordance with Specifications and Drawings.
- (b) In areas where doing so will not interfere with existing below ground infrastructure, the subsoil grade shall be decompacted to a depth of 200mm. A minimum depth of 150mm will be permitted only in areas where obstructions exist at greater depths.

E34.3.3 Topsoil

- (a) A minimum of 150mm of Topsoil shall be placed above decompacted subsoil in all areas to be seeded.
- (b) Topsoil shall be placed in a manner as to avoid compaction of decompacted subsoil.
- (c) Topsoil shall be lightly incorporated evenly into prepared subsoil to a depth of 200-250 mm.
 - (i) The Contractor shall take care not to bury Topsoil when incorporating into decompacted subsoils.
- (d) The Contractor to submit for review and approval all growth media preparation activities, prior to seeding.

E34.3.4 Fine Grading

- (a) Topsoil and Fine Grading shall be as shown on the drawings.
- (b) The Contractor shall fine grade Topsoil, to eliminate rough spots, ruts or other similar low areas to ensure positive drainage and to facilitate consistent seed placement and seed rate during planting.
- (c) The incorporated Topsoil shall be lightly consolidated and the surface shall be left smooth, firm and level prior to seeding.
- (d) All seeded areas are to be free of woody debris and rocks. The Contract Administrator will advise the Contractor of any debris clean-up requirements.

E34.3.5 Erosion Control

- (a) Annual cereal cover crops will be seeded and managed throughout the growing season to help protect against soil erosion.
- (b) Cover crops may require management to prevent excessive built-up of plant stock and to limit seed production on-site.
 - (i) Cover crop management may involve any of the following activities: mowing, herbicide application, and/or thatch removal.
- (c) The Contract Administrator shall evaluate all seeded areas for potential soil erosion during the life of The Project and the Contractor shall take appropriate mitigation measures as directed by the Contract Administrator.
- (d) Rutting or damage caused during seeding operation shall be repaired at the Contractor's cost to the satisfaction of the Contract Administrator.

E34.3.6 Weed Control

- (a) Properly timed weed control shall be undertaken in the seeded areas to facilitate grass seedling establishment. Two to three weed control treatments per year will be undertaken during the establishment period; treatment approach to be determined based on weed species presence and abundance observed during weed surveys.
- (b) Weed control prescriptions shall be reviewed by The Contract Administrator prior to undertaking any weed control activities. No herbicide application shall be undertaken without consent of the Contract Administrator.
- (c) For herbicide treatments, products, timing, and rates will be supplied by a certified herbicide applicator with experience in weed control in native revegetation projects.
- (d) Herbicide application shall be undertaken by a licensed pesticide applicator in accordance with all local, provincial and federal regulations, whichever is more stringent. Owner and adjacent land owner environmental policies shall be considered in developing and implementing weed control approach.
- (e) Herbicide is to be applied in accordance with the manufacturer's instructions and the Manitoba Agriculture Guide to Crop Protection and Herbicide Recommendations for Landscape Applicators, latest editions.
- (f) Glyphosate cannot be used at any time following seeding of the Salt Tolerant Natural Areas Seed mix.
- (g) The Contractor shall not apply broad-leaf herbicides in areas seeded to perennial grass cover prior to seedlings reaching the 2-3 leaf stage. Determination of 2-3 leaf stage shall be made by the Contract Administrator.
- (h) Herbicide application technique must control spray drift and protect adjacent non-target vegetation, habitat and property.
- (i) The Contractor shall undertake all reasonable and permissible means of restricting seed-rain of invasive or otherwise problematic weed species from areas immediately adjacent The Project for the duration of The Project.

E34.3.7 Seeding

- (a) Prior to seeding permanent grass cover, the seeding area shall be free of noxious perennial grassy and broadleaf weeds listed in the Manitoba Noxious Weed Act C.C.S.M. c. N110.
- (b) Prior to seeding permanent grass cover seeding areas shall be free of weedy perennial species that may not be listed as noxious weeds but which will become invasive within the planting over time, including but not limited to, quackgrass, smooth brome, sweet clover and dandelion.
- (c) Annual weeds including green and yellow foxtail (*Setaria* spp.), barnyard grass (*Echinochloa crus galli*), if present, are to be controlled so as to not compromise short term or long term grass stand establishment. Post seeding control of these species, and species with similar tendencies in permanent plantings, shall be at the direction of the Contract Administrator.
- (d) Cover Crop Seeding to be undertaken as soon as possible following topsoil placement and preparation, during suitable seeding windows. Cover crop seeding can be done using any of the three seeding methods described below (E34.3.8-E34.3.10).
- (e) Grass will be mechanically seeded using a Truax seed drill to allow for accurate distribution and proper seed coverage. In areas where the Truax cannot reach, a Brillier seed drill will be used. To a much smaller degree, broadcasting methods will be utilized only in areas where equipment cannot reach. All seeding methods require the same seedbed conditions and post-plant maintenance outlined in the specifications.
- (f) Contour seeding must be employed to discourage down slope erosion on sloped areas.

- (g) While on-site, seed requiring short-term storage shall be stored by the Contractor in a secure, dry and rodent-free environment either at or below ambient outdoor temperatures.
- (h) Following seeding, The Contractor shall return to the Contract Administrator the shipment tags from each bag of seed planted on site.

E34.3.8 Drill Seeding

- (a) Drill seeding shall be undertaken using a Truax, two or three box native seed drill with seed box agitators, on-row packers and depth bands, capable of uniformly applying the specified mixes to a depth of 5.0-12.0mm (0.25" – 0.5").
- (b) A 1.8 – 2.4m (6.0 – 8.0') three point hitch-mounted Truax native seed drill is preferred. Alternatively a low ground pressure configuration capable of delivering native seed consistently at the proper rate and depth as per seeding specifications may be acceptable, pending Contract Administrator approval.
- (c) The Truax seed drill must be capable of being equipped with trash plows to prevent light debris from interfering with seed placement during native drill seeding.
- (d) The Contract Administrator shall supply drill seeding rates for the Salt Tolerant and Natural Areas Seed Mix and the rate shall be provided on a bulk seeds per 1/10 m² (approximately / ft²) basis.

E34.3.9 Brillion Seeding

- (a) Permitted only in areas that are inaccessible to Truax drill seeding equipment.
- (b) Brillion seeding must be accomplished using a Brillion Ag Seeder or Brillion Landscape Seeder with a Double Roller set-up capable of placing seed uniformly at a depth of 5.0-12.0mm (0.25" – 0.5").
- (c) Brillion seeding equipment must be fitted with Seed Box agitators capable of keeping the seed mix evenly blended throughout seeding operations to ensure seed of variable weights and dimensions are dispersed evenly.
- (d) The Contract Administrator shall supply Brillion seeding rates for the Salt Tolerant and Natural Areas Seed Mix and the rate shall be provided on a bulk seeds per 1/10 m² (approximately / ft²) basis.

E34.3.10 Harrow-Broadcast-Harrow Seeding

- (a) Permitted only in areas that are inaccessible to all mechanical seeding equipment.
- (b) Broadcast seeding is preceded by one or more harrow passes and is then followed by a second harrow pass once seed has been broadcasted at the specified rate.
- (c) An industrial fertilizer applicator may be used for broadcast seeding to facilitate consistency of seed flow. A manual broadcast seeder may be used for small areas requiring manual seeding. Seed mix must be suitably agitated within the seeder/spreader to ensure seed of variable weights and dimensions are dispersed evenly.
- (d) The Contract Administrator shall supply Harrow-Broadcast-Harrow seeding rates for the Salt Tolerant and Natural Areas Seed Mix and the rate shall be provided on a bulk seeds per 1/10 m² (approximately / ft²) basis.

E34.4 Acceptance

- (a) A minimum of 6-8 grass seedlings with permanent roots (4-leaf stage) have been documented per 1/10 square meter, by the end of the first growing season.
- (b) Seeded areas are free of rutted, eroded, bare or dead spots.

E34.5 Method of Measurement

- E34.5.1 Supply and installation of Natural Seeding shall be measured on an area basis. The area to be paid for shall be the total number of square meters material installed and maintained in accordance with this Specification and the Drawings, and as acceptable to the Contract Administrator.
- E34.5.2 Weed Control is considered a lump sum item. No measurement shall be made.
- E34.6 Basis of Payment
- E34.6.1 Payment for Installation of Natural Seeding shall be paid for at the Contract Unit Prices for "Native Grass Planting". This price shall be payment in full for supplying all labour, equipment and materials, including erosion control, maintenance, grow-in, and performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator. Payment for Native Grass Planting shall be in accordance with the following:
- (a) Sixty five (65%) percent of quantity following supply and placement.
 - (b) Remaining thirty five (35%) percent of quantity following termination of the Acceptance criteria.
- E34.6.2 Payment for Installation of Weed Control shall be paid for at the Contract Lump Sum Price for the "Weed Control". This price shall be payment in full for supplying all labour, equipment and materials, including licenses, regulatory approvals and performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator. Payment for Weed Control shall be in accordance with the following:
- (a) Fifty (50%) percent of payment following year 1 of warranty period.
 - (b) Remaining fifty (50%) percent of payment following year 2 of warranty period.

E35. SALT TOLERANT GRASS SEEDING

DESCRIPTION

- E35.1 Further to CW 3520 and CW3540, this specification shall cover sub-grade preparation and the supply and placement of Salt Tolerant Grass Seed.

MATERIALS

- E35.2 Salt Tolerant Grass Seed
- E35.2.1 Salt Tolerant Grass Seed for regional and collector boulevards, medians and interchange areas shall be a mixture composed of:
- (a) Seventy percent (70%) Fults or Nuttals Alkaligrass (*Puccinellia* spp.), twenty percent (20%) Audubon or Aberdeen Creeping Red Fescue and ten percent (10%) Perennial Ryegrass.

EQUIPMENT

- E35.3 Scarification equipment shall be suitable for the area being scarified, shall be capable of scarifying the sub-grade to the specified depth and shall be accepted by the Contract Administrator. For confined areas a toothed bucket may be acceptable. For larger areas tilling equipment may be required.

CONSTRUCTION METHODS

- E35.4 Preparation of Existing Grade
- E35.4.1 Prior to placing topsoil, in areas to be seeded greater in width than 600mm, prepare the existing sub-grade by scarifying to a minimum depth of 75mm and to a maximum depth of 100mm to the satisfaction of the Contract Administrator.

E35.4.2 Scarification shall consist of breaking up and loosening the sub-grade. No scarification shall occur within the edge of a tree canopy (or drip line).

E35.5 Salt Tolerant Grass Seeding

E35.5.1 Salt Tolerant Grass Seed shall be sown at a rate of 2.2 kilograms per 100 square meters.

MEASUREMENT AND PAYMENT

E35.6 Supply, placement and maintenance of Salt Tolerant Grass Seed will be paid for at the Contract Unit Price per square metre for "Salt Tolerant Grass Seeding", measured as specified herein, which price shall be payment in full for supplying all materials and for completing all operations herein described and all other items incidental to the work included in this Specification. Payment for Salt Tolerant Grass Seeding shall be in accordance with the following:

- (a) Sixty five (65%) percent of quantity following supply and placement.
- (b) Remaining thirty five (35%) percent of quantity following termination of the Maintenance Period.

E36. STRUCTURAL EXCAVATION

E36.1 Description

E36.1.1 This Specification covers all operations relating to the following:

- (a) Excavation required to construct the Empress Overpass Rehabilitation Works, Pedestrian Accessibility Ramps, and Empress St. Retaining Wall.

E36.1.2 The Works also include the following items, which are incidental to the Work.

- (a) Preparation of the base of excavations.
- (b) The design, fabrication, erection, and removal of all temporary shoring, and such temporary protective measures as may be required to construct the Works.
- (c) The proper off-site disposal of surplus or unsuitable material.
- (d) Dewatering and or precipitation removal of the excavations as may be required for construction of the works in the dry.

E36.1.3 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 Work as hereinafter specified.

E36.2 Submittals

E36.2.1 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any excavations on the Site the following:

- (a) Detailed design calculations and Shop Drawings for all shoring that is signed, sealed, and dated by a Professional Engineer experienced in shoring design and licensed to practice in the Province of Manitoba in accordance with E5, "Shop Drawings".
- (b) The Professional Engineer who designed the temporary shoring system shall inspect the temporary shoring system during construction, and certify, in writing to the Contract Administrator, that construction is in conformance with the approved design.

E36.3 Materials and Equipment

E36.3.1 General

- (a) Protection
 - (i) The Contractor shall ensure no damage to existing facilities and equipment and provide protection if required. The facilities include

- (ii) Close to South Pedestrian Accessibility Ramp:
- (iii) Manitoba Hydro 5 of 4 Way underground ductline and manhole;
- (iv) Shaw underground fiber and coax line;
- (v) BellMTS underground copper cable;
- (vi) Gas service to 1460 Portage Avenue;
- (vii) City of Winnipeg water line; and
- (viii) Secondary cables to street lights.
- (ix) Close to North Pedestrian Accessibility Ramp:
- (x) Manitoba Hydro 115 kV underground primary cable;
- (xi) Underground primary Manitoba Hydro cable to transformer;
- (xii) Manitoba Hydro Secondary cables to street lights;
- (xiii) BellMTS underground copper cable; and
- (xiv) City of Winnipeg water line.
- (xv) Close to Empress St Retaining Wall
- (xvi) Shaw conduit;
- (xvii) 3 of 3 way of 4in ducts with a 4 in reinforced concrete envelope; and
- (xviii) Gas line.

(b) Excavation

- (i) The Contractor shall 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 workmanship-like manner, to the satisfaction of the Contract Administrator.
- (ii) All excavated materials 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.
- (iii) Excavated material shall be unclassified excavation and shall include the excavation and satisfactory disposal of all cleared and grubbed materials, earth, gravel, asphalt, concrete pavement, sandstone, loose detached rock, shale, rubbish, cemented gravel or hard pan, disintegrated stone, rock in ledge or mass formation wet or dry, trees, shrubs, augured material for the vertical drains, abandoned utilities, existing timber or other culverts and structures, or all other material of whatever character which may be encountered.

E36.3.2 Equipment

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

E36.4 Construction Methods

E36.4.1 Excavation

- (a) Excavations shall be completed to the elevations required to construct the Works or to such other elevations as may be directed by the Contract Administrator in the field. Excavation sequence shall be done in a "top down" direction, in order to maintain stability. The dimensions of the excavation shall be such as to give sufficient clearances for the construction of forms and their subsequent removal.
- (b) All material shall be brought to the surface by approved method, suitable fill material placed on site where required as approved by the Contract Administrator or disposed of away from the site.
- (c) After each excavation is completed, the Contractor shall notify the Contract Administrator.
- (d) The Contractor shall excavate only material that is necessary for the expeditious construction of the structure or as set out by the Contract Administrator in the field. If

the Contract Administrator permits the excavation of existing stock piles, or trenches within the right-of-way, the Contractor shall, on completion of the Work, backfill the trenches to the elevation of the original ground existing at the time of excavation and compact the backfill material, all at their own expense and as directed by the Contract Administrator.

- (e) All excess excavated material shall become the property of the Contractor and shall be removed from the site.
- (f) During construction the Contractor may be required to dewater excavations.
- (g) No measurement and payment of dewatering of excavation will be made and shall be considered incidental to the Work.

E36.5 Measurement and Payment

E36.5.1 Structural Excavation

- (a) The excavation required for the Empress Overpass Rehabilitation Works, construction of Pedestrian Accessibility Ramps, and Empress St. Retaining Wall will not be measured. This Item of Work shall be paid for at the Contract Lump Sum Price for "Structural Excavation", which price will be payment in full for supplying all materials/equipment and performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E37. STRUCTURAL BACKFILL

E37.1 Description

E37.1.1 This Specification covers all operations relating to the following:

- (a) Empress Overpass Rehabilitation Works, construction of Pedestrian Accessibility Ramps, and Empress St. Retaining Wall.

E37.1.2 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 Work as hereinafter specified.

E37.2 Materials

E37.2.1 General

- (a) Protection
 - (i) The Contractor shall provide protection to ensure no damage to existing facilities, equipment, and utilities.
- (b) Backfilling
 - (i) 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.
 - (ii) All materials shall be accepted 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 Specification detailed herein, or are found to be defective in manufacture, or have become damaged in transit, storage, or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at their own expense.
 - (iii) Backfill materials shall be free of frozen lumps and shall be placed and compacted in an unfrozen state. Backfill shall not be placed on frozen subsoil.
 - (iv) All granular backfill for the Empress Overpass Rehabilitation Works, construction of Pedestrian Accessibility Ramps, and Empress St. Retaining

Wall shall be clean and free from organic material and in accordance with CW 2030-R7.

- (v) All granular backfill for the Empress Overpass, Empress St Retaining Wall, Pedestrian Accessibility Ramps shall be Material in accordance with the following gradation requirements:

CANADIAN METRIC SIEVE SIZE	PERCENT PASSING BY WEIGHT
50 000	100
20 000	75 – 100
5 000	45 – 85
2 500	35 – 55
315	15 – 35
160	5 – 20
80	0 – 7

- (vi) Non-granular cohesive material shall be highly plastic clay (exhibiting putty-like properties with considerable strength when dry) and non-organic. Material with very high swelling potential such as bentonite clay will not be permitted. When proposed material characteristics 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. Non-granular cohesive material shall have a minimum Plasticity Index of 40. The non-granular cohesive material shall be free of rocks and stones.
- (vii) Excavated material may be used for backfilling provided it meets the above requirements. Excavated granular material intended to be used for backfilling must not be contaminated by topsoil or organic materials.

E37.2.2 Equipment

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

E37.3 Construction Methods

E37.3.1 Backfilling

- (a) The Contract Administrator shall be notified at least one (1) working day in advance of any backfilling operations. No backfill shall be placed against any concrete until accepted by the Contract Administrator.
- (b) All backfill material shall be supplied, placed, and compacted in lifts of 150 mm (maximum) to a minimum of ninety-five percent (95%) of Standard Proctor Dry Density. Lifts shall be brought up on all sides at the same time.
- (c) The Contractor shall be required to provide necessary water or equipment during compaction of backfill material to achieve the required densities.
- (d) The Standard Proctor Density for granular and clay backfill material shall be determined at the optimum moisture content in accordance with standard laboratory Proctor Compaction Test Procedure.
- (e) The field density of the compacted layers shall be verified by Field Density Tests in accordance with ASTM Standard, Test for Density of Soil in Place by the Sand-Cone Method, or equivalent as accepted by the Contract Administrator in accordance with B6.
- (f) The frequency and number of tests to be made shall be as determined by the Contract Administrator.
- (g) 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 materials 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 acceptance that may have previously been given. The Contract Administrator reserves the right to reject any materials or Works which are not in accordance with the requirements of this Specification.

- (h) The Contract Administrator shall be allowed free access for the inspection and control testing of constituent materials both at the site of the Work and at any plant used for production of the materials to determine whether the material is being supplied and placed in accordance with this Specification.
- (i) Any backfill material that does not meet the gradation and/or compaction requirements of this Specification shall be removed and replaced by the Contractor at their own expense, to the satisfaction of the Contract Administrator.

E37.4 Measurement and Payment

E37.4.1 Structural Backfill

- (a) The backfilling required for the Empress Overpass Rehabilitation Works, construction of Pedestrian Accessibility Ramps, and Empress St. Retaining Wall will not be measured. This Item of Work shall be paid for at the Contract Lump Sum Price for "Structural Backfill", which price will be payment in full for supplying all materials/equipment and performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E38. SUPPLYING AND PLACING SUBSURFACE DRAINAGE

E38.1 Description

E38.1.1 General

- (a) This Specification covers all operations relating to the supply and installation of the subdrain pipe and drain systems located, at The Pedestrian Accessibility Ramps Modular Blocks Retaining Walls, and drainage channel including leads and connections to the catch basin.
- (b) 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.

E38.2 Material and Equipment

E38.2.1 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.

E38.2.2 Drain Pipes, Fittings, and Accessories

- (a) Perforated and non-perforated drain pipes, fittings, and other accessories and appurtenances shall conform to the requirements of the City of Winnipeg Standard Construction Specification CW 3610-R5 and requirements CSA G401-14, for Corrugated Steel Pipe (CSP). Corrugated steel drain pipe shall be perforated and non-perforated, aluminized Type 2, 1.6 mm gauge, complete with filter sock and with the 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 2130-R12 and CW3120-R4.

E38.2.3 Drainage Fabric

- (a) Drainage fabric shall be in accordance with CW3120-R4 or as accepted by the Contract Administrator in accordance with B6.

E38.2.4 Drainage Material

- (a) Drainage material shall be in accordance with Specification CW 3120-R4.

E38.2.5 Equipment

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

E38.3 Construction Methods

E38.3.1 Subdrain Systems

- (a) Install drain pipe system as shown on the Drawings. The supply and installation of this drain pipe system shall include the drain pipe, all required fittings, drain pipe drainage 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.
- (c) Subdrain Systems of the Retaining Walls must be completely installed and backfilled within two (2) weeks of the initial excavation for the subdrain systems.

E38.4 Measurement and Payment

E38.4.1 Subdrain Systems

- (a) The supply and installation of the subsurface drainage system will not be measured. This Item of Work shall be paid for at the Contract Lump Sum Price for "Supplying and Placing Subsurface Drainage", which price will be payment in full for supplying all materials / equipment and for completing all operations herein described and all other items incidental to the work included in this Specification, and accepted by the Contract Administrator.

E39. TURF REINFORCEMENT MAT (TRM)

E39.1 Description

- (a) This Specification shall cover the supply, installation, and maintenance of Turf Reinforcement Mat (TRM), as specified herein 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.

E39.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ASTM D1117 – Standard Guide for Evaluating Nonwoven Fabrics;
 - (ii) ASTM D1388 – Standard Test Method for Stiffness of Fabrics;
 - (iii) ASTM D6525 – Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products;
 - (iv) ASTM 6818 – Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products;
 - (v) Erosion Control Technology Council (ECTC) Guidelines.
 - (vi) ASTM D6459 – Determination of Erosion Control Blanket Performance in Protecting Hillslopes from Rainfall – Induced Erosion.
 - (vii) ASTM D6460 – Determination of Erosion Control Blanket Performance in Protecting Earthen Channels from Storm Water – Induced Erosion.

- (b) The following specifications
 - (i) D27 – ENVIRONMENTAL PROTECTION PLAN;
 - (ii) E33 – TOPSOIL AND FINISH GRADING
 - (iii) E35 – SALT TOLERANT GRASS SEEDING.

E39.3 Scope of Work

E39.3.1 The Work under this Specification shall include the following items, to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator:

- (a) Supplying and installing erosion control blanket on disturbed slopes and drainage water discharge areas.
- (b) Complying with all requirements outlined in D27, "ENVIRONMENTAL PROTECTION PLAN".

E39.4 Submittals

E39.4.1 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E39.4.2 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material.

E39.5 Materials

E39.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall 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.

E39.5.2 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
- (b) TRM shall be furnished in rolls and wrapped with suitable material to protect against moisture extrusion and extended ultraviolet exposure prior to placement.

E39.6 Equipment

E39.6.1 General

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

E39.7 Construction Methods

E39.7.1 General

- (a) TRM shall be placed on all disturbed and exposed slopes at the North Pedestrian Accessible Ramp for which revegetation is required.
- (b) Locations of TRM will be confirmed on site with the Contract Administrator.

E39.7.2 Complying with Environmental Protection Requirements

- (a) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into Omand's Creek from areas disturbed as a result

of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D27, "Environmental Protection Plan".

- (b) The Contractor shall monitor his work and implement appropriate sediment control measures as site conditions warrant.
- (c) The Contractor shall monitor, maintain, and repair all sediment control measures until vegetation has re-established in restored areas and there no longer is a potential for sediment releases due to construction.
- (d) Disturbed areas shall be restored. Erosion control blankets, as approved by the Contract Administrator, shall be used to control potential erosion of areas where vegetation has been damaged, up until permanent vegetation has been re-established.

E39.7.3 Turf Reinforcement Mat

- (a) TRM shall be Recyclex TRM, as manufactured by American Excelsior Company, Arlington, TX (1-866-9FIBERS), or equivalent as accepted by the Contract Administrator in accordance with B6.
- (b) Turf Reinforcement Mat, consists of 100% post-consumer recycled polyester (green or brown bottles) with 80% of fibers \geq 5 inches in length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the TRM. The top of each netting. Fibers shall be tightly crimped and curled to allow fiber interlock and to retain 95% memory of the original shape after loading by hydraulic events. Fibers shall have a specific gravity of great then 1.0; therefore, the TRM will not float during hydraulic events. Recyclex TRM shall meet Federal Government Executive Order initiatives for use of products made from, or incorporating, recycled goods. Recyclex TRM shall be manufactured in the U.S.A. and the fibers shall be made from 100% recycled post-consumer goods.
- (c) TRM shall have the following material characteristics:

Width	8.0 ft (2.4m)	16ft (4.9 m)
Length	90.0 ft (27.4 m)	90.0 ft (27.4 m)
Area	80.0 yd ² (66.9 m ²)	160.0 yd ² (133.8 m ²)
Weight	50.0 lb (22.7kg)	100.0 lb (45.4 kg)
Fiber Length (80% min)	\geq 5.0 in (\geq 12.7 cm)	\geq 5.0in (\geq 12.7cm)
Mass per Unit Area (\pm 10%)	0.625 lb/yd ² (0.4 mm x 25.4 mm)	0.75 in x 1.0 in (19.1 mm x 25.4mm)
Net Openings	Polypropylene Top	0.75 in x 1.0 in (19.1 mm x 25.4 mm)
	Polypropylene Bottom	0.75 in x x0.75 in (19.1 mm x 19.1 mm)
		0.75 in x 0.75 in (19.1 mm x 19.1 mm)

(d) TYPICAL INDEX VALUES:

Index Property	Test Method	Value
Thickness	ASTM D 6525	0.371 in (9.4mm)
Light Penetration	ECTC Procedure	55%
Resiliency	ASTM D 6524	85%
Mass per Unit Area	ASTM D 6566	0.63 lb/yd ² (342 g/m ²)

MD - Tensile Strength Max.	ASTM D 6818	387.6 lb/ft (5.7 kN/m)
TD - Tensile Strength Max	ASTM D 6818	340.8 lb/ft (5.0kN/m)
MD - Elongation	ASTM D 6818	21.2%
TD - Elongation	ASTM D 6818	20.3%
Swell	ECTC Procedure	26%
Water Absorption	ASTM D 1117/ECTC	20%
Specific Gravity	ASTM D 792	1.28%
UV Stability	ASTM D 4355 (1,000 hr)	90% minimum
Porosity	Calculated	97.6%
Bench-Scale Rain Splash	ASTM D 7101	SLR = 6.17 @ 2 in/hr ^{1,2}
Bench-Scale Rain Splash	ASTM D 7101	SLR = 5.90 @ 4 in/hr ^{1,2}
Bench-Scale Rain Splash	ASTM D 7101	SLR = 5.63 @ 6 in/hr ^{1,2}
Bench -Scale Shear	ASTM D 7207	2.84 lb/ft ² @ 0.5 in soil loss ²
Germination Improvement	ASTM D 7322	525.6%

(e) Staples shall be U-shaped, 11 gauge steel wire and shall be 1 inch wide by 6 inches long, or 2 inches wide by 8 inches long.

E39.7.4 Site Preparation

- (a) Before placing TRM, the Contractor shall certify that the subgrade has been properly compacted, graded smooth, has no depressions, voids, soft or uncompacted areas, is free from obstructions such as tree roots, protruding stones or other foreign matter, and is seeded and fertilized according to project specifications. The Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, Contractor signifies that the preceding work is in conformance with this Specification.
- (b) Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations.
- (c) No Vehicular traffic shall be permitted directly on the TRM.

E39.7.5 TRM Installation

- (a) TRM shall be installed in accordance with manufacture's Installation Guidelines, Staple Pattern Guides, and details. The extent of TRM shall be as shown on the Drawings.
- (b) TRM shall be orientated in vertical strips and anchored with staples, as identified in the Staple Pattern Guide. Adjacent strips shall be overlapped to allow for installation of a common row of staples that anchor through the nettings fo both TRMs. Horizontal joints between TRMs shall be sufficiently overlapped with the uphill end on top for a common row of staples so that the staples anchor through the nettings of both TRMs.

E39.8 Quality Control

E39.8.1 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.

E39.9 Measurement and Payment

E39.9.1 Turf Reinforcement Mat

- (a) Supplying and installing Turf Reinforcement Mat will be measured on an area basis and Turf Reinforcement Mat will be paid for at the Contract Unit Price per square metre for "Supply and Install Turf Reinforcement Mat", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E40. STRUCTURAL CONCRETE

E40.1 Description

E40.1.1 This Specification shall cover all operations relating to the preparation of Portland Cement structural concrete for, and all concreting operations related to, the construction of structural concrete works as specified herein and as shown on the Drawings.

E40.1.2 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 Work as hereinafter specified.

E40.2 Scope of Work

E40.2.1 The Work under this Specification shall include:

- (a) Supplying and placing structural concrete for Empress Overpass Rehabilitation Works including:
 - (i) Concrete overlay on deck, approach slabs and abutment backwalls;
 - (ii) Traffic barriers;
 - (iii) Cycling path curb;
 - (iv) Expansion slabs;
 - (v) Roadway slabs; and
 - (vi) Expansion joint dams
- (b) Supplying and placing structural concrete for Pedestrian Accessibility Ramps including:
 - (i) Piers
 - (ii) Diaphragms
 - (iii) Drainage channel; and
 - (iv) Slabs on grade
- (c) Supplying and placing structural concrete for the Empress Street Retaining Wall including:
 - (i) Pile cap; and
 - (ii) Wall
- (d) Quality control tests of all concrete supplied.

E40.3 Submittals

E40.3.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to the commencement of any Work on Site, the proposed materials to be used.

E40.3.2 Concrete Mix Design Requirements

- (a) The Contractor shall submit a concrete mix design statement to the Contract Administrator for each of the concrete types specified herein that reflects the specified performance properties of the concrete. The mix design statement shall contain all the information as outlines on the concrete mix design statement as shown on the Manitoba Ready Mix Concrete Association website (www.mrmca.com). In addition, the mix design statement must indicate the expected method of placement (buggies, chute, or pump) methods are to be used, the method of placement must include a clear description of the pumping methods (line, vertical drop, length of hose, etc.).
- (b) The Supplier shall submit directly, in confidence, to the City of Winnipeg, the concrete mix designs for each of the concrete types specified herein. The purpose of this confidential submission will be for record keeping purposes and may be used as information related to supplementary testing and investigation of suspected defective concrete. The City of Winnipeg will advise the Supplier if the information needs to be released to third parties. The concrete mix design shall contain a description of the constituents and proportions, and at the minimum the following:
 - (i) Cementitious content in kilograms per cubic metre or equivalent units, and type of cementitious materials;
 - (ii) Designated size, or sizes, of aggregates, and the gradation;
 - (iii) Aggregate source location(s);
 - (iv) Weights of aggregates in kilograms per cubic metre or equivalent units. Mass of aggregates is saturated surface dry basis;
 - (v) Maximum allowable water content in kilograms per cubic metre or equivalent units and the water/cementitious ratio;
 - (vi) The limits for slump;
 - (vii) The limits for air content;
 - (viii) Quantity of other admixtures;
 - (ix) Certification that all concrete constituents are compatible;
 - (x) Certification that the concrete mix(es) will meet the specified concrete performance criteria requirements.
- (c) The concrete mix design statements must be received by the Contract Administrator a minimum of fourteen (14) days prior to the scheduled commencement of concrete placement for each of the concrete types. The concrete mix designs must be received by the City of Winnipeg a minimum of five (5) Business Days prior to the scheduled commencement of concrete placement for each the concrete types.
 - (i) The mix design statement shall also include the expected slump measurement for each concrete type. The tolerances for acceptance of slump measurements in the field, by the Contract Administrator, shall be in accordance to CSA A23.1-04 Clause 4.3.2.3.2.
 - (ii) Any change in the constituent materials of any approved mix design shall require submission of a new concrete mix design statement, mix design, and mix design test data. If, during the progress of the Work, the concrete supplied is found to be unsatisfactory for any reason, including poor workability, the Contract Administrator may require the Contractor to make any necessary adjustments and associated resubmissions.

E40.3.3 Concrete Mix Design Test Data

(a) Concrete

- (i) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, test data showing that the concrete to be supplied will meet the performance criteria stated in this Specification for each concrete type.
- (ii) The Contractor shall submit at a minimum, the test data to prove that the minimum compressive strength, flexural performance and post-cracking residual strength index (Ri) for Fibre Reinforced Concrete (FRC) only, air content, and slump of the concrete to be supplied meets or exceeds the performance criteria. Testing for Ri of concrete shall be completed in accordance with E40.7.5(e).
- (iii) Testing for air void system shall be completed in accordance with E41.10.5(c).
- (iv) Testing for rapid chloride permeability shall be completed in accordance with E41.10.5(d).
- (v) Testing for flexural strength of concrete reinforced with fibres shall be completed in accordance with ASTM C1609.
- (vi) All tests shall be based on the concrete samples taken from the point of discharge into the formwork. For example, at the concrete chute from the delivery truck if being placed by buggies, or at the end of the pump line should the Contractor choose to pump the concrete into place.

E40.3.4 Aggregates

- (a) The Contractor shall furnish, in writing to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, the location of the sources where aggregate will be obtained in order that some may be inspected and tentatively accepted by the Contract Administrator. Changes in the source of aggregate supply during the course of the Contract shall not be permitted without notification in writing to and the expressed approval of the Contract Administrator.
- (b) The Contractor shall submit to the Contract Administrator for review and approval recent test information on sieve analysis of fine and coarse aggregates in accordance with CSA Standard Test Method A23.2-2A.
- (c) The Contractor shall submit to the Contract Administrator for review and approval recent test information on tests for organic impurities in fine aggregates for concrete, in accordance with CSA Standard Test Method A23.2-7A.
- (d) The Contractor shall submit to the Contract Administrator for review and approval recent test information on relative density and absorption of coarse aggregate, in accordance with CSA Standard Test Methods A23.2-12A.
- (e) The Contractor shall submit to the Contract Administrator for review and approval recent test information on petrographic examination of aggregates for concrete, in accordance with CSA Standard Test Methods A23.2-15A. The purpose of the petrographic analysis is to ensure the aggregates provided are of the highest quality for use in the production of concrete and will produce a durable overlay. An acceptable aggregate will have an excellent rating as judged by an experienced petrographer, with a (weighted) petrographic number typically in the range of 100 to 120.
- (f) The Contractor shall submit to the Contract Administrator for review and approval recent test information on resistance to degradation of large-size coarse aggregate by abrasion and impact in the Los Angeles Machine, in accordance with CSA Standard Test Method A23.2-16A.
- (g) The Contractor shall submit to the Contract Administrator for review and approval recent test information on potential alkali reactivity of cement aggregate combinations (mortar bar method), in accordance with CSA Standard Test Method A23.2-27A.

- E40.3.5 The Contractor shall submit to the Contract Administrator copies of all material quality control test results.
- E40.3.6 Notification of Ready Mix Supplier
- (a) The Contractor shall submit to the Contract Administrator the name and qualifications of the Ready Mix Concrete Supplier that he is proposing to use, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement. The Contract Administrator will verify the acceptability of the Supplier and the concrete mix design requirements. Acceptance of the Supplier and the concrete mix design(s) by the Contract Administrator does not relieve or reduce the responsibility of the Contractor or Supplier from the requirements of this Specification.
- E40.3.7 Temporary False Work, Formwork and Shoring Works
- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, detailed design calculations and shop drawings for any temporary Works, including falsework, formwork, and shoring, that are sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba.
- (b) Design Requirements
- (i) All forms shall be of wood, metal or other materials as approved by the Contract Administrator.
- (ii) The falsework, formwork, and shoring for these Works shall be designed by a Professional Engineer registered in the Province of Manitoba. Falsework shall be designed according to the requirements of CSA S269.1, "False Work for Construction Purposes." The shop drawings shall bear the Professional Engineer's seal. Shop drawings submitted without the seal of a Professional Engineer will be rejected. The submission of such shop drawings to the Contract Administrator shall in no way relieve the Contractor of full responsibility for the safety and structural integrity of the formwork and shoring.
- (iii) The falsework, formwork, and shoring for these Works shall be designed to safely support all vertical and lateral loads until such loads can be supported by the concrete all in accordance with CSA Standard CAN/CSA S269.3-M92. All proposed fastening methods to the existing deck superstructure must be submitted to the Contract Administrator for review and approval.
- (iv) The loads and lateral pressures outlined in Part 3, Section 102 of "Recommended Practice for Concrete Formwork", (ACI 347) and wind loads as specified by the National Building Code shall be used for design. Additional design considerations concerning factors of safety for formwork elements and allowable settlements outlined in Section 103 of the above reference shall apply.
- (v) As a minimum, the following spacings shall apply for studding and walers:
1. 20 mm plywood: studding 400 mm centre to centre maximum;
 2. Walers 760 mm centre to centre maximum.
- (vi) Forms shall be designed and constructed so that the completed Work will be within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings.
- (vii) Formwork shall be designed to provide chamber, where applicable, to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads.
- (viii) Slots, recesses, chases, sleeves, inserts, bolts, hangers, and other items shall be accommodated in the design, in coordination and cooperation with the trade concerned. No openings in structural members are to be shown on the shop drawings without the prior written approval of the Contract Administrator.
- (ix) Shores shall be designed with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.

- (x) Mud sills of suitable size shall be designed beneath shores, to be bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlement during or after concreting. Shores must not be placed on frozen ground.
 - (xi) Shores shall be braced horizontally in two (2) directions and diagonally in the same two (2) vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.
 - (xii) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings.
 - (xiii) Formwork shall be designed to have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings.
 - (xiv) Forms shall be designed to be sufficiently tight to prevent leakage of grout or cement paste.
- (c) Shop drawings shall show design loads, type, and number of equipment to be used for placing the concrete, method of construction, method of removal, type and grade of materials, and any further information that may be required by the Contract Administrator. The Contractor shall not proceed with any Work on site until the shop drawings have been reviewed and approved in writing by the Contract Administrator. Falsework must be designed to carry all loads associated with construction of overhangs including deflection due to dead loads, placement of concrete, hoarding, construction live loads, and any other loads that may occur.
- (d) For timber formwork and falsework, the shop drawings shall specify the type and grade of lumber and show the size and spacing of all members. The shop drawings shall also show the type, size and spacing of all ties or other hardware, and the type, size and spacing of all bracing.

E40.3.8 Screed for Deck Slab Concrete

- (a) Plans for anchoring support rails shall be submitted to the Contract Administrator for review and acceptance at least fourteen (14) Days prior to the scheduled commencement of concrete placement. The Contract Administrator's written acceptance must be received by the Contractor prior to the installation of any anchorage devices.

E40.3.9 Deck Concrete Overlay Pour Sequence and Schedule

- (a) The Contractor shall pour the deck concrete overlay in accordance with the pour sequence as outlined in the Drawings. Should the Contractor opt to submit an alternate construction pour sequence for the deck slab concrete, the Contractor shall submit the proposed alternate construction pour sequence to the Construction Administrator for review, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement.
- (b) The Contractor shall submit to the Contract Administrator for review, at least fourteen (14) Days prior to the placement of concrete, details of the construction joints.
- (c) The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to scheduled commencement of concrete placement, the proposed concrete placement schedule for all other structural concrete placements of this Specification.

E40.4 Materials

E40.4.1 General

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

E40.4.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanship like manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA-A23.1-04.

E40.4.3 Concrete

- (a) Concrete materials susceptible to frost damage shall be protected from freezing.
- (b) Concrete shall have nominal compressive strengths (f'c) and meet the requirements for hardened concrete as specified in the following Table.

Requirements for Hardened Concrete

Type of Concrete	Location	Nominal Compressive Strength [MPa]	Class of Exposure	Air Content Category	Max Aggregate Size	Special Requirements	Post Residual Cracking Index
Type 1	Deck, abutment backwalls, and approach slabs partial depth repair Bridge traffic barriers Expansion slabs and roadway slabs South Pedestrian Accessibility Ramp slabs on grade, drainage channel, North Pedestrian Accessibility Ramp piers and slabs on grade	35 @ 28 Days	C-1	1	20 mm	Synthetic Fibres	0.15
Type 2	North Pedestrian Accessibility Ramp diaphragms	40 @ 28 Days					
Type 3	Empress Street Retaining wall	35 @ 28 Days					

E40.4.4 Aggregates

(a) General

- (i) All aggregates shall be handled to prevent segregation and inclusion of any foreign substances, and to obtain uniformity of materials. The two (2) sizes of coarse and fine aggregates, and aggregates secured from different sources, shall be piled in separate stockpiles. The site of the stockpiles shall be cleaned of all foreign materials and shall be reasonably level and firm or on a built up platform. If the aggregates are placed directly on the ground, material shall not be removed from the stockpile within 150 mm of the ground level. This material shall remain undisturbed to avoid contaminating the aggregate being used with the ground material.
- (ii) The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA A23.2-27A-04. Current (less than eighteen (18) months old) test data evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA A23.2-14A-04 or CSA A23.2-25A-04 is required.

- (iii) Petrographic analysis when performed shall be in accordance with MTO (Ministry of Transportation Ontario) Lab Test Method LS 609. The (weighted) petrographic number shall not exceed 130.

E40.4.5 Fine Aggregate

- (i) Fine aggregate shall meet the grading requirements of CSA A23.1-04, Table 10, FA1, be graded uniformly and not more than three percent (3%) shall pass a 75 um sieve. 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.
- (ii) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1-04, Table 12.

E40.4.6 Coarse Aggregate - Standard

- (a) The maximum nominal size of coarse aggregate shall be 20 mm and meet the grading requirements of CSA A23.1-04, Table 11, Group I. Coarse aggregate shall be uniformly graded and not more than two percent (2%) shall pass a 75 um sieve.
- (b) 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; shall have a minimum of two (2) fractured faces; and shall have an absorption not exceeding three percent (3%).
- (c) 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.
- (d) Course aggregate when tested for abrasion in accordance with ASTM C131 shall not have a loss greater than thirty percent (30%).
- (e) Tests of the coarse aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1-04, Table 12, for concrete exposed to freezing and thawing.

E40.4.7 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.

E40.4.8 Cementitious Materials

- (a) Cementitious materials shall conform to the requirements of CSA-A3001 and shall be free from lumps.
- (b) Should the Contractor choose to include a silica fume admixture in the concrete mix design, the substitution of silica fume shall not exceed eight percent (8%) by mass of cement.
- (c) Should the Contractor choose to include fly ash in the concrete mix design, the fly ash shall be Class CI or F and the substitution shall not exceed thirty percent (30%) by mass of cement.
- (d) Cementitious materials shall be stored in a suitable weather-tight building that shall 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 the formation of lumps, shall not be used in the Work.

E40.4.9 Water

- (a) Water to be used for all operations in the Specification, including mixing and curing of concrete or grout, surface texturing operations, and saturating the substrate shall conform to the requirements of CSA A23.1-04 and shall be free of oil, alkali, acidic, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

E40.4.10 Synthetic Fibres

- (a) The synthetic fibres shall consist of one hundred percent (100%) virgin polypropylene or one hundred percent (100%) virgin polyolefin as accepted by the Contract Administrator. The dosage shall be designed by the Contractor to meet the requirements for post-cracking residual strength index (Ri).

E40.4.11 Formwork

- (a) Formwork materials shall conform to CSA Standard A23.1, and American Concrete Publication SP4, "Formwork for Concrete."
- (b) 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 O121-08, a minimum of 20 mm thick.
- (c) Where form liner is not being used, form sheeting shall be Douglas Fir, overlay form liner type conforming to CSA Standard O121-08. Approved Manufacturers are "Evans" and "C-Z."
- (d) Boards used for formwork shall be fully seasoned and free from defects such as knots, warps, cracks, etc., which may mark the concrete surface.
- (e) No formwork accessories will be allowed to be left in place within 50 mm of the surface following form removal.
- (f) Items to be left in place, i.e., within the structural concrete component, but not within the outer 50 mm, 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) Notwithstanding Clause E40.4.11(f), where the structural concrete component is reinforced with black steel reinforcing (refer to E40.4.3 for permissible components), the use of black steel formwork accessories will be permitted.
- (h) Forms for exposed surfaces that do not require a form liner may be either new plywood or steel as authorized by the Contract Administrator.
- (i) Studding shall be spruce or pine and shall have such dimensions and spacing that they shall withstand without distortion all the forces to which the forms shall be subjected.
- (j) Walers shall be spruce or pine, with minimum dimensions of 100 mm x 150 mm. Studding shall be spruce or pine, with minimum dimensions of 50 mm x 150 mm.
- (k) Stay-in-place formwork or false work is not acceptable and shall not be used by the Contractor unless specifically shown on the Drawings.

E40.4.12 Form Coating

- (a) Form coating shall be "Sternson C.R.A." by Sternson, "SCP Strip Ease" by Specialty Construction Products, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.13 Permeable Formwork Liner

- (a) Formwork liner shall be Texel Drainform, Hydroform, or equal as accepted by the Contract Administrator, in accordance with B6. This formwork liner shall be used on all exposed substructure and superstructure formed surfaces, except soffit surfaces, or where a normal form finish is specified.
- (b) Paper-lined forms shall be used on all soffit surfaces, The Contractor shall provide conclusive evidence that the paper-lined form proposed for use will not stain or otherwise blemish the hardened concrete surface.

E40.4.14 Curing Compound

- (a) Curing compounds shall be liquid membrane-forming and conform to the requirements of ASTM Standard C309-98a.
- (b) Curing compound for approach slabs and slope paving shall be resin-based and white-pigmented.”
- (c) WR Meadows 1215 WHITE Pigmented Curing Compound is an approved product, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.15 Curing Blankets

- (a) Curing blankets for wet curing shall be 100 percent polyester, 3 mm thick, white in colour. An approved product is “Mirafi Geotextile P150”. Alternately, a 10 oz burlap, 5 mil polyethylene, curing blanket white in colour shall be used; “Curelap” manufactured by Midwest Canvas, together with a second layer of burlap, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.16 Bonding Agents

- (a) Latex Bonding Agent
 - (i) Latex bonding agent shall be Acryl-Stix, SikaCem 810, or equal as accepted by the Contract Administrator, in accordance with B6. Polyvinyl acetate-based latexes will not be permitted. Planicrete AC by MAPEI is approved for use as a latex bonding agent on concrete greater than twenty-eight (28) days in age.
- (b) Bonding Grout
 - (i) The grout for bonding the new deck slab concrete to the existing concrete deck slab concrete shall be mixed in an agitating hopper slurry pump and shall consist of the following constituents, by weight:
 - 1 part water;
 - 1 part latex bonding agent;
 - 1½ parts Type GUSF Portland cement.
 - (ii) The consistency of the bonding grout shall be such that it can be brushed on the existing concrete surface in a thin, even coating that will not run or puddle in low spots.

E40.4.17 Epoxy Adhesive

- (a) Epoxy adhesive for bonding concrete to steel shall be one (1) of the following approved products: Sternson ST432 or ST433, Dural Duralbond, Capper Capbond E, Sikadur 32 Hi-bond, Concessive 1001 LPL, Meadows Rezi-Weld 1000, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.18 Epoxy Grout

- (a) Epoxy grout shall be one (1) of the following approved products: Sternson Talygrout 100, Sika Sikadur 42, CPD Epoxy Grout by Specialty Construction Products, Meadows Rezi-Weld EG-96, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.19 Cementitious Grout

- (a) Cementitious grout shall be nonshrink and nonmetallic. Approved products are Sternson M-bed Standard, Specialty Construction Products CPD Non-Shrink Grout, Sika 212 Non-Shrink Grout, or equal as accepted by the Contract Administrator, in accordance with B7 Substitutes. The minimum compressive strength of the grout at 28 days shall be 40 MPa.

E40.4.20 Patching Mortar

- (a) Patching mortar shall be made of the same 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 or placing.

E40.4.21 Flexible Joint Sealant

- (a) Flexible joint sealant for all horizontal, vertical, and sloping joints shall be guaranteed non-staining, grey polyurethane, accepted by the Contract Administrator and applied in strict accordance with the details shown on the Drawings and the Manufacturer's instructions including appropriate primers if recommended. Approved products are Vulkem 116 by Mameco, Sonolastic NP1 by Sonneborn, Sikaflex-1a by Sika, Bostik 915 by Bostik, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.22 Fibre Joint Filler

- (a) Fibre joint filler shall be rot-proof and of the preformed, nonextruding, resilient type made with a bituminous fibre such as Flexcell and shall conform to the requirements of ASTM Standard D1751-99 or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.23 EMSEAL Precompressed Foam Joint Filler

- (a) Expansion joint seal shall be EMSEAL BEJS or equivalent as approved by the Contract Administrator to ASTM C711 and ASTM G155-00A.
- (b) Sealant system shall be comprised of three (3) components:
 - (i) Cellular polyurethane foam impregnated with hydrophobic one hundred percent (100%) acrylic, water-based emulsion, factory coated with highway-grade, fuel resistant silicone;
 - (ii) Field-applied epoxy adhesive primer;
 - (iii) Field-injected silicone sealant bands.
- (c) Impregnation agent to have proven non-migratory characteristics. Silicone coating to be highway-grade, low-modulus, fuel resistant silicone applied to the impregnated foam sealant at a width greater than maximum allowable joint extension and which when cured and compressed will form a bellows. Depth of seal as recommended by manufacturer. BEJS foam seal to be installed into manufacturer's standard field-applied epoxy adhesive. The BEJS SYSTEM is to be installed recessed from the surface such that when the field-applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellows, the system will be ½" (12 mm) down from the substrate surface.
- (d) Material shall be capable, as a dual seal, of movements of +50% to -50% (100% total) of nominal material size. Changes in plane and direction shall be executed using factory fabricated "Universal 90" transition assemblies. Transitions shall be warranted to be watertight at inside and outside corners through the full movement capabilities of the product.
- (e) All substitute candidates to be certified in writing to be free in composition of any waxes or asphalts, wax compounds or asphalt compounds. All substitute candidates shall be certified in writing to be:
 - (i) Capable of withstanding sixty-five degrees Celsius (65°C) for three (3) hours while compressed down to the minimum of movement capability dimension of the basis of design product (minus fifty percent (-50%) of normal material size) without evidence of any bleeding of impregnation medium from the material;
 - (ii) That the same material after the heat stability test will self-expand to the maximum of movement capability dimension of the basis-of-design product (plus fifty percent (-50%) of nominal material size) within twenty-four (24) hours at room temperature twenty degrees Celsius (20°C).

E40.4.24 Low density EVA Foam

- (a) Low density ethylene vinyl acetate (EVA) foam shall be supplied and installed to the thicknesses and extents shown on the Drawings. Maximum density of EVA foam shall be 30 kg/m³. EVA foam shall be of type approved by the Contract Administrator.
- (b) Alternatively, low density polyethylene foam may be substituted for EVA foam. The maximum density of polyethylene foam shall be 30 kg/m³. Low density polyethylene foam shall be Ethafoam™ 180 by Dow Chemical Company, or equivalent as approved by the Contract Administrator in accordance with B6.

E40.4.25 Extruded Polystyrene Foam

- (a) Supply and install extruded polystyrene foam (also known as Styrofoam™) to the thicknesses and extents as shown on the Drawings. Extruded polystyrene foam shall be Styrofoam™ Brand Cladmate™ or equivalents as approved by the Contract Administrator in accordance with B6.
- (b) Low density Styrofoam shall be the type accepted by the Contract Administrator, in accordance with B7 Substitutes.
- (c) High density Styrofoam shall be expanded polystyrene with a minimum compressive stress of 207 kPa at ten percent (10%) deformation.
- (d) Low density Styrofoam shall be the type accepted by the Contract Administrator, in accordance with B6.

E40.4.26 Backup Rod

- (a) Backup rod shall be pre-formed compressible polyethylene, urethane, neoprene, or vinyl foam backer rod, extruded into a closed cell form and oversized thirty to fifty percent (30 to 50%).

E40.4.27 Screed Bases and Chairs

- (a) Screed bases shall be Hilti HAS 304 stainless steel threaded rods, or equal as accepted by the Contract Administrator, in accordance with B6.
- (b) Screed chairs shall be Mega Screed as supplied by Brock White Canada Company, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.28 Stainless Steel Dowels

- (a) Anchor units for Aluminum Handrail/ Biogele Rail shall be across Richmond Type DGRS - Stainless Steel.
- (b) Traffic barrier dowels shall conform to the requirements of ASTM A 955/A 955M Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement, as specified in E42.5.3(c).
- (c) The dowels shall be fabricated to the details shown on the Drawings.

E40.4.29 Waterstop

- (a) The waterstop, as indicated on the Drawings, shall be PVC waterstop conforming to CGSB 41-6P-35M polyvinyl chloride, edges wire looped for tying, or as accepted by the Contract Administrator, in accordance with B6.
- (b) Install PVC waterstop in all joints in a continuous manner as shown on the Drawings. Install waterstop continuous without displacing reinforcement. But weld splices to manufacturer's directions. Secure in place to prevent dislodgement during placing of concrete.
- (c) Tie the waterstop adequately for support in accordance with manufacturer's instruction, but at spacing no greater than 300 mm to ensure proper embedment and to prevent displacement during concrete placement.
- (d) No separate measurement or payment will be made for the waterstop as it is considered incidental to the Contract Lump Sum Price for "Supply and Place Structural Concrete (Retaining walls cladding joints).

E40.4.30 Dampproofing

- (a) Dampproofing materials shall be applied to all buried concrete surfaces in contact with the soil to within 300 mm of Finished Ground Elevation, with the exception of those surfaces cast directly against the soil or in contact with prefabricated drainage composite. Dampproofing materials shall be mineral colloid emulsified asphalt complying with Canadian General Standards Board Specification No. 37.16-M89.
- (b) Acceptable product is Bakelite/Flintguard 710-11 Foundation Coating as manufactured by Bakor, Elsro Fibrated Foundation Coating, Insulmastic 7103 Fibered Waterproofing, or equal as accepted by the Contract Administrator, in accordance with B6.
- (c) All damaged concrete, including tie holes to be filled with non-shrink grout prior to application of dampproofing.
- (d) Primer for dampproofing shall be asphalt primer, penetrating type conforming to CGSB 37-GP-9Ma. Acceptable products are Bakor Penetrating 910-01 Asphalt Primer as manufactured by Bakor Inc., Elsro Asphalt Primer No. 510, Insulmastic 7501 C/B Roof & Foundation Primer, or equal as accepted by the Contract Administrator, in accordance with B6.

E40.4.31 E40.4.31 Void Form

- (a) Void form shall be supplied by Void Form orientated, or equal as accepted by the Contract Administrator, in accordance with B6

E40.4.32 Anchor Units for Aluminum Handrail / Bicycle Rail

- (a) Anchor Units for Aluminum Handrail / Bicycle rail shall be across - Richmond DGRS
- 1

E40.4.33 Miscellaneous Materials

Miscellaneous materials shall be of the type specified on the Drawings or as accepted by the Contract Administrator, in accordance with B6.

E40.4.34 Benchmark Plugs

- (a) Benchmark plugs shall be supplied by the City of Winnipeg. Installation by the Contractor shall be considered incidental to these Works. Installation locations shall be determined by the Contract Administrator.

E40.5 Equipment

E40.5.1 General

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

E40.5.2 Vibrators

- (a) The Contractor shall have 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) The Contractor shall have standby vibrators available at all times during the pour.

E40.5.3 Screed

- (a) The Contractor may choose to use a mechanical or non-mechanical screed to strike the surface of the concrete overlay.
- (b) The screed shall be constructed to span the full out-to-out width of the concrete placement in one (1) continuous operation.

- (c) Screed rails are required and shall be sufficient in number and length to ensure that the concrete cover is maintained and the finished elevation of the concrete overlay meets the design elevations.
- (d) Screed guides shall be placed and fastened in position to ensure finishing of the concrete to the required profile. Supporting rails, upon which the finishing machine travels, shall be placed outside the area to be concreted. Provisions for anchorage of supporting rails shall provide for horizontal and vertical stability; positive anchorage may be required by the Contract Administrator. A hold-down device shot into concrete will not be permitted, unless the concrete is to be subsequently resurfaced.
- (e) The mechanical screed on guides or rails shall be supported so that they are completely clear of the finished surface.
- (f) Internal vibration of the concrete will be required with mechanical screeding. Care shall be taken not to overwork the concrete surface.
- (g) Care shall be taken to ensure that the screed bars are seated uniformly on the screed chairs and that the ends of the screed bars do not overhang the screed chairs by more than 75 mm.
- (h) Screed surface touching concrete shall not be made of aluminum (magnesium acceptable).
- (i) The supply, setup, operation, and takedown of the screed for concrete overlay shall be considered incidental to the placement of the concrete overlay. No separate measurement or payment shall be made for this Work.

E40.6 Construction Methods

E40.6.1 General

- (a) It is intended that this Section cover all construction Work associated with Structural Concreting operations.
- (b) Rate of application shall be the rate required to meet the requirements of ASTM C309-98a for the texture of concrete the curing compound is being applied to.

E40.6.2 Temporary False Work, Formwork, and Shoring

(a) Construction Requirements

- (i) The Contractor shall construct falsework, formwork and shoring for the new deck slab concrete overhangs strictly in accordance with the accepted shop drawings.
- (ii) All forms shall be of wood, metal or other materials as approved by the Contract Administrator.
- (iii) The falsework, formwork, and shoring for these Works shall be erected, and braced, as designed, and maintained to safely support all vertical and lateral loads until such loads can be supported by the concrete. All proposed fastening shall be as shown on the accepted shop drawings.
- (iv) Forms shall be constructed and maintained so that the completed Work is within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings.
- (v) Formwork shall be cambered, where necessary to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads.
- (vi) 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 shop drawings without the prior written approval of the Contract Administrator.
- (vii) Shores shall be provided with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.
- (viii) 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 settlement during or after concreting. Shores must not be placed on frozen ground.
- (ix) Shores shall be braced horizontally in two (2) directions and diagonally in the same two (2) vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.
 - (x) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings.
 - (xi) Formwork shall have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings.
 - (xii) Forms shall be constructed so as to be sufficiently tight to prevent leakage of grout or cement paste.
- (b) Form panels shall be constructed so that the contact edges are kept flush and aligned.
 - (c) Forms for the concrete barriers shall be accordingly aligned to each other and to the geometry shown on the Drawings so as to provide a smooth, continuous barrier. Any misalignments in the barrier shall be cause for rejection and removal of same. No snap ties within the barriers shall be placed below 250 mm above the top of the upper lift elevation.
 - (d) 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 as accepted by the Contract Administrator.
 - (e) Where prefabricated panels are used, care shall be taken to ensure that adjacent panels remain flush. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provide a smooth, plane surface.
 - (f) Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be commercially manufactured types. 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 30 mm in diameter. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size. Torch cutting of steel hangers and ties will not be permitted. Formwork hangers for exterior surfaces of decks and curbs shall be an acceptable break-back type with surface cone, or removable threaded type. Cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in matching colour of surrounding concrete.
 - (g) 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.
 - (h) It shall be permissible to use the forms over again where possible to a maximum of three (3) uses, provided 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 their condition and his decision shall be final regarding the use of them again.
 - (i) Where required by the Contract Administrator, the Contractor shall cast test panels not using less than two (2) panels of representative samples of the forms he proposes for reuse and shall strip them after forty-eight (48) hours for the Contract Administrator to judge the type of surface produced.
 - (j) All form lumber, studding, ties etc., becomes the property of the Contractor when the Work is finished, and it shall be removed from the concrete and the Site by the Contractor after the concrete is set, incidental to the Work of this Specification, and the entire site shall be left in a neat and clean condition.

- (a) Concrete construction joints shall be located only where shown on the Drawings or as otherwise directed in writing by the Contract Administrator. Concrete construction joints shall be formed at right angles to the direction of the main reinforcing steel. All reinforcing steel shall be continuous across the joints.
- (b) Forms shall be re-tightened and all reinforcing steel shall be thoroughly cleaned at the joint prior to concreting.
- (c) After the forms are stripped off the construction joint, the entire face of the joint, including the reinforcing steel, shall be thoroughly cleaned down to sound concrete and the surface roughened.
- (d) Refer to E40.6.14, "Preparation for Concreting Against Hardened Concrete" for the requirements to prepare the hardened concrete at a construction joint for receiving new concrete.

E40.6.4 Bridge Deck Screeds

- (a) Setting Deck Screeds
 - (i) The Contractor shall adjust screeds to maintain the specified overlay thickness. Adjust screed heights to plan elevations or to such other elevation as may be determined by the Contract Administrator in the field. Screed bases will be permitted to be drilled and grouted into existing concrete and shall be adjustable to achieve the required elevations.
 - (ii) The screed chairs and screed rail supports shall be spaced to prevent deflections of the screed bars or screed rails during screeding operations.

E40.6.5 Concrete Bridge Traffic Barrier Joints

- (a) For the joint sealing at all locations, the contractor shall submit shop drawings and his proposed installation procedures to the Contract Administrator for approval fourteen (14) days prior to installation.
- (b) The installation of the fibre joint filler and the EMSEAL joint sealing shall be undertaken as shown on the drawings.
- (c) EMSEAL joint seals shall not be field spliced except when specifically permitted by the Contract Administrator in writing.
- (d) Furnish fibre joint filler for each joint in a single piece for the required depth and width for each joint, unless otherwise approved by the Contract Administrator. If permitted, multiple pieces shall be fastened together for a given joint by butting ends and securing in place by stapling or other positive fastening methods.
- (e) The EMSEAL joint sealing at the barrier joints shall be installed as per the Manufacturer's recommendations.
- (f) All joint sealing of Bridge traffic barriers shall take place prior to the installation of the Bituminous Paving.
- (g) The supply and installation of EMSEAL joint sealing and fibre joint fillers shall be considered incidental to the Work, and no additional measurement or payment shall be made for this Work.

E40.6.6 Anchor Units for Bridge Traffic Barrier and End Rail Units

- (a) All anchor units shall be as specified on the Drawings.
- (b) All anchor units shall be held securely in place so as not to become displaced during concrete placement operations.

E40.6.7 Permeable Formwork Liner

- (a) Permeable formwork liner shall be used on all exposed surfaces.
- (b) The permeable formwork liner shall be used for only one (1) application.

- (c) The supply, setup, application, and removal of permeable formwork liner shall be considered incidental to the placement of structural concrete, and no separate measurement or payment shall be made for this Work.

E40.6.8 Control Joint Seals

- (a) Formed control joints sealant for all horizontal, vertical and sloping joints shall be applied in strict accordance with the details shown on the Drawings and the Manufacturer's instructions including appropriate primers if recommended.
- (b) Form control joints shall be thoroughly cleaned before sealing.

E40.6.9 Benchmarks

- (a) The Contractor shall install benchmark plugs supplied by the Contract Administrator at such locations on the structure as may be directed by the Contract Administrator.

E40.6.10 Structure Identification Date

- (a) The Contractor shall indent into the exposed concrete a structure identification date at such location as shown on the Drawings, in accordance with the detail shown on the Drawings, or as otherwise directed by the Contract Administrator.

E40.6.11 Roadway and Expansion Slabs Works

- (a) The Contractor shall undertake the Roadway and Expansion slabs works, as shown on the Drawings.

E40.6.12 Supply of Structural Concrete

- (a) All structural concrete shall be supplied from a plant certified by the Manitoba Ready Mix Concrete Association. The Contractor, upon request from the Contract Administrator, shall furnish proof of this certification.
- (b) All mixing of concrete must meet the provisions of CSA A23.1-04, Clause 5.2, Production of Concrete.
- (c) Time of Hauling
 - (i) The maximum time allowed for all types of concrete to be delivered to the Site of the Work, including the time required to discharge, shall not exceed one hundred and twenty (120) minutes after batching. Batching of all types of concrete is considered to occur when any of the mix ingredients are introduced into the mixer, regardless of whether or not the mixer is revolving. For concrete that includes silica fume and fly ash, this requirement is reduced to ninety (90) minutes.
 - (ii) Each batch of concrete delivered to the Site shall be accompanied by a time slip issued at the batching plant, bearing the time of batching. In hot or cold weather, or under conditions contributing to quick stiffening of the concrete, a time less than one hundred and twenty (120) and/or ninety (90) minutes may be specified by the Contract Administrator. The Contractor will be informed of this requirement twenty-four (24) hours prior to the scheduled placing of concrete.
 - (iii) To avoid the reduction of delivery and discharge time in hot weather, the Contractor will be allowed to substitute crushed ice for a portion of the mixing water provided the specified water/cementitious ratio is maintained. All of the ice shall be melted completely before discharging any of the concrete at the delivery point.
 - (iv) Unless otherwise noted in E40.4.3, no retarders shall be used.
 - (v) The concrete, when discharged from truck mixers or truck agitators, shall be of the consistency and workability required for the job without the use of additional mixing water. If the slump of the concrete is less than that designated by the mix design statement, then water can be added on site provided the additional water meets the requirements of CSA A23.1-04 5.2.4.3.2. If additional water is to be added on site, it must be done under the guidance of the Suppliers' designated quality control person. The Supplier shall certify that the addition of

water on site does not change the Mix Design for the concrete supplied. Any other water added to the concrete without such control will be grounds for rejection of the concrete by the Contract Administrator.

- (vi) A record of the actual proportions used for each concrete placement shall be kept by the Supplier and a copy of this record shall be submitted to the City upon request.

(d) Delivery of Concrete

- (i) The Contractor shall satisfy himself that the Concrete Supplier has sufficient plant capacity and satisfactory transporting equipment to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such that the development of cold joints will not occur. The methods of delivering and handling the concrete shall facilitate placing with a minimum of rehandling, and without damage to the structure or the concrete.

E40.6.13 Concrete Placement Schedule

- (a) The Contractor shall submit to the Contract Administrator the proposed concrete placement schedule for all concrete placements for review and approval. If, in the opinion of the Contract Administrator, the volume of the placement is deemed larger than can be placed with the facilities provided, the Contractor shall either:
 - (i) Limit the amount to be placed at any time (using adequate construction joints);
 - (ii) Augment his facilities and Plant in order to complete the proposed placement;
 - (iii) In the case of continuous placing, provide additional crews and have adequate lighting to provide for proper placing, finishing, curing and inspecting.
- (b) The Contractor shall adhere strictly to the concrete placement schedule, as approved by the Contract Administrator.

E40.6.14 Preparation for Concreting Against Hardened Concrete

- (a) All hardened concrete against which new concrete is to be placed shall be prepared in the following manner:
 - (i) Concrete shall be removed to sound concrete or to the limits as shown on the Drawings, whichever is greater. The resulting surface shall be roughened to remove latent cement and miscellaneous debris.
 - (ii) All existing surfaces and exposed reinforcing steel are to be sandblasted to reveal a clean substrate and kept clean until concrete placement. Sandblasting shall be followed by a high pressure water wash to remove all residues.
 - (iii) Immediately prior to placing new concrete, bonding grout shall be thoroughly brushed onto the entire surface of the existing hardened concrete in a thin and even coating that will not run or puddle.

E40.6.15 Placing Structural Concrete

(a) General

- (i) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to concrete placement so that an adequate inspection may be made of formwork, shoring, reinforcement, deck joints, mechanical screed setup, and related Works. No concrete pour shall be scheduled without the prior written approval of the Contract Administrator.

(b) Dry Run for Screed Machine

- (i) The Contractor shall conduct a dry run of the screed machine in the presence of the Contract Administrator to verify that the screed supporting rails are properly set to ensure compliance with the specified longitudinal and transverse deck grades. Sufficient screed supporting guide rails to provide the required coverage for the entire pour, as approved by the Contract Administrator, shall be set out and adjusted for height at least one (1) Working Day prior to the proposed pour. The Contract Administrator will verify that the screed machine and screed rails have been adjusted so that the height of the screed above the

existing concrete at each point meets the requirements. To confirm the Contractor's adjustments of the machine and screed rails, the screed machine shall be "dry run", and screed clearance measurements taken at each support point by the Contractor. Resetting of the machine and/or screed rails shall be done by the Contractor as required by the Contract Administrator.

(c) Placing Structural Concrete

- (i) Placement of concrete overlay shall not be permitted when the surface moisture evaporation exceeds 0.75 kg/m²/h. Fog misting is mandatory regardless of drying conditions. The Contractor shall use fog misting operations as accepted by the Contract Administrator.
- (ii) The nomograph, Figure D1, Appendix D of CSA Standard A23.1-04 shall be used to estimate surface moisture evaporation rates.
- (iii) 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. All equipment and processes are subject to acceptance by the Contract Administrator.
- (iv) Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent segregation and a marked change in consistency.
- (v) Runways for concrete buggies and all pumping equipment shall be supported directly by the formwork and not on reinforcement.
- (vi) 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.
- (vii) Formwork liners shall be cooled immediately prior to placing concrete by spraying with cold water.
- (viii) Placing of concrete, once started, shall be continuous. No concrete shall be placed on concrete which 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 accepted by the Contract Administrator.
- (ix) Concrete shall be placed as nearly as possible in its final position. Rakes or mechanical vibrators shall not be used to transport concrete.
- (x) The maximum free drop of concrete into the forms shall not be greater than 1.5 m, otherwise rubber tubes or pouring ports spaced not more than 1.5 m vertically and 2.5 m horizontally shall be used. The Contractor shall obtain the Contract Administrator's acceptance, prior to pouring concrete, of all placing operations.
- (xi) All concrete, during and immediately after depositing, shall be consolidated by mechanical vibrators so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into the corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Mechanical vibrators shall have a minimum frequency of 7000 revolutions per minute immersed.
- (xii) Vibrators shall be inserted systematically into the concrete at intervals such that the zones of influence of the vibrator overlap (generally 300 mm 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. The vibrators shall be inserted vertically and withdrawn out of the concrete slowly. Spare vibrators in good working condition shall be kept on the job site during all placing operations.
- (xiii) Concrete shall not be placed during rain or snow unless adequate protection is provided for formwork and concrete surfaces, to the satisfaction of the Contract Administrator.

- (a) Finishing Operations for Unformed Surfaces
 - (i) The Contractor shall ensure that sufficient personnel are provided for the finishing of the surfaces. In the event that the depositing, vibrating, and screeding operations progress faster than the concrete finishing, the Contractor shall reduce the rate of concrete placement or cease the depositing of concrete until the exposed area of unfinished concrete has been satisfactorily minimized. The Contract Administrator's judgement in this matter shall be final and binding on the Contractor. All loads of concrete that exceed the one hundred and twenty (120) minute discharge time limit during the delay, while the finishing operations catch up, shall be rejected.
- (b) Type 1 Finish – Exposed Formed Surfaces
 - (i) A permeable formwork liner finish shall be applied to all exposed formed surfaces including all exposed concrete surfaces not included in Type 2, Type 3, Type 4 finishes.
 - (ii) Exposed surfaces imply all surfaces exposed to view including surfaces to 300 mm below finish grade elevations.
 - (iii) All surfaces to receive a formwork liner finish shall be formed using an approved permeable formwork liner.
 - (iv) The surfaces shall be patched as specified in this Specification.
- (c) Type 2 Finish – Unformed Surfaces
 - (i) All unformed concrete surfaces shall be finished as outlined hereinafter.
 - (ii) Screeding of all unformed concrete surfaces shall be performed by the sawing movement of a straightedge along wood or metal strips or form edges that have been accurately set at required elevations.
 - (iii) Screeding shall be done on all concrete surfaces as a first step in other finishing operations. Screeding shall be done immediately after the concrete has been vibrated.
 - (iv) After screeding, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared. Concrete surfaces after floating shall have a uniform, smooth, granular texture.
- (d) Type 3 Finish - Surfaces Below Finished Grade
 - (i) All surfaces below 300 mm below finished grade except underside of footings shall be patched in accordance with the requirements of Sections E40.4.17, E40.4.18, and E40.6.22E40.6.22 of this Specification.
 - (ii) All surfaces below 300 mm below finish grade shall receive dampproofing in accordance with E40.4.33 of this Specification.
- (e) Working Base Concrete Finish
 - (i) During placing, concrete working base shall be vibrated, screeded and floated.
 - (ii) The supply, set up, operation, and finishing of working base concrete shall be considered incidental to the works of this specification, and no separate measurement or payment shall be made for this Work.

E40.6.17 General Curing Requirements

- (a) Refer to E40.6.22 for cold weather curing requirements and E40.6.21 of this Specification for hot weather curing requirements.
- (b) The use of curing compound shall not be allowed on concrete areas that are to receive additional concrete, dampproofing, a waterproofing membrane, or an asphalt overlay.
- (c) Freshly finished concrete shall have either a curing compound applied, or shall be moist cured by immediately applying wet curing blankets to the exposed concrete surface immediately following finishing operations and continuously wetted for at least seven (7) consecutive days thereafter. Construction joints shall be cured by means of wet curing blankets only.

- (d) Curing compound shall be applied at the rate required by ASTM P198 for the accepted product. The compound must be applied uniformly and by roller. Spraying of the compound will not be permitted.
- (e) Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping, running water, vibration, and mechanical shock. No machinery shall travel in the vicinity of freshly placed concrete for a period of twenty-four (24) hours. Concrete shall be protected from freezing until at least twenty-four (24) hours after the end of the curing period.
- (f) Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3°C in one (1) hour or 20°C in twenty-four (24) hours.
- (g) Care shall be exercised to ensure that the polyester curing blanket is well drained and that it is placed as soon as the surface will support it without deformation. The Contractor shall 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 satisfactory to the Contract Administrator.
- (h) Formed surfaces shall receive, immediately after stripping and patching, the same curing as finished surfaces.
- (i) For curing of barriers, formwork shall remain in place for six (6) consecutive days following concreting. The top surface of the concrete surface shall be moist cured during this timeframe.

E40.6.18 Form Removal

- (a) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to form removal. The Contractor shall not commence any form removal operations without the prior written acceptance of the Contract Administrator.
- (b) All forms shall remain in place and the concrete shall not be loaded for a minimum of seven (7) days after initial concrete placement, unless otherwise authorized by the Contract Administrator in writing.
- (c) Stripping of the forms shall not be permitted until a concrete strength of 28 MPa has been achieved.
- (d) Field-cured test specimens representative of the cast-in-place concrete being stripped shall be tested as specified in this Specification to verify the concrete strength.

E40.6.19 Patching of Formed Surfaces

- (a) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to removal of forms. Immediately after forms have been removed and before the Contractor commences any surface finishing or concrete patching operations, all newly exposed concrete surfaces shall be inspected by the Contract Administrator.
- (b) Any repair or surface finishing started before this inspection may be rejected and required to be removed.
- (c) Patching of formed surfaces shall take place within twenty-four (24) hours of formwork removal.
- (d) All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back 75 mm from the surface before patching.
- (e) 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, then applying bonding grout followed by patching mortar. Bonding grout shall be well brushed onto the area immediately prior to patching. When the bonding grout begins to lose the water sheen, the patching mortar shall be thoroughly trowelled into the repair area to fill all voids. It shall be struck off slightly higher than the adjacent concrete surface and left for one (1) hour before final finishing to facilitate initial

shrinkage of the patching mortar. It shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification. The final colour shall match the surrounding concrete.

- (f) Concrete shall be cast against forms which will produce plane surfaces with no bulges, indentations, or protuberances other than those shown on the Drawings. All objectionable fins, projections, offsets, streaks, or other surface imperfections on the concrete surface shall be removed by means acceptable to the Contract Administrator. Cement washes of any kind shall not be used.
- (g) The arrangement of panel joints shall be kept to a minimum. Panels containing worn edges, patches, or other defects which will impair the texture of concrete surfaces shall not be used.

E40.6.20 Cold Weather Concreting

- (a) The requirements of CSA Standard A23.1-04 shall be applied to all concreting operations during cold weather, i.e., if the mean daily temperature falls below five degrees Celsius (5°C) during placing or curing.

E40.6.21 Hot Weather Concreting

(a) General

- (i) The requirements of this section shall be applied during hot weather, i.e., air temperatures forecast to go higher than twenty-seven degrees Celsius (27°C) during placing.
- (ii) Concrete at discharge shall be at as low a temperature as possible, preferably as low as fifteen degrees Celsius (15°C), but not above 25°C. Concrete containing silica fume shall be between ten degrees Celsius (10°C) minimum and eighteen degrees Celsius (18°C) maximum at discharge. Aggregate stockpiles should be cooled by water sprays and sun shades.
- (iii) The Contractor shall use cold water and/or ice in the mix to keep the temperature of the fresh concrete down, if required. Ice may be substituted for a portion of the mixing water; provided it has melted by the time mixing is completed.
- (iv) 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.
- (v) Sun shades and wind breaks shall be used as required during placing and finishing.
- (vi) Work shall be planned so that concrete can be placed as quickly as possible to avoid "cold joints".
- (vii) The Contract Administrator's acceptance is necessary before the Contractor may use admixtures such as retardants to delay setting, or water reducing agents to maintain Workability and strength, and these must appear in the Mix Design Statement submitted to the Contract Administrator.
- (viii) Hot weather curing shall follow immediately after the finishing operation.

(b) Hot-Weather Curing

- (i) When the air temperature is at or above twenty-five degrees Celsius (25°C), curing shall be accomplished by fog misting and by using saturated absorptive fabric, in order to achieve cooling by evaporation. Note that fog misting is mandatory for all deck slab and median slab pours at all temperatures.
- (ii) Mass concrete shall be water cured for the basic curing period when the air temperature is at or above twenty degrees Celsius (20°C), in order to minimize the temperature rise of the concrete.

(c) Job Preparation

- (i) When the air temperature is forecast to rise to twenty-five degrees Celsius (25°C) or higher during the placing period, provisions shall be made by the Contractor for protection of the concrete in place from the effects of hot and/or

drying weather conditions. Under severe drying conditions, the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by mist fogging and evaporation, to the satisfaction of the Contract Administrator.

(d) Concrete Temperature

- (i) The temperature of the concrete as placed shall be as low as practicable and in no case greater than the following temperatures for the indicated size of the concrete section.

Acceptable Concrete Temperatures

Thickness of Section	Temperature degrees Celsius (°C)	
	Minimum	Maximum
Less than:		
1.0 m	10	27
1.2 m	5	25

E40.6.22 Cleanup

- (a) The Contractor shall cleanup equipment and construction debris on at least a daily basis to the satisfaction of the Contract Administrator.

E40.7 Concrete Quality

E40.7.1 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.
- (c) Quality Assurance testing shall be undertaken by the Contract Administrator. Quality Control testing shall be undertaken by the Contractor.

E40.7.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E40.7.3 Materials

- (a) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Quality Assurance Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City of Winnipeg for any materials taken by the Contract Administrator for testing purposes.
- (b) All materials shall conform to CSA Standard A23.1-04.
- (c) All testing of materials shall conform to CSA Standard A23.2-04.
- (d) All materials shall be submitted to the Contract Administrator for acceptance at least twenty (20) Business Days prior to its scheduled incorporation into any construction. 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 material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

E40.7.4 Quality Assurance and Quality Control

- (a) The Contract Administrator shall be afforded full access for the inspection and control and assurance 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.
- (b) The Contract Administrator reserves the right to reject concrete in the field that does not meet the Specifications.
- (c) The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for Quality Assurance tests and provide such assistance and use of tools and construction equipment as is required.
- (d) Quality Assurance and control tests will be used to determine the acceptability of the concrete supplied by the Contractor.
- (e) The Contractor will be required to undertake Quality Control tests, of all concrete supplied. All test results are to be copied to the Contract Administrator immediately after the tests have been performed.
- (f) The frequency and number of concrete Quality Control tests shall be in accordance with the requirements of CSA Standard A23.1-04. An outline of the quality tests is indicated below.
- (g) Contract Administrator shall undertake cover meter survey of top of bridge deck and inside face of barriers. Concrete areas with cover not within specified tolerances will be rejected.

E40.7.5 Concrete Testing

- (a) Slump tests shall be made in accordance with CSA Standard Test Method A23.2-5C-04, "Slump of Concrete". If the measured slump falls outside the limits in E40.3.2 of this Specification, a second test shall be made. In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented.
- (b) Air content determinations shall be made in accordance with CSA Standard Test Method A23.2-4C-04, "Air Content of Plastic Concrete by the Pressure Method". If the measured air content falls outside the limits in E40.3.2 of this Specification, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Contract Administrator reserves the right to reject the batch of concrete represented.
- (c) The air-void system shall be proven satisfactory by data from tests performed in accordance with the latest edition and all subsequent revisions of ASTM Standard Test Method C457 for all types of concrete. The spacing factor, as determined on concrete cylinders moulded in accordance with CSA Standard Test Method A23.2-3C, shall be determined prior to the start of construction on cylinders of concrete made with the same materials, mix proportions, and mixing procedures as intended for the project. If deemed necessary by the Contract Administrator to further check the air-void system during construction, testing of cylinders may be from concrete as delivered to the job Site and will be carried out by the Contract Administrator. The concrete will be considered to have a satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 microns with no single test greater than 260 microns.
- (d) Rapid chloride permeability testing shall be performed in accordance with ASTM C 1202 or CAN/CSA A23.2-23C, with testing performed at 56 days for all types of concrete.
- (e) Testing for post-cracking residual strength index (Ri) of FRC shall be as follows:

- (i) One (1) set of five (5) concrete beam specimens, 100 mm by 100 mm by 350 mm long, shall be tested at 7 days in accordance with the latest edition of ASTM C1609.
 - (ii) The initial cracking load of the concrete (P_p) and the post cracking residual strength (P_{cr}), which shall be taken as the average of loads corresponding to deflection values of 0.5 mm, 0.75 mm, 1.0 mm, and 1.25 mm, shall be tabulated for each of the specimens. The R_i for each specimen, which shall be taken as the ratio of P_{cr} over P_p , shall be tabulated.
 - (iii) Tests conducted in accordance to ASTM C 1609 will be considered invalid if the initial crack in the specimen has occurred after 0.2 mm deflection.
 - (iv) The R_i shall be taken as the average of the R_i 's from a minimum of five valid (5) specimens.
 - (v) The Contractor shall submit a report as specified in ASTM C 1609, including a summary of the results of all post-cracking residual strength index tests and all load deflection curves.
- (f) Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method CSA-A23.2-1C-04, "Sampling Plastic Concrete".
- (g) Test specimens shall be made and cured in accordance with CSA Standard Test Method A23.2-3C-04, "Making and Curing Concrete Compression and Flexure Test Specimens".
- (h) Compressive strength tests at twenty-eight (28) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) day strength test, the strength of two (2) companion standard-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C-04, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the average of the strengths of the two (2) specimens. A compressive strength test at seven (7) days shall be taken, the strength of which will be used only as a preliminary indication of the concrete strength, a strength test being the strength of a single standard cured specimen.
- (i) Compressive strength tests on specimens cured under the same conditions as the concrete Works shall be made to check the strength of the in-place concrete so as to determine if the concrete has reached the minimum allowable working compressive strength as specified in E40.4.3 of this Specification and also to check the adequacy of curing and/or cold weather protection. At least two (2) field-cured test specimens shall be taken to verify strength of the in-place concrete. For each field-cured strength test, the strength of field-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C-04, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the strength of the specimen.

E40.7.6 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. The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an acceptable manner to the satisfaction of the Contract Administrator.

E40.8 Measurement and Payment

E40.8.1 Supply and Place Structural Concrete

- (a) Supplying and placing structural concrete will not be measured. This Work shall be paid for at the Contract Lump Sum Price for the "Items of Work" listed here below, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.
- (b) Items of Work:

- (i) Supply and Place Structural Concrete
 - (ii) Concrete Overlay;
 - (iii) Traffic Barriers;
 - (iv) Cycling Path Curb;
 - (v) Expansion Slabs;
 - (vi) Roadway Slabs;
 - (vii) Expansion Joint Dams;
 - (viii) Piers;
 - (ix) Diaphragms;
 - (x) Drainage Channel;
 - (xi) Slabs on Grade;
 - (xii) Pile Cap; and
 - (xiii) Wall.
- (c) Supplying and installing all the listed materials, concrete design requirements, equipment, construction methods, and quality control measures associated with this Specification and Drawings shall be considered incidental to "Supply and Place Structural Concrete", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise.
- (d) Supplying and placing structural concrete for the Rock-Socketed caissons will be measured and paid for in accordance with E59.

E41. SELF COMPACTING CONCRETE

E41.1 Description

E41.1.1 This Specification shall cover all operations relating to the preparation of self-compacting concrete for, and all concreting operations related to, the construction of concrete works as specified herein and as shown on the Drawings.

E41.1.2 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 work as hereinafter specified.

E41.2 Referenced Specifications and Drawings

E41.2.1 The latest edition and subsequent revisions of the following:

- (a) ACI 309 – Guide for Consolidation of Concrete;
- (b) ACI 347 – Guide to Formwork for Concrete;
- (c) American Concrete Publication SP4 – Formwork for Concrete;
- (d) ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings;
- (e) ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine;
- (f) ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete;
- (g) ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete;
- (h) ASTM C457 – Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete;
- (i) ASTM C494 – Standard Specification for Chemical Admixtures for Concrete;
- (j) ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete;

- (k) ASTM C1202 – Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration;
- (l) ASTM C1399 – Standard Test Method for Obtaining Average Residual-Strength of Fibre-Reinforced Concrete;
- (m) ASTM C1609 – Standard Test Method for Flexural Performance of Fibre-Reinforced Concrete (Using Beam with Third Point Loading);
- (n) ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types);
- (o) CAN/CSA A23.1/A23.2 – Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete;
- (p) CAN/CSA A3001 – Cementitious Materials for Use in Concrete;
- (q) CAN/CSA G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;
- (r) CAN/CSA G164-M92 – Hot Dip Galvanizing of Irregularly Shaped Articles;
- (s) CAN/CSA O121 – Douglas Fir Plywood;
- (t) CAN/CSA-S6 – Canadian Highway Bridge Design Code;
- (u) CAN/CSA S269.1 – False Work for Construction Purposes;
- (v) CAN/CSA S269.3 – Concrete Formwork;
- (w) ICRI Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers, and Polymer Overlays;
- (x) Ministry of Transportation Ontario MTO Lab Test Method LS 609 – Petrographic Analysis of Coarse Aggregate;
- (y) Ontario Provincial Standard Specification OPSS 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material;
- (z) SSPC-SP6/NACE No.3 Commercial Blast Cleaning.

E41.3 Scope of Work

E41.3.1 The Work under this Specification shall involve the following concrete Works:

- (a) Pier repair self-compacting concrete Works shall comprise of new cast-in-place pier column jackets at the centre pier columns #6 through #10.
- (b) Quality Control and Quality Assurance testing, including retention of a third-party testing company, acceptable to the Contract Administrator, retained and paid for by the Contractor. Quality Control testing shall be undertaken by the Contractor.

E41.4 Submittals

E41.4.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods, material and sequence of operations.

E41.5 Concrete Mix Design Test Data

E41.5.1 Concrete

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, test data showing that the concrete to be supplied will meet the performance criteria stated in this Specification for each concrete type.

- (b) The Contractor shall submit to the Contract Administrator copies of all material quality control test results.

E41.5.2 Notification of Ready Mix Supplier

- (a) The Contractor shall submit to the Contract Administrator the name and qualifications of the Ready Mix Concrete Supplier that he is proposing to use, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement. The Contract Administrator will verify the acceptability of the Supplier and the concrete mix design requirements. Acceptance of the Supplier and the concrete mix design(s) by the Contract Administrator does not relieve or reduce the responsibility of the Contractor or Supplier from the requirements of this Specification.

E41.5.3 Temporary False Work, Formwork and Shoring Works

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the scheduled erection of Temporary False Work, Formwork, and Shoring Works, Shop Drawings for any temporary Works, including false work, formwork, and shoring, that are sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba.
- (b) Design Requirements
 - (i) All forms shall be of wood, metal or other materials as approved by the Contract Administrator.
 - (ii) The false work, formwork, and shoring for these Works shall be designed by a Professional Engineer registered in the Province of Manitoba. False work shall be designed according to the requirements of the requirements of the CAN/CSA S269.1. The Shop Drawings shall bear the Professional Engineer's seal. Shop Drawings submitted without the seal of a Professional Engineer will be rejected. The submission of such Shop Drawings to the Contract Administrator shall in no way relieve the Contractor of full responsibility for the safety and structural integrity of the formwork and shoring.
 - (iii) The false work, formwork, and shoring for these Works shall be designed to safely support all vertical and lateral loads until such loads can be supported by the concrete all in accordance with the requirements of CAN/CSA S269.3. All proposed fastening methods to the existing structure must be submitted to the Contract Administrator for review and approval. Drilling into the precast concrete slabs will not be accepted.
 - (iv) The loads and lateral pressures outlined in Part 3, Section 102 of ACI 347 and wind loads as specified by the Manitoba Building Code shall be used for design and the formwork design must be calculated to resist at least the full hydrostatic concrete pressure. Additional design considerations concerning factors of safety for formwork elements and allowable settlements outlined in Section 103 of the above reference shall apply.
 - (v) As a minimum, the following spacing's shall apply, for studding and waling:
 - 20 mm plywood: studding 400 mm centre to centre (max);
 - Walers 760 mm centre to centre (max).
 - (vi) Forms shall be designed and constructed so that the completed Work will be within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings.
 - (vii) Formwork shall be designed to provide camber, where applicable, to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads.
 - (viii) Slots, recesses, chases, sleeves, inserts, bolts, hangers, and other items shall be accommodated in the design, in coordination and cooperation with the trade concerned. No openings in structural members are to be shown on the Shop Drawings without the prior written approval of the Contract Administrator.
 - (ix) Shores shall be designed with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.

- (x) Mud sills of suitable size shall be designed beneath shores, to be bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlement during or after concreting. Shores must not be placed on frozen ground.
 - (xi) Shores shall be braced horizontally in two (2) directions and diagonally in the same two (2) vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.
 - (xii) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings.
 - (xiii) Formwork shall be designed to have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings.
 - (xiv) Forms shall be designed to be sufficiently tight to prevent leakage of grout or cement paste.
- (c) Shop Drawings shall show design loads, type, and number of equipment to be used for placing the concrete, method of construction, method of removal, type and grade of materials, and any further information that may be required by the Contract Administrator. The Contractor shall not proceed with any Work on site until the Shop Drawings have been reviewed and approved in writing by the Contract Administrator. False work must be designed to carry all loads associated with construction of overhangs including deflection due to dead loads, placement of concrete, hoarding, construction live loads, and any other loads that may occur.
- (d) For timber formwork and false work, the Shop Drawings shall specify the type and grade of lumber and show the size and spacing of all members. The Shop Drawings shall also show the type, size and spacing of all ties or other hardware, and the type, size and spacing of all bracing.

E41.6 Materials

E41.6.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall 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.

E41.6.2 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 the latest edition and all subsequent revisions of CAN/CSA-A23.1.

E41.6.3 Concrete

- (a) Concrete materials susceptible to frost damage shall be protected from freezing.
- (b) Concrete shall be Agilia Vertical, LaFarge North America, proprietary ready-mix concrete, or accepted equal and meet the requirements for hardened concrete as specified in the following:

Concrete Mix Design Requirements

Location	Nominal Compressive Strength MPa	Class of Exposure	Air Content Category	Max Aggregate Size	Special Requirements	Slump-Flow

Centre Pier Column Jackets	35 @ 28 Days	C-1	1	10 mm	Self-Compacting Concrete 28-Day Moist Cured Electrical Resistivity < 15,000 ohm-cm Low-Shrinkage Concrete according to the definition of CAN/CSA-A23.1, Clause 8.9.2	550-650 mm
Rock- Socketed Caissons	35 @ 28 Days	F-1, S-1	2	20 mm	Self-Compacting	550 – 650 mm

E41.6.4 Formwork

- (a) Formwork materials shall conform to CAN/CSA A23.1, and American Concrete Publication SP4, "Formwork for Concrete."
- (b) 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-M1978, a minimum of 20 mm thick.
- (c) Where form liner is not being used, form sheeting shall be Douglas Fir, overlay form liner type conforming to CAN/CSA "O121". Approved Manufacturers are "Evans" and "C-Z."
- (d) Boards used for formwork shall be fully seasoned and free from defects such as knots, warps, cracks, etc., which may mark the concrete surface.
- (e) No formwork accessories will be allowed to be left 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.
- (f) Forms for exposed surfaces that do not require a form liner may be either new plywood or steel as authorized by the Contract Administrator.
- (g) Studding shall be spruce or pine and shall have such dimensions and spacing that they shall withstand without distortion all the forces to which the forms shall be subjected.
- (h) Walers shall be spruce or pine, with minimum dimensions of 100 mm x 150 mm. Studding shall be spruce or pine, with minimum dimensions of 50 mm x 150 mm.
- (i) Stay-in-place formwork or false work is not acceptable and shall not be used by the Contractor unless specifically shown on the Drawings.

E41.6.5 Form Coating

- (a) Form coating shall be "Sternson C.R.A." by Sternson, "SCP Strip Ease" by Specialty Construction Products, or equal as accepted by the Contract Administrator, in accordance with B6.

E41.6.6 Permeable Formwork Liner

- (a) Formwork liner shall be Texel Drainaform, Hydroform, or equal as accepted by the Contract Administrator, in accordance with B6. This formwork liner shall be used on all formed surfaces.

E41.6.7 Patching Mortar

- (a) Patching mortar shall be made of the same 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 one (1) part cement to two (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 or placing.

E41.6.8 Flexible Joint Sealant

- (a) Flexible joint sealant for all horizontal, vertical, and sloping joints shall be guaranteed non-staining, grey polyurethane, accepted by the Contract Administrator and applied in strict accordance with the details shown on the Drawings and the Manufacturer's instructions including appropriate primers if recommended. Approved products are Vulkem 116 by Mameco, Sonolastic Np1 by Sonneborn, Sikaflex-1a by Sika, Bostik 915 by Bostik, or equal as accepted by the Contract Administrator, in accordance with B6.

E41.6.9 Fibre Joint Filler

- (a) Fibre joint filler shall be rot-proof and of the performed, nonextruding, resilient type made with bituminous fibre such as Flexcell and shall conform to the requirements of ASTM D 1751 or equal as accepted by the Contract Administrator, in accordance with B6.

E41.6.10 Backup Rod

- (a) Backup rod shall be performed compressible polyethylene, urethane, neoprene, or vinyl foam backer rod, extruded into a closed cell form and oversized thirty to fifty percent (30% to 50%).

E41.6.11 Miscellaneous Materials

- (a) Miscellaneous materials shall be of the type specified on the Drawings or as accepted by the Contract Administrator, in accordance with B6.

E41.7 Equipment

E41.7.1 General

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

E41.8 Construction Methods

E41.8.1 General

- (a) It is intended that this Section cover all construction Work associated with Structural Concreting operations.
- (b) Rate of application shall be the rate required to meet the requirements of ASTM C309 for the texture of concrete the curing compound is being applied to.

E41.8.2 Temporary False Work, Formwork, and Shoring

- (a) Construction Requirements
 - (i) The Contractor shall construct false work, formwork and shoring strictly in accordance with the accepted Shop Drawings.
 - (ii) The false work, formwork, and shoring for these Works shall be erected, and braced, as designed, and maintained to safely support all vertical and lateral

- loads until such loads can be supported by the concrete. All proposed fastening shall be as shown on the accepted Shop Drawings.
- (iii) Forms shall be constructed and maintained so that the completed Work is within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings.
 - (iv) Formwork shall be cambered, where necessary to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads.
 - (v) 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 Shop Drawings without the prior written approval of the Contract Administrator.
 - (vi) Shores shall be provided with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.
 - (vii) 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 settlement during or after concreting. Shores must not be placed on frozen ground.
 - (viii) Shores shall be braced horizontally in two (2) directions and diagonally in the same two (2) vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.
 - (ix) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings.
 - (x) Formwork shall have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings.
 - (xi) Forms shall be constructed so as to be sufficiently tight to prevent leakage of grout or cement paste.
- (b) Form panels shall be constructed so that the contact edges are kept flush and aligned.
 - (c) Forms for the concrete barriers shall be accordingly aligned to each other and to the geometry shown on the Drawings so as to provide a smooth, continuous barrier. Any misalignments in the barrier shall be cause for rejection and removal of same.
 - (d) 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 as accepted by the Contract Administrator.
 - (e) Where prefabricated panels are used, care shall be taken to ensure that adjacent panels remain flush. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provide a smooth, plane surface.
 - (f) Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be commercially manufactured types. 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 30 mm in diameter. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size. Torch cutting of steel hangers and ties will not be permitted. Formwork hangers for exterior surfaces of decks and curbs shall be an acceptable break-back type with surface cone, or removable threaded type. Cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in colour.
 - (g) 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.
 - (h) It shall be permissible to use the forms over again where possible to a maximum of three uses, provided 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 their condition and his decision shall be final regarding the use of them again.

- (i) Where required by the Contract Administrator, the Contractor shall cast test panels not using less than two (2) panels of representative samples of the forms he proposes for reuse and shall strip them after forty-eight (48) hours for the Contract Administrator to judge the type of surface produced.
- (j) All form lumber, studding, etc., becomes the property of the Contractor when the Work is finished, and it shall be removed from the concrete and the site by the Contractor after the concrete is set, incidental to the Work of this Specification, and the entire site shall be left in a neat and clean condition.

E41.8.3 Concrete Construction Joints

- (a) Concrete construction joints shall be located only where shown on the Drawings or as otherwise directed in writing by the Contract Administrator. Concrete construction joints shall be formed at right angles to the direction of the main reinforcing steel. All reinforcing steel shall be continuous across the joints.
- (b) Forms shall be re-tightened and all reinforcing steel shall be thoroughly cleaned at the joint prior to concreting.
- (c) After the forms are stripped off the construction joint, the entire face of the joint, including the reinforcing steel, shall be thoroughly cleaned down to sound concrete and the surface roughened.
- (d) Refer to E41.8.6, "Preparation for Concreting Against Hardened Concrete", for the requirements to prepare the hardened concrete at a construction joint for receiving new concrete.

E41.8.4 Permeable Formwork Liner

- (a) Permeable formwork liner shall be installed according to the manufacturer's instructions. The Contractor shall ensure the liner is free of folds, bends, or wrinkles that would create a non-uniform surface finish.
- (b) The permeable formwork liner shall be used for only one (1) application.
- (c) The supply, setup, application, and removal of permeable formwork liner shall be considered incidental to the placement of structural concrete, and no separate measurement or payment shall be made for this Work.

E41.8.5 Supply of Concrete

- (a) All concrete shall be supplied from a plant certified by the Manitoba Ready Mix Concrete Association. The Contractor, upon request from the Contract Administrator, shall furnish proof of this certification.
- (b) All mixing of concrete must meet the provisions of CAN/CSA A23.1, Clause 5.2, Production of Concrete.
- (c) Time of Hauling
 - (i) The maximum time allowed for all types of concrete to be delivered to the Site of the Work, including the time required to discharge, shall not exceed one hundred and twenty (120) minutes after batching. Batching of all types of concrete is considered to occur when any of the mix ingredients are introduced into the mixer, regardless of whether or not the mixer is revolving. For concrete that includes silica fume and fly ash, this requirement is reduced to ninety (90) minutes.
 - (ii) Each batch of concrete delivered to the Site shall be accompanied by a time slip issued at the batching plant, bearing the time of batching. In hot or cold weather, or under conditions contributing to quick stiffening of the concrete, a time less than one hundred and twenty (120) and/or ninety (90) minutes may be specified by the Contract Administrator. The Contractor will be informed of this requirement twenty-four (24) hours prior to the scheduled placing of concrete.

- (iii) To avoid the reduction of delivery and discharge time in hot weather, the Contractor will be allowed to substitute crushed ice for a portion of the mixing water provided the specified water/cementitious ratio is maintained. All of the ice shall be melted completely before discharging any of the concrete at the delivery point.
 - (iv) Unless otherwise noted in E41.6.3, no retarders shall be used.
 - (v) The concrete, when discharged from truck mixers or truck agitators, shall be of the consistency and workability required for the job without the use of additional mixing water. If the slump of the concrete is less than that designated by the mix design statement, then water can be added on site provided the additional water meets the requirements of CAN/CSA A23.1 5.2.4.3.2. If additional water is to be added on site, it must be done under the guidance of the Suppliers' designated quality control person. The Supplier shall certify that the addition of water on site does not change the Mix Design for the concrete supplied. Any other water added to the concrete without such control will be grounds for rejection of the concrete by the Contract Administrator.
 - (vi) A record of the actual proportions used for each concrete placement shall be kept by the Supplier and a copy of this record shall be submitted to the City upon request.
- (d) Delivery of Concrete
- (i) The Contractor shall satisfy himself that the Concrete Supplier has sufficient plant capacity and satisfactory transporting equipment to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such that the development of cold joints will not occur. The methods of delivering and handling the concrete shall facilitate placing with a minimum of rehandling, and without damage to the structure or the concrete.
- (e) Concrete Placement Schedule
- (i) The Contractor shall submit to the Contract Administrator the proposed concrete placement schedule for all concrete placements for review and approval. If, in the opinion of the Contract Administrator, the volume of the placement is deemed larger than can be placed with the facilities provided, the Contractor shall either:
 - Limit the amount to be placed at any time (using adequate construction joints);
 - Augment his facilities and Plant in order to complete the proposed placement;
 - In the case of continuous placing, provide additional crews and have adequate lighting to provide for proper placing, finishing, curing and inspecting.
 - (ii) The Contractor shall adhere strictly to the concrete placement schedule, as approved by the Contract Administrator.
 - (iii) At least two (2) days prior to the first self-compacting concrete pour, a Pre-Pour Meeting shall be held at the work site. The purpose of the meeting will be to confirm the understanding of all parties of the schedule and procedure for the concrete pour and concurrent quality control and quality assurance testing. The meeting shall be attended by a minimum of one (1) representative of the Contract Administrator, one (1) representative of the City, the Contractor's Site Superintendent, the Contractor's Supervisor, the concrete supplier's designated quality control representative responsible for ensuring the supplied concrete meets the Contract Specifications for supply and delivery, and a representative of the third-party testing company. Each representative shall be a responsible person capable of expressing the position of the party they represent on any matter discussed at the meeting including the Work schedule and the need to make any revisions to the Work schedule.

E41.8.6 Preparation for Concreting Against Hardened Concrete

- (a) All hardened concrete against which new concrete is to be placed shall be prepared in the following manner:
 - (i) The resulting surface shall be roughened to remove latent cement and miscellaneous debris.
 - (ii) Following the completion of concrete removals, all surfaces at the cold joint interface including concrete and exposed reinforcing steel are to be sandblasted to the requirements of SSPC-SP6/NACE No.3 Commercial Blast Cleaning to reveal a clean substrate and kept clean until concrete placement. Sandblasting shall be followed by a high pressure water wash to remove all residues.

E41.9 Placing Concrete

- (a) General
 - (i) The Contractor shall notify the Contract Administrator at least one (1) Working day prior to concrete placement so that an adequate inspection may be made of formwork, shoring, reinforcement and related Works.
- (b) Placing Concrete
 - (i) 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. All equipment and processes are subject to acceptance by the Contract Administrator.
 - (ii) Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent segregation and a marked change in consistency.
 - (iii) Runways for concrete buggies and all pumping equipment shall be supported directly by the formwork and not on reinforcement.
 - (iv) 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.
 - (v) Formwork liners shall be cooled immediately prior to placing concrete by spraying with cold water.
 - (vi) Placing of concrete, once started, shall be continuous. No concrete shall be placed on concrete which 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 accepted by the Contract Administrator.
 - (vii) When the Contractor chooses to pump the concrete, the operation of the pump shall produce a continuous flow of concrete without air pockets. The equipment shall be arranged such that vibration is not transmitted to freshly placed concrete that may damage the concrete. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
 - (viii) Concrete shall be placed as nearly as possible in its final position. Rakes or mechanical vibrators shall not be used to transport concrete.
 - (ix) The maximum free drop of concrete into the forms shall not be greater than 1.5 m, otherwise rubber tubes or pouring ports spaced not more than 1.5 m vertically and present on a minimum of two (2) opposite faces of the pier column form shall be used. The Contractor shall obtain the Contract Administrator's acceptance, prior to pouring concrete, of all placing operations.
 - (x) Concrete shall not be placed during rain or snow unless adequate protection is provided for formwork and concrete surfaces, to the satisfaction of the Contract Administrator.

E41.9.2 General Curing Requirements

- (a) Refer to E41.9.5, "Cold Weather Concreting" for cold weather curing requirements and E41.9.6, "Hot Weather Concreting" of this Specification for hot weather curing requirements.
- (b) Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping, running water, vibration, and mechanical shock. No machinery shall travel in the vicinity of freshly placed concrete for a period of twenty-four (24) hours. Concrete shall be protected from freezing until at least twenty-four (24) hours after the end of the curing period.
- (c) Changes in temperature of the concrete shall be uniform and gradual and shall not exceed three degrees Celsius (3°C) in one (1) hour or twenty degrees Celsius (20°C) in twenty-four (24) hours.
- (d) The use of curing compound shall not be allowed on concrete areas that are to receive additional concrete, dampproofing, a waterproofing membrane, or an asphalt overlay.
- (e) Formed surfaces shall receive, immediately after stripping and patching, the curing compound coating.
- (f) For curing of formed surfaces, formwork shall remain in place for seven (7) consecutive days following concreting. The top surface of the concrete surface shall be moist cured during this timeframe.
- (g) Curing compound shall be applied at the rate specified by the Manufacturer for the accepted product. The compound must be applied uniformly and by roller.
- (h) Following the completion of patching operations, the surface shall be sprayed with an initial coating of curing compound, as per the Manufacturer's recommendations. As soon as initial set has occurred, the surface shall receive a second roller-applied application of curing compound, to the satisfaction of the Contract Administrator.

E41.9.3 Form Removal

- (a) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to form removal. The Contractor shall not commence any form removal operations without the prior written acceptance of the Contract Administrator.
- (b) All forms shall remain in place and the concrete shall not be loaded for a minimum of seven (7) days after initial concrete placement, unless otherwise authorized by the Contract Administrator in writing.
- (c) Field-cured test specimens representative of the cast-in-place concrete being stripped shall be tested as specified in this Specification to verify the concrete strength.

E41.9.4 Patching of Formed Surfaces

- (a) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to removal of forms. Immediately after forms have been removed and before the Contractor commences any surface finishing or concrete patching operations, all newly exposed concrete surfaces shall be inspected by the Contract Administrator.
- (b) Any repair or surface finishing started before this inspection may be rejected and required to be removed.
- (c) Patching of formed surfaces shall take place within twenty-four (24) hours of formwork removal.
- (d) All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back 75 mm from the surface before patching.
- (e) 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, then applying bonding grout followed by patching mortar. Bonding grout shall be well brushed onto the area immediately prior to patching. When the bonding grout begins

to lose the water sheen, the patching mortar shall be thoroughly trowelled into the repair area to fill all voids. It shall be struck off slightly higher than the adjacent concrete surface and left for one (1) hour before final finishing to facilitate initial shrinkage of the patching mortar. It shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification. The final colour shall match the surrounding concrete.

- (f) Concrete shall be cast against forms which will produce plane surfaces with no bulges, indentations, or protuberances other than those shown on the Drawings. All objectionable fins, projections, offsets, streaks, or other surface imperfections on the concrete surface shall be removed by means acceptable to the Contract Administrator. Cement washes of any kind shall not be used.
- (g) The arrangement of panel joints shall be kept to a minimum. Panels containing worn edges, patches, or other defects which will impair the texture of concrete surfaces shall not be used.

E41.9.5 Cold Weather Concreting

- (a) The requirements of CAN/CSA A23.1 shall be applied to all concreting operations during cold weather, i.e., if the mean daily temperature falls below five degrees Celsius (5°C) during placing or curing.

E41.9.6 Hot Weather Concreting

(a) General

- (i) The requirements of this section shall be applied during hot weather, i.e., air temperatures forecast to go higher than twenty-seven degrees Celsius (27°C) during placing.
- (ii) Concrete at discharge shall be at as low a temperature as possible, preferably as low as fifteen degrees Celsius (15°C), but not above twenty-five degrees Celsius (25°C). Concrete containing silica fume shall be between ten degrees Celsius (10°C) minimum and eighteen degrees Celsius (18°C) maximum at discharge. Aggregate stockpiles should be cooled by water sprays and sun shades.
- (iii) The Contractor shall use cold water and/or ice in the mix to keep the temperature of the fresh concrete down, if required. Ice may be substituted for a portion of the mixing water; provided it has melted by the time mixing is completed.
- (iv) 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.
- (v) Sun shades and wind breaks shall be used as required during placing and finishing.
- (vi) Work shall be planned so that concrete can be placed as quickly as possible to avoid "cold joints".
- (vii) The Contract Administrator's acceptance is necessary before the Contractor may use admixtures such as retardants to delay setting, or water reducing agents to maintain Workability and strength, and these must appear in the Mix Design Statement submitted to the Contract Administrator.
- (viii) Hot weather curing shall follow immediately after the finishing operation.

(b) Hot-Weather Curing

- (i) When the air temperature is at or above twenty-five degrees Celsius (25°C), curing shall be accomplished by fog misting and by using saturated absorptive fabric, in order to achieve cooling by evaporation. Note that fog misting is mandatory for all deck slab and median slab pours at all temperatures.
- (ii) Mass concrete shall be water cured for the basic curing period when the air temperature is at or above twenty degrees Celsius (20°C), in order to minimize the temperature rise of the concrete.

(c) Job Preparation

- (i) When the air temperature is forecast to rise to twenty-five degrees Celsius (25°C) or higher during the placing period, provisions shall be made by the Contractor for protection of the concrete in place from the effects of hot and/or drying weather conditions. Under severe drying conditions, the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by mist fogging and evaporation, to the satisfaction of the Contract Administrator.

(d) Concrete Temperature

- (i) The temperature of the concrete as placed shall be as low as practicable and in no case greater than the following, for the indicated size of the concrete section.

Acceptable Concrete Temperatures

Thickness of Section, (Meters)	Temperatures degrees Celsius (°C)	
	Minimum	Maximum
Less than:		
1	10	27
1.2	5	25

E41.9.7 Cleanup

- (a) The Contractor shall clean up equipment and construction debris on at least a daily basis to the satisfaction of the Contract Administrator.

E41.10 Concrete Quality

E41.10.1 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.
- (c) Quality Assurance testing shall be undertaken by a third-party testing company, acceptable to the Contract Administrator, retained and paid for by the Contractor. Quality Control testing shall be undertaken by the Contractor.

E41.10.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Independent Inspector for testing purposes as required. There will be no charge to the City for samples taken.

E41.10.3 Materials

- (a) All materials supplied under this Specification shall be subject to inspection and testing by the Independent Quality Assurance Testing Laboratory approved by the Contract Administrator. There shall be no charge to the City of Winnipeg for any materials taken by the Independent Inspector for testing purposes.
- (b) All materials shall conform to the latest edition and all subsequent revisions of CAN/CSA A23.1.

- (c) All testing of materials shall conform to the latest edition and all subsequent revisions of CAN/CSA A23.2.
- (d) All materials shall be submitted to the Contract Administrator for acceptance at least twenty (20) Business Days prior to its scheduled incorporation into any construction. 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 material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

E41.10.4 Quality Assurance and Quality Control

- (a) The Contract Administrator shall be afforded full access for the inspection and control and assurance 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.
- (b) The Contract Administrator reserves the right to reject concrete in the field that does not meet the Specifications.
- (c) The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for Quality Assurance tests and pay for such tests and assistance and use of tools and construction equipment as is required.
- (d) Quality Assurance and Control tests will be used to determine the acceptability of the concrete supplied by the Contractor.
- (e) The Contractor will be required to retain qualified third-party testing company to undertake Quality Assurance tests, of all concrete supplied. All test results are to be copied to the Contract Administrator immediately after the tests have been performed.
- (f) The frequency and number of concrete Quality Control and Quality Assurance tests shall be in accordance with the requirements of CAN/CSA A23.1. An outline of the quality tests is indicated below.
- (g) Any and all Work performed by the Contractor for which the results of Quality Assurance testing, certified by the third-party testing company and as required by this Specification, cannot be produced by the Contractor may be rejected by the Contract Administrator.

E41.10.5 Concrete Testing

- (a) Slump tests shall be made in accordance with CSA Standard Test Method A23.2-5C, "Slump of Concrete". If the measured slump falls outside the limits in E41.6.3 of this Specification, a second test shall be made. In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented.
- (b) Air content determinations shall be made in accordance with CSA Standard Test Method A23.2-4C, "Air Content of Plastic Concrete by the Pressure Method". If the measured air content falls outside the limits in E41.6.3 of this Specification, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Contract Administrator reserves the right to reject the batch of concrete represented.
- (c) The air-void system shall be proven satisfactory by data from tests performed in accordance with the latest edition and all subsequent revisions of ASTM Standard Test Method C457. The spacing factor, as determined on concrete cylinders moulded in accordance with CSA Standard Test Method A23.2-3C, shall be determined prior to the start of construction on cylinders of concrete made with the same materials, mix proportions, and mixing procedures as intended for the project. If deemed necessary by the Contract Administrator to further check the air-void system during construction, testing of cylinders may be from concrete as delivered to the job Site and will be carried out by the Contract Administrator. The concrete will be considered to have a

satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 microns with no single test greater than 260 microns.

- (d) Rapid chloride permeability testing shall be performed in accordance with ASTM C1202.
- (e) The conductivity of the concrete shall be determined in accordance with ASTM C1202, and shall meet the special requirements of E41.6.3.
- (f) Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method A23.2-1C, "Sampling Plastic Concrete".
- (g) Test specimens shall be made and cured in accordance with CSA Standard Test Method A23.2-3C, "Making and Curing Concrete Compression and Flexure Test Specimens".
- (h) Compressive strength tests at twenty-eight (28) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) day strength test, the strength of two (2) companion standard-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the average of the strengths of the two (2) specimens. A compressive strength test at seven (7) days shall be taken, the strength of which will be used only as a preliminary indication of the concrete strength, a strength test being the strength of a single standard cured specimen.
- (i) Compressive strength tests on specimens cured under the same conditions as the concrete Works shall be made to check the strength of the in-place concrete so as to determine if the concrete has reached the minimum allowable working compressive strength as specified in E41.6.3 of this Specification and also to check the adequacy of curing and/or cold weather protection. At least two (2) field-cured test specimens shall be taken to verify strength of the in-place concrete. For each field-cured strength test, the strength of field-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the strength of the specimen.

E41.10.6 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. The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an acceptable manner to the satisfaction of the Contract Administrator.

E41.11 Measurement and Payment

E41.11.1 Self-Compacting Concrete

- (a) Supplying and placing self-compacting concrete will not be measured. This Item of Work shall be paid for at the Contract Lump Sum Price for "Centre Pier Column Jackets Self-Compacting Concrete" listed here below, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.
- (b) Supplying and installing all the listed materials, concrete design requirements, equipment, construction methods, and Quality Control and Quality Assurance measures associated with this Specification and Drawings shall be considered incidental to "Concrete Pier Column Jackets Self-Compacting Concrete", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise.
- (c) The supply and placing of self-compacting concrete for the rock-socketed caissons shall be paid for under Specifications E59.

E42. SUPPLYING AND PLACING REINFORCING STEEL

E42.1 Description

E42.1.1 This Specification shall cover all operations relating to the supply, fabrication, delivery, and placement of Plain Steel Reinforcement, ChrōmX 9100 Steel Reinforcement and Stainless Steel Reinforcing, and associated bar accessories, as specified herein and as shown on the Drawings.

E42.1.2 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 Work as hereinafter specified.

E42.2 Scope of Work

E42.2.1 The Work under this Specification shall involve supplying and placing all steel reinforcing, as shown on the Drawings for the following Works:

Scope of Work

	Item	Type Of Steel Reinforcing
Empress Overpass	Deck	Stainless Steel
	Abutment Backwalls	Stainless Steel
	Approach Slabs	Stainless Steel
	Traffic Barriers	Stainless Steel
	Expansion Slabs	ChrōmX 9100 Steel
	Roadway Slabs	ChrōmX 9100 Steel
North Pedestrian Accessibility Ramp	Diaphragms	ChrōmX 9100 Steel
	Piers	ChrōmX 9100 Steel
	Precast Prestressed Concrete Slabs	ChrōmX 9100 Steel
	Rock Socketed Caissons	Plain Steel
	Slabs On Grade	ChrōmX 9100 Steel
South Pedestrian Accessibility Ramp	Slabs On Grade	ChrōmX 9100 Steel
	Drainage Channel	Plain Steel
	Empress Street Retaining Wall	ChrōmX 9100 Steel
	Centre Pier Column Jackets	Plain Steel

E42.3 References

E42.3.1 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

- (a) ASTM A1035– Standard Specifications for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement;
- (b) ASTM A955M – Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcing;
- (c) ASTM A615M – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement;
- (d) CAN/CSA A23.1/A23.2 – Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete;
- (e) CAN/CSA G30.18-M92 – Billet Steel Bars for Concrete Reinforcement;
- (f) ACI 315R – Manual of Engineering and Placing Drawings for Reinforced Concrete Structures;

- (g) Reinforcing Steel Institute of Canada (RSIC), Manual of Standard Practice.

E42.4 Submittals

E42.4.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty-one (21) Days prior to the scheduled commencement of any fabrication, and the qualifications of the Contractor and its Operators.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to commencement of any schedule Work on the Site, a proposed schedule, including methods and sequence of operations.
- (c) The Contractor shall submit to the Contract Administrator for review, at least fourteen (14) Days prior to the commencement of any Work on Site a Certificate of Compliance from the Manufacturer stating that the stainless steel materials supplied comply with the provisions of ASTM A955M and these Specifications, including corrosion resistance.
- (d) Contractor shall submit all original mill certificates to the Contract Administrator prior to placement of reinforcing on site.
- (e) Contractor to submit Shop Drawings (including bar lists) in accordance with section E4 and the latest edition of the Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada (RSIC).
- (f) The Contractor shall submit a Quality Control Testing Program to the Contract Administrator in accordance with E42.7.

E42.5 Materials

E42.5.1 General

- (a) The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.
- (b) Bundles of reinforcing steel shall be identified by tags containing bar marks.
- (c) The reinforcing steel shall not be placed directly on the ground. Sufficient timber pallets or blocking shall be placed under the reinforcing steel to keep them free from dirt and mud.

E42.5.2 Handling and Storage of Stainless Steel Reinforcing

- (a) Stainless steel reinforcing shall be store separately from other reinforcing steel with the bar tags maintained and clearly visible until placing operations commence. Stacks of bundles of straight bars shall have adequate blocking to prevent contact between the layers of bundles.
- (b) Chains for steel bands used for shipping shall not be in direct contact with stainless steel reinforcing. Wood or approved alternate should be used to protect the bars
- (c) Nylon or polypropylene slings shall be used for moving stainless steel reinforcing.
- (d) Keep carbon steel tools, chains, slings, etc. off stainless steel reinforcing.

E42.5.3 Reinforcing Steel

- (a) Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, mechanical connections and dowels.
- (b) All plain reinforcing steel shall conform to the requirements of CSA Standard CAN/CSA G30.18-M92, Grade 400W, Billet-Steel Bars for Concrete Reinforcement.
- (c) ChrömX 9100, shall conform to the requirements of ASTM A 1035 CM Grade 100.
- (d) Stainless steel, as shown on the Drawings, shall be a high-manganese, low-nickel, nitrogen-strengthened austenitic stainless steel. Stainless steel reinforcing shall meet or exceed the minimum requirements of ASTM A955M, 300 Series, minimum Grade

420, of the Types listed below “Type of Stainless Steel Reinforcing”. Reinforcing deformations shall conform to the requirements of ASTM A615M. All hooks and bends shall be bent using pin diameters and dimension recommended by Reinforcing Steel Institute of Canada (RSIC), Manual of Standard Practice.

- (e) If, in the opinion of the Contract Administrator, any reinforcing steel provided for the concrete Works exhibit flaws in manufacture or fabrication, such material shall be immediately removed from the Site and replaced with acceptable reinforcing steel. No additional costs will be applied to this Contract for the replacement of deficient reinforcing steel.
- (f) All reinforcing steel shall be straight and free from paint, oil, millscale, and injurious defects. Rust, surface seams or surface irregularities will not be cause for rejection, provided that the minimum dimensions, cross-sectional area, and tensile properties of a hand wire-brushed specimen are not less than the requirements of CSA Standard CAN/CSA G30.18-M92 and ASTM A955M.

Types of Stainless Steel Reinforcing

Common or Trade Name	AISI Type	UNS Designation
Type 316 LN	316 LN	S31653
Type 2205	Duplex 2205	S31803
Type 2304	EnduraMet 2304	S32304

E42.5.4 Bar Accessories

- (a) Bar accessories shall be of types suitable for each type of reinforcing and a type acceptable to the Contract Administrator. They shall be made from a non-rusting material, and they shall not stain, blemish, or spall the concrete surface for the life of the concrete.
- (b) Bar chairs, bolsters, and bar supports shall be cementitious material as acceptable to the Contract Administrator. Plastic, PVC or galvanized bar chairs may be permitted if accepted in writing by the Contract Administrator prior to installation.
- (c) The use of pebbles, pieces of broken stone or brick, plastic, metal pipe, and wooden blocks, will not be permitted.
- (d) Placing of bar supports shall be done to meet the required construction loads.
- (e) Tie wire shall be the following:
 - (i) Black, soft-annealed 1.6 mm diameter wire or Nylon coated wire for black steel reinforcing;
 - (ii) Stainless steel, fully annealed 1.6 mm diameter wire, Type 316 or 316L for stainless steel reinforcing and ChrômX 9100.
- (f) Approved products are as supplied by Con Sys Inc., Box 341, Pinawa, Manitoba, Canada R0E 1L0 (204) 753-2404, or equal as accepted by the Contract Administrator in accordance with B6.
- (g) Bar accessories are not included in the Drawings and shall include bar chairs, spacers, clips, wire ties, wire (16 gauge minimum), or other similar devices and are to be acceptable to the Contract Administrator. The supplying and installation of bar accessories shall be deemed to be incidental to the supplying and placing of reinforcing steel.

E42.5.5 Mechanical Splices

- (a) Mechanical splices shall meet the requirements of the reinforcing steel manufacturer. The proposed mechanical splice shall be submitted to the Contract Administrator for acceptance.

E42.5.6 Bonding Agent/Grout

- (a) Epoxy resin shall conform to the requirements of ASTM C881. Type I or Type IV, Grade 3 epoxy shall be used for bonding reinforcing steel into hardened concrete. An approved product is Hilti RE500 V3 or equal, as approved by the Contract Administrator in accordance with B6.
- (b) An aggregate filler may be used in accordance with manufacturer's directions when the drilled hole is sized for the head of a stud rather than a shaft only.

E42.6 Construction Methods

E42.6.1 Fabrication of Reinforcing Steel

- (a) General
 - (i) Reinforcing steel shall be fabricated in accordance with CSA Standard CAN/CSA G30.18-M92 to the lengths and shapes as shown on the Drawings.
- (b) Plain Steel Reinforcing
 - (i) Heating shall not be used as an aid in bending plain steel reinforcing.
 - (ii) Hooks and bends should be smooth and not sharp.
 - (iii) Fabrication of the black steel reinforcing shall be straight and free of paint, oil, mill scale, and injurious defects.
- (c) ChrōmX 9100 Steel;
 - (i) All reinforcing steel shall be fabricated in accordance with the latest edition of the Reinforcement Steel Manual of Standard Practice by the RSIC, to the lengths and shapes as shown on the Drawings.
 - (ii) Low carbon chromium steel reinforcing shall be bent to the proper shape in a plant that has suitable devices for bending as recommended in Reinforcing Steel Institute of Canada (RSIC) Manual of Standard Practice.
 - (iii) Heating shall not be used as an aid in bending of low carbon chromium steel reinforcing. The equipment used in the plant shall not cause any surface contamination or damage to the surface of the bars. Bar cutting shall be done by shearing or with a water-cooled saw. Torch cutting shall not be permitted.
- (d) Stainless Steel Reinforcing;
 - (i) Heating shall not be used as an aid in bending stainless steel reinforcing.
 - (ii) Hooks and bends should be smooth and not sharp.
 - (iii) Fabrication of the solid stainless steel reinforcing shall be such that the bar surfaces are not contaminated with deposits of iron and/or non-stainless steel or damage to the surface of the bars.
 - (iv) The stainless steel reinforcing shall be mechanically or chemically de-scaled prior to fabrication, leaving a totally passive stainless steel finish free of millscale, slag, or oxidation. Iron contamination shall be removed with picking paste or by wire brushing. Wire brush cleaning shall be done with stainless steel wire brushes only.
 - (v) All hand tools shall be stainless tools that have not been used on carbon steel.

E42.6.2 Placing of Reinforcing Steel

- (a) Reinforcing steel shall be placed accurately in the positions shown on the Drawings and shall be retained in such positions by means of a sufficient number of bar accessories so that the bars shall not be moved out of alignment during or after the depositing of concrete. The Contract Administrator's decision in this matter shall be final.
- (b) Reinforcing steel shall be free of all foreign material in order to ensure a positive bond between the concrete and steel. The Contractor shall also remove any dry concrete which has been deposited on the steel from previous pouring operations before additional concrete may be placed. Intersecting bars shall be tied positively at each intersection.

- (c) Splices in reinforcing steel shall be made only where indicated on the Drawings. Prior acceptance by the Contract Administrator shall be obtained where other splices must be made. Welded splices shall not be permitted.
- (d) Reinforcing steel shall be placed to provide a clear space between the reinforcing bars as shown on the Drawings to accurately place preformed holes where necessary.
- (e) Reinforcing steel shall not be straightened or re-bent in a manner that shall injure the metal. Bars with bends not shown on the Drawings shall not be used.
- (f) Heating of reinforcing steel shall not be permitted without prior acceptance by the Contract Administrator.
- (g) Reinforcing steel shall be placed within the tolerances specified in CAN/CSA A23.1.
- (h) The Contractor shall supply and place all necessary support accessories to ensure proper placement of reinforcing steel. All reinforcement shall be accurately placed in the positions shown on the Drawings, and firmly tied and chaired before placing the concrete.
- (i) Distances from the forms shall be maintained by means of stays, spacers, or other approved supports. Spacers and supports for holding reinforcing steel at the required location and ensuring the specified concrete cover over the reinforcing steel shall be as specified in E42.5.4, "Bar Accessories"
- (j) Welding or tack welding is not permitted.
- (k) Unless otherwise shown on the Drawings, the minimum distance between bars shall be 40 mm.
- (l) Bars shall be tied at all intersections, except where spacing is less than 250 mm in each direction, when alternate intersections may be tied.

E42.6.3 Splicing

- (a) Splices shall only be provided as shown on the Drawings. Splices other than as shown on the Drawings shall not be permitted without the written approval of the Contract Administrator.
- (b) For lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the required minimum clear distance to other bars, and the required minimum distance to the surface of the concrete. In general, suitable lap lengths shall be supplied as detailed on the Drawings.

E42.7 Quality Control

E42.7.1 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.
- (c) A minimum of one (1) Business Day advance notice shall be given to the Contract Administrator prior to the placing of any concrete to allow for inspection of the reinforcing steel.
- (d) After all reinforcing steel has been placed, a final inspection shall be made prior to the placement of concrete to locate any damage or deficiencies. All visible damage or any deficiencies shall be repaired to the satisfaction of the Contract Administrator before concrete is placed.

E42.7.2 Access

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

E42.7.3 Quality Testing

- (a) Quality control testing may be used to determine the acceptability of the reinforcing steel supplied by the Contractor.
- (b) The Contractor shall provide, without charge, the samples of reinforcing steel required for quality control tests and provide such assistance and use of tools and construction equipment as is required.

E42.8 Measurement and Payment

E42.8.1 Supplying and Placing Reinforcing Steel

- (a) Supplying and Placing Reinforcing Steel Bars shall be measured on a mass basis, as computed from the reviewed Shop Drawings.
- (b) Supplying and Placing Reinforcing Steel Bars will be paid for at the Contract Unit Price per kilogram for the "Items of Work" listed here below, which price shall be payment in full for supplying all materials and for completing all operations herein described and all other items incidental to the work included in the Specification, accepted and measured by the Contract Administrator.

E42.8.2 Items of Work:

- (a) Supply of Reinforcing Steel;
 - (i) Plain Steel Reinforcing
 - (ii) ChrōmX 9100 Reinforcing;
 - (iii) Stainless Steel Reinforcing.
- (b) Placing Reinforcing Steel;
 - (i) Plain Steel Reinforcing
 - (ii) ChrōmX 9100 Reinforcing;
 - (iii) Stainless Steel Reinforcing.

E42.8.3 The measurement excludes the mass of bar accessories, which are incidental to the Works.

E42.8.4 Supplying and Installing all listed materials, construction methods, and quality control measures associated with this Specification and Drawings shall be considered incidental to "Supply of Reinforcing Steel" and "Placing Reinforcing Steel", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise by the Contract Administrator.

E42.8.5 The supply and placing of reinforcing steel bars for rock-socketed caissons shall be paid for under E59.

E42.8.6 The supply and placing of reinforcing steel bars for precast prestressed concrete slabs shall be paid for under Specifications E60.

E43. STEEL STRAPPING

E43.1 Description

- (a) This Specification shall cover all operations relating to the supply and installation of high-tensile steel strapping, as specified herein 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.

E43.2 Scope of Work

- (a) The work under this Specification shall include the supply and installation of high-tensile steel strapping to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator.
- (b) Provide high strength steel strapping around severely corroded or broken steel ties at the centre pier columns as directed by the Contract Administrator.

E43.3 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled structural removals around the centre pier columns, the proposed type of steel strapping, including installation methods.

E43.4 Materials

E43.4.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) High-Tensile Steel Strapping shall have a minimum breaking strength of 50kN per ribbon.
- (c) The Contractor shall 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.

E43.5 Measurement and Payment

E43.5.1 Steel Strapping

- (a) The supply and installation of high-tensile steel strapping will be measured on a unit basis and paid for at the Contract Unit Price Per Unit for "Steel Strapping", which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work, included in this Specification and accepted by the Contract Administrator.

E44. SUPPLY, FABRICATION AND ERECTION OF MISCELLANEOUS METAL

E44.1 Description

E44.1.1 General

- (a) This Specification covers all operations relating to the following:
 - (i) Supply, fabrication, and erection of miscellaneous metal as shown or described on the Drawings and in this Specification. Miscellaneous metal includes, but is not limited to:
 - South Pedestrian Access Ramp Bollard Post.
 - North Pedestrian Accessibility Ramp Drainage System.
 - (ii) Quality control of materials and fabrication.
 - (iii) Galvanizing of miscellaneous metal.
- (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.

E44.2 References

E44.2.1 References and Related Specifications:

- (a) All related Specifications shall be current issued or latest revision at the first date of tender advertisement;
- (b) CAN/CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel;
- (c) CAN/CSA W48, Filler Metals and Allied Materials for Metal Arc Welding;
- (d) CSA W59, Welded Steel Construction (Metal Arc Welding);
- (e) CAN/CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles;
- (f) CSA W47.1, Certification of Companies for Fusion Welding of Steel;
- (g) ASTM A36, Standard Specification for Carbon Structural Steel;
- (h) ASTM A53, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless;
- (i) ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished;
- (j) ASTM A123, Standard Specification for Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products;
- (k) ASTM A276, Standard Specification for Standard Specification for Stainless Steel Bars and Shapes;
- (l) ASTM A320, Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for Low Temperature Service;
- (m) ASTM F3125, High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength ;
- (n) ASTM A404, Standard Specification for General Requirements for Stainless Steel Bars, Billets and Forgings;
- (o) ASTM A449, Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use;
- (p) ASTM A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement;
- (q) ASTM A500, Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes;
- (r) ASTM A514, Standard Specification for High- Yield- Strength, Clenched and Tempered Alloy Steel Plate, Suitable for Welding;
- (s) ASTM A516, Standard Specification for Pressure Vessel Plates, Carbon Steel, For Moderate and Low Temperature Service;
- (t) ASTM A517, Standard Specification for Pressure Vessel Plates, Alloy Steel, High Strength, Quenched and Tempered;
- (u) ASTM A615, Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement;
- (v) ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar;
- (w) ASTM B22, Standard Specification for Bronze Castings for Bridges and Turntables;
- (x) ASTM B29, Standard Specification for Refined Lead;
- (y) ASTM B100, Standard Specification for Wrought Copper-Alloy Bearing and Expansion Plates and Sheets for Bridge and Other Structural Use;
- (z) ANSI B46.1, Surface Texture (Surface Roughness, Waviness, and Lay);
- (aa) AASHTO/AWS D1.5M/D1.5, Bridge Welding Code;

- (bb) AWS D1.1, Structural Welding Code – Steel;
- (cc) AWS D1.6, Structural Welding Code – Stainless Steel.

E44.3 Submittals

E44.3.1 The Contractor shall submit the following to the Contract Administrator:

- (a) Copies of Mill Test Certificates showing chemical analysis and physical tests of all miscellaneous metal prior to commencement of fabrication. Miscellaneous metal without this certification will be rejected.
- (b) Certification of chemical analysis and physical tests for all materials;
- (c) A complete set of Shop Drawings prior to commencement of fabrication. The Contractor shall indicate on the Shop Drawings all the necessary material specifications for the materials to be used and identify the components in accordance with the Drawings and Specifications. Applicable welding procedures, stamped as approved by the Canadian Welding Bureau, shall be attached to the Shop Drawings. In no case will the Contractor be relieved of responsibility for errors or omissions in the Shop Drawings.
- (d) Clearly indicate shop and erection details including cuts, copes, connections, holes, bearing plates, threaded fasteners, and welds. Indicate welds by CSA / AWS welding symbols.
- (e) Shop Drawings shall be drawn to the same system (Metric or Imperial) as the Contract Drawings.
- (f) Manufacturer's test reports of mechanical tests on high strength bolts, if requested by the Contract Administrator.

E44.4 Materials

E44.4.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.
- (b) The Contractor shall mark all materials to identify its material specification and grade. This shall be done by suitable marking or by a recognized colour coding.
- (c) The types and grades of structural steel used shall be as shown on the Drawings or as specified in this Specification.
- (d) Materials called for under these Specifications and on the Drawings shall, unless otherwise specified, satisfy the testing procedures and be in strict accordance with the requirements set out in the latest edition of the standards identified.

E44.4.2 General Requirements for Miscellaneous Metals

- (a) Miscellaneous metals shall conform to the material grades specified on the Drawings, and meet the requirements and satisfy the testing procedures of CSA G40.21.
- (b) Furnish to the Contract Administrator's Shop Inspector mill test reports, properly correlated to all steel sections to be used for steel construction under this Specification.
- (c) Fabrication shall be carried out in the Fabricator's own plant, the use of subcontractors for all or portions of the fabrication will only be considered unless applied for in writing by the Fabricator and subsequently approved in writing by the Contract Administrator. The Fabricator shall be fully responsible for the quality of work and shall bear all additional costs related to work being carried out at the subcontractors plant such as additional quality inspections, shipment, etc.
- (d) When mill test certificates originate from a mill outside of Canada or the United States of America, the Contractor shall have the information on the mill test certificate tested and verified by independent testing by a Canadian laboratory. This laboratory shall be

certified by an organization accredited by the Standards Council of Canada to comply with the requirements of OSO/IEC 17025 for the specific tests or types of tests required by the material standard specified on the mill test certificate. The mill test certificate shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is in conformance with the specified requirements. The stamp shall include the appropriate material specification number, testing date and the signature of an authorized officer of the Canadian laboratory.

E44.4.3 Steel plates and threaded rods

- (a) Shall be supplied and installed by the Contractor as shown on the Drawings.

E44.4.4 Anchor Units for Aluminum Pedestrian Handrail/Bicycle Rail

- (a) Anchor units for the aluminum pedestrian handrail/bicycle rail shall be stainless steel Acrow-Richmond Type DGRS-1

E44.4.5 Welded Steel Construction

- (a) Welded steel construction (Metal Arc Welding) shall conform to the requirements and satisfy the testing procedures of CSA W59, AWS D1.6 and Welded Highway & Railway Bridges - AWS D1.1 of The American Welding Society & Addendum.

E44.4.6 Shear Stud Connectors

- (a) Shear stud connectors shall conform to the requirements of ASTM A108, Grades 1015, 1018 and 1020.

E44.4.7 Barrier Steel Inlet at Catchbasin and Catch Pit

- (a) Shall be supplied and installed by the Contractor as shown on the Drawings.

E44.4.8 Zinc

- (a) Zinc for hot dipped, galvanized coatings shall conform to the requirements of ASTM A123.

E44.5 Construction Methods

E44.5.1 Fabrication

(a) General

- (i) The workmanship shall meet established practice in modern shops. Special emphasis shall be placed in prevention of cracks, notch-like flaws and bruises that may lower the structure's resistance to fatigue and brittle fracture.
- (ii) The punching of identification marks on members will not be allowed unless authorized in writing by the Contract Administrator.
- (iii) If damage occurs to the miscellaneous metal during fabrication, the Contract Administrator shall be notified immediately to facilitate the implementation of remedial measures. Remedial repair measures are subject to the approval of the Contract Administrator.
- (iv) Dimensions and fabrication that control field matching of parts shall receive careful attention in order to avoid field adjustments.
- (v) Cutting shall be in accordance with AWS D1.1, D1.6 and CSA W59.

(b) Clean Material

- (i) The material shall be clean, free from rust, mill scale, and other foreign matter before being worked in the shop. Material shall be cleaned by wheelabrating, sandblasting or other methods subject to the Contract Administrator's approval.

(c) Finish

- (i) All portions of the Work shall be neatly finished. Shearing, cutting, chipping and machining shall be done neatly and accurately. Finished members shall be true to line and free from twists, bends, open joints, and sharp corners and edges.

(d) Bending

- (i) When bending is necessary in order to meet the requirements of the design, it shall be done with care and by methods subject to the approval of the Contract Administrator. The bend line shall be at right angles to the direction of rolling. The internal radius of bend of load carrying sections shall not be less than twice the thickness of the bend section when bent cold, and if a smaller radius of bend is essential, the material shall be bent hot and later annealed. Before bending, the edges of the section in the region of the bend shall be smoothed and rounded to a radius of 2 mm.
- (e) Welding
 - (i) Specifications

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. Welding of stainless steel shall conform to the requirement of the American Welding Society AWS D1.6.
 - (ii) Welding Operator Qualification

Welding operators shall be qualified in accordance with the requirements of C.W.B. at the time of fabrication for the processes that will be required as part of the Work. Qualification shall have been issued within two (2) years of commencement of fabrication.
 - (iii) The reports of the results of the qualification tests shall bear the welding operator's name, the identification mark he will use and all pertinent data of the tests. Evidence that the welding operators have been executing satisfactory welding in the required processes within the six (6) month period immediately prior to commencement of fabrication shall also be provided to the Contract Administrator. The Contractor shall bear the whole cost and be fully responsible for the qualification of all welding operators.
- (f) Welding Procedures, Specifications and Qualification
 - (i) Welding procedures that conform in all respects to the approved procedures of AWS D1.1, D1.6 and CSA W59 shall be deemed as pre-qualified and are exempt from tests or qualifications.
 - (ii) Welding procedures that do not conform to approved procedures in AWS D1.1, D1.6 and CSA W59 shall be qualified by tests carried out in accordance with AWS D1.1 or D1.6.
 - (iii) The Contract Administrator may accept previous qualifications of the welding procedure.
- (g) Welding Materials
 - (i) All electrodes for manual shielded metal arc welding shall conform to the low-hydrogen classification requirements of the latest edition of the American Welding Society's Filler Metal Specification AWS A5.1 or AWS A5.5 and the CAN/CSA W48 Specification and be capable of producing weld metal having an impact strength of at least 27 J (Charpy V-Notch) at minus eighteen degrees Celsius (-18°C).
 - (ii) All bare electrodes and flux used in combination for submerged arc welding, the electrode and gas shielding used in combination for gas metal-arc welding, or the electrode and shielding medium used in combination for flux cored arc welding of steels shall conform to the requirements in the latest edition of the American Welding Society AWS A5.17, A5.18 or A5.20 and CAN/CSA W48 and be capable of producing weld metal having a minimum impact strength of 27 J (Charpy V Notch) at minus eighteen degrees Celsius (-18°C), or shall be capable of producing low alloy weld metal having the mechanical properties listed in Table 4.1.1 of AWS D1.1.
 - (iii) Low alloy weld properties shall be determined from a multiple pass weld made in accordance with the requirements of the latest edition of the applicable

- Specification (AWS A5.17, A5.18, or A5.20) or the welding procedure specification.
- (iv) Every user shall demonstrate that each combination of electrode and shielding medium will produce weld metal having the above mechanical properties until the applicable AWS Filler Metal Specification is issued. At that time, the AWS Filler Metal Specification will control. The test assembly for Grades E100XX and E110XX shall be made using CAN/CSA G40.21M 700Q or ASTM A514/A517 steel.
 - (v) The Contract Administrator may accept evidence of record of a combination that has been satisfactory tested in lieu of the test required, provided the same welding procedure is used.
 - (vi) Electrodes conforming to AWS A5.1 shall be purchased & delivered in hermetically sealed containers or shall be dried for at least two (2) hours between two hundred and thirty degrees Celsius (230°C) and two hundred and sixty degrees Celsius (260°C) before they are used. Electrodes conforming to AWS A5.5 shall be purchased & delivered in hermetically sealed containers or shall be dried one (1) hour and fifteen
 - (vii) (15) minutes at a temperature of four hundred and twenty-five degrees Celsius (425°C) + fifteen degrees Celsius (15°C) before being used.
 - (viii) All electrodes for use in welding ASTM A514/A517 and CSA 700 Q. steel having a strength lower than that of the E100XX classification shall be dried for 1 hour + 15 min. at a temperature of four hundred and twenty-five degrees Celsius (425°C) + fifteen degrees Celsius (15°C) before being used.
 - (ix) Electrodes shall be dried prior to use if the hermetically sealed container shows evidence of damage. Immediately after removal from hermetically sealed containers or from drying ovens, electrodes shall be stored in ovens held at a temperature of at least one hundred and twenty degrees Celsius (120°C). E70XX electrodes that are not used within four (4) hours, E80XX within two (2) hours, E90XX within one (1) hour, and E100XX and E110XX within 0.5 hour after removal from hermetically sealed containers or removal from a drying or storage oven shall be re-dried before use. In humid atmospheres, these time limits will be reduced as directed by the Contract Administrator. Electrodes that have been wet shall not be used. Electrodes shall be re-dried no more than once.
 - (x) Flux used for submerged arc welding shall be non-hygroscopic, dry and free of contamination from dirt, mill-scale, or other foreign material. All flux shall be purchased in moisture-proof packages capable of being stored under normal conditions for at least six (6) months without such storage affecting its welding characteristics or weld properties.
 - (xi) Flux from packages damaged in transit or handling shall be discarded or shall be dried before use at a minimum temperature of one hundred and twenty degrees Celsius (120°C) for one (1) hour. Flux shall be placed in the dispensing system immediately upon opening a package. If flux is used from an open package or an open hopper that has been inoperative for four (4) hours or more, the top 25 mm shall be discarded. Flux that has been wet shall not be used. Flux fused in welding shall not be reused.
- (h) Preheat and Interpass Temperature
- (i) The minimum preheat and interpass temperatures for welding miscellaneous metal shall conform to AWS D1.1, D1.6 and CSA W59.
- (i) Welding Processes
- (i) Welding processes which do not conform to the provisions of AWS D1.1, D1.6 or CSA W59 shall not be used without the written approval of the Contract Administrator.

Base Metal	Welding Process					Base Metal
	SMAW		GMAW	FCAW	SAW	
CSA	CSA	CSA	CSA	CSA	CSA	
G40.21M	W48.1	W48.3	W48.4	W48.5	W48.6	ASTM
	AWS	AWS	AWS	AWS	AWS	
	A.5.1	A5.5	A5.18,5.28	A5.20	A5.17,5.23	
230G	E60XX		E70S-X	E60T-X	F6X-XXX	A53 Gr B
260W,260T	E70XX		E70U-X	E70T-X	F7X-XXXX	A500 Gr A
						A516Gr55,60
						A36
300W	E70XX		E70S-X	E70T-X ^a	F7X-XXXX	A441>4"
300T	or	E70XX		or	or	A550GrB
	E60XX		E70U-X	F60T-X	F6X-XXXX	A501
350G ^d						A529
350W						A570Gr D,E
						A572Gr42,45
						A607Gr45
						A242
						A441#4"
						A516Gr65,70
350R ^{b,c}			E70S-X			A570Gr50,55
350A ^{b,c}	E70XX	E70XX		E70T-X ^a		588 ^c
			E70U-X		F7X-XXXX	A606
						A607Gr50,55
400A ^{b,c}						A618
						A633Gr,A,B, C,D
400G ^d ,400W						
400T		E80XX	GrE80S	GrE80T	GrF80	A572Gr60,65
480W		E90XX	GrE90S	Gr390T	GrF90	
480T						
480A ^{b,d}		E100XX	GrE100S	GrE100T	GrF100	
700Q ^d		E110XX	GrE110S	Gr3110T	GrF110	A514
						A517

Footnotes for Matching of Base Metal and Electrode

Combinations

a) *Exclusive of E70T-2, E70T-3, E70T0-G*

b) *When steels of Types R and A are used in the exposed, bare, unpainted condition, the electrodes suggested or others*

producing a similar alloy composition in the deposited metal should be used. For applications where the material is not boldly exposed, where a colour match is not important, for all but capping passes in multipass welds and for narrow single pass welds, the electrodes suggested for Grades 300T, 400T and 480T may be used (See CAN/CSA G40.21M).

c) *See Clauses 5.2.1.4 and 5.2.1.5 and Table 5-2 of CSA W59.*

d) *See Mfg. Specifications.*

Use of the same-type filler metal having the next higher mechanical properties as listed in the AWS or CSA Specifications is permitted:

.1 In joints involving base metals of different yield points or strength, filler metal applicable to the lower strength base metal may be used subject to the Contract Administrator's approval.

.2 When welds are to be stress relieved, the deposited weld metal shall not exceed 0.05% vanadium.

.3 See AWS D1.1 article 4.20 for Electroslag and Electro gas weld metal requirements. Appendix C Impact Requirements are mandatory.

.4 Lower strength filler metal may be used for fillet welds and partial penetration groove welds when indicated on the plans or in the special provisions.

- (j) Distortion and Shrinkage Stresses
 - (i) Distortion and shrinkage stresses shall be kept to a minimum by the use of jigs and fixtures, utilizing heat distribution and a welding sequence. Areas contiguous to welding operations shall be preheated to a maximum temperature of one hundred and twenty degrees Celsius (120°C), if necessary in the estimation of the Contract Administrator to prevent distortion or weld cracking. The provisions of AWS D1.1, D1.6 and CSA W59 shall be followed in the control of distortion and shrinkage stresses.
- (k) Tack Welding
 - (i) All tack welds shall be a minimum of 10 mm in length and made with low hydrogen electrodes and shall not be incorporated in the final structure without specific written authorization by the Contract Administrator.
- (l) Stud Shear Connectors
 - (i) The accessories, equipment and welding procedures for the installation of the shear connectors shall be in accordance with AWS D1.1 and CSA W59. Welding by hand will not be allowed.
- (m) Hot-Dip Galvanizing
 - (i) Galvanizing, when called for on the Drawings, shall be done in accordance with ASTM A123 and CSA G164;
- (n) All metal surfaces to be galvanized shall be cleaned thoroughly of rust, rust scale, mill scale, dirt, paint and other foreign material to SSPC – SP 6 (sand, grit or shop blasting or pickling) prior to galvanizing.
- (o) Heavy deposits of oil and grease shall be removed with solvents prior to blasting or pickling to SSPC – SP 1.

E44.5.2 Handling, Delivery and Storage of Materials

- (a) Precautionary measures shall be taken to avoid damage to miscellaneous metal during handling, transit, stockpiling and erecting. Pinholes, or other field connection holes shall not be used for lifting purposes. Special attention is directed to the shipping and storing of miscellaneous metal.
- (b) Damaged parts shall not be installed in the structure and may be rejected at the discretion of the Contract Administrator.
- (c) Materials that are not placed directly in the structure shall be stored above probable high water, on skids, platforms or in bins in a manner that will prevent distortion or the accumulation of water or dirt on the miscellaneous metal. The materials shall be kept separate and stored properly for ease of inspection, checking and handling and shall be drained and protected from corrosion.

E44.5.3 Erection

- (a) Layout
 - (i) Before erection of miscellaneous metal, the Contractor shall satisfy himself that the installation locations are in accordance with the Drawings and Specifications. All discrepancies discovered by the Contractor shall be brought immediately to the attention of the Contract Administrator.

E44.5.4 Workmanship

- (a) The parts shall be assembled as shown on the Drawings and all match marks shall be observed. The material shall be handled carefully so that no parts will be bent, broken or otherwise damaged.
- (b) Hammering which will injure or distort the member is not permitted.

E44.5.5 Misfits and Field Fitting

- (a) Misfits of any part or parts to be erected under this Specification may be cause for rejection. No field fitting shall be undertaken by the Contractor until the cause for misfit

of parts has been determined and the Contract Administrator, so informed, has given direct approval to accept the Contractor's proposed corrective measures. The Contract Administrator's decision as to the quantity of such work to be performed at the Contractor's expense will be final and binding.

E44.5.6 Field Welding

- (a) All field welding shall be electric arc welding, and shall be carried out in accordance with the Drawings, AWS D1.1,D1.6 and CSA W59.

E44.5.7 Final Cleaning

- (a) All metal surfaces shall be left free of dirt, dried concrete, debris or foreign matter to the satisfaction of the Contract Administrator.

E44.6 Quality Control

E44.6.1 The Contractor shall be responsible for making a thorough inspection of materials to be supplied under this Work. All miscellaneous metal shall be free of surface imperfections, pipes, porosity, laps, laminations and other defects.

- (a) Welding
 - (i) All welding may be subject to inspection by Non-Destructive Testing. This inspection shall be carried out in a manner approved of the Contract Administrator.
- (b) The Contractor shall provide sufficient access and shop area to permit the performance of the tests.
- (c) The Contractor shall give the Contract Administrator not less than twenty-four (24) hours' notice of when work will be ready for testing and shall advise the Contract Administrator of the type and quantity of work that will be ready for testing.
- (d) All defects revealed shall be repaired by the Contractor at their own expense and to the approval of the Contract Administrator.

E44.7 Quality Assurance

E44.7.1 All materials will be subject to physical inspection by the Contract Administrator and will be subject to rejection during the course of the Work and for the length of time as specified in the General Conditions, if, in the opinion of the Contract Administrator, the materials involved do not meet the requirements of the Drawings and this Specification.

E44.7.2 All materials shall be subject to testing by the Contract Administrator and will be approved only if the requirements of the Drawings, standards and this Specification are met. The Contractor shall supply the specimens for testing in accordance with the requests of the Contract Administrator.

E44.7.3 The Contractor shall furnish facilities for the inspection of material and workmanship in the mill, shop and field, and the Contract Administrator shall be allowed free access to the necessary parts of the Works.

E44.8 Measurement and Payment

E44.8.1 Miscellaneous Metal

- (a) Supply, fabrication and erection of miscellaneous metal will be measured on a weight basis and will be paid for at the Contract Unit Price Per Kilogram the for "Items of Work" listed here below, which price shall be payment in full for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.
- (b) Items of Work:
- (c) Miscellaneous Metal:
 - (i) Supply
 - (ii) Ramps Drainage System

- (iii) Bollard Post
- (iv) Erection
- (v) Ramp Drainage System
- (vi) Bollard Post

E45. HOT-POURED RUBBERIZED ASPHALT WATERPROOFING

E45.1 Description

E45.1.1 This Specification shall cover the supply of labour, equipment, tools, and material necessary for the application of hot poured rubberized asphalt waterproofing on the bridge deck as specified herein and as shown on the Drawings.

E45.1.2 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 completion of all Work as hereinafter specified.

E45.2 Referenced Specifications and Drawings

E45.2.1 The latest version of the City of Winnipeg Standard Construction Specifications and the latest edition and all subsequent revisions of the following standards:

- (a) CAN/CGSB-27.9M – Primer, Asphalt, Unfilled for Asphalt Roofing, Dampproofing and Waterproofing;
- (b) CGSB-37-GP-50M – Hot Applied Rubberized Asphalt for Roofing and Waterproofing;
- (c) CGSB-37-GP-51M – Application of Hot Applied Rubberized Asphalt for Roofing and Waterproofing;
- (d) CGSB-37-GP-56M – Membrane, Bituminous, Prefabricated and Reinforced for Roofing.

E45.3 Scope of Work

E45.3.1 The Work under this Specification shall involve:

- (a) Preparing the concrete deck to receive the waterproofing membrane;
- (b) Applying primer to the concrete deck;
- (c) Placing the asphalt waterproofing membrane on the concrete deck;
- (d) Placing polyester fabric protection layers and protection board, as shown on the Drawings;
- (e) Supplying and installing wick drains and associated end drainage at the interface of the bridge deck and bridge traffic barriers.

E45.4 Submittals

E45.4.1 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E45.4.2 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material.

E45.5 Materials

E45.5.1 General

- (a) The Contractor shall 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.
- (b) The Contractor shall 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.

E45.5.2 Hot Poured Rubberized Asphalt Waterproofing

- (a) The hot poured rubberized asphalt waterproofing system shall consist of the following compounds:
 - (i) Primer;
 - (ii) Hot applied rubberized asphalt waterproofing membrane;
 - (iii) Polyester fabric;
 - (iv) Protection board.
- (b) The hot poured rubberized asphalt waterproofing membrane shall be a two (2) layer, fabric-reinforced system. Each layer shall be 2.0 to 3.0 mm in thickness. The intermediate fabric reinforcement shall be placed between the layers.
- (c) The Contractor shall supply and install approved protection board to cover the hot poured rubberized asphalt waterproofing membrane.

E45.5.3 Primer

- (a) The entire concrete surface to be waterproofed shall receive a prime coat conforming to the requirements of damproofing / waterproofing primer CGSB37-GP-9Ma, 930-18 (BAKOR) or approved equivalent in accordance with B6, at an application rate in accordance with the Manufacturer's recommended methods.
- (b) Primer shall be stored at temperatures of 5°C and above to facilitate handling. Materials shall be stored in a dry location and shall be kept in an upright position.

E45.5.4 Hot Poured Rubberized Asphalt Waterproofing Membrane (Two (2) layers)

- (a) The hot poured rubberized asphalt waterproofing membrane shall be Bemalastic 1213 BDM by McAsphalt or 790-11 by BAKOR, or an approved equivalent, in accordance with B6.
- (b) The waterproofing membrane shall be melted, mixed, and applied according to the Manufacturer's recommendations.
- (c) The layering operation shall be such that the waterproofing membrane is applied in two (2) 2.0 mm – 3.0 mm thick layers.
- (d) Discontinuities in the waterproofing membrane shall be avoided and joints lapped a minimum of 150 mm. The waterproofing membrane shall be applied to the entire bridge deck and approach slab and shall extend up the face of the barriers to the top (proposed elevation) of the asphalt pavement.
- (e) At the Contract Administrator's discretion, samples from the kettles shall be tested by the Contractor.

E45.5.5 Polyester Fabric

- (a) An intermediate reinforcing layer shall be placed between the layers of waterproofing membrane. The intermediate reinforcing layer shall be spun-bonded polyester fabric such as Reemay 2016 grade, BAKOR Polyester Fabric Reinforcing Sheet, McAsphalt Fabric Reinforcement BP-16 or approved equivalent in accordance with B6, and set into the first layer of waterproofing membrane to achieve a minimum of fifty percent (50%) bleed through. Maximum overlap or gap between sheets of 6 mm.

E45.5.6 E45.5.6 Protection Board

- (a) The protection board shall be a durable panel of 3 mm thickness specifically designed to provide a protective cushion between the hot mix asphalt pavement and the hot-

applied rubberized asphalt waterproofing membrane for bridges and shall be approved by the Contract Administrator.

- (b) The protection board shall be BAKOR Asphalt Protection Board, McAsphalt Protection Board BP-Asp PB, or approved equivalent in accordance with B6.
- (c) The protection boards shall be placed on top of the upper layer of waterproofing and rolled by means of a linoleum or lawn type roller while the membrane is still warm to ensure good contact with the membrane. The protection boards shall be placed with edges overlapping 25 mm both longitudinally and transversely. The protection board's edge shall be within 5 mm of all barriers. Protection boards shall be placed such that the longitudinal (direction of traffic) joints are staggered at least 150 mm. Instances where edges of the protection board curl up, the edges shall be cemented down using asphalt waterproofing. Protection boards that are warped, distorted, or damaged in any way shall be rejected.

E45.5.7 Surface Conditioner

- (a) Surface conditioner shall be applied to the concrete surfaces of the bridge deck, and approach slab and shall conform to the Manufacturer's recommended methods.

E45.6 Wick Drains

- (a) Wick drains shall consist of composite polypropylene with a total thickness of 3.6 mm, supplied in widths of 100 mm.
- (b) The puncture strength shall be a minimum of 0.45kN, measured in accordance with the requirements of the latest edition of ASTM D4833
- (c) Wick Drain shall be one (1) of the approved products: American Wick Drain and distributed by Layfield and Nilex Inc under private labels Nilex NuDdrain MD7407 and Layfield Wick Drain Type 1, or an approved equal as accepted by the Contract Administrator in accordance with B6.
- (d) The rubber membrane shall consist of butyl rubber with a total thickness of 1.2 mm.
- (e) Rubber membrane shall be one (1) of the approved products: Elastoshet 6147, BP47 Elastomeric Reinforcement, BAKOR 990-25, or an approved equal as accepted by the Contract Administrator in accordance with B6.

E45.7 Equipment

E45.7.1 General

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

E45.8 Construction Methods

E45.8.1 General

- (a) No installation work shall be performed during rainy or inclement weather and on frost or wet covered surfaces.
- (b) Temporary protection of the membrane shall be provided to prevent mechanical damage or damage from spillage of oil or solvents until such time as permanent protection is provided.

E45.8.2 Melting On-Site

- (a) Cakes of rubberized asphalt waterproofing shall be melted in an approved double shell melter under continuous agitation until the material can be drawn free flowing and lump free from the melter.
- (b) The temperature of the rubberized asphalt waterproofing shall not exceed two hundred and eighteen degrees Celsius (218°C) at any time during the entire melting procedure.

E45.8.3 Application

- (a) 1.2 thick 300 mm wide Bituthene 3000 shall be placed as shown in drawings prior to placement of waterproofing membrane in accordance with the Manufacturer's requirements.
- (b) The entire concrete surface area onto which the hot poured rubberized asphalt waterproofing is to be applied shall be thoroughly cleaned by means of sand blasting. The sand blasted surfaces shall be sound, free from curing compounds, laitance, and scaling. All rough spots, ridges and edges in the concrete surface resulting from protrusions of concrete aggregate or cement paste shall be removed by light chipping or grinding to leave a smooth and level surface. Immediately prior to the application of the hot poured rubberized asphalt waterproofing, a final cleaning of the concrete surfaces shall be done using high velocity compressed air. The concrete surfaces shall be dry, clean, and free from frost, dust, dirt, and all foreign matter. The Contractor shall contain and collect all products of the sand blasting operation including dust, debris, and spent abrasive so as to ensure that all of these materials are prevented from entering into surrounding area. All debris and spent abrasive shall be collected and disposed of off-site by the Contractor at a proper disposal facility. The Contractor is responsible for the preparation of the concrete surfaces to ensure that the hot-poured rubberized asphalt waterproofing can be installed in accordance with the Manufacturer's requirements.
- (c) The Contractor shall ensure that the concrete surfaces onto which the hot poured rubberized asphalt waterproofing is to be applied is prepared (including supply and application or waterproofing primer) to the degree that the hot poured rubberized asphalt waterproofing can be installed in accordance with the Manufacturer's requirements.
- (d) After the concrete deck and approach slab have been cleaned, they shall be covered with surface conditioner. The quantity used shall be 160 mL/m², or as recommended by the Manufacturer. The surface conditioner shall be allowed to dry before the application of the rubberized asphalt waterproofing.
- (e) The primer shall be applied at a uniform rate, as recommended by the Manufacturer, avoiding over-spraying or ponding of material. The primer shall be dry before applying the rubberized asphalt waterproofing.
- (f) The rubberized asphalt waterproofing shall be brought to a temperature of between 190°C and 218°C.
- (g) The application of the rubberized asphalt waterproofing shall be carried out under the supervision of experienced personnel.
- (h) Apply membrane in a smooth fashion, free from air pockets, wrinkles, or tears, and in accordance with the Manufacturer's recommended methods. Ensure full bond of membrane to substrate.
- (i) Apply the first layer of hot rubberized asphalt membrane evenly to a minimum thickness of 2 mm to form a continuous monolithic coating over horizontal and vertical surfaces.
- (j) Apply fabric reinforcing sheet and firmly press into first layer of hot membrane. Overlap fabric approximately 6 mm ensuring that a layer of membrane is present between overlaps. Apply a second layer of membrane over the fabric to a minimum thickness of 3 mm.
- (k) The Contractor shall supply and install an elastomeric sheet membrane which is compatible with the hot-poured rubberized asphalt waterproofing material. The elastomeric sheet membrane shall be installed at the designated locations shown on the Drawings. Installation of the heavy-duty elastomeric sheet membrane shall be in accordance with the Manufacturer's recommendations.
- (l) Protection course shall be rolled onto hot applied rubberized asphalt membrane surface while still warm and tacky.
- (m) Lap protection course shall be 50 mm on side laps and 150 mm on end laps, staggering laps.

E45.8.4 Installation of Wick Drains

- (a) Wick drains shall be installed along the full length of the bridge deck and approach slab at the interface between the slab and traffic barrier.
- (b) Wick drains shall be installed when the hot poured rubberized asphalt waterproofing membrane is still hot and tacky. Special attention shall be given to waterproofing and wick drain modifications at deck drain pipe locations.
- (c) Tack coat shall not be applied to wick drains.

E45.9 Quality Control

E45.9.1 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.

E45.9.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E45.10 Measurement and Payment

E45.10.1 Hot-Poured Rubberized Asphalt Waterproofing

- (a) Hot-poured rubberized asphalt waterproofing with protection board shall be measured on area basis and paid for at the Contract Unit Price per square meter for "Hot-Poured Rubberized Asphalt Waterproofing with Protection Board", which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work includes in this Specification, accepted and measured by the Contract Administrator.

E46. RIPRAP (STRUCTURAL)

E46.1 Description

E46.1.1 These Specifications govern all operations necessary for and pertaining to the supplying and placing of approved riprap as a protective covering as indicated on the Drawings or designated by the Contract Administrator in the field.

E46.1.2 This Specification shall amend and supplement Specification No. CW 3615.

E46.2 Referenced Specifications

- (a) All reference standards and related specifications shall be current issue or latest revision at the date of tender advertisement.
- (b) Specifications
 - (i) CW 3615-R4 – for Riprap
 - (ii) CW 3130-R4 for "Separation Geotextile Fabric".

E46.3 Submittals

E46.3.1 The Contractor shall submit the proposed supplier(s) and location of quarry sites at least ten (10) business days prior to the supply of riprap to the Site, to confirm that sufficient quantity of specified rock is available.

E46.3.2 The Contractor shall supply representative test results at least ten (10) business days prior to the supply of riprap to the Site, demonstrating that the material to be supplied is of adequate quality and gradation to satisfy the material specifications contained herein.

E46.4 Materials

E46.4.1 Rock

(a) Rock for riprap shall consist of hard, dense, durable rock. The rock shall be quarried rock or fieldstone, dense and durable, and resistant to the action of frost and water and suitable in all other respect for the purpose intended. Stone rip-rap shall be free of sod, roots, organic material and debris prior to placement. Individual pieces of stone shall be free of defects such as seams or cracks prior to placement. Where stipulated, rock is to be of the same type as that existing in place meeting the following properties:

- (i) minimum bulk specific gravity of 2.6 (ASTM C127);
- (ii) maximum Los Angeles abrasion loss of thirty –two percent (32%) (ASTM C535);
- (iii) maximum Magnesium Sulphate Soundness Loss of thirteen percent (13%) (ASTM C88);
- (iv) maximum absorption of two and a half percent (2.5%) (ASTM C127);
- (v) gradation requirements, as follows:

The riprap shall be well graded having a full range and even distribution of sizes and shall conform to the following gradation:

Gradation Requirements for Rip-rap

Diameter (mm)	Percent Passing by dry Weight
350	100%
300	75%
200	25%
5	0-5%

- (b) Individual particles shall be shaped such that no dimension is greater than four (4) times the smallest dimension. Flat, elongated, or platy particle shapes will not be accepted.
- (c) The diameter shall be taken as the average of the shortest and longest dimension measured on an individual piece of riprap.
- (d) Contractors supplying riprap shall be responsible for demonstrating that the material is of adequate quality, gradation, and volume to meet the material specifications contained herein.
- (e) All materials set forth in this Specification shall be subject to inspection and testing by the Contract Administrator or by the testing laboratory designated by the Contract Administrator.
- (f) The Contract Administrator will visit proposed quarry Sites for inspection of the proposed riprap material and quarry faces a minimum of fourteen (14) days prior to supply and placement of riprap.
- (g) No supply and placement of riprap will be permitted prior to the Contract Administrator approving the source.
- (h) The testing frequency necessary to confirm the material quality will be specified at the discretion of the Contract Administrator.

E46.4.2 Geotextile

- (a) The geotextile shall be non-woven type, and supplied and placed in accordance with CW 3130-R4 for "Separation Geotextile Fabric".

E46.5 Construction Methods

- (a) The bed for riprap shall be shaped and trimmed to the lines as shown on the Drawings or as staked in the field by the Contract Administrator, prior to placing of any riprap. No riprap shall be placed until the bed has been inspected and approved by the Contract Administrator.
- (b) Place a layer of geotextile fabric under the riprap. Anchor the geotextile fabric on the upstream and downstream end of the rock filled trenches as shown on the Drawings.
- (c) Place the rock riprap carefully on the geotextile fabric so that it does not tear. Place the rock in such a manner that the larger stones are uniformly distributed and smaller rocks serve to fill the spaces between the larger rocks. Sufficient hand work shall be done to procure a neat and uniform surface with the thickness as shown on the Drawings.

E46.6 Measurement and Payment

E46.6.1 Riprap

- (a) Riprap measurement and payment will be in accordance with CW3615.
- (b) This work shall include all necessary trimming and excavation and the removal off site, of the excess excavated material, unless otherwise specified in the Specifications for the Work.
- (c) Sub-excavation and disposal of excavated soil, shaping the riprap bed, supplying, loading, hauling, placing geotextile and stone riprap shall be considered incidental to the Work.

E47. STRUCTURAL REMOVALS

E47.1 Description

E47.1.1 General

- (a) This Specification shall cover all operations relating to the removal and disposal of miscellaneous existing bridge components, as specified herein and as shown on the Drawings. This Specification shall cover structural removal Works, including all necessary staging, demolition, removal, salvaging, transporting, unloading, stockpiling, dismantlement, and disposal of applicable materials.
- (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.

E47.2 References

- (a) D27 - ENVIRONMENTAL PROTECTION PLAN;
- (b) E7 - TRAFFIC CONTROL;
- (c) E8 – TRAFFIC MANAGEMENT
- (d) City of Winnipeg By-Law No. 7070/97 Part 5, Control of Discharge to Sewers;
- (e) ICRI Guideline No. 03732.

E47.3 Details of the Existing Structure

- (a) The applicable details and structure dimensions of the existing structures are shown on the Drawings for information only in establishing the methods and limits of Work.

- (b) The information shown has been obtained from existing Drawings, measurements, and observations at the Site. The accuracy of this information is not guaranteed and the Contractor must verify all information before commencing Work.
- (c) A Bridge Condition Assessment was completed by Morrison Hershfield Ltd. The testing report is provided in Appendix 'B'. The Contractor is to complete a deterioration survey with the Contract Administrator to confirm the limits of repairs prior to commencing repair activities on the Empress Overpass substructure.

E47.4 Scope of Work

E47.4.1 The Work under this Specification shall specifically include the following items to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator:

- (a) Removal and disposal of the existing bridge structure as follows:
 - (i) Complete removal and disposal of the concrete cover on the centre pier columns;
 - (ii) Complete removal and disposal of deck top epoxy wearing surface;
 - (iii) Complete removal and disposal of the concrete traffic barriers and aluminium railing system;
 - (iv) Partial depth removal and disposal of the bridge deck concrete;
 - (v) Longitudinal and transverse groove concrete removal and disposal for Cathodic Protection system connectivity;
 - (vi) Partial depth removal and disposal of the abutment backwalls concrete;
 - (vii) Partial depth removal and disposal of the bridge approach slabs concrete;
 - (viii) Partial removal and disposal of deck expansion joints as per Drawings;
 - (ix) Partial removal and salvage of existing Empress Overpass pedestrian handrail at North Pedestrian Accessibility Ramp connection;
 - (x) Partial removal and salvage of existing south stairway handrail of the Empress Overpass at South Pedestrian Accessibility Ramp connection;
 - (xi) Partial removal and disposal of existing south stairway curb of the Empress Overpass at South Pedestrian Accessibility Ramp connection;
 - (xii) Partial removal and disposal of Portage Avenue North and South sidewalk curbs at the Pedestrian Accessibility ramps connection to Portage Avenue.
- (b) All materials not identified for salvage shall be disposed of at an approved disposal facility by the Contractor. Any disposal fees shall be considered incidental to this work;
- (c) Completing all structural removals with appropriate equipment satisfactory to the Contract Administrator. Under no circumstances shall demolition products find their way outside the construction site limits. See D27, "ENVIRONMENTAL PROTECTION PLAN" for more information;
- (d) Providing saw cuts as shown on the Drawings and where otherwise necessary to limit the extent of demolition;
- (e) Repairing any over demolition and damage to reinforcing steel or other structural components to the satisfaction of the Contract Administrator;
- (f) Complying with any and all environmental requirements identified in the Specifications or otherwise applicable to the proposed Works.

E47.5 Submittals

E47.5.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any removal Works on Site, a detailed removal plan and schedule clearly illustrating the method and sequence by which he proposes to perform the structural removals including a description of the measures that will be implemented to meet the applicable environmental requirements identified in "PART D - Supplemental Conditions". The

removal procedure shall include Detailed Design notes and Shop Drawings that are sealed, signed, and dated by a Professional Engineer licensed to practice in the Province of Manitoba necessary for the following proposed items:

- (i) Work platforms (suspended from the existing superstructure, supported from the existing ground, or otherwise);
- (ii) Type and capacity of removal equipment;
- (iii) Sequence of removal operations;
- (iv) Design of demolition catch platforms (if different than work platforms) to contain all removal/demolition debris from entering into the right-of-way below;
- (v) Description of the measures that will be implemented to meet the requirements of identified in "PART D - Supplemental Conditions".

E47.5.2 Hydro-Demolition

- (a) The Contractor shall prepare and submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any hydro-demolition Work on Site, a hydro-demolition plan detailing the Contractor's proposed hydro-demolition runoff control and disposal methods and procedures. Wastewater from the hydro-demolition process shall meet the requirements of the City of Winnipeg By-Law No. 7070/97 Part 5, Control of Discharge to Sewers, prior to entering the City's land drainage sewer system. At no time can runoff of wastewater be permitted to enter the watercourse or the City's land drainage system unfiltered.

E47.6 Materials

E47.6.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall 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.

E47.7 Demolition Catch Platforms and Work Platforms

- (a) (a) Shall be in accordance with E49, "TEMPORARY PROTECTION SYSTEM".

E47.8 Equipment

E47.8.1 General

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

E47.8.2 Hydro-Demolition Equipment

- (a) The hydro-demolition equipment shall be a self-propelled tracked machine that utilizes a high pressure water jet stream capable of removing concrete to the limits shown on the Drawings or as directed by the Contract Administrator and be capable of removing rust and concrete particles from reinforcing steel. The use of a hand-held lance shall be acceptable for horizontal and vertical surfaces. Pneumatic hammers (15 kg, 35 pound class maximum) may be used in areas that are inaccessible or inconvenient to the self-propelled machine such as, but not limited to, areas not to exceed 300 mm away from the bridge edges, subject to approval of the Contract Administrator.
- (b) The above specified self-propelled tracked machine shall meet the minimum/maximum dimensions shown on the Drawings with respect to track spacing, length of machine, etc. and shall not exceed 2500 kg GVW.
- (c) The use of any hydro-demolition equipment not conforming to the above requirements will not be permitted unless a formal request is provided by the Contractor for the Contract Administrator's review accompanied by a sealed, signed, and dated letter

prepared by a Professional Engineer licensed to practice in the Province of Manitoba certifying that the proposed hydro-demolition equipment will not detrimentally affect the structural integrity of the structure.

E47.9 Sequence of Structural Removals

E47.9.1 Construction sequencing of all structural removals shall take place as shown on the Drawings.

E47.10 Construction Methods

E47.10.1 General

- (a) The Contractor shall be fully responsible for ensuring the Public safety in all areas, and will be held responsible for any loss or damage caused due to neglect by the Contractor or his employees.
- (b) The Contractor shall provide flagmen, guards, barricades, railings, and necessary warning lights, and whenever/wherever necessary, warning signs and lights at the excavations, temporary sidewalks, removals, and/or other construction, to secure the safety of workmen and the Public. The safety precautions shall comply with all Provincial Statutes applicable to the Work. The Contractor shall provide all other protective measures as may be required by any Law in force in Manitoba and the Canada Labour Code.
- (c) Traffic and pedestrian control shall conform to the requirements of E7, "TRAFFIC CONTROL" and E8, "TRAFFIC MANAGEMENT".
- (d) Under no circumstances shall the Contractor close any portion of existing roadways or walkways to traffic without prior written approval of the Contract Administrator. If any existing roadway is to be closed to traffic in no case shall the Contractor commence any construction operations until such time that all the signs, barricades, and flashers have been erected to the satisfaction of the Contract Administrator.
- (e) The Contractor shall generally prevent any unspecified and undesirable movement or settlement of the existing structure, damage to any existing structures to remain, and damage to any services, paving, trees, landscaping and adjacent grades not specified for removal/disturbance. The Contractor shall design and provide any bracing, shoring or underpinning necessary to complete the work as required and shall have any designs for this Work sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba. If the safety of the structure and/or existing services appears to be endangered during structural removal operations or if the Work is detrimentally impacting the environment, the Contractor shall cease operations and notify the Contract Administrator immediately. Additionally, if the Work is proceeding in a fashion unsatisfactory to the Contract Administrator for any reason, the Contractor will be notified and shall cease operations immediately.
- (f) In no case will the Contractor be permitted to use removal equipment, or other equipment or methods which may cause damage to any remaining structural components or to any new construction. In the event that any component is damaged, the Contractor shall repair such component at his own expense to the satisfaction of the Contract Administrator.
- (g) Construction methods specific to the removal of each bridge component are provided in the following Clauses. Generally, the items have been listed in the order of removals however the Removal Sequence outlined in E63.9 shall govern.

E47.10.2 Pier Columns Concrete Cover Removal

- (a) No removal works including the pier columns concrete cover removals will be permitted to occur prior to the implementation of the necessary traffic control requirements in accordance with E7, "TRAFFIC CONTROL".
- (b) Removals to take place one column at a time, working from the top downwards. Removals to subsequent columns are not to take place until the previous column concrete repair has cured for a minimum of seven (7) days.

- (c) Remove the pier column concrete cover to the depth and limit of removals for each stage of construction, as specified on the Drawings.
- (d) Removals shall be undertaken using a combination of sawcutting, scraping, and chip hammering, or by other means, as accepted by the Contract Administrator.
- (e) Upon completion of removals using the methods above, the concrete surface shall be prepared by the use of a hand-held hydro-demolition lance.
- (f) The existing concrete surface shall be roughened and prepared in accordance with ICRI Guideline No. 03732 CSP6 (Medium Scarification).

E47.10.3 Deck top epoxy wearing surface removal

- (a) The entire deck top epoxy wearing surface layer on the Empress overpass shall be completely removed by roto-milling, scraping, or other means accepted by the Contract Administrator. Remove material from site.

E47.10.4 Deck partial expansion joint removal

- (a) Remove and dispose the existing Bridge deck expansion joints and deals for each construction stage as shown on the Drawings.
- (b) Concrete encasing the expansion joints and shall be remove to the limits shown on the Drawings.
- (c) Equipment used for the removal of the expansion joints and expansion joint dams shall be selected so that no damage is caused to the remaining deck and abutment concrete.
- (d) Concrete shall be roughened and prepared in accordance with ICRI Guideline No. 03732, CSP4 (Light Scarification).

E47.10.5 Traffic Barriers Removal

- (a) Traffic and median Barrier concrete shall be removed for each construction stage, to the limits specified o the Drawings.
- (b) Removal shall be undertaken using a combination of sawcutting, scraping, and chip hammering, or by other means, as accepted by the Contract Administrator.
- (c) Upon completion of removals using the methods above, the concrete surface shall be prepared by the use of a hand-held hydrodemolition lance.
- (d) The existing concrete surface shall be roughened and prepared in accordance with ICRI Guideline No. 03732, CSP6 (Medium Scarification).

E47.10.6 Partial depth removal of deck, abutment backwalls and approach slabs

- (a) Remove and dispose of the concrete deck slab to the depths and limits shown on the Drawings for each construction stage. The Contractor is advised that the final extent of removal may be +/- 0-15 mm from that shown on the Drawings. The concrete deck slab may be removed by a combination of saw cutting, roto-milling and hydro-demolition, or by any other means acceptable the Contract Administrator.
- (b) Removal by hydro-demolition shall be completed in accordance with this Specification.
- (c) The final surface preparation of the deck concrete to remain (concrete substrate) shall be conducted by abrasive blasting, hydro-demolition. The resulting surface shall be roughened to the minimum following requirements:
 - (i) For horizontal surfaces, concrete shall be removed, roughened, and prepared in accordance with ICRI Guideline No. 03732, CSP8 (Scabbled)
 - (ii) For vertical surfaces, concrete shall be removed, roughened, and prepared in accordance with ICRI Guideline No. 03732, CSP6 (Medium Scarification).
- (d) The Contractor is advised that, there exists the potential for full-depth "blow-throughs" of the deck to occur. The Contractor shall take care during the hydro-demolition process to minimize the occurrence of any blow-throughs. Any blow-throughs will

need to be cast along with partial depth deck concrete as specified on the Drawings and will be measured and paid as per E40, "**Structural Concrete**".

E47.10.7 Longitudinal and transverse strip groove deck concrete removal for Cathodic Protection connectivity

- (a) Longitudinal and transverse strip groove deck concrete removal for Cathodic Protection system connectivity shall be completed as shown on the Drawings.
- (b) Remove deck concrete to the depth and limits of removal for each stage of construction as specified on the Drawings.
- (c) Removal shall be undertaken using a combination of sawcutting, scraping, and chip hammering, or by other means, as accepted by the Contract Administrator.
- (d) Upon completion of removals using the methods above, the concrete surface shall be prepared by the use of a hand-held hydrodemolition lance.

E47.10.8 Removal Methods by Hydro-Demolition

- (a) Prior to the commencement of any removal operation by hydro-demolition, the hydro-demolition equipment shall be calibrated on an area of sound concrete approximately 600 mm x 1500 mm as directed by the Contract Administrator. The cost of the calibration procedure is incidental to the Work. The Contractor shall provide the Contract Administrator with the following settings:
 - (i) Water pressure;
 - (ii) Machine staging control (step);
 - (iii) Nozzle size;
 - (iv) Nozzle speed.
- (b) During the calibration, any or all of the above settings may be adjusted in order to achieve removal in accordance with the requirements of the Drawings. When the designated depth of removal is attained, the settings shall be recorded and maintained throughout the removal operation unless otherwise directed by the Contract Administrator. The depth of removal shall be verified periodically and, if necessary, the equipment recalibrated to ensure the depth of removal as indicated on the Drawings is achieved.
- (c) Wastewater from the hydro-demolition process shall meet the requirements of the City of Winnipeg By-Law No. 7070/97 Part 5, Control of Discharge to Sewers, prior to entering the City's land drainage sewer system. At no time can runoff of wastewater be permitted to enter the watercourse, or enter the City's land drainage system unfiltered. The Contractor shall complete daily pH tests in the presence of the Contract Administrator on wastewater runoff to ensure that all discharging of wastewater is in compliance with the City's By-laws. All test reports shall be submitted to the Contract Administrator, and must be within acceptable limits prior to any wastewater entering the City's land drainage sewer system.
- (d) The Contractor shall take all necessary precautions to ensure that no sound concrete located below the required depth of removal is damaged or removed. Any damage caused to sound concrete or reinforcing steel beyond the required limit of removal or excessive removal of concrete beyond the required depth of removal by the Contractor during any demolition procedure will be repaired by the Contractor at the Contractor's own expense to the satisfaction of the Contract Administrator.
- (e) Where applicable, any "shadowing" of the reinforcing steel by concrete not removed by the process of hydro-demolition shall be removed by the Contractor through other approved means.
- (f) After the hydro-demolition is completed, the remaining concrete surface shall be inspected through methods of sounding by the Contract Administrator to ensure that all deteriorated concrete has been removed. Should deteriorated concrete be found, the Contractor shall remove the areas of deteriorated concrete by additional passes of the hydro-demolition equipment or other equipment approved by the Contract

Administrator. Payment for removal of these areas shall be considered incidental to the Work.

- (g) Upon completion of the hydro-demolition of each section of the Work, the Contractor shall remove all cuttings, slurry containing the products of hydro-demolition, and all other debris from the resulting concrete surface so as to produce a thoroughly clean surface. Cleaning of each section shall be done before debris and water are allowed to dry on the deck surface and prior to the placement of reinforcing steel.
- (h) There is a possibility that during hydro-demolition, blow-throughs may occur. Since it is difficult to predict when or even if a blow-through will occur, the following contingency plan shall be undertaken by the Contractor for this eventuality:
 - (i) In instances where a blow-through of the deck does occur, the Contractor will be required to halt the water jet immediately and stop the flow of water and deck solids. The latter may be accomplished by immediately placing sandbags in the location of the blow-through opening. Sandbags shall be supplied on standby by the Contractor for just such an occurrence. After the blow-through opening is dammed, the hydro-demolition work may resume.
 - (i) All exposed reinforcing steel which is left unsupported by the hydro-demolition process shall be adequately supported and protected from all equipment. All reinforcing steel damaged or dislodged by these operations, as deemed by the Contract Administrator, shall be replaced with new reinforcing of the same size at the expense of the Contractor.

E47.11 Waste Handling and Disposal of Removed Materials

- (a) Dispose of all surplus and unsuitable material off-site, in accordance with D27, "Environmental Protection Plan".
- (b) Wherever practical, the Contractor shall recycle disposed materials.
- (c) The Contractor shall submit a list of locations of disposal/recycling for all removed materials to the Contract Administrator.
- (d) The Contractor shall promptly haul all removed materials indicated for disposal, off and away from the site. No storage of any materials on-site will be allowed without written approval from the Contract Administrator. It shall be the Contractor's responsibility to find suitable disposal areas away from the site.

E47.12 Bridge Deck Survey

- (a) The Contractor shall complete a survey of the existing bridge deck on a 1 m x 1 m grid prior to commencing any deck removals (with exception of the superstructure isolation and deck overhang removals). The elevations shall be submitted to the Contract Administrator for comparison with the final deck surface elevations to determine the final extent of removals.
- (b) The Contractor shall complete a survey of the final bridge deck on the same 1 m x 1 m grid as used E47.12(a) after completion of all removals and final preparation of the deck surface. The elevations shall be submitted to the Contract Administrator for review and comparison with the pre-existing survey to determine the final extent of removals.
- (c) The Contract Administrator shall use the results of the final survey to provide the final screed elevations for the new deck slab concrete. The final screed elevations shall be provided within five (5) Business Days from receipt of the survey elevations.

E47.13 Construction Load Limitations for Equipment

- (a) Following removal of the top deck slab and sidewalk concrete, equipment travelling across the deck shall be limited to a gross vehicle weight of 2,500 kg travelling with its wheels overtop the girder centerlines.

E47.14 Quality Control

E47.14.1 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.

E47.14.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E47.15 Measurement and Payment

E47.15.1 Structural Removals

- (a) Structural Removals will not be measured. Structural removals shall be paid for at the Contract Lump Sum Price for the "Items of Work" listed here below performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.
- (b) Items of Work:
Structural Removals:
 - (i) Epoxy Wearing Surface
 - (ii) Traffic Barriers
 - (iii) Expansion Joints
 - (iv) Concrete Overlay
 - 1. 35 mm Depth
 - 2. 95 mm Depth
 - 3. Longitudinal and Transverse Grooves
 - (v) Ramp Connection

E48. SUPPLY AND INSTALLATION OF BEARINGS

E48.1 Description

E48.1.1 The Specification shall cover all operations selected to:

- (a) Supply, fabrication, delivery and installing North Pedestrian Accessibility Ramps Expansion Bearings, shown on the Drawings and in this Specification;
- (b) Supply, fabrication, delivery and installing North Pedestrian Accessibility Ramps Temporary Elastomeric Bearings Strip, shown on the Drawings and in this Specification;
- (c) Repair of Empress Overpass bearings as shown on the Drawings;
- (d) Quality control of materials and fabrication;

E48.2 Submittals

E48.2.1 The Contractor shall submit the following to the Contract Administrator, in accordance with the Specification:

- (a) Detailed Shop Drawings for the bearings that are stamped, signed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba in accordance with E5, "Shop Drawings".
- (b) Documentation of all Quality Control testing undertaken for bearings as specified herein.

E48.3 Materials

E48.3.1 Bearings

- (a) Expansion Bearings shall be laminated elastomeric as shown on the Drawings.
- (b) Temporary Elastomeric Bearings Strip shall be plain elastomeric as shown on the Drawings.

E48.3.2 Bearing Top Plates and Retaining Plates

- (a) Plates and all required fittings shall be supplied and installed by the Contractor as shown on the Drawings.
- (b) Steel for plates shall be in accordance with latest edition of CAN/CSA G40.21, Grade 300W.
- (c) All plates shall be hot-dip galvanized in accordance with ASTM A123 and CSA G164 to a minimum net retention of 610 g/m².

E48.3.3 Bearing Miscellaneous

- (a) All miscellaneous plates and fittings shall be supplied and installed by the Contractor as shown on the Drawings.

E48.3.4 Threaded rods and Epoxy

- (a) Threaded rods and Epoxy shall be in accordance with the Drawings and E68 Drilling and Placing Dowels.

E48.3.5 Welding Consumables

- (a) (a) The requirements of E44, "SUPPLY, FABRICATION AND ERECTION OF MISCELLANEOUS METAL" shall apply.

E48.4 Bearing Fabrication and Supply

E48.4.1 Bearings shall be fabricated from new materials. Bearings shall be fabricated in accordance with the latest editions of AASHTO LRFD Bridge Design Manual, AASHTO LRFD Bridge Construction Specifications and AASHTO M251 "Standard Specification for Plain and Laminated Elastomeric Bridge Bearings".

E48.4.2 Internal steel reinforcing plates for laminated bearings shall be rolled mild steel with a minimum yield strength of 300 MPa. All other steel shall be in accordance with the latest edition of CAN/CSA G40.21, Grade 300W.

E48.4.3 PTFE surface shall be unfilled flat sheets made from pure virgin PTFE resin satisfying the requirements of the latest edition of ASTM D4894. PTFE shall be resistant to all acids, alkalis and petroleum products, stable at temperatures from negative two hundred and twenty degrees Celsius (-220°C) to two hundred and sixty degrees Celsius (+260°C), non-flammable and non-absorbing of water.

E48.4.4 Elastomer shall be neoprene or natural rubber, AASHTO low temperature Grade 4 or 5 with a Shore A Hardness of 60 and a shear modulus (G) between 0.90 and 1.38 MPa.

E48.4.5 The overall dimensions of the bearings shall be within a tolerance of +/- 3 mm in plan and height. PTFE fabrication tolerances shall be in accordance with the latest edition of the AASHTO LRFD Bridge Construction Specifications. Other fabrication tolerances for the elastomeric pads shall be in accordance with the latest version of AASHTO M251.

E48.4.6 Bearings shall be clearly marked with their position on site and direction of installation. Markings shall be clearly visible on all bearings to prevent mix-up on site. Information

marked on the bearings must correspond with the information contained on the approved Shop Drawings for the bearings. Bearings shall be supplied with suitable handling devices as required. Temporary clamping devices shall be used to maintain the correct orientation of the parts during handling, transport, storage, and installation but are not to be used for slinging or suspending bearings unless specifically designed for this purpose. Bearings shall be protected during handling, transport, storage, and installation from damage, distortion, and all deleterious material and contaminants including moisture and dust.

- E48.4.7 The bearing Supplier shall verify the condition of the bearings supplied to the work site.
- E48.4.8 The internal steel plates shall be sand-blasted and cleaned of all surface coating rust, mill scale before bonding, shall be free of sharp edges and burrs, and shall have a minimum edge cover of 5 mm of elastomer.
- E48.4.9 Welding procedures shall be such as to minimize distortion of the bearing components and to avoid damage to finished work or bonded materials. All welding shall conform to the requirements of CSA Standard W59-03 (R208).
- E48.4.10 Completed bearings shall have the supplier's name (or trademark) and a serial number indelibly marked thereon. The serial number shall be unique and such as to enable other bearings manufactured at the same time to be traced through the production control records should the need arise. Where practicable the serial number shall also be visible after installation of the bearing in the structure.
- E48.4.11 Stainless steel plates shall conform to the latest edition of ASTM Standard A167, Type 304
- E48.5 Corrosion Protection
- E48.5.1 All exposed surfaces of the steel plates shall be zinc metalized. Surfaces to be metalized shall be blast cleaned in accordance with SSPC-SP5, "White Metal Blast Cleaning".
- E48.5.2 All non-sliding bearing surfaces shall be zinc metalized with a minimum coating of 0.25 mm in accordance with CSA Standard G189-1966 (R2003) "Sprayed Metallic Coatings for Atmospheric Corrosion Protection".
- E48.5.3 All edges of steel (bearing plates, etc.) to be metalized shall be slightly rounded in order that metalizing will adhere.
- E48.6 Construction Methods
- E48.6.1 General
- (a) Any structural steel components that in the opinion of the Contract Administrator have been damaged or otherwise rendered useless by the improper handling by the Contractor shall be replaced by the Contractor at his own expense.
- (b) Bearings stored on site shall be carefully handled, stored, and protected from direct sunlight, moisture, extreme temperatures, heavy loads, and to the satisfaction of the Contract Administrator.
- E48.6.2 Threaded Rod for retaining plate
- (a) Threaded rod shall be supplied and installed as per E52, "DRILLING AND PLACING DOWELS".
- (b) Threaded rod shall be installed as shown on the Drawings.
- (c) Where applicable, the location of the threaded rod in relation to the expansion bearing assembly shall correspond with the temperature at the time of erection, as directed by the Contract Administrator.
- E48.6.3 Bearings
- (a) Before erection of the bearings, the Contractor shall satisfy himself that the location of substructure units and elevations of bridge seats are in accordance with the Drawings and Specifications. All discrepancies discovered by the Contractor shall be brought immediately to the attention of the Contract Administrator.

- (b) The Contractor shall accurately assemble and install the bearings as specified on the Drawings and as directed by the Contract Administrator.
- (c) Bearing centrelines shall be within +/-3 mm of their correct positions after installation. Threaded fixings shall be tightened uniformly to avoid overstressing any part of the bearing. Bearings and their surrounding areas shall be left clean after installation.
- (d) Where applicable, the stainless steel surface of the bearings, the Teflon coated bearing pads and the machined surfaces of steel bearings that have been cast into the slabs shall be protected from damage at all times. The plywood and polyethylene covers shall not be removed until immediately prior to the positioning of the bearings over the bearing seats.
- (e) The bearings shall be set on the properly finished bearing areas in exact position and shall have a full and even bearing on the concrete.
- (f) Where the design requires that the slabs bear on neoprene pads placed directly on abutment seat concrete, the Contractor shall supply and install shims cut from lead sheeting as determined by the Contract Administrator to ensure full and uniform bearing.
- (g) Any bearings that in the opinion of the Contract Administrator have been damaged or otherwise rendered unusable by improper storage or handling by the Contractor shall be replaced by the Contractor at his expense.

E48.6.4 Equipment

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

E48.7 Measurement and Payment

E48.7.1 Bearings

- (a) Supply, Fabrication, Delivery and Installation of Bearings will be measured on a unit basis and paid for at the Contract Unit Price Per Unit for "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.
- (b) Items of Work:
 - (i) Supply and installation of Bearings
 - (ii) Expansion Elastomeric Bearings
 - (iii) Temporary Elastomeric Bearings
- (c) Bearings Repair will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for "Bearing Repair", which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E49. TEMPORARY PROTECTION SYSTEM

E49.1 Description

- E49.1.1 This Specification shall cover all operations related to the design, supply, installation, maintenance and removal of temporary protective systems.
- E49.1.2 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 completion of all Work as hereinafter specified.

E49.2 Scope of Work

E49.2.1 The Work under this Specification shall involve:

- (a) Demolition Catch Platforms and Work Platforms;
- (b) Temporary protective systems shall also intended to permit the contractor to carry out the following works:
 - (i) Hydrodemolition and other demolition work on the Empress overpass deck
 - (ii) Demolition work on the Empress Overpass substructure.

E49.3 Submittals

E49.3.1 General

- (a) The protective systems shall be designed by, prepared by, and bear the seal and signature of a Professional Engineer (Design Engineer) registered in the Province of Manitoba. Detailed drawings, specifications and design notes for the protective systems, bearing the seal and signature of the Design Engineer shall be submitted by the Contractor to the Contract Administrator at least seven (7) calendar days prior to the start of any protection system installation. The submission of the protection system detailed drawings, specifications and design notes to the Contract Administrator shall in no way relieve the Contractor of full responsibility for the design and safe and effective functioning of the protective system.
- (b) The Contractor shall provide the Contract Administrator with proof that the protective systems are installed in accordance with the detailed drawings and specifications. This proof shall be in the form of a letter bearing the seal and signature of protective systems' Design Engineer certifying that the protective system Design Engineer has carried out a personal inspection of the installation, and that the installation is in accordance with the design.

E49.4 Construction Methods

E49.4.1 General

- (a) The Contractor shall be responsible for constructing the temporary protective systems.
- (b) The Contractor shall be fully responsible for ensuring the public safety in areas underlying and adjacent to the construction site. The Contractor will be responsible for any loss or damage caused as a result of the Contractor's actions. Any debris that enters the roadway envelope of a travelled lane shall be immediately cleaned up by the Contractor.
- (c) It can be suspended from the existing superstructure, supported from the existing ground, or otherwise. Any stay-in-place anchorages that are installed shall be stainless steel, and shall be set back a minimum of 12 mm from the exposed surface, and subsequently grouted with a high quality grout. The details of any proposed anchorages or attachments to the existing structure shall be included in the submitted drawings of the temporary protective system, and subject to the approval of the Contract Administrator.

E49.4.2 Demolition Catch Platforms and Work Platforms

- (a) The Contractor shall provide all necessary access/work platforms to facilitate structural removals and associated inspection of all Works by the Contract Administrator.
- (b) The platforms shall be designed by the Contractor's Engineer to support the anticipated construction live load as well as any anticipated dead load resulting from fallen removal/demolition debris.
- (c) The platforms shall be designed to be of a type that does not detrimentally affect the structural integrity of the existing bridge structure. Drilling into the slabs to secure any platforms shall not be permitted.

- (d) The Contractor shall construct temporary protective systems to prevent debris, tools, forms, waste products, construction materials and equipment, and any material whatsoever from falling into river or otherwise entering the adjacent travelled lanes. The Contractor shall take all necessary safety precautions to ensure that no materials leave the construction work areas and subsequently enter the roadway envelope or river during the Contractor's construction operations. The roadway envelope of any travelled lane is defined as follows. Horizontally, it is the space occupied from hypothetical lane edge to lane edge.
- (e) For work above Portage Avenue (i.e. along the edges of the bridge structure), a catch platform system shall be provided. For work beside traffic, a protective wall system shall be provided. Together, these items shall be referred to as the temporary protective systems. The Contractor shall be responsible for the design, supply, installation, maintenance and removal of the temporary protective systems.
- (f) The systems shall include but not necessarily be limited to deck edge platforms along both exterior edges of the bridge and other catch platforms beneath the bridge superstructure as required for construction purposes and to collect and contain products of demolition, hydrodemolition and all other debris, and prevent them from falling onto underlying surfaces.
- (g) The protective systems shall be designed and constructed as required to catch and retain all products of demolition, including those produced by hydrodemolition. Collection and containment information and details associated with the demolition catch platform as related to control and containment of products of hydrodemolition including runoff from hydrodemolition shall form part and parcel of the hydrodemolition runoff control plan detailed in the Specification for Structural Removals.
- (h) The Contractor is advised that construction work including but not limited to; dismantling, general demolition and removals, hydro demolition, reinforcing bar installation, concrete forming, concrete pouring, and related construction works will be occurring in close proximity to the travelling public and over Seine River

E49.5 Measurement and Payment

E49.5.1 Temporary Protection System

- (a) Design, supply, installation, maintenance and removal of temporary protective systems will not be measured. This Item of Work shall be paid for at the Contract Lump Sum Price for "Temporary Protective Systems" which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator

E50. TYPE 1 ANODE - DISTRIBUTED GALVANIC CORROSION CONTROL

E50.1 Description

- (a) The Work under this section consists of designing, supplying, installing and energizing a zinc-based galvanic corrosion control system consisting primarily of embedded zinc anodes, including required electrical connections, materials, testing and ensuring continuity of the reinforcing steel to all elements as outlined in the Drawings, at the Centre Pier Columns and Deck Overlay.
- (b) The Works also include designing, supplying and installation of one (1) monitoring system to check the activeness of the protection system in terms of polarization potential and current density.
- (c) 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.

E50.2 References

- (a) ACI 222R (2001) Protection of Metals in Concrete Against Corrosion;
- (b) ASTM B6 Standard Specification for Zinc;
- (c) ASTM B69 (2001) Standard Specification for Rolled Zinc;
- (d) ASTM B418 Standard Specification for Cast and Wrought Galvanic Zinc Anodes;
- (e) SSPC-10 (1994) Near-White Blast Cleaning.

E50.3 Submittals

- (a) Shop drawings showing typical galvanic corrosion control system installation details, such as distributed anode installation locations, type and location of anode standoff spacers, reinforcing connections shall be prepared by the Contractor and submitted for approval prior to any field installations. The shop drawings shall clearly illustrate the layout of the anodes as applies to the abutments on this project, in both elevation and section views.

E50.4 Materials

E50.4.1 Zinc Anode

- (a) Distributed galvanic units shall be alkali-activated zinc with nominal exterior dimensions of 32 mm. The distributed anode unit shall consist of 0.89 kg of zinc per linear meter of anode. The zinc anode shall be manufactured in compliance with ASTM B418 Type II (Z13000) and ASTM B69 Rolled Special High Grade Zinc (Z13004) using zinc in compliance with ASTM B6 Special High Grade (Z13001) with iron content less than 15 ppm. The dimensions and zinc content of the anode shall be as recommended by the Contractor's enlisted NACE specialist and as approved by the Contract Administrator.
- (b) The zinc shall be alkali-activated with a pH greater than 14. The anode unit shall contain no constituents that are corrosive to reinforcing steel as per ACI 222R such as chlorides, bromides, or other halides. The anode unit shall be supplied with a minimum of two (2) lead wires of sufficient length to make connections between anodes and the reinforcing steel.
- (c) The galvanic protection shall be Galvanode DAS distributed anode system supply by Vector Corrosion Technologies, or approved equal.
- (d) Application for approved equals shall be requested in writing two (2) weeks before submission of project bids. Application for galvanic anode equals shall include verification of the following information:
 - (i) The zinc anode is alkali-activated with a pH of 14 or greater;
 - (ii) The anode unit does not contain any corrosive constituents detrimental to reinforcing steel, e.g. chloride, bromide, etc;
 - (iii) Proven track record of the anode technology showing satisfactory field performance with a minimum of three projects of similar size and application;
 - (iv) Independent third party evaluation of the anode technology, e.g. Hitec, Concrete Innovations Appraisal Service, BRE, etc.

E50.5 Construction Methods

E50.5.1 General

- (a) The galvanic corrosion protection shall consist of the anodes as indicated on the Drawings. The anode units are connected to the reinforcing steel and encased in a concrete with a minimum of 50.8 mm of clear concrete cover over the anode units. For deck area the concrete clear cover under the membrane and asphalt topping can be 25.4 mm.

E50.5.2 Manufacturer Technical Assistance

- (a) The Contractor shall enlist and pay for a NACE-qualified Cathodic Protection Specialist employed by the corrosion mitigation technology company to provide the design of distributed anode to be used as well as a monitoring system.

- (b) The Contractor will enlist and pay for the services of a NACE-qualified corrosion technician supplied by the galvanic anode manufacturer to provide training and on-site technical assistance during the installation of the galvanic protection system. The qualified corrosion technician shall have verifiable experience in the installation and testing of embedded galvanic control systems for reinforced concrete structures.
- (c) The Contractor shall coordinate its work with the designated corrosion technician to allow for site support during project start-up and initial anode installation. The technician shall provide Contractor training and support for development of application procedures, shop drawings for submittals, anode and concrete installation, reinforcing steel connection procedures, and verification of electrical continuity of embedded steel.

E50.5.3 Surface Preparation

- (a) The deck and Centre Pier Columns removals shall be performed in accordance with the lines and grades shown on the Drawings.
- (b) Longitudinal and transverse concrete groove removal shall be performed for electrical connectivity of the top layer reinforcement to as shown on the Drawings
- (c) After the removals, any additional spalled and delaminated concrete should be removed until solid concrete is encountered.
- (d) Exposed reinforcing steel and concrete should be cleaned by abrasive blasting or other means to remove all corrosion by-products and other materials that may inhibit bonding of the concrete encasement.

E50.5.4 Reinforcing Steel Connections

- (a) The Contractor shall directly connect each anode unit to exposed reinforcing steel receiving corrosion protection. Whenever possible, electrical connections should be located where reinforcing steel is exposed. Electrical connections to the Reinforcing Steel shall be established using suitable mechanical, welded stud or brazing techniques. Proposed electrical connection details shall be approved by the anode manufacturer and shall be detailed on the shop drawing submittal.
- (b) All reinforcing steel connections shall receive a coat of 100% solids, non-conductive epoxy such that no wire connections or brazing material will be in contact with the concrete pouring is complete. The Contractor shall verify continuity between the connections and the reinforcing steel prior to coating with epoxy.

E50.5.5 Electrical Continuity

- (a) Reinforcing steel shall be tested for electrical continuity. Maximum DC resistance shall be 1 ohm or maximum DC voltage shall be 1 mV. Steel found to be discontinuous shall have continuity re-established by tying to other bars with steel tie wire or other approved means.

E50.5.6 Installation of Anodes

- (a) (a) Distributed galvanic anode units shall be installed as shown on the Drawings. The anodes shall be installed as per manufacturer's instructions.

E50.6 Measurement and Payment

E50.6.1 Distributed Galvanic Anode System

- (a) The design supply, installation and energizing of the distributed galvanic anode system as shown on the Drawings will not be measured. This work shall be paid for at the Contract Lump Sum Price for the "Items of Work" listed here below" which price shall be payment in full, for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.
- (b) Items of Work:
Distributed Galvanic Anode System:

- (i) Center Pier Columns
- (ii) Deck Overlay

E51. TYPE 2 ANODE - DISCRETE GALVANIC PROTECTION SYSTEM

E51.1 Description

- (a) The Work under this section consists of designing, supplying, installing and energizing a zinc-based galvanic corrosion control system consisting primarily of embedded zinc anodes, including required electrical connections, materials, testing and ensuring continuity of the reinforcing steel to all elements as outlined in 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.

E51.1.1 References

- (a) ACI/ICRI 1999 Concrete Repair Manual
- (b) ACI Guideline No. 222 – Corrosion of Metals in Concrete
- (c) ACI 562-13 Code Requirements for Evaluation, Repair and Rehabilitation of Concrete Buildings
- (d) ACI Repair Application Procedure (RAP) Bulletin 8 – Installation of Embedded Galvanic Anodes (2010)
- (e) ICRI Guideline 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete resulting from Reinforcing Steel Corrosion
- (f) ASTM B418-12 – Standard Specification for Cast and Wrought Galvanic Zinc Anodes

E51.2 Submittals

- (a) Shop drawings showing typical galvanic corrosion control system installation details, such as distributed anode installation locations, type and location of anode standoff spacers, reinforcing connections shall be prepared by the Contractor and submitted for approval prior to any field installations. The shop drawings shall clearly illustrate the layout of the anodes as applies to the abutments on this project, in both elevation and section views.

E51.3 Materials

E51.3.1 Embedded Galvanic Anodes

- (a) Discrete galvanic units shall be alkali-activated zinc meant to be embedded into concrete repairs and for corrosion prevention only. Nominal dimensions shall be 125 mm x 25 mm x 25 mm or as approved. The anodes shall be pre-manufactured with a nominal 60 grams of zinc in compliance with ASTM B418 Type II cast around a pair of uncoated, non-galvanized steel tie wires and encased in a highly alkaline cementitious shell with a pH of 14 or greater.
- (b) The galvanic anodes shall be alkali-activated and shall contain no intentionally added chloride, bromide or other constituents that are corrosive to reinforcing steel as per ACT 562-13. Anode units shall be supplied with integral unspliced wires for directly tying to the reinforcing steel. Embedded galvanic anodes shall be Galvashield® XPT available from Vector Corrosion Technologies (www.vector-corrosion.com) USA (813) 830-7566, Canada (204) 489-9611 or approved equal.
- (c) Application for approved equals shall be requested in writing two weeks before submission of project bids. Application for galvanic anode approved equals shall include verification of the following information:

- (i) The zinc anode is alkali-activated with an alkaline cementitious shell with a pH of 14 or greater.
- (ii) The galvanic anode shall contain no intentionally added constituents corrosive to reinforcing steel, e.g. chloride, bromide, etc.
- (iii) The anode manufacturer shall provide documented test results from field installations showing that the anodes have achieved a minimum of 10 years in service.
- (iv) The galvanic anode shall have been used in a minimum of ten projects of similar size and application.
- (v) The galvanic anode units shall be supplied with solid zinc core (ASTM B418) cast around uncoated, non-galvanized, non-spliced steel tie wires for wrapping around the reinforcing steel and twisting to provide a durable steel to steel connection between the tie wire and the reinforcing steel.
- (vi) The anode manufacturer shall provide third party product evaluation, such as from Concrete Innovations Appraisal Service, BBA, etc.

E51.3.2 Repair Materials

- (a) Repair mortars, concrete, and bonding agents shall be portland cement-based materials with suitable electrical resistivity less than 15,000 ohm-cm. Non-conductive repair materials such as epoxy, urethane, or magnesium phosphate shall not be permitted. Repair materials with significant polymer modification and/or silica fume content may have high resistivity. Insulating materials such as epoxy bonding agents shall not be used unless otherwise called for in the design.

E51.3.3 Storage

- (a) Deliver, store, and handle all materials in accordance with manufacturer's instructions. Anode units shall be stored in dry conditions in the original unopened containers in a manner to avoid exposure to extremes of temperature and humidity.

E51.4 Construction Methods

E51.4.1 General

- (a) The galvanic corrosion protection shall consist of the anodes as indicated on the Drawings. The anode units are connected to the reinforcing steel and encased in a concrete with a minimum of 50 mm of clear concrete cover over the anode units. For deck area the concrete clear cover under the membrane and asphalt topping can be 25 mm.

E51.4.2 Manufacturer Corrosion Technician

- (a) The Contractor will enlist and pay for a technical representative employed by the galvanic anode manufacturer to provide training and on-site technical assistance during the initial installation of the galvanic anodes. The technical representative shall be a NACE-qualified corrosion technician (Cathodic Protection Technician-CP2 or higher).
- (b) The qualified corrosion technician shall have verifiable experience in the installation and testing of embedded galvanic protection systems for reinforced concrete structures.
- (c) The contractor shall coordinate its work with the designated corrosion technician to allow for site support during project startup and initial anode installation. The corrosion technician shall provide contractor training and support for development of application procedures, verification of electrical continuity, and project documentation.

E51.4.3 Concrete Removal

- (a) Remove loose or delaminated concrete.

- (b) Undercut all exposed reinforcing steel by removing concrete from the full circumference of the steel as per ICRI R310.1R to the limits indicated on the Drawings or as per the Contract Administrator.
- (c) Concrete removal shall continue along the reinforcing steel until no further delamination, cracking, or significant rebar corrosion exists and the reinforcing steel is well bonded to the surrounding concrete as per ICRI R310.1R.

E51.4.4 Cleaning and Repair of Reinforcing Steel

- (a) Clean exposed reinforcing steel of rust, mortar, epoxy coating, etc. to provide sufficient electrical connection and mechanical bond.
- (b) If significant reduction in the cross section of the reinforcing steel has occurred, replace or install supplemental reinforcement as directed by the Contract Administrator.
- (c) Secure loose reinforcing steel by tying tightly to other bars with steel tie wire.
- (d) Verify electrical continuity of all reinforcing steel, including supplemental steel, as per Section E51.4.6(f).

E51.4.5 Edge and Surface Conditioning of Concrete

- (a) Concrete patches shall be square or rectangular in shape with squared corners per ICRI Guideline 310.1R-2008.
- (b) Saw cut the patch boundary as per the Drawings or as directed by the Contract Administrator.
- (c) Create a clean, sound substrate by removing bond-inhibiting materials from the concrete substrate by high pressure water blasting or abrasive blasting.

E51.4.6 Galvanic Anode Installation

- (a) Install anode units and repair material immediately following preparation and cleaning of the steel reinforcement.
- (b) Anode spacing shall be such to provide full protection for the entire patch perimeter. Anode spacing is dependent on the reinforcing steel density. Maximum anode spacing shall be as per the manufacturer's guidelines to provide a 20 year service life.
- (c) Place the galvanic anodes as close as possible to the patch edge while still providing sufficient clearance between anodes and substrate to allow the repair material to fully encase the anode with a minimum concrete or mortar cover over the anode of 25mm. If necessary, increase the size of the repair cavity to accommodate the anodes.
 - (i) Place the anode such that the preformed BarFit™ groove fits along a single bar or at the intersection between two bars and secure to each clean bar.
 - (ii) If less than 25 mm of concrete cover is expected, place anode beneath the bar and secure to clean reinforcing steel.
- (d) The tie wires shall be wrapped around the cleaned reinforcing steel at least one full turn in opposite directions and then twisted tight to create a secure electrical connection and allow no anode movement during concrete placement.
- (e) Repair materials with resistivity greater than 15,000 ohm-cm are not to be used.
- (f) Electrical Continuity
 - (i) Confirm electrical connection between anode tie wire and reinforcing steel by measuring DC resistance (ohm Ω) or DC potential (mV) with a multi-meter.
 - (ii) Electrical connection is acceptable if the DC resistance measured with the multi-meter is 1 Ω or less or the DC potential is 1 mV or less.
 - (iii) Confirm electrical continuity of the exposed reinforcing steel within the repair area. If necessary, electrical continuity shall be established by tying discontinuous steel to continuous steel using steel tie wire.
 - (iv) Electrical continuity between test areas is acceptable if the DC resistance measured with multi-meter is 1 Ω or less or the potential is 1 mV or less.

E51.4.7 Concrete or Mortar Replacement

- (a) If the repair procedures require the concrete surface to be saturated with water, do not damage the anode nor allow the anode units to be soaked for greater than 20 minutes.
- (b) Complete the repair with the repair material, taking care not to damage, loosen or leave voids around the anode

E51.5 Measurement and Payment

E51.5.1 Discrete Galvanic Anode System

- (a) The supply and installation of Discrete Galvanic Protection System as shown on the Drawings will be measured on a Unit Basis. This work shall be paid for at the Contract Unit Price Per Unit for "Discrete Galvanic Anode System" which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator

E52. DRILLING AND PLACING DOWELS

E52.1 Description

- (a) This Specification shall cover all operations related to drilling and preparation of dowel holes, supply and placing epoxy grout and installation of the applicable anchorages.
- (b) Dowels shall include the following post-installed anchorages and reinforcing bars:
 - (i) Dowels for pier column jacketting
 - (ii) Dowels for anchoring bridge barriers and curb

E52.2 Materials

- (a) Epoxy grout shall be Hilti HIT-RE 500-V3 or equivalent as approved by the Contract Administrator. The epoxy grout shall be suitable for horizontal, vertical or overhead dowel grouting application as required.

E52.3 Construction Methods

- (a) In bridge deck and pier columns, the Contractor shall core or drill holes and place dowels at the locations and in accordance with the details as shown on the Drawings. Holes for dowels shall be drilled or cored.
- (b) The Contractor shall predetermine the locations of existing steel bars prior to drilling or coring, using an effective reinforcing steel bar locator. Dowel hole locations as shown on the Drawings, shall be relocated as required to avoid conflicts with existing reinforcing steel bars as approved by the Contract Administrator.
- (c) Dowel hole diameters shall be in accordance with the recommendations of the epoxy adhesive grout manufacturer.
- (d) All holes shall be thoroughly cleaned prior to the installation of grout and dowels.
- (e) The epoxy adhesive grout shall be prepared, placed and cured in accordance with the recommendations of the epoxy adhesive grout manufacturer.

E52.4 Measurement and Payment

E52.4.1 Drilling and Placing Dowels

- (a) Drilling and placing dowels will not be measured. This Item of Work shall be paid for at the Contract Lump Sum Price for "Drilling and Placing Dowels", which price shall be payment in full for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

- (b) The supply of reinforcing steel for the dowels will be measured and paid for in accordance with E42.

E53. SELF CONSOLIDATING CONCRETE REPAIRS

E53.1 Description

- (a) The Work covered under this item shall include all operations relating to the Empress Overpass pier cap repairs as shown on the Drawings and in the locations as directed by the Contract Administrator.
- (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 Work as hereinafter specified.

E53.2 Materials

E53.2.1 General

- (a) Unless otherwise listed herein, materials shall be in accordance with E40, "**Structural Concrete**".

E53.2.2 Concrete

- (a) The Contractor shall be responsible for the design and performance of all concrete mixes supplied under this specification. Either ready mix concrete or proprietary repair mortars, where applicable, may be used having the following minimum properties in accordance with CSA A23.1:
 - (i) Class of Exposure : C-1;
 - (ii) Compressive Strength @ 28 days = 35 MPa;
 - (iii) Maximum Aggregate Size = 10mm;
 - (iv) Air Content: Category 1 per Table 4 of latest CSA A23.1; and,
 - (v) Slump Flow = 550-600mm
- (b) The concrete mix shall meet the latest edition CSA A23.1 Cl. 8.9.2 Low Shrinkage requirements.
- (c) The concrete mix shall have an electrical conductivity less than 15,000 ohm-cm.
- (d) Mix design for ready mix concrete shall be submitted to Contract Administrator at least two (2) weeks prior to concrete placing operations.
- (e) The workability of the concrete mix shall be consistent with the Contractor's placement operations.
- (f) Any proposed proprietary repair mortar shall be subject to the approval of the Contract Administrator and must meet or exceed the properties of the ready mix concrete.
- (g) The temperature of all types of concrete shall be between fifteen degrees Celsius (15°C) and twenty-five (25°C) at discharge. Temperature requirements for concrete containing silica fume shall be between ten degrees Celsius (10°C) and eighteen degrees Celsius (18°C) at discharge unless otherwise approved by the Contract Administrator.
- (h) Concrete materials susceptible to frost damage shall be protected from freezing.
- (i) Concrete repair material shall be compatible with the concrete substrate and the Contractor's method of placement. The Contractor may choose to use a proprietary repair mortar subject to the approval of the Contract Administrator.

E53.3 Equipment

E53.3.1 General

- (a) Equipment shall be in accordance with E40, "**Structural Concrete**".

E53.4 Construction Methods

E53.4.1 General

- (a) The Contractor may consider form and pour, pressure grouting or low velocity spraying as application methods for concrete repairs. Other methods shall be subject to the approval of the Contract Administrator.

E53.4.2 Removal of Existing Concrete and Concrete Surface Preparation

- (a) All areas requiring repair shall have their perimeters sawcut to a depth of 25 mm. The only exception to sawcutting will be in areas where there is no room for a concrete saw.
- (b) Remove all concrete in the repair area to a minimum depth
 - (i) 25 mm beyond the exposed rebar;
 - (ii) 6 mm larger than the largest size aggregate in the repair material beyond the exposed rebar;
 - (iii) to the depth of delamination;
 - (iv) whichever is greater.
- (c) In locations where anodes or post-installed rebar will be present, remove concrete to provide a minimum of 50 mm cover.
- (d) Concrete removal may be undertaken by mechanical means with chipping hammers of appropriate size so as not to damage the substrate concrete as accepted by the Contract Administrator. Alternatively, hydrodemolition may be used.
- (e) Clean all resulting concrete and steel surfaces by grit-blasting. All unsound and stained concrete shall be fully removed. Exposed rebar shall be cleaned to a near-white condition.
- (f) If recommended by the mortar/grout manufacturer's directions, pre-wet the patch surfaces for the duration recommended.

E53.4.3 Form Work and Shoring

- (a) Formwork and shoring shall be in accordance with E40 Structural Concrete.

E53.4.4 Formliner

- (a) Formliner shall be used on all exposed formed surfaces.

E53.4.5 Bonding New Concrete to Existing Concrete

- (a) The Contractor is responsible to create a bond between the new mortar/concrete and the existing substrates. This may be done by either the application of a suitable bonding agent or grout or by using a self-bonding mortar or concrete. The Contract Administrator will check all repaired areas for bond using a hammer "sounding" method after form removal. Place mortar or concrete by trowelling, pumping, spraying, or into forms ensuring that all entrapped air is removed.
- (b) Should a bonding grout be used, it shall be applied immediately before concrete placement. It shall be thoroughly brushed onto the existing hardened concrete surface in a thin and even coating that will not puddle.

E53.4.6 Mixing and Placing Concrete

- (a) Mixing and placing concrete shall be in accordance with E40, "**Structural Concrete**". Where proprietary repair mortars are used, they shall be prepared in accordance with the manufacturer's instructions.

E53.4.7 General Curing

- (a) Concrete Curing shall be in accordance with E40, "**Structural Concrete**". Where proprietary repair mortars are used, they shall be cured in accordance with the manufacturer's instructions.

- (b) Refer to Clauses E40, "**Structural Concrete**" for cold weather and hot weather curing requirements, respectively.

E53.4.8 Form Removal

- (a) Form Removal shall be in accordance with E40, "**Structural Concrete**".

E53.4.9 Patching of Formed Surfaces

- (a) Patching of Formed Surfaces shall be in accordance with E40, "**Structural Concrete**".

E53.4.10 Cold Weather Concreting

- (a) Cold Weather Concreting shall be in accordance with E40, "**Structural Concrete**".

E53.4.11 Hot Weather Concreting

- (a) Hot Weather Concreting shall be in accordance with E40, "**Structural Concrete**".

E53.5 Measurement and Payment

E53.5.1 Pier Surface Repairs

E53.5.2 Pier Surface Repairs will be measured on a area basis and paid for at the Contract Unit Price per square meter for "Pier Surface Repairs" which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E54. ALUMINUM PEDESTRIAN HANDRAIL/BICYCLE RAIL

E54.1 Description

E54.1.1 Aluminum Pedestrian Handrail/Bicycle Rail

- (a) This Specification shall cover all operations relating to the supply and installation of the aluminum pedestrian handrail/bicycle rail as specified herein 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 other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E54.2 Referenced Specifications and Drawings

E54.2.1 The latest edition and subsequent revisions of the following:

- (a) ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate;
- (b) ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes;
- (c) ASTM B276 – Standard Specification for Stainless Steel Bars and Shapes;
- (d) ASTM D1187 – Standard Specification for Asphalt-Base Emulsions for use as Protective Coatings and Metal;
- (e) CAN/CSA W47.2 – Certification of Companies for Fusion Welding of Aluminum;
- (f) CAN/CSA W59.2 – Welded Aluminum Construction;
- (g) CAN/CSA S157 – Strength Design in Aluminum.

E54.3 Scope of Work

E54.3.1 The Work under this Specification shall involve:

- (a) Supplying and installing aluminum pedestrian handrail / bicycle rail for Empress Overpass and Pedestrian Accessibility Ramps;

- (b) Alteration to existing Empress overpass West handrail at North Pedestrian Accessibility Ramp junction;
- (c) Supplying and installing all miscellaneous items and other items associated with the Work.

E54.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the proposed Shop Drawings showing all fabrication details of the aluminum pedestrian handrail/bicycle rail. Fabrication shall take place as shown on the Drawings.
- (c) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the scheduled commencement of any fabrication, the operator's qualifications detailed in B6 and mill certificates.
- (d) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the proposed welding procedures and welding consumable certificates. The Contractor shall submit copies of the welding procedures which he intends to use, for examination and acceptance by the Contract Administrator.
 - (i) The Contractor shall submit copies of the welding procedures which he intends to use, for examination and acceptance by the Contract Administrator.
 - (ii) Such procedures shall be accompanied by documentary proof that they have been qualified previously by the Canadian Welding Bureau at the plant where the Work is to be carried out.
 - (iii) The procedures shall include the following information: joint type, welding process, welding position, base metal specification, welding consumable specification and size, preheat requirements, amperage and voltage requirements, speed, polarity, and welding equipment, including a description of travel for automatic welding.

E54.5 Materials

E54.5.1 General

- (a) All materials supplied under this Specification shall be of a type acceptable to the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall 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.

E54.5.2 Material for the Aluminum Pedestrian Handrail/Bicycle Rail

- (a) Extruded Shapes or Drawn Tubing for Rails and Posts: shall conform to the latest edition and all subsequent revisions of CAN/CSA Aluminum Alloy and Temper HA.5 SG 11 R-T6 (ASTM B221 Alloy 6351-T6), or HA.7 GA 11 M-T6 (ASTM B221 Alloy 6061-T6).
- (b) Aluminum sheet, bar, support pin, angle, and plate shall conform to the latest edition and all subsequent revisions of ASTM B221- Alloy 5083, ASTM B209 Alloy 6061-T6 or Alloy 6351-T6.
- (c) Bolts and cap screws, nylon lock nuts, and washers - stainless steel conforming to ASTM A276, Type 316.

E54.5.3 Bituminous Paint

- (a) Bituminous paint shall be an alkali-resistant coating and conform to the requirements of ASTM D1187. Supply of bituminous paint shall be considered incidental to the supply of aluminum pedestrian handrail.

E54.5.4 Anchorage System

- (a) The rail anchorage system is specified and paid for in accordance with E44, "STRUCTURAL CONCRETE".

E54.5.5 Aluminum Shims

- (a) Aluminum shims shall conform to ASTM Standard B221, Alloy 6061-T6, and shall be supplied as required to facilitate the installation of the rail posts as shown on the Drawings. Supply of shims will be considered incidental to the supply of aluminum pedestrian handrail.

E54.5.6 Aluminum Filler Alloys for Welded Construction

- (a) Aluminum filler alloys for welded construction shall be one (1) of the following: ER4043, ER5183, ER5356, ER5554, ER5556, or ER5654.

E54.5.7 Hinges

- (a) Hinges shall be stainless steel and manufactured by Angama, Type STBB 460, or equal as approved by the Contract Administrator in accordance with B6.

E54.6 Equipment

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be in good working order.

E54.7 Construction Methods

E54.7.1 Layout

- (a) Before fabrication and/or installation of the aluminum pedestrian handrail, the Contractor shall satisfy himself of all required aluminum rail and enclosure section dimensions, by field measurements.

E54.7.2 Fabrication

- (a) General
 - (i) No fabrication shall commence until permission to do so has been received from the Contract Administrator.
 - (ii) All fabrication shall be carried out in accordance with this Specification and the Drawings.
 - (iii) The Fabricator shall fabricate the entire aluminum pedestrian handrail/bicycle rail in sections, to permit the installation of the rail sections onto the concrete.
 - (iv) The punching of identification marks on the members will not be allowed.
 - (v) Any damage to members during fabrication shall be drawn to the attention of the Contract Administrator in order that the Contract Administrator may accept remedial measures.
 - (vi) Dimensions and fabrication details which control the field matching of parts shall receive very careful attention in order to avoid field adjustment.
 - (vii) Components of the railings and enclosures shall be joined by means of bolt, cap screws, and welds as called for on the Drawings.
- (b) Sample Panel
 - (i) The Contractor shall be required to supply the Contract Administrator with one (1) completely fabricated handrail/bicycle rail sample panel, including at least two (2) posts, prior to proceeding with the fabrication of the remainder. The sample, once accepted, shall be identifiable for the duration of the Project, but may be incorporated into the rail system. It shall become the standard for acceptance of all aluminum pedestrian handrail/bicycle rail panels.

(c) Cutting

- (i) Material 13 mm thick or less may be sheared, sawn, or cut with a router. Materials more than 13 mm thick shall be sawn or routed. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided whenever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

(d) Welding

- (i) Welded construction shall conform to the requirements of the latest edition and all subsequent revisions of CAN/CSA W59.2, Welded Aluminum Construction and W47.2, Certification of Companies for Fusion Welding of Aluminum.
- (ii) Welding will be done by qualified welders using the Metal Inert Gas (MIG) process. All areas to be welded should be thoroughly cleaned with a suitable solvent followed by wire brushing if surfaces are heavily oxidized. The size of fillet for equal leg fillet welds is defined as the leg length of the largest isosceles right angle triangle which can be inscribed within the fillet weld section. Welds must penetrate into the root corner. All butt welds should have full penetration to ensure maximum strength. Defective welds should be repaired by chipping out the defective area and rewelding. Particular care must be paid to the elimination of craters and cold starts.
- (iii) Welders and procedure should be qualified as agreed between the Contract Administrator and the Fabricator. The minimum requirements for mechanical test results of joints butt welded with Alcan 56S filler alloy shall be 259 MPa for Alcan D45S-H1 1A and 165 MPa for Alcan B51S-T4 alloy. In addition to the mechanical tests, soundness tests should be made as follows:

Guided Bend Test: All bend tests should be fully guided through an angle of 180°. Root, face, and side bend tests in Alcan D54S parent alloy welded in Alcan 56S filler wire require a bend radius of 2T where T is the thickness of the material. For Alcan B51S parent alloy welded with 56S filler wire, a bend radius of 4T is required. Root bend and face bend specimens on material 10 mm thick and less should be 305 mm long and a minimum of 25 mm in width and cut from a plate having a minimum butt weld length of 450 mm. No test piece should be taken within 25 mm of the ends of the weld. Side bend tests should be carried out on material over 10 mm in thickness.

Specimens should be 10 mm in width. Longitudinal edges should be given in 2 mm radius. There should be no crack greater than 3 mm in length. If a crack starts from an edge, the specimen should be disregarded.

Fracture Test: The butt-welded joint shall have a notch not exceeding 2 mm in depth sawn on the four (4) sides of the weld bend and the weld broken. Inspection of the fracture should reveal no gas pockets or inclusions greater than 2 mm in diameter and the area lost due to scattered gas, porosity or voids should not exceed three percent (3%) of the area under inspection.

(e) Bolting

- (i) Bolt holes in 10 mm or thinner material may be drilled or punched to finished size. In material thicker than 10 mm, the holes shall be drilled to finished size or subpunched smaller than the normal diameter of the fastener and reamed to size.
- (ii) The finished diameter of the holes shall be not more than seven percent (7%) greater than the nominal diameter of the fastener, except:
 - Slotted holes for expansion purposes shall be provided as required on the Drawings.

Holes for anchor bolts may be up to 50 percent greater than the nominal bolt diameter with a maximum of 13 mm greater than the nominal bolt diameter.

Holes shall not be drilled in such a manner as to distort the metal, but holes only slightly misaligned may be reamed to render a reasonable fit.

In all bolts, the finished shank shall be long enough to provide full bearing, and washers shall be used under the nuts to give full grip when the nuts are tightened.

E54.7.3 Installation of Aluminum Pedestrian Handrail/Bicycle Rail

- (a) The aluminum pedestrian handrail/bicycle shall be brought on-site and accurately installed as shown on the Drawings.
- (b) The rails shall be set true to the line and grade as shown on the Drawings or as required by the Contract Administrator.
- (c) The material 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. The Contractor shall report to the Contract Administrator any corrective measures.
- (d) Except where shown on the Drawings, field welding shall not be permitted unless acceptable to the Contract Administrator. The rail posts shall be set on aluminum shims, as required, to achieve the correct elevation and grade. Additional aluminum shims shall be installed as required to achieve the correct elevation and grade. The surface of the bottom shim that is in contact with concrete shall be separated with a minimum of two (2) coats of bituminous paint. A minimum 3 mm aluminum shim shall be installed under each post.

E54.8 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 inspecting or acceptance 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance 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.

E54.8.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E54.8.3 Testing

- (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.

E54.9 Measurement and Payment

E54.9.1 Aluminum Pedestrian Handrail/Bicycle Rail

- (a) Supplying and Installing the aluminum pedestrian handrail/bicycle rail shall be measured on a length basis and paid for at the Contract Unit Price per metre for "Supply and Install Aluminum Pedestrian Handrail/Bicycle Rail", which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification, accepted and measured by the Contract Administrator.

E55. ASPHALTIC CONCRETE PAVING ON BRIDGE

E55.1 Description

- (a) This Specification shall cover all operations relating to the supply of labour, equipment, tools and material necessary for the application of tack coat and the placing and compaction of the asphaltic hot mix overlay on the bridge deck. The thickness of the overlay shall be as specified 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, handling and storage, and all things necessary for and incidental to the satisfactory performance and completion of all Work as herein specified and as indicated on the Drawings.

E55.2 Scope of Work:

- (i) Surface preparation of the roadway and cycle track on bridge deck;
- (ii) Supplying and applying the tack coat;
- (iii) Supplying, hauling, placing and compacting of asphaltic hot mix (overlay) on the bridge deck.
- (iv) Installation of Tactile separation on the cycling path.
- (v) The quality control (QC) testing of all materials.

E55.3 References

- (a) All related Specifications and reference Standards are in accordance with the most current issue or latest revision:
 - (i) City of Winnipeg's Specification CW 3410 (latest edition) - Asphaltic Concrete Pavement Works;
 - (ii) Hot-Poured Rubberized Asphalt Waterproofing with Protection Board.

E55.4 Submittals

- (a) In addition to Specification CW 3410 - Asphaltic Concrete Pavement Works, the Contract shall submit the following to the Contract Administrator fourteen (14) days prior to the Work, the proposed mix design and test results for verification and approval.

E55.5 Materials

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

E55.5.1 Tack Coat and Bituminous Pavement

- (a) The tack coat and bituminous pavement for the class specified on the Drawings shall conform to the requirements of the Specification CW 3410-R12 - Asphaltic Concrete Pavement Works;
- (b) Asphalt shall be Type 1A.

E55.5.2 Caulking Compound and Miscellaneous Joint Materials

- (a) Caulking compound and miscellaneous joint materials shall be as shown on the Drawings or approved by the Contract Administrator.

E55.6 Construction Methods

E55.6.1 Surface Preparation

- (a) Surfaces to receive asphalt concrete paving shall be thoroughly cleaned by means of a power broom and compressed air. All surfaces to which the tack coat is to be applied shall be dry and free from scale, dirt, grime, grease, oil or other contaminants.

E55.6.2 Application of Tack Coat

- (a) Tack coat shall be applied to the entire surface of the deck and approach slabs. The quantity used shall not exceed 550 mL/m². Curbs and all other like appurtenances having a vertical face shall receive a brushed-on application of tack coat to the height of the compacted asphalt mat. All puddles or other excess of the tack coat shall be thoroughly spread out by brushing the material over the surrounding surface.
- (b) The vertical surfaces of the curbs and all other like appurtenances and the bridge deck areas within one (1) foot of such abutting surfaces, shall receive a further coating of paving grade (150/200 penetration) asphalt cement.
- (c) The treated surface shall be allowed to cure until it becomes tacky before applying the asphalt mix.

E55.6.3 Distribution

- (a) The distributor used in applying the liquid bituminous tack coat shall be of a type, size and equipped as to meet the following requirements:
 - (i) It shall be capable of applying bituminous tack coat on the deck and approach slabs in accurately measured quantities.
 - (ii) It shall be equipped with:
 - A heating unit capable of maintaining the asphalt in the tank at the specified temperature;
 - A thermometer so placed as to accurately measure the temperature of the material in the tank;
 - A tachometer operated by an independent wheel, or a similar suitable device, that will allow the operator to determine the correct travel speed for applying the specified quantity of asphaltic material;
 - A pressure gauge to indicate to the operator that the required nozzle pressure is being maintained;
 - Spray nozzles, with quick acting positive shutoff, of a design which will ensure a uniform fan-shaped spray;
 - A strainer on the discharge line to prevent clogging;
 - A spray bar of adjustable length that can be raised or lowered;
 - A spray bar having a heating device, asphalt circulation system, or other device which will provide a uniform viscosity of material in all portions of the spray bar;
 - A hose and nozzle attachment to be used for spraying, by hand, areas inaccessible to the distributor spray bar;
 - (iii) On smaller bridge decks, the use of manual spraying equipment suitable for applying the liquid bituminous material uniformly at the desired rate will be allowed.

E55.6.4 Transportation of Bituminous Pavement Mixture

- (a) The mixture shall be transported from the mixing plant to the job site in vehicles with tight boxes having metal bottoms previously cleaned of all foreign materials. When directed by the Contract Administrator, the vehicles shall be suitably insulated. Each vehicle shall be equipped with a closely fitting tarpaulin of canvas or other suitable material of sufficient size to overhang the truck box on all sides when the vehicle is

loaded. Tarpaulins shall be used to completely cover the mixture at all times, even during the placing of the load into the spreader.

- (b) All loads not properly covered will be rejected.

E55.6.5 Placing Asphaltic Concrete Paving Mixture

- (a) The Contractor shall spread the asphalt pavement mixture by means of a self-propelled mechanical paver complete with screed. The paver shall be equipped with both automatic and manual controls capable of adjusting the screed to produce the required profile, cross section and longitudinal joint matching. Unless otherwise permitted the paver shall be operated using automatic controls. The automatic control of profile shall be accomplished by reference to a floating beam or skid. The beam or skid shall have a minimum length of 9 metres. A floating beam shall be supported by wheels or skis in a floating tandem arrangement. The number and arrangement of wheels or skis and the nature of the beam or skid shall be subject to the Contract Administrator's approval. When paving adjacent to a newly laid lane on final lift or adjacent to a curb, control of profile may be accomplished by reference to a shoe on the adjacent final lift or curb.
- (b) The paver shall produce a uniformly textured surface free from tearing, tracking or other objectionable surface irregularities. If the surface condition is not acceptable, spreading operations shall cease until equipment adjustments, repairs or replacement are made. Spreading operations shall not recommence without the approval of the Contract Administrator. Delays and expense entailed in adjustments, repairs or replacement of equipment shall be the responsibility of the Contractor.
- (c) The paver shall proceed in the same direction as the lap of the protection board and the sequence of spreading operations with respect to lanes and lifts shall be approved by the Contract Administrator.
- (d) The spreader shall be capable of spreading the mixture true to the elevations, grades and crown as shown on the Drawings. The allowable variation in the bituminous pavement surface shall not exceed 6 mm when measured using a 3 meter straight edge. Particular attention shall be paid to the setting of the spreader when laying the mixture in the areas adjacent to protruding joints in order to avoid bumps in the areas of such joints. In correcting the areas adjacent to a joint or when removing excess mixture, the material shall be picked up and not cast on the surface of the freshly spread bituminous pavement.
- (e) Immediately after the course is screeded, and before roller compaction is started, the remainder of the surface shall be checked, all inequalities adjusted, and all high spots removed and replaced with satisfactory material. Irregularities in alignment and grade along the curb shall be corrected by the addition or removal of mixture before the edge is rolled.
- (f) The speed of the spreader shall be maintained at a uniform rate that is in balance with the amount of bituminous pavement mixture being delivered to the bridge site.
- (g) The Contractor shall apply a tack coat between successive lifts as approved by the Contract Administrator.

E55.6.6 Compaction of Asphalt Overlay Mixture

- (a) The breakdown and finishing operations shall be carried out by a steel three (3)-wheeled or tandem roller. The intermediate rolling shall be done by a self-propelled pneumatic-type roller. Delays in rolling freshly-spread mixture will not be tolerated.
- (b) All areas next to vertical curb median faces and protruding deck joints shall be worked with hot iron tampers, mechanical vibratory tampers or by other means satisfactory to the Contract Administrator.

E55.6.7 Construction Joints in Asphalt Overlay

- (a) Longitudinal and transverse joints shall be made in a careful manner in order to assure a well-bonded, sealed and level joint. A transverse joint shall be cut back to its full depth perpendicular to the mat at the end of the run. On resuming laying of the

paving mixture, the exposed edges shall be painted with a thin coat of hot asphalt cement.

- (b) Before placing the paving mixture against them, all contact surfaces of longitudinal joints, curbs, leaders, etc., shall be painted with a thin coat of hot asphalt cement, as well as heated with a propane joint heater.
- (c) The allowable variation in the surface across a transverse joint shall not exceed 6 mm when measured using a 3 m straight edge centred on the joint.
- (d) In raking joints, excess mix material shall be picked up and removed from the surface of the freshly spread asphalt.

E55.6.8 Joints in Asphalt Overlay

- (a) When called for on the Drawings, the Contractor shall, after the completion of the asphalt paving, saw-cut the asphalt in the transverse direction for the full roadway width at every pier and abutment to the dimensions as shown on the Drawings.
The joints shall then be constructed in accordance with the Drawings.

E55.6.9 Weather

- (a) Paving asphalt to be laid to a compacted thickness of less than 40 mm shall not be started unless the air temperature is at least ten degrees Celsius (10°C) and rising, and not until all frost or moisture has evaporated to leave a dry surface. For greater thicknesses of asphalt pavement, the temperature requirement may be reduced to five degrees Celsius (5°C), providing the temperature is rising.

E55.6.10 Protection of Exposed Bridge Surfaces

- (a) Utmost care shall be taken to prevent the surfaces of the curbs above the compacted asphalt mat, as well as the newel posts and approach railing, from being disfigured by materials such as tack coating, caulking compound, cement and asphalt mixture.
- (b) If the exposed surfaces are marred as a result of the Contractor's operations, restoration shall be made by the Contractor at his expense and to the satisfaction of the Contract Administrator.

E55.7 Quality Control and Quality Assurance

E55.7.1 Quality Control

- (a) The quality control testing by the Contractor shall meet the requirements specified in the Specification CW 3410-R12 - Asphaltic Concrete Pavement Works.

E55.7.2 Quality Assurance

- (a) All materials supplied by the Contractor to be permanently incorporated in the finished product are subject to the inspection and approval of the Contract Administrator.
- (b) The Contractor shall take random field samples and conduct quality assurance tests on the materials, including the asphalt hot mix as directed by the Contract Administrator. If any material or the asphalt hot mix is proven to be of inferior quality, the Contract Administrator will reject such material.
- (c) In cases where bituminous pavements have already been laid and are proven in later tests to be inferior, the Contractor shall remove such material and replace it with proper material at his own expense.

E55.8 Measurement and Payment

E55.8.1 Asphalt Overlay on Bridge

- (b) Asphalt paving shall be measured on a weight basis and paid for at the Contract Unit Price per tonne for "Asphalt Overlay on Bridge", measured as specified herein, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E56. CELLULAR CONCRETE BACKFILL

E56.1 Description

- (a) This Specification shall cover the supply and installation of cellular concrete backfill, as specified herein 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 other things necessary or incidental to the satisfactory performance and completion of all Work as hereinafter specified.

E56.2 References

- (a) CAN/CSA A3001, Cementitious Materials for Use in Concrete
- (b) CSA A23.1, Concrete Materials and Methods of Concrete Construction
- (c) ASTM C869, Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete
- (d) ASTM C796, Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam
- (e) ASTM C495-99a, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete

E56.3 Qualification

- (a) The Contractor is to submit the qualifications of the Subcontractor that is to produce and place the cellular concrete for review and approval by the Contract Administrator.
- (b) The approved Subcontractor producing and placing cellular concrete shall have a record of experience and quality of work that is satisfactory to the Contract Administrator, and shall be capable of developing a mix design, batching, mixing, handling, and placing cellular concrete. The Subcontractor shall be certified by the manufacturer of the foaming agent and regularly engaged in the production and placement of cellular concrete. The Subcontractor shall have an adequate number of fully qualified workers who are thoroughly trained and experienced in the production and placement of cellular concrete.

E56.4 Equipment

- (a) The specialized batching, mixing, and placing equipment shall be automated and certified for the purpose by the manufacturer of the cellular concrete material. Dry-mix equipment must be able to receive bulk cement and produce over 100 cubic metres per hour on site, continuously, from one piece of equipment, and pump through hoses or pipes up to a flat lineal distance of 1000 metres. Bulk cement shall be weighed on a scale that operates within a tolerance of one and one-half percent (1.5%) per batch. Wet-mix equipment must be able to receive slurry on site into the equipment and process it continuously during ready-mix supply, and pump through hoses or pipes up to a flat lineal distance of 200 metres.
- (b) Cellular concrete must be pumped by a positive displacement pump (Peristaltic or similar). A foam generator shall be used to continuously produce pre-formed foam, which shall be injected and mixed with the cementitious slurry downstream of the positive displacement slurry pump. The equipment shall be calibrated to produce a precise and predictable volumetric rate of foam with stable uniform microbubbles.

E56.5 Materials and Testing

- (a) Cellular concrete shall be CEMATRIX CMEF-400 lightweight engineered fill, or equal as accepted by the Contract Administrator, in accordance with B6, with the following properties:
 - (i) Minimum unconfined compressive strength at 28 days of 0.3 MPa.
 - (ii) Wet cast density of 400 kg/m³ (+/-10%)

- (b) Portland cement shall conform to the requirements of CSA Standard CAN/CSA A3001, Type GU or HE. Supplementary cementing materials shall conform to the requirements of CSA Standard CAN/CSA A3001.
- (c) Mixing water shall conform to the requirements of CSA Standard A23.1. Water of questionable quality shall not be used unless proven to produce specimens whose 28-day compressive strength is at least 90% of those made with known acceptable water and an identical material mix.
- (d) Foaming agents shall conform to the requirements of ASTM C869 when tested in accordance with the provisions of ASTM C796. CEMATRIX CF-1 or PROVOTON foaming agents shall be used, or equal as accepted by the Contract Administrator, in accordance with B6. The Subcontractor shall be pre-qualified and approved in writing by the foaming agent manufacturer, referencing this Project. A copy of the written approval is to be submitted to the Contract Administrator prior to the commencement of the work.
- (e) The fresh cellular concrete density shall be measured and recorded once per production run, or once for every 50 cubic metres, or once per 30 minutes, whichever is more frequent. The density shall be maintained within +/- 10% of the design density.
- (f) Cellular concrete samples must be captured, cured, and tested to verify the compressive strength requirement is satisfied. One sample is comprised of one set of six cellular concrete cylinders. One sample should be taken for each placement, or every 100 m³, whichever is more frequent. Cylinders are cast in 75mm by 150mm cylindrical plastic molds. The sample mold must be lined with "freezer paper" with the plastic side against the cellular concrete. Cellular concrete cylinders shall be cured and tested as per ASTM C495-99a, modified to represent the field curing conditions for geotechnical applications.

E56.6 Subgrade Conditions and Site Preparation

- E56.6.1 The subgrade shall be cleared of vegetation, soft, wet, muddy, loose soil and other deleterious material, and graded and compacted to the lines and grades shown on the relevant drawings. The prepared subgrade shall be good competent level ground with nominal compaction to provide a firm base. The placement area shall be free of standing water during placement of cellular concrete and until backfill is placed on top of the cellular concrete. Snow and ice must be removed from the area prior to placement.

E56.7 Installation

- E56.7.1 The Quality Control and Quality Assurance Manual Cematrix Cellular Concrete, Document Number: QCS-007, Last Updated: September 29, 2011 shall apply to the work.
- E56.7.2 Any items to be fully or partially encased in the cellular concrete shall be properly set and stable prior to the installation of the cellular concrete.
- E56.7.3 Where required, formwork should be designed and installed to withhold cellular concrete, and may require lining with poly sheeting or similar impermeable membrane to prevent leakage. The sheet drain system on the side of the steel sheet piles shall also be lined with poly sheeting.
- E56.7.4 Cellular concrete may be placed during freezing conditions, provided measures are taken to prevent damage to the cellular concrete until sufficient strength has been attained. Care should be taken to avoid freezing before initial set. Cellular concrete must not be placed during heavy or prolonged precipitation.
- E56.7.5 Once mixed, the cellular concrete shall be conveyed promptly to the location of placement without excessive handling.
- E56.7.6 The Contractor shall determine the maximum lift thickness based on density and any other considerations that may impact placement. Cellular concrete shall be cast in a formed area within 1 to 2 hours, to permit an undisturbed setting.

- E56.7.7 Finished surface elevation shall be with +/- 25mm of the design grades shown on the Drawings. Cellular Concrete can be placed with a maximum slope of 1%. Slopes greater than 1% will require profiling by creating steps for the Cellular Concrete with formwork.
- E56.7.8 Loading of, or traffic on, the cellular concrete shall be prevented until the material has attained sufficient strength to withstand the loads with no damage. Backfill can commence with cellular concrete supports foot traffic without leaving an indentation.

E56.8 Measurement and Payment

E56.8.1 Cellular Concrete

- (a) Cellular concrete shall be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Cellular Concrete" which price shall be payment in full for performing all operations herein described and all other items incidental to the Work included in this Specification, accepted and measured by the Contract Administrator.

E57. STEEL BEARING PILES

E57.1 Description

- (a) This Specification shall cover the supply and driving of steel bearing piles.
- (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 other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E57.2 Scope of Work

- (a) The Work under this Specification shall involve:
- (i) Supplying and driving steel H piles for the Empress St. Retaining Wall.

E57.3 Referenced Specifications

- (a) The latest edition and all subsequent revisions to the following Standards:
- (i) CAN/CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;
- (ii) CSA W59 – Welded Steel Construction (Metal Arc Welding); and
- (iii) AASHTO/AWS D1.5m / D1.5 Bridge Welding Code.

E57.4 Submittals

E57.4.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E57.4.2 Steel Mill Certificates

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement Work on site, the steel mill certificates.

E57.4.3 Pile Driving System

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, details of the proposed pile driving system and Manufacturer's specifications and catalogue for all mechanical hammers used, showing the data necessary for computing the bearing value of the pile driven.

E57.4.4 Welding Certification

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, proof of qualification for the Contractor and the welders conducting the Work (if applicable).
 - (i) The Contractor shall produce evidence that all welding operators to be employed on the Work are currently qualified by the C.W.B. in the processes in which they are to be employed on the Work.
 - (ii) The Contractor shall produce evidence relative to each operator, that he has been executing satisfactory welding in the required processes within the six month period previous to the award of this Contract.

E57.4.5 Welding Procedures

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, the welding procedures specific to the Work (if applicable). The procedures shall include the following information: joint type, welding process, welding position, base metal specification, welding consumable specification and size, preheat requirements, amperage and voltage requirements, speed, polarity, and welding equipment.
- (b) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, Shop Drawings for pile tip and cutting shoe installations.

E57.5 Materials

E57.5.1 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. Piling shall be handled, hauled, and stored in a manner that avoids damage to piles and all associated piling material.
- (b) The Contractor shall not be permitted to drag piles along the ground.
- (c) Any piles excessively damaged through negligence or improper handling operations shall be immediately removed from the site and replaced with sound piles. This shall be done at the Contractor's own expense.

E57.5.2 Steel "H" Piles

- (a) Steel "H" piles shall be structural HP 250X85 steel members conforming to CSA G40.21, Grade 350W or ASTM A572 Grade 50.
- (b) Pile driving points shall be Point No. HPP-S-12, by Titus Steel Co. Ltd., Mississauga, Ontario, or Pruyn HP75750, by Associated Pile and Fitting Corporation, Clifton, NJ, USA or an alternated to be accepted at the discretion of the Engineer.
- (c) All welding shall conform to CSA Standard W59, electric arc method.
- (d) Splices shall not be permitted for piles.
- (e) Shear stud connectors shall conform to the requirements of ASTM A108, Grade 1020, and shall be of a design suitable for end welding using automatic stud welding equipment.

E57.6 Equipment

- (a) Pile driving system to be used by the Contractor shall be of such a capacity that the required bearing and pile penetration shall be obtained without damaging the piles.
- (b) The pile driving hammer used to install steel H piles shall be capable of delivering a minimum energy of 35 kJ to the pile head, with the ability to reliably operate at different energy levels (i.e. different fuel settings, variable strokes, variable ram weight, etc.). The amount of energy delivered to the pile head may need to be increased to reach refusal and to prevent pile damage.
- (c) Pile driver leads shall be used to support the piles while they are being driven.

- (d) The heads of steel bearing piles shall be cut squarely if required and protected by a pile cap. The pile cap shall be designed to hold the axis of the pile in line with the axis of the hammer. The top of the cap shall have a timber or polyethylene shock block (ie. capblock or hammer cushion).

E57.7 Construction Methods

E57.7.1 Preconstruction Meeting

- (a) Prior to pile driving a preconstruction meeting with the Contractor, Piling Subcontractor, Geotechnical Engineer, and Contract Administrator shall be held to review the Pile Driving submission and review the proposed pile driving system, sequence of work, refusal requirements, and energy settings.

E57.7.2 Geotechnical Report

- (a) The preliminary geotechnical report is available for bidders to view during the tender period. Bidders may view the report during the tender period by contacting the Contract Administrator identified in D3.1. Borehole logs are also provided on the Drawings.

E57.7.3 Location and Alignment of Piles

- (a) The piles shall be located to the positions shown on the Drawings. Pile lengths on Drawings have been calculated based on estimated tip elevation and pile cut-off elevations. The Contractor shall be responsible for reviewing all boring logs and geotechnical information for the verification of required supply pile lengths to support their driving equipment and operations.
- (b) Piles shall not be jacked or pulled into their final positions.

E57.7.4 Installing Pile Tips and Shear Stud Connectors

- (a) All pile driving points shall be welded by the Contractor prior to commencement of pile driving operations.
- (b) Material to be welded shall be preheated in accordance with CSA W59.
- (c) All Shear Stud Connectors shall be welded by the Contractor after all the H Piles have been driven to refusal and re-driven and cut to cut-off elevation.

E57.7.5 Pile Refusal Requirements

- (a) H piles shall be driven to practical refusal into the bedrock layer.
- (b) Refusal criteria for all piles shall be considered to be three consecutive sets of ten (10) to fifteen (15) blows per 25mm of pile penetration, provided that a well maintained hammer capable of delivering the required energy to the pile head per blow is utilized. Final refusal criteria will be confirmed by the Contract Administrator following submission of the items noted in E57.4, and following driving of the first pile to refusal.

E57.7.6 Driving of Piles

- (a) Pile driving equipment shall be operated from existing grade.
- (b) The piles shall be driven to the positions shown on the Drawings. Piles shall not deviate more than two (2) percent for battered piles, nor more than two (2) percent out-of-plumb for vertical piles. Piles shall not be more than 75 mm off centre, measured at time of cut off.
- (c) The method of driving shall be such as not to impair the strength of the pile. All piles shall be driven to refusal as end bearing piles. The Contractor will be required to remove any surface and/or shallow depth obstruction(s) to obtain the required penetration of the pile.
- (d) Piles shall be driven in the most practicable manner to ensure that the piles at the boundaries are in their correct final positions.
- (e) Driving stresses shall not exceed 85% of the yield stress of the steel.

- (f) All piles shall be re-driven for one set of the refusal criteria a minimum of twenty-four (24) hours following installation of all piles for a given footing. If relaxation of any pile is observed upon re-driving, all piles shall be re-driven to a minimum of one set of the specified refusal criteria on a daily basis until no further relaxation of piles is observed.
- (g) Upon re-driving a pile, all adjacent piles exhibiting heave of 6mm or more should be re-driven to a minimum of one set of the refusal criteria.
- (h) Driving of all piles shall be continuous without intermission until the pile has been driven to final elevation.
- (i) Where boulders or other obstructions make it difficult to drive certain piles in the location shown and to the proper bearing strata or depth, the Contractor shall resort to all usual methods to install piles as required.
- (j) Any piles that are excessively crushed or bent through negligence or carelessness the Contractor shall be removed or otherwise replaced, unless, in the opinion of the Contract Administrator, the damage is so slight that the pile can be repaired properly, which repairs shall be done by this Contractor.
- (k) Pile driver leads shall be used to support the piles while they are being driven and shall be braced to the supporting crane, to be used for securely and accurately support the pile in its required position during driving. Leads shall be of sufficient length to be supported firmly 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. Battered piles shall be driven with inclined leads.
- (l) For pile installation monitoring purposes, the Contractor shall paint markings on each pile at 0.25 metre intervals, with a label at each 1.0 metre interval, starting from the toe of the pile.
- (m) Pre-boring of piles is not permitted, unless approved by the Contract Administrator.
- (n) For practical refusal of piles, the final set shall be determined by three consecutive readings meeting the set criteria identified by the Contract Administrator. Final set will be measured and recorded in blows per 25mm by the Contract Administrator. Refer also to E57.7.5 regarding refusal requirements.

E57.7.7 Splicing of Piles

- (a) Splicing of piles will not be permitted for any of the Work, unless approved by the Contract Administrator. If splices are required at the Contract Administrator's direction, the Contractor shall be reimbursed for the cost of providing a splice as specified in C7.4(d).

E57.7.8 Cut-Off of Piles

- (a) After piles have been driven to the required penetration and re-driven, the Contractor shall mark the required cut-off elevation on each pile. The top of all piles shall be neatly cut off (true and level) at the cut-off elevation specified on the Drawings.

E57.8 Quality Control

E57.8.1 Inspection

- (a) 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.

E57.8.2 Pile Driving Records

- (a) The Contract Administrator will keep a record of each and every pile driven. The records shall give the driving date, installation time, pile type, size, length, location, final penetration depth, rate of penetration (i.e. number of blows per 250mm of pile penetration), final three sets meeting refusal criteria, hammer type and fuel setting (drop height). 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 reported immediately to the Contract Administrator. The required set per blow will be subject to acceptance by the Contract Administrator, showing regard to the specific driving equipment and piles permitted.

E57.9 Measurement and Payment

E57.9.1 Steel H Piles

- (a) Supplying of steel H piles shall be measured per lineal metre of steel piling supplied as measured by the Contract Administrator. This Item of Work shall be paid for at the Contract Unit Price per metre for "Supply Steel H Piles", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work.
- (b) Driving of steel H piles shall be measured per linear metre of driven steel piling. The length to be paid for shall be the total number of lineal metres of piling shown on the Drawings or authorized by the Contract Administrator, less fifty (50) percent of the total number of lineal metres of piling cut off after driving as measured in the field by the Contract Administrator. This Item of Work shall be paid for at the Contract Unit Price per metre for "Drive Steel H Piles", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work.
- (c) Supplying and installing all the listed materials, equipment, construction methods, and quality control measures associated with this Specification and Drawings shall be considered incidental to "Supply Steel H Piles", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise.

E58. EXPANSION JOINTS

E58.1 Description

- (a) This Specification shall cover the supply and installation of expansion joints and miscellaneous steel items, as specified herein and 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 other things necessary for and incidental to the satisfactory performance and completion of all Work hereinafter specified.

E58.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished;
 - (ii) ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings;
 - (iii) ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension;
 - (iv) ASTM D471 – Standard Test Method for Rubber Property – Effect of Liquids;
 - (v) ASTM D573 – Standard Test Method for Rubber – Deterioration in an Air Oven;
 - (vi) ASTM D1149 – Standard Test Methods for Rubber Deterioration – Cracking in an Ozone Controlled Environment;
 - (vii) ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness;
 - (viii) CAN/CSA G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;
 - (ix) CAN/CSA W59 – Welded Steel Construction (Metal Arc Welding);

- (x) CAN/CSA G164-M92 – Hot Dip Galvanizing of Irregularly Shaped Articles; and
- (xi) Ontario Provincial Standard Specification OPSS 1210 – Material Specification for Deck Joint Assemblies.

E58.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Supplying and installing expansion joints at the Empress Street Overpass north and south abutments;
 - (ii) Supplying and installing expansion joints at SU-3 and SU-6 of the North Pedestrian Accessibility Ramps;
 - (iii) Supplying and installing the expansion joint seals;
 - (iv) Completing a watertight verification of the expansion joint seals; and
 - (v) Supply and installing the expansion joint cover plates and other miscellaneous steel items.

E58.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the proposed Shop Drawings showing all fabrication details and any proposed field splice details of the steel components of the expansion joints. The complete expansion joint shop fabrication and installation shall be done by or under the direct supervision of a trained factory representative, who shall also be responsible for the expansion joint installation procedure.
- (c) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site, the proposed approved materials to be used.

E58.5 Materials

E58.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall 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.

E58.5.2 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 the latest edition and all subsequent revisions of CAN/CSA-A23.1.
- (b) Store materials under cover in a dry and clean location off the ground.

E58.5.3 Expansion Joints

- (a) Empress Overpass expansion joints shall be a box seal type where and as shown on the Drawings.
- (b) North Pedestrian Accessibility Ramp Expansion joints shall be strip seal type where and as shown on the Drawings.
- (c) Empress Overpass expansion joints shall be Wabo Joint System “D-300” box seal system, as specified in the Drawings, or equal as accepted by the Contract Administrator, in accordance with B6.

- (d) North Pedestrian Accessibility Ramp Expansion joints shall be System “SE-500” and “SE-300” strip seal system as specified in the Drawings, or equal as accepted by the Contract Administrator, in accordance with B6.
- (e) Expansion joints shall have fabricated cover plates and slider plates as shown on the Drawings.
- (f) The seals at each joint shall be made out of neoprene, as accepted by the Contract Administrator and shall be supplied in one continuous piece, separate from the steel extrusions or joint. No shop or field splicing will be allowed in the seals.
- (g) All fasteners and hardware of the modular bridge deck expansion joints shall be Grade 316, stainless steel.

E58.5.4 Steel

- (a) Steel supplied for the fabrication of the expansion joints shall conform to the requirements of CAN/CSA G40.21, Grade 300W, or equal as accepted by the Contract Administrator, in accordance with B6. They shall be galvanized after shop fabrication in accordance with CAN/CSA G164-M92 to a minimum net retention of 610 g/m².

E58.5.5 Steel Extrusions

- (a) Steel for the extrusions shall conform to the requirements of CAN/CSA G40.21, Grade 230G minimum.

E58.5.6 Anchor Studs

- (a) Anchor studs shall conform to the requirements of ASTM A108, Grade Designation 1020 and shall be galvanized.

E58.5.7 Miscellaneous Steel Items

- (a) Rods, cover plates, brackets and washer plates, slider plates, and all other associated steel items shown on the Drawings shall be fabricated from steel conforming to the requirements of CAN/CSA G40.21, Grade 300W and shall be galvanized in accordance with CAN/CSA G164 M92 to a minimum net retention of 610 g/m².
- (b) The sidewalk and North Pedestrian Accessibility Ramp cover plate shall be coated with an approved non-slip grit paint.

E58.5.8 Galvanizing Touch-up and Field Applied Galvanizing

- (a) Field-applied galvanizing, to touch-up damaged hot-dip galvanizing, metallizing, or field welds, shall be done with self-fluxing, low temperature, zinc-based alloy rods in accordance with ASTM A780.
- (b) Approved products are:
 - (i) Galvalloy as manufactured by Metalloy Products Company, P.O. Box No. 3093, Terminal Annex, Los Angeles, California; and
 - (ii) Welco Gal-Viz Galvanizing Alloy, as manufactured by Thermocote Welco, Highway 161 York Road, Kings Mountain, North Carolina. Locally, both products are available from Welder Supplies Limited, 25 McPhillips Street, Winnipeg.

E58.5.9 Welding

- (a) Welding shall be of a low oxygen classification. Manual electrodes shall be E7016 or E7018. All welding shall be in accordance with CAN/CSA W59.

E58.5.10 Prefomed Neoprene Joint Seals

- (a) Further to E58.5.3(e)E58.5.3(f), the prefomed neoprene expansion joint seals shall be manufactured from a vulcanized elastomeric compound using crystallization resistant polychloroprene (neoprene) as the only polymer.
- (b) The prefomed neoprene expansion joint seals shall meet the requirements of the latest edition and all subsequent revisions of Ontario Provincial Standard Specification

(OPSS) 1210 "Material Specification for Preformed Neoprene Joint Seals", and as amended herein. All tests will be made on specimens prepared from the extruded seals.

E58.5.11 Epoxy Adhesive

- (a) Epoxy adhesive for concrete to steel bonding shall be one of the following approved products: Sternson ST432 or ST433, Dural Duralbond, Capper Capbond E, Sikadur 32 Hi-bond, Concessive 1001 LPL, Meadows Rezi-Weld 1000, or equal as accepted by the Contract Administrator, in accordance with B6.

E58.5.12 Epoxy Grout

- (a) Where epoxy grout is used, it shall be Sternson Talygrout 100, Sika Sikadur 42, CPD Epoxy Grout by Specialty Construction Products, Meadows Rezi-Weld EG-96, Duralcrete, Dural 103 Gel, or equal as accepted by the Contract Administrator, in accordance with B6.

E58.5.13 Cementitious Grout

- (a) Cementitious grout shall be nonshrink and nonmetallic. Approved products are Sternson M-bed Standard, Specialty Construction Products CPD Non-Shrink Grout, Sika 212 Non-Shrink Grout, or equal as accepted by the Contract Administrator, in accordance with B6. The minimum compressive strength of the grout at 28 days shall be 40 MPa

E58.6 Equipment

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

E58.7 Construction Methods

E58.7.1 Fabrication

- (a) No fabrication shall commence until acceptance of the Shop Drawings from the Contract Administrator has been obtained.
- (b) Care shall be taken to ensure that all members are straight and flat and free from twists, bends, and distortions due to welding. The units shall be shop assembled and checked for matching of sliding surfaces, correct cross-fall and skew, as well as accurate positioning and alignment of supporting brackets. The Contractor shall exercise care in the handling of all units during shipping and loading operations prevent twists, bends, and warping.
- (c) Matching expansion joint assemblies shall be assembled and bolted together for shipping.
- (d) Expansion joint assemblies shall be shop checked for fit and match marked.
- (e) All metal surfaces to be galvanized shall be cleaned thoroughly of rust, rust scale, mill scale, dirt, paint, and other foreign material by commercial sand, grit or shop blasting, and pickling prior to galvanizing. Heavy deposits or oil and grease shall be removed with solvents prior to blasting and pickling.
- (f) In no case shall weldments be substituted for extrusion shapes.
- (g) The zinc coating shall be adherent, continuous, and reasonably smooth. It shall be free from imperfections such as blisters; gritty or uncoated areas; acid, black spots, or dross particle adhering to the coating; or other imperfections inconsistent with good commercial galvanizing practice. Globules of zinc that will interfere with the intended use of the material will not be permitted.
- (h) The colour of the galvanizing shall be consistent and continuous.

E58.7.2 Installation

- (a) The Contractor shall install expansion joints as shown on the Drawings and shall be responsible for the correct matching and seating of parts. The expansion joints shall

be checked for accurate matching of sliding plates with the bridge deck expansion joints installed at the specified skews and crossfalls. One field splice in the length of the expansion joint is permitted.

- (b) The edges of the expansion joint cover plates shall be seal welded to the expansion joint cover plates as shown on the Drawings.

E58.7.3 Galvanizing Touch-up Prior to Placement of Concrete

- (a) Any areas of damaged galvanizing and field welds are to receive field applied galvanizing.
- (b) Surfaces to receive field-applied 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. Field-applied galvanizing shall be blended into existing galvanizing of surrounding surfaces and shall be buffed and polished if required to match the surrounding surfaces. Care shall be taken to not overheat surfaces beyond 400°C and to not apply direct flame to the alloy rods.
- (c) The process is to be repeated as required to achieve a thickness comparable to original galvanizing, as approved by the Contract Administrator.

E58.7.4 Placement of Concrete at Expansion Joints

- (a) The expansion joint assemblies shall be set in position, and secured rigidly in place, such that they will remain true to line and elevation during and after concreting, in accordance with approved details as shown on the Shop Drawings.
- (b) Care shall be taken during consolidation of the concrete to ensure that there are no voids in the concrete under and around the expansion joint components and associated reinforcing steel.
- (c) Before concreting, the expansion joint opening shall be set to give the correct width for the mean concrete temperature of the deck. The gap width shall be obtained from the Temperature Width Adjustment Table provided on the Drawings, as approved on-site by the Contract Administrator immediately prior to the start of concrete placement.
- (d) Immediately in front of concrete placement at the expansion joints, all metal contact surfaces between the expansion joint and concrete shall be coated with epoxy adhesive.
- (e) After the concrete has set for seventy-two (72) hours, and after the removal of the Manufacturer's temporary clamping channels, epoxy grout shall be used to fill any associated bolt holes.

E58.7.5 Field Welding and Touch-Up Galvanizing

- (a) Prior to installation of the seals, the flange of the expansion joint edge members shall be vulcanized or seal welded to the corner plates, as shown on the Drawings, to provide watertight joints.
- (b) Any areas of damaged galvanizing or metallizing on miscellaneous steel items shall receive field-applied touch-up galvanizing, in accordance with ASTM A780.
- (c) 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. Field-applied galvanizing shall be blended into existing galvanizing of surrounding surfaces and shall be buffed and polished if required to match the surrounding surfaces. Care shall be taken to not overheat surfaces beyond 400°C and to not apply direct flame to the alloy rods.

E58.7.6 Installation of Seal

- (a) A permanent seal at each expansion joint unit shall be installed as one continuous piece after completion of all concreting operations, to the satisfaction of the Contract Administrator.
- (b) Only upon completion of all concrete cleanup operations shall the Contractor open up the seating areas and prepare them for them installation of the seals.
- (c) The installation of the expansion joint seal will be completed according to the construction phasing, as detailed on the Drawings.

E58.7.7 Watertight Verification of Joint Seal

- (a) Prior to installing the expansion joint and sidewalk cover plates, the Contractor shall dyke off the bridge deck expansion joints and maintain a minimum of 75 mm of water over all areas of the seal for a period of not less than four (4) hours, with no leakage. Any and all leaks shall be corrected, using mechanical or other adjustment of the bridge deck expansion joints to the satisfaction of the Contract Administrator. In no case shall caulk or other temporary devices or materials be used to seal leaks in the expansion joints. The Contract Administrator's decision in this regard shall be final.
- (b) Prior to commencing the test, the Contractor shall remove all expansion joints forming materials and debris from the deck and from the substructure units below. The Contractor shall provide safe access, acceptable to the Contract Administrator, to the pier tops for inspection of the expansion joints during the testing.

E58.7.8 Watertight Verification of Expansion Joint and Concrete Blockouts

- (a) Prior to installing the expansion joint and sidewalk cover plates, the Contractor shall dyke off the bridge deck expansion joints and maintain a minimum of 75 mm of water over all areas of the seal for a period of not less than four (4) hours, with no leakage. Any and all leaks shall be corrected, using mechanical or other adjustment of the bridge deck expansion joints to the satisfaction of the Contract Administrator. In no case shall caulk or other temporary devices or materials be used to seal leaks in the expansion joints. The Contract Administrator's decision in this regard shall be final.
- (b) Prior to commencing the test, the Contractor shall remove all expansion joints forming materials and debris from the deck and from the substructure units below. The Contractor shall provide safe access, acceptable to the Contract Administrator, to the pier tops for inspection of the expansion joints during the testing.

E58.7.9 Installation of Expansion Joint Cover Plates

- (a) Perform cutting, drilling, and fitting required for installation of expansion joint cover assemblies. Touch-up galvanizing shall be completed in accordance with E58.7.5, E58.7.5, "Field Welding and Touch-Up GalvanizingE58.7.5".
- (b) Install joint cover assemblies in true alignment and proper relationship to the opening of the expansion joint and adjoining finished surfaces measured from the established lines and levels.
- (c) Allow for thermal expansion and contraction of metal to avoid buckling.
- (d) Set floor covers at elevations flush with adjacent finished floor materials unless otherwise shown.
- (e) Locate wall, ceiling, and overhang covers in continuous contact with adjacent surfaces. Securely attach in place using required accessories. Make allowances for change in joint size due for installation.
- (f) Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints.

E58.8 Fabrication Warranty

- (a) Before final acceptance of the expansion joints by the Contract Administrator, the bridge deck expansion joints supplier shall provide the City with a written warranty stating that they will perform satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the date of issuance of the

Certificate of Acceptance (Certificate of Acceptance is issued after the successful completion by the Contractor of the Project's standard warranty period), provided that the expansion joints have been properly installed, acceptable to the Contract Administrator. The Supplier shall state that they have observed the installation and found it to be in accordance with their recommended procedure. The Supplier shall warranty the replacement of the expansion joints, including removal of the defective expansion joint assemblies and supply and installation of the replacement expansion joint, at no cost to the City, in the event that the joint does not perform satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the date of issuance of the Certificate of Acceptance.

E58.9 Installation Warranty

- (a) The Contractor shall ensure that the expansion joints are installed in such a manner that will not void the fabrication warranty.
- (b) Similar to the expansion joint Supplier, and before final acceptance by the Contract Administrator, the Contractor shall warranty, in writing, the performance of the expansion joints and concrete expansion joint blockouts for a period of five (5) years from the date of issuance of the Certificate of Acceptance (Certificate of Acceptance is issued after the successful completion by the Contractor of the Project's standard warranty period). Provide in the warranty for the replacement of the expansion joints at no cost to the City, including all direct and indirect costs in the event that the expansion joints do not perform satisfactorily in the range of design movement and under the design loads for a period of five (5) years from the date of issuance of the Certificate of Acceptance.

E58.10 Quality Control

E58.10.1 General

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to the 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.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance 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.

E58.10.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E58.10.3 Expansion Joint Seal Markings

- (a) All expansion joint seals shall be identified as to the Manufacturer by means of a continuous permanent mould mark. The mould marks shall be registered with the Contract Administrator and shall be used on all seals produced by the respective Manufacturer. The seal shall also be permanently marked, on the side of the seal, with the date of production and the batch/lot, at intervals of not more than 1.2 m.
- (b) The Contractor shall supply to the Contract Administrator a summary of the seals identifying the date of manufacture, the batch/lot, and the proposed installation location.

E58.10.4 Joint Seal Samples and Testing Procedures

- (a) The Contractor shall supply seal sample material at no charge to The City for quality control testing purposes. The samples will each be 1.5 m long. Each sample will represent not more than three expansion joint seals of the same size, lot, and make and shall be continuous with same until sampled by the Contract Administrator. As

soon as the seals to be used in the joint assemblies have been manufactured, they shall be available to the Contract Administrator for sampling.

- (b) Testing procedures will be in accordance with the latest revisions of the methods indicated in the table below.
- (c) All materials failing to meet the Specification requirements will be rejected.
- (d) Lots rejected may be culled by the supplier and, upon satisfactory evidence of compliance with the Specifications, will be accepted.

Physical Requirements

Property	Physical Requirements	Test Procedure*
1. Tensile Strength	Minimum 13.5 MPa	ASTM D412 OPSS 1210.07.03.01.02
2. Elongation at Break	Minimum 250%	ASTM D412 OPSS 1210.07.03.01.02
3. Hardness, Type A Durometer	55: +7 Points -5 Points	ASTM D2240 OPSS 120.07.03.01.03
4. Oven aging Test 70 Hours at 100°C Reduction in Tensile Strength Reduction in Elongation Increase in Hardness	Maximum 20% Maximum 20% Maximum 10 Points	ASTM D573
5. Permanent Set at Break	Maximum 10%	ASTM D412
6. Low Temperature Stiffening Hardness, Type A Durometer	Maximum 15 Points	ASTM D2240 OPSS 1210.07.03.01.03
7. Oil Swell, ASTM Oil No. 3 70 H at 40°C (wipe with toluene to remove surface contamination)	45 max	ASTM D471
8. Ozone Resistance	No Cracks	ASTM D1149
9. **Safe Compressibility Test (Z min.) Bridge Seal - < 63.5 mm > 63.5 mm	Minimum 50% Minimum 55%	OPSS 1210.07.03.01.04
10. **Pressure Generation at 15% Deflection	Minimum 20 kPa	OPSS 1210.07.03.01.04
11. **Recovery 22 h at -28°C 70 h at - 10°C 70 h at + 100°C	Minimum 80% No Cracking Minimum 88% Splitting or Minimum 85% Sticking	OPSS 1210.07.03.01.05

* ASTM - American Society for Testing and Materials OPSS - Ontario Provincial Standard Specification

** This physical requirement not applicable to lock-in type joint seals

E58.11 Measurement and Payment

E58.11.1 Expansion Joints

- (a) Supplying and installing expansion joints shall be measured at a unit basis. This Item of Work shall be paid for at the Contract Unit Price Per Unit for the "Items of Work" listed here below, which price shall be paid in full for supplying all materials and

performing all operations herein described and all other items incidental to the Work included in this Specification, accepted and measured by the Contract Administrator.

- (b) Items of Work:
- (c) Supply and Install Expansion Joints:
 - (i) Empress Overpass
 - (ii) North Pedestrian Accessibility Ramp.
- (b) SU-3
- (c) SU-6

E59. ROCK-SOCKETED CAISSONS

E59.1 Description

E59.1.1 General

- (a) This Specification covers all operations relating to the supply and installation of rock-socketed caissons for the North Pedestrian Accessibility Ramp piers including but not limited to overburden drilling, rock coring, water control, rock socket inspection, supply and installation of temporary steel casings, supply and placement of concrete and reinforcing steel, removal of temporary steel casings and disposal of excavated materials.
- (b) 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 Work as hereinafter specified.

E59.1.2 Definition

- (a) Overburden: All material encountered above the bedrock including imported fill and native soils.
- (b) Weathered Rock Zone: Weathered rock encountered above the sound bedrock including voids and soil filled cavities which would require steel casing to support the caisson hole.
- (c) Sound Rock: Rock which may contain fractures but a casing is not required to support the caisson hole.
- (d) Caisson Shaft: portion of the caisson within overburden and weathered rock.
- (e) Rock socket: portion of the caisson within sound rock.

E59.1.3 Elevations on Drawings

- (a) The caisson elevations shown on the Drawings are approximate only. Refer to the test hole logs and all other available information to gain more knowledge about the surface and subsurface conditions.

E59.2 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any tremie concrete operations the proposed tremie concrete procedures.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any caisson construction operations the proposed drilling and casing procedures.

E59.3 Materials

E59.3.1 General

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

E59.3.2 Handling and Storage

- (a) Storage of materials shall be in accordance with CSA Standard CAN/CSA A23.1. Materials damaged by careless or negligent handling or storage by the Contractor shall be replaced at the Contractor's expense.

E59.3.3 Testing

- (a) All materials supplied under this Specification shall be subject to inspection by the Contract Administrator and testing 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 be approved by the Contract Administrator at least twenty-one (21) 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 Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at their own expense.

E59.3.4 Concrete

- (a) The concrete shall conform to the Specifications E41, "SELF COMPACTING CONCRETE".
- (b) The concrete shall be placed by the tremie method.

E59.3.5 Reinforcing Steel

- (a) The reinforcing steel shall conform to Specification E42, "SUPPLYING AND PLACING REINFORCING STEEL" of this Specification.

E59.4 Equipment

E59.4.1 All equipment shall be of a type accepted by the Contract Administrator and shall be kept in good working order

E59.4.2 Tremie Equipment

- (a) The tremie pipe shall consist of a tube, having a diameter of not less than 250 mm, constructed with sections having flange couplings fitted with gaskets. The discharge end shall have a proper seal so that water will not enter the tube at any time.

E59.5 Construction Methods

E59.5.1 Location and Alignment of Caissons

- (a) The Caissons shall be installed in the positions shown on the Drawings or as directed by the Contract Administrator. The Contractor will be required to remove obstructions in order to achieve the proper alignment.
- (b) Alignment shall not deviate more than two percent (2%) of caisson length out of plumb and not more than 75 mm off centre at the top of caisson.
- (c) Clear distance between permanent limits of the caisson shaft and 115 kV line must be 1.0 m minimum.

E59.5.2 Buried Utilities

- (a) The Contractor shall exercise extreme caution when constructing the caissons in the vicinity of existing buried utilities and buildings. The drawings show the approximate locations of the existing buried utilities. The Contractor shall be responsible for determining the exact location of the buried utilities from the appropriate Utility Authorities or through hydro-excavation methods prior to constructing the caissons.

- (b) 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 operation in constructing caissons, as determined by the Contract Administrator.

E59.5.3 Rock-Socketed Caisson Installation

- (a) Prior to rock-socketed caisson construction, the Contractor shall advance a proof-core hole at the location of each rock-socketed caisson to prove the rock soundness to a depth of at least 2 m below the bottom of each rock-socket, except for those at piers SU-2 and SU-4 where proof-coring has already been conducted. Proof-coring shall be conducted from ground surface using a small diameter rock core barrel (e.g. HQ) under the direct supervision of the Geotechnical Engineer. The final depth of each proof core shall be as directed by the Geotechnical Engineer based on actual bedrock conditions encountered, such that sufficient information is obtained for the Geotechnical Engineer to finalize the rock socket depth and length.
- (b) The Contractor shall install shaft holes and temporary steel casings to diameters indicated on the Drawings at each caisson location. The steel casings shall be advanced into bedrock to the depth indicated on the Drawings or as determined by the Contract Administrator. Telescoping temporary casings are considered acceptable provided they do not adversely impact buried utilities or the design intent of the caisson. Casings shall be advanced through weathered rock. It is anticipated casings with teeth will be required.
- (c) Protection boards, i.e. swamp mats, are to be installed on the ground above the 115 kV line prior to starting any rock-socket caisson installation activities. Protection boards are to remain until the completion of all rock-socket caisson installation activities.
- (d) Manitoba Hydro requires a minimum of two weeks' notice prior to commencement of hydroexcavation or drilling activities. As much notice as possible shall be provided.
- (e) Prior to drilling the Contractor shall hydro excavate to locate the 115 kv hydro cable adjacent to each caisson location to confirm the cable does not interfere with the caisson location.
- (f) For rock-sockets located within 1.5 m of the 115 kV buried Hydro cable, it is Manitoba Hydro's preference that the 115 kV line be de-energized, if at all possible. Please contact Darryl Stocki at Manitoba Hydro at 204-918-0341 to coordinate.
- (g) The Contractor shall install rock sockets using core barrels to diameters indicated on the Drawings. The sockets shall be advanced into sound bedrock to the depth indicated on the Drawings or as determined by the Contract Administrator. Contractor shall permit access by the Contract Administrator to review all recovered core as it is retrieved from the caisson hole. Ensure loose material is removed and the caisson is free of foreign material. Any water or material removed from the caisson holes shall be collected and removed from site and properly disposed of at Contractor's own expense.
- (h) Following the excavation of the rock sockets to the required depth, the Contractor is required to provide evidence to the Contract Administrator that the socket is in an acceptable condition. A remote television inspection with video link to the surface or other similar inspection means will be required to demonstrate that the specified condition of the completed sockets have been met, to the satisfaction of the Contract Administrator. Dewatering of the caisson hole is expected to be required to permit down-hole camera inspection.
- (i) The inspection shall consist of the following. Inspection shall be performed in each rock socket with the Contract Administrator and Contractor present. The inspection shall be capable of showing all vertical and bottom faces of the rock socket. If, following the inspection by an approved method, in the opinion of the Contract Administrator the rock socket for any given caisson has not penetrated a continuous section of sound bedrock of the depth and quality suitable for rock socket installation,

the Contractor will be required to extend the length of the socket until this condition is satisfied or as directed by the Contract Administrator.

- (j) The Contractor shall maintain accurate records of the bedrock strata elevation, tip elevations, casing depth, and socket length for each caisson. At the completion of these works, three (3) copies are to be submitted to the Contract Administrator.
- (k) The Contract Administrator may reduce the length of rock sockets at the time of installation based on the quality of rock as determined by the Contract Administrator.
- (l) Upon acceptance of the rock socket by the Contract Administrator the Contractor shall place the reinforcing steel as indicated on the Drawings and fill the entire length of the caissons with tremie concrete to the top of caisson elevation.

E59.5.4 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 excavation intact before concrete is placed.
- (b) Spacers shall be utilized to properly locate the reinforcing steel cage in the excavation.

E59.5.5 Placing Concrete

- (a) Care shall be taken to ensure that anchor bolts are vertically aligned and that anchor bolts 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 caisson.
- (c) Concrete shall be placed to the elevations as shown on the Drawings. The top surface of the pile shall be finished smooth with a hand float.
- (d) All concrete, during and immediately after deposition, shall be consolidated by mechanical vibrations so that the concrete is thoroughly worked around the reinforcement and around embedded items; eliminating all air or stone pockets that may cause honeycombing, pitting, or planes of weakness.
- (e) Temporary casing removal shall be conducted such that the cross-section of the caisson is not compromised through necking or sloughing of the caisson hole.

E59.5.6 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 excavation 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 excavation 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 excavation.

E59.5.7 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.

E59.5.8 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.

E59.5.9 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 their own expense. Also, concrete allowed to freeze prior to the three (3) days will not be accepted for payment

E59.6 Quality Control

E59.6.1 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.

E59.6.2 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.

E59.7 Measurement and Payment

E59.7.1 Construction of Rock-socketed Caissons

- (a) Construction of Rock-socketed Caissons shall be measured on a length basis and paid for at the Contract Unit Price per metre for the "Items of Work" listed here below, which price shall be payment in full for supplying all materials and for completing all operations herein described and all other items incidental to the work included in this Specification, accepted and measured by the Contract Administrator. Supply, installation and removal of temporary steel casings for installation of caissons are incidental to the Work.
- (b) Items of Work:
 - Rock-Socketed Caissons
 - (ii) Caisson Shaft
 - (iii) Rock-Socket

E60. PRECAST PRESTRESSED CONCRETE SLABS

E60.1 Description

E60.1.1 This Specification shall cover the supply of all material, labour, plant, and equipment required to complete the work as hereinafter specified and as shown on the Drawings including but not necessarily confined to the following:

- (a) Supply of all materials and the fabrication of precast prestressed concrete slabs for North Pedestrian Accessibility Ramp as shown on the Drawings, including delivery and erection.
- (b) Storage of fabricated slabs until delivered to the Site for erection.

E60.2 References and Related Specifications

E60.2.1 References

- (a) CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction
- (b) CAN/CSA-A23.2, Methods of Test and Standard Practices for Concrete
- (c) CAN/CSA-A23.4/CSA-A251, Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products
- (d) CAN/CSA-A3001, Cementitious Materials for Use in Concrete
- (e) CAN/CSA – G30.14, Deformed Steel Wire for Concrete Reinforcement
- (f) CAN/CSA – G30.18, Billet-Steel Bars for Concrete Reinforcement
- (g) CAN/CSA – G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel
- (h) CAN/CSA G 164, Hot Dip Galvanizing of Irregularly Shaped Articles
- (i) CAN/CSA G 279, Steel for Pre-stressed Concrete Tendons
- (j) CAN/CSA W47.1, Certification of Companies for Fusion Welding of Steel
- (k) ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished
- (l) ASTM A496 Standard Specification for Steel Wire, Deformed for Concrete Reinforcement
- (m) ASTM C 260, Standard Specification for Air-Entraining Admixtures for Concrete
- (n) ASTM C 494, Standard Specification for Chemical Admixtures for Concrete
- (o) ASTM C 1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

E60.2.2 Related Specifications

- (a) Specification E40, “Structural Concrete”
- (b) Specification E42, “Supplying and Placing Reinforcing Steel”

E60.3 Submittals

- (a) The Contractor shall submit the following to the Contract Administrator:
 - (i) Certificate of Compliance with the CPCQA Certification Program in Precast and Prestressed Structural, Architectural and Specialty, Group B, Bridge Components. Proof of this certification shall be provided to the Contract Administrator.
 - (ii) 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 Contractor implementing the change.
 - (iii) Stressing calculations shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba and include the following:
 - 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.

A calibration graph for each jack, calibrated not more than 6 months prior to stressing operation.

The proposed method of tensioning the draped strands, including a comprehensive description and drawing of the proposed hold-up and hold-down devices.

The proposed sequence of stressing and destressing operations.

The anchorage losses experienced by the Contractor under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation.

A copy of the proposed "Record of Concrete Strength" and "Record of Pre-Tensioning" forms to be used by the Contractor.

- (iv) Copies of the stress-strain curve for the prestressing steel.
- (v) 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.
- (vi) Letter of Validation from the Canadian Welding Bureau (CWB) and CWB approved welding procedures for the Contractor's miscellaneous metal supplier. The Contractor's miscellaneous metal supplier shall fulfill the requirements of CSA W47.1, Division 2.1 (minimum).
- (vii) Loading, handling, and transportation procedures, including the proposed route and all traffic control procedures shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba.
- (viii) Bending procedures for strands extended at slab ends.

E60.4 Materials

- (a) Manufacturer's specifications for the concrete for the precast concrete slab shall be strictly followed and shall supersede this Specification should any discrepancies exist.

E60.4.2 Concrete

- (a) Concrete 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 C-1, Air Content Category 1 for hardened concrete.

E60.4.3 Coarse Aggregate

- (a) 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 be uniformly graded and not more than 1% shall pass a 75 μ m sieve. 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.
- (b) 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.

E60.4.4 Fine Aggregate

- (a) Fine aggregate shall meet the grading requirements of CSA A23.1, Table 10, FA1, be graded uniformly and not more than 3% shall pass a 75 μ m sieve. 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.
- (b) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12.

E60.4.5 Admixtures

- (a) Air-entraining admixtures shall conform to the requirements of ASTM C 260 and the City of Winnipeg Specification

- (b) Chemical admixtures shall conform to the requirements of ASTM C 494 or C 1017 for flowing concrete.

E60.4.6 Cementitious Materials

- (a) Cementitious materials shall conform to the requirements of CSA-A3001.
- (b) Should the Contractor choose to include a silica fume admixture in the concrete mix design, the substitution of silica fume shall not exceed 8% by mass of cement.
- (c) Should the Contractor choose to include fly ash in the concrete mix design, the fly ash shall be Class CI and the substitution shall not exceed 15% by mass of cement.

E60.4.7 Grout

- (a) Grout shall have a compressive strength of 45 MPa @ 28 days and shall be non-shrink, non-metallic. Admixtures to be used in grout must be approved by the Contract Administrator. Grout specified within this Specification section shall be used for the grouting the post-tensioning ducts, anchor rods and the precast slab shear keys.
- (b) Shear key preparation shall include light sand blasting prior to grout installation as deemed acceptable to the Contract Administrator.

E60.4.8 Prestressing Steel

- (a) Prestressing steel shall be Grade 1860 MPa and shall conform to the requirements of CSA Standard G279 and this Specification.
- (b) 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.
- (c) Stress-Strain Curves One stress-strain curve shall be provided by the Manufacturer for each reel.
- (d) Testing Should the Contract Administrator consider it necessary, approval of the prestressing strand, in addition to the requirements of CSA G 279, shall be based on tests carried out by the Contractor in a testing laboratory satisfactory to the Contract Administrator. The Contractor shall test a minimum of three representative specimens of the strands to be used in the slabs. The results of these tests shall be supplied to the Contract Administrator. The Contract Administrator may also require the Contractor 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 Contractor's expense in order to determine whether the material is suitable to be used in the slab.
- (e) All strands that:
 - (i) are contaminated by substances having a deleterious effect on the steel or concrete or on the bond strength of concrete to strand or,
 - (ii) sustain physical damage,shall be replaced either by the Contractor or cleaned to the satisfaction of the Contract Administrator.

E60.4.9 Reinforcing Steel

- (a) Reinforcing steel shall be ChromX 9100 and shall conform to the requirements of E42, "SUPPLYING AND PLACING REINFORCING STEEL".

E60.4.10 Structural Inserts

- (a) Structural inserts shall be Dayton Superior Type F-57 expanded coil ferrule insert, galvanized. Insert to come as a unit with 25mm diameter, 50mm long, A307 bolts, with lock washers, galvanized. Inserts shall be galvanized in accordance with ASTM A123 to a net retention of 610 g/m².

E60.4.11 Dowels

- (a) Dowels shall be stainless steel and shall conform to the requirements of of E42, "Supplying and Placing Reinforcing Steel".

E60.4.12 Form Retarder

- (a) Form retarder for achieving exposed aggregate finish in areas to be in contact with grout after erection shall be MBT Tuf-Cote or equal as accepted by the Contract Administrator, in accordance with B6.

E60.4.13 Other Materials

- (a) Miscellaneous metal, anchor inserts and lifting devices and all other incidental materials shall be supplied as shown on the Drawings and shall be subject to the approval of the Contract Administrator.

E60.5 Manufacture

E60.5.1 General

- (a) Precast fabrication shall meet the requirements of CAN/CSA – A23.4-16, including Annexes A and B, together with PCIMNL-116 and 117 and CPCQA certification requirements.
- (b) All precast concrete components shall be plant manufactured by a manufacturer currently engaged in the special process of precast and prestressed concrete work. This manufacturer shall be a registered member of the Canadian Prestressed Concrete Institute
- (c) All plant casting operations for the production of prestressed and precast concrete shall be under the direct supervision of a Registered Professional Engineer in the Province of Manitoba.
- (d) The casting operations of the manufacturer shall be continuously open to inspection by representatives of the Contract Administrator. Complete and up-to-date copies of all shop drawings together with a complete set of the Contract Drawings and Specifications shall be kept available for their use.
- (e) During production of the precast members, weight checks shall be carried out on completed units when requested by the Contract Administrator.
- (f) Mark each member with identifying number and date of casting.

E60.5.2 Shop drawings

- (a) Shop drawings shall be sealed by a Professional Engineer Registered in the Province of Manitoba shall be submitted to the Contract Administrator a minimum of fourteen (14) days prior to the slab fabrication.

E60.5.3 Tolerances

- (a) The distance centreline to centreline of bearings shall not vary by more than 6.5 mm from the lengths shown on the plans, when measured 12 hours after the completion of the stress transfer.
- (b) Cross-sectional dimensions including the locations of the prestressing steel shall not vary from those shown on the plans by more than 3.5 mm.
- (c) The bottom surface of members at the bearing areas shall be in a true level plan, which does not vary by more than 1.5 mm from a true straight edge placed in any direction across the area or plate.

E60.5.4 Formwork

- (a) The faces of the forms shall be smooth to impart a good finish to the concrete and particular care shall be taken to ensure the verticality and rigidity of the side forms of surfaces which will be in contact with each other after erection. The faces of the forms shall be treated with a release agent to ensure that stripping may be carried out without damage to the concrete. Care shall be taken to maintain all embedded material free of the release agent.

- (b) Forms shall be constructed as to allow for the redistribution of loading and the movement of the member, which will take place upon application of the prestressing force.
- (c) Outside Forms
 - (i) The faces of the forms shall be smooth so as to impart a good finish to the concrete. Forms shall result in precast prestressed slabs that conform to the shape, lines and dimensions as shown on the Drawings and within the tolerances described in Section E20.5.3 of this Specification. Forms shall be properly braced or tied together to maintain position and shape.
 - (ii) Forms shall be designed for the rate and method of concrete placement and constructed to allow for the redistribution of loading and the movement of the form that will take place upon application of the prestressing force.
 - (iii) The faces of the forms shall be treated with a release agent to ensure that stripping may be carried out without damage to the concrete. Care shall be taken to prevent the release agent from coming in contact with any reinforcement, pre-stressing stand or embedded materials.
 - (iv) Forms shall include temporary openings to facilitate the removal of all foreign substances prior to placing the concrete.
 - (v) Recesses at the ends of the slabs to facilitate positioning of prestressing strands will not be allowed.
- (d) Void Forms
 - (i) Void forms shall be positioned accurately and be strong enough to withstand all pressures and uplift forces without excessive distortion. The void forms shall be well secured and remain in place during the operations of placing and vibrating concrete so that their correct positions with respect to the horizontal and vertical axes of the slabs will be maintained within the limits of the dimensional tolerances.
 - (ii) All void forms shall be vented to alleviate expansion forces from occurring during curing. Each void form shall have 15 mm round vent holes in both the bottom and top slabs.
 - (iii) The void forms and retaining devices shall be tested by the Contractor and accepted by the Contract Administrator prior to the fabrication of the slabs to ensure that the shape and position of the void forms are maintained throughout slabs fabrication.
- (e) The following formed surfaces require an exposed aggregate finish:
 - (i) exposed surfaces in the shear keys
 - (ii) exposed surfaces in the recesses for lifting devices, etc.
 - (iii) interior portions of the fixed end dowel holes.

E60.5.5 Stressing

- (a) The Contractor shall submit to the Contract Administrator the following at least 7 days prior to the start of stressing operations.
 - (i) Copies of the stressing sequence and of the 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 to be used in the stressing operation.
 - (iii) The proposed method of tensioning the strands.
 - (iv) The proposed method of distressing and the distressing sequence.
 - (v) The anchorage losses experienced by the Contractor under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation.

- (vi) A copy of the proposed "Record of Concrete Strength" form, and the "Record of Pre-Tensioning" to be used by the Contractor.
- (vii) Camber calculations of slabs at release.
- (b) The elongation calculations, distressing sequence and all other items having an effect upon the design and performance of the members shall be prepared by a Professional Engineer Registered in Manitoba and the required submissions shall be stamped by the Professional Engineer.
- (c) The submission of the stressing calculations to the Contract Administrator shall in no way relieve the Contractor of the Full responsibility for the success or failure of the stressing operations.
- (d) The initial force in each strand shall be as shown on the plans or as specified by the Contract Administrator. Prior to the stressing of the strands to the initial force, a 2.2 kN load shall be applied to each strand to eliminate slack and equalize stresses. For the first member stressed, the 2.2 kN load shall be applied to all strands and then rechecked before stressing any of the strands to the initial force.
- (e) A pre-calibrated pressure gauge, tensionmeter or load cell shall be used as a check on the elongation, the accuracy of which shall be verified by the Contractor whenever the Contract Administrator considers it necessary.
- (f) Before the stressing operation begins, the Contractor shall have filled out 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 of the each strand. During the stressing operation, the Contractor shall record the actual jack gauge reading, the measure gross elongation, the measured anchorage losses, and then calculate the actual net elongation for each strand.
- (g) The actual net elongation of a strand shall not vary from the required net elongation by more than 3.5 mm. The actual anchorage losses encountered shall be used to modify the gross elongation required, if the actual net elongations are consistently greater or less than the required net elongation.
- (h) At no time shall the actual jack pressure exceed the pressure corresponding the calculated gross elongation by the 5 percent. If the required gross elongation is not obtained by stressing to this maximum allowable jack pressure at one end of the member, it will be necessary to complete the stressing from the other end of the member.
- (i) A copy of the "Record of Pre-Tensioning" form shall be submitted to the Contract Administrator upon completion of the pre-tensioning of each member.
- (j) Tensioning shall be carried out in a manner such that the jack is coaxial with the tendon or strand. If the strands are tensioned individually, care shall be taken to ensure the unravelling of the strand does not take place.
- (k) For pre-tensioned members, the Contract Administrator has allowed for a stress loss due to an increase in temperature of the prestressing strands from the time of tensioning to the time of initial set of the concrete. In order to verify the design value used for this stress loss, the Contractor shall keep an accurate record of the temperature of the concrete in each member from the time of placing of the concrete until the completion of the steam curing of the first three (3) members fabricated and every third member thereafter. The results shall be plotted on the graph with the ambient air temperature of the same member.
- (l) 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 distressing sequence shall be approved by the Contract Administrator.
- (m) All pre-tensioning strands shall be cut off flush with the end of the member and the exposed ends of the pre-tensioning strands and a 50 mm strip of adjacent concrete shall be cleaned and painted. Cleaning shall be by abrasive blast to remove all dirt and residue that is not firmly bonded to the metal or concrete surfaces. The surfaces shall be immediately coated with 25 mm coat of zinc-rich paint approved the Contract

Administrator. The paint shall be thoroughly mixed at the time of application and shall be worked into any voids in the pre-tensioning strands.

E60.5.6 Reinforcing Steel

- (a) Reinforcing steel shall be placed accurately in the positions shown on the plans, and shall be retained in such positions by means of bar accessories and wires so that the bars shall not be moved out of alignment, during or after the deposition of concrete. Bar accessories shall be galvanized or shall be made from non-rusting material
- (b) Reinforcing steel shall be kept free of all foreign materials in order to ensure a positive bond between the concrete and steel. The Contractor shall remove any material, which has been deposited on the steel before concrete is placed.
- (c) Intersecting bars shall be tied positively at each intersection.

E60.5.7 Placing of Anchorages

- (a) The anchorages shall be centred in the positions shown on the Drawings. The anchorages shall be fastened securely to the forms to prevent displacement during the placing and vibrating of concrete. The joints between the forms and anchorages shall be taped to prevent leakage of concrete mortar. The placement tolerance shall be as per CSA A23.4.

E60.5.8 Depositing of Concrete

- (a) Concrete shall be deposited carefully and well worked by vibrating so that it shall fill the forms completely and make complete contact with all reinforcing bars, prestressing strands, and anchorages.
- (b) The concrete shall be deposited in such frequent locations in the forms that there shall be no necessity for moving large quantities of concrete from place to place in the forms. The concrete shall be placed in layers not exceeding 600 mm in depth and each layer shall be vibrated into place by methods, which will not permit the ingredients to separate. The Contractor shall provide and use different personnel on the depositing equipment and on the vibrating equipment to ensure that each batch of concrete shall be properly worked into place as deposited.
- (c) The buckets, chutes or any other equipment used to deposit concrete in the members shall be positioned as close to the top of the forms as possible to keep the free fall of the concrete to a minimum.
- (d) The depositing of concrete in each unit shall be a single continuous complete operation so that each unit shall be monolithic without joints.
- (e) Before any concrete shall be deposited, the interior of the forms shall be made free of all chips, earth, shavings, sawdust, rubbish or other foreign substances.

E60.5.9 Testing of Concrete

- (a) Concrete compressive strength requirements will consist of a minimum strength, which must be attained before various loads, or stresses are applied to the concrete. With the exception of the concrete strengths required for:
 - (i) Transfer of the pre-tensioning forces.
 - (ii) Subjecting a member to freezing temperatures.
 - (iii) Hauling and erecting a member.
- (b) All concrete shall attain the minimum strength as shown the Drawings and indicated in this Specification at the age of 28 days. The compressive strength of the concrete is to be determined in accordance with CSA Standard A23.2-2000.
- (c) The minimum number of test cylinders that a Contractor shall mould from each separately mixed batch of concrete to be placed in a member is as follows:
 - (i) Two (2) cylinders to be tested prior to the transfer of the pre-tensioning forces where applicable.
 - (ii) Three (3) cylinders for the determination of 28 day strength.

- (iii) Two (2) cylinders to be tested prior to the member being hauled to the site and erected, where applicable. In the event that the strength of the concrete cylinder(s) tested prior to the transfer of the pre-tensioning forces is less than the strength required for transferring the pre-tensioning forces, the Contractor shall mould and test additional cylinders from each subsequent batch of concrete. The number of additional cylinders to be moulded and tested for the purpose of establishing the required concrete strength for the transfer of the pre-tensioning forces will be determined by the Contract Administrator. All test cylinders shall be cured under the same conditions as the member until such time as the steam curing or moist curing of the member has been completed.
- (d) In addition to the moulding of the specified number of test cylinders the Contractor will be required to perform the following tests on every separate batch of concrete to be placed in a member:
 - (i) slump
 - (ii) air
 - (iii) temperatureand to record the results of such tests.
- (e) The Contractor shall be responsible for maintaining an up-to-date record of all test results on a "Record of Concrete Strength" form approved by the Contract Administrator. A separate "Record of Concrete Strength" form is to be prepared for each member and the strengths of the test cylinders as well as the pertinent data are to be listed in the same order as the batches of concrete were placed in the forms. A complete set of test results is to be submitted to the Contract Administrator within seven (7) days after the date that the 28 day cylinders from the last member were tested. All costs involved in performing and recording the previously mentioned tests will be the responsibility of the Contractor.
- (f) The Contract Administrator at his own discretion and at the City's expense may make any other tests deemed necessary on the concrete, on the components of the concrete as well as on any finished or partially finished member. The Contractor must allow the Contract Administrator unhindered access to the concrete, concrete components and members and to also assist the Contract Administrator in carrying out any test.

E60.5.10 Vibrating Concrete

- (a) Vibrators shall only be used when acceptable to the concrete supplier.
- (b) External vibration shall be used when sections are too small or inaccessible for the internal type.
- (c) Internal vibrators shall be used in all sections, which are sufficiently large, and they shall be supplemented by platform or screed-type vibrators in the event that satisfactory top surfaces cannot be obtained with the internal type alone; internal vibrators shall be supplemented with vibrators operated against outside of the forms to improve vertical surfaces.
- (d) 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 25 mm slump.
- (e) 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. Form vibrators shall be attached to the forms in such a manner as to transmit the vibration to the concrete effectively and the vibrators shall be raised in lifts as filling of the forms proceeds; the dimension of each lift being not more than the height of concrete visibly affected by the vibration. The form vibrators shall be spaced

horizontally apart at distances not greater than the radius through which the concrete is visibly affected.

- (f) Internal vibrators shall be kept constantly moving vertically in the concrete and they shall be applied at points uniformly spaced that are not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from the surrounding concrete. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively but care shall be taken to avoid hitting the forms with sufficient force to damage them.
- (g) With form or internal vibrators, the vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 20 seconds of vibration per square foot of surface of each layer of the concrete, computed on the basis of the visibly affected radius and taking overlapping into consideration. Surface vibrators shall be applied only long enough to embed the coarse aggregate and to bring enough mortar to the surface for satisfactory screeding.
- (h) Care will have to be exercised so as not to damage the prestressing steel in any way, and so that the vibration is not transferred through the steel to concrete already poured and which is at the stage between the initial and final set.
- (i) The tops of all members shall receive a screeded, untrowelled surface.
- (j) Immediately after the removal of the forms, any defects in the concrete shall be brought to the Contract Administrator's attention and they shall be repaired as directed by the Contract Administrator, provided the defects are not extensive enough to cause rejection of the member.
- (k) Honeycomb, if any, shall be repaired as soon as the forms are taken off, subject to the approval of the Contract Administrator. When approved by the Contract Administrator, repairs shall be accomplished by removing any aggregate that is loose or that is not thoroughly bonded to the surrounding concrete, washing the sound concrete with clean water, using a wire brush to remove any loose particles and by applying an approved epoxy resin to the dried areas to be patched immediately prior to the applying of cement mortar. Patched areas shall be rubbed flush with the surrounding surface after the cement mortar has hardened.
- (l) Holes made by hold-up or hold-down devices or other fabrication equipment, shall be cleaned of all oil or grease, washed with clean water and then, without delay, patched flush with the surface of the member with the cement mortar
- (m) All objectionable fins, projections, offsets, steaks, or other surface imperfections shall be totally removed to the Contract Administrator's satisfaction by approved means.

E60.5.11 Concrete Finish

- (a) The top surfaces of the slabs shall be finished to produce even indentations at right angles to the longitudinal centreline of the slabs. The indentations shall be 5 mm (minimum), full amplitude, and spaced not greater than 15 mm apart.
- (b) The Contractor shall construct a 25 mm deep recess around all lifting devices. These recesses shall be rectangular in shape with vertical sides, and the distance between the lifting device and the vertical sides shall not exceed 50 mm.
- (c) 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 slab. Should the top surface exhibit excessive laitance or "frothing", or any other deleterious effects, the Contractor shall repair the concrete to the satisfaction of the Contract Administrator.
- (d) 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

- (e) 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.
- (f) Holes made by hold-up or hold-down devices or other fabrication equipment, shall be cleaned of all oil and grease, washed with clean water and then, without delay, patched flush with the surface of the slab with the approved cementitious mortar.
- (g) All objectionable fins, projections, offsets, streaks, and other surface imperfections shall be removed totally to the Contract Administrator's satisfaction by approved means.
- (h) Finally, the concrete surface shall be wetted down thoroughly and all air pockets and other surface cavities shall be filled carefully with the approved cementitious mortar. When sufficiently dry, the surface shall be rubbed down to leave a smooth and uniform finish. Cement washes of any kind will not be allowed.
- (i) If, in the Contract Administrator's opinion, repairs to the concrete are not satisfactory or will be detrimental to the strength or long-term durability of the slab, the Contractor shall, and as directed by the Contract Administrator, replace the slab.
- (j) Surfaces to be in contact with grout after slab erection (recesses for lifting devices, shear keys, etc.) shall be given an exposed aggregate finish.

E60.5.12 Curing

- (a) Concrete shall be either moist cured for a minimum of three days from the time of casting or steam cured until the concrete has reached a strength (fci) as shown on the plans or as specified by the Contract Administrator.
- (b) If steam curing is used, it shall not be applied until after the initial set has taken place. Initial set shall be considered to have taken place four (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 member in question.
- (c) From the time of pre-tensioning to the time of initial set, the ambient air temperature of the member shall not vary by more than $\pm 3^{\circ}$ C. During steam curing the ambient air temperature shall rise at a rate not to exceed 15° C per hour to a maximum temperature of 70° C.
- (d) An air temperature recording thermometer approved by the Contractor Administrator shall be laced on the top of the member after placing of concrete is completed and the thermometer shall not be removed until after steam curing has been completed. A graph showing the ambient air temperature plotted against the time of day shall be submitted to the Contract Administrator by the Contractor upon completion of the steam curing for each member. 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.
- (e) Once curing has been completed, the temperature of the concrete shall not be allowed to fall at a rate exceeding 15° C per hour.
- (f) The members shall not be subjected to freezing temperatures until reaching the design strength (f'c) as shown on the plans.

E60.5.13 Grouting

- (a) Grout shall be mixed preferably in a colloidal grout mixer of the roller type or a high speed stirring mixer capable of operating from 1,800 to 2,000 r.p.m. The mixing shall be done at high speeds for 2 or 3 minutes, followed by slow agitation until the grout is used up.
- (b) From the mixer, the grout shall pass through a strainer into positive displacement grouting pumps equipped with a re-circulating device for use when the grout is not being injected.

- (c) The member shall be kept from freezing for at least 72 hours beyond the completion of grouting or mortaring operations, providing that the preceding temperatures have not been below 15.6°C. In the event that the preceding temperatures are below 15.6°C, the 72 hours may be extended by the Contractor Administrator.
- (d) The Contractor shall take not less than six (6) standard cubes at his own cost during each day of grouting operations for 7 and 28 day strength determinations. The results of these tests as well as the slump, air tests and grout temperature shall be supplied to the Contractor Administrator.
- (e) The Contractor must take steps as to ensure the ducts will not have air pockets upon completion of grouting. Grout admixtures to increase flowability are acceptable. Admixtures must be reviewed by the Contract Administrator.

E60.5.14 Handling, Storage and Loading

- (a) Lifting devices shall be cast into the concrete at the locations as shown on the Shop Drawings.
- (b) The lifting devices shall be of such a nature as to avoid twisting, racking, or other distortions while handling, storing, moving and erecting the slabs. The devices shall be anchored fully to the main body of concrete. The devices shown on the Drawings are minimum requirements and the Contractor shall satisfy himself as to the adequacy of the devices. The slabs shall be picked up only by the lifting devices.
- (c) The Contractor shall be responsible for storage of the slabs from the completion of their fabrication until they are required for erection. The Contractor may have to store, free of charge, all or portions of the Substantial Performance date, depending upon the actual construction progress.
- (d) During storage and hauling, the slabs shall be maintained in an upright position and shall be supported within 50 mm on the inside of the bearing area. Extreme care shall be exercised during the handling and storage of the precast slabs to avoid twisting, cracking or other distortion that may result in damage to the slabs.

E60.5.15 Handling and Transportation of Slabs

- (a) The Contractor shall load and transport all of the slabs in accordance with the following:
 - (i) The Contractor shall be responsible for the design, supply, installation and removal of temporary wind bracing and lateral stability bracing for slabs as may be required during all of the Contractor's handling operations, including loading and transporting of the slabs.
 - (ii) Should the Contractor choose to transport the slabs to a storage location, he shall also be responsible for the unloading procedures. The submission of design calculations and Shop Drawings for the temporary wind bracing and lateral stability bracing to the Contract Administrator shall in no way relieve the Contractor of the full responsibility for the success or failure of the design.
- (b) All loading and transporting of the slabs shall be under the direction of a Professional Engineer, registered in the Province of Manitoba. The Engineer shall be experienced in bridge slab loading and transporting and shall be present for slab loading and transporting.
- (c) The members shall not be transported until the concrete design strength ($f'c$) has been reached.
- (d) Extreme care shall be exercised during the handling and transportation of the precast slabs to avoid twisting, cracking or other distortion that may result in damage to the slab.
- (e) The Contractor shall be responsible for protecting the slabs at restraint points on the vehicle. Any damaged corners or surfaces of the slabs are to be regarded as honeycomb and repaired in accordance with E20.5.12 of this Specification.

- (f) The Contractor and the Contract Administrator shall visually inspect the slabs once they have been loaded on the hauling equipment and immediately prior to the unloading. Extensive cracking of the slabs during transportation will be basis for rejection by the Contract Administrator.
- (g) When transporting bridge slabs, the Contractor shall be responsible for ensuring that all of the required permits have been acquired and the conditions of all permits are met.
- (h) The Contractor shall submit his proposed route for transporting the slabs including traffic control procedures as part of the proposed loading and transporting procedure. In all traffic control situations, the flagmen must be trained and properly attired in flagman's vest and approved headgear with approved flagman's stop/slow paddle or fluorescent red flag. The proper advance signing must also be in place.
- (i) No loose timber blocking will be permitted for use as temporary works for any aspect of slab handling, storage and transportation.
- (j) It is the Contractor's responsibility to ascertain the actual weight of the slabs. The concrete in the precast prestressed slabs may be denser than regular concrete and the slabs contain a high percentage of reinforcement and stressing strands that also tend to increase the weight of the slabs.

E60.6 Erection

E60.6.1 Submittals

The Contractor shall submit the following to the Contract Administrator:

- (a) A schedule and detailed plan clearly illustrating the method and sequence by which the Contractor proposes to unload and erect the precast prestressed concrete slabs. The slab erection procedure shall include detailed design notes and Shop Drawings that are sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba necessary to describe the following:
 - (i) Proposed lifting methodology, devices, their locations on slabs and patching procedures after erection.
 - (ii) Type and capacity of equipment.
 - (iii) Sequence of operation, including position of cranes, trucks with slabs, and traffic accommodation.
 - (iv) Detailed crane position on the ground, particularly adjacent to substructure elements, such as piers and abutments, with details of load distribution on wheels and outriggers. If approved by the Contract Administrator, details of crane position on the structure, showing wheel loads and axle spacing of equipment moving on structure.
 - (v) Loads and their position from crane wheels and outriggers during all positions of lifting when crane is on or adjacent to the structure.
 - (vi) Details of temporary falsework, including proposed methods to be used to ensure stability and the required splice elevations and structure shape prior to placing concrete and details of release (if applicable).
 - (vii) Method of providing temporary supports for stability.
 - (viii) Details of lifting of units, showing vertical forces at lifting devices.
 - (ix) Provisions for control and adjustment of errors for width and positioning of curbs or exterior units (if applicable).
 - (x) Complete details of blocking for bearings where necessary to constrain movement due to horizontal forces and/or gravity effects.
 - (xi) Provide an "As Constructed" detailed survey of the substructure showing the following:
 1. Location and elevation of all bearing seats;
 2. Shim height at each bearing location, if applicable;

3. Top of slab elevations at each bearing (and each splice location where applicable).
- (xii) Detailed design notes and Shop Drawings for the bearings that are stamped signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba.

E60.6.2 General

- (a) Slab erection time must be 90 days minimum after transfer of pre-stressing forces into the precast slabs.
- (b) Written proof of the concrete strength of the precast prestressed concrete box slabs shall be submitted to the Contract Administrator at least three (3) business days prior to the erection of the precast prestressed concrete box slabs.
- (c) Unloading and erection of the concrete slabs shall be under the direction of a Professional Engineer licensed to practice in the Province of Manitoba. The Professional Engineer shall be experienced in bridge slab erection and be present for all stages of the slab erection.
- (d) Any slab that in the opinion of the Contract Administrator has been damaged or otherwise rendered useless by the improper handling by the Contractor shall be replaced by the Contractor at his own expense.
- (e) It is the Contractor's responsibility to ascertain the actual weight of the slabs. The concrete in the precast prestressed slabs may be denser than regular concrete and may contain a high percentage of reinforcing steel and stressing strands that also tend to increase the weight of the slabs.
- (f) Loose timber blocking will not be permitted for use as temporary works for any aspect of slab erection.
- (g) Before taking possession or erection of the slabs, the Contractor shall verify that the lengths of the slabs, the layout of the substructure units, the elevations of the bearing seats, and the location of the anchor bolts are in accordance with the Drawings and Specifications. All discrepancies discovered by the Contractor shall be brought immediately to the attention of the Contract Administrator.

E60.6.3 Lifting Hooks and Lifting Holes

- (a) After the Contract Administrator has approved the erection positions of the slabs, all lifting hooks shall be cut off flush with the top of the slabs.
- (b) All lifting holes shall be filled with an approved grout.

E60.6.4 Placing and Grouting of Anchor Rods

- (a) The Contractor shall drill holes in the substructure unit to the size and depth as shown on the plans.
- (b) Drilling shall be done through holes already provided in the designated slabs. The Contractor shall exercise utmost care not to damage the slabs during drilling operations.
- (c) After the holes have been drilled and cleaned out by compressed air, anchor rods shall be placed and grouted as shown on the plans.
- (d) Cement grout shall be prepared as specified in Section E40.4.19 of this Specification.

E60.6.5 Removal of Falsework and Site Clean-up

- (a) Upon completion of the erection and before final acceptance, the Contractor shall remove all temporary falsework. He shall remove all piling, excavated or surplus materials, rubbish and temporary buildings, replace or renew any damaged fences and restore in an acceptable manner all property damaged during the execution of the Work. Disposal of surplus materials shall be in a manner and location satisfactory to the Contract Administrator.

- (b) The Contractor shall leave the bridge site, roadway and adjacent property in a neat restored and presentable condition, satisfactory to the Contract Administrator. When requested by the Contract Administrator, the Contractor shall provide written evidence that affected property owners and/or regulatory agencies have been satisfied.

E60.6.6 Quality Assurance

- (a) The Contractor shall provide an office within the plant facilities for the exclusive use of the Contract Administrator for the duration of the contract that is equipped with a desk, two (2) chairs, a digital telephone and an internet connection. Upon completion of the project, all equipment and the office space will be returned to the Contractor in an "as-is" condition.
- (b) The Contract Administrator, at his discretion, may complete other tests deemed necessary on:
 - (i) The concrete;
 - (ii) The concrete constituent materials; or
 - (iii) Any finished or partially finished slab.
- (c) The Contractor shall allow the Contract Administrator unhindered access to the concrete, concrete constituent materials and slabs and shall assist the Contract Administrator in carrying out any test.
- (d) During production of the precast slabs, the Contractor shall weigh completed slabs to verify the mass when requested by the Contract Administrator.
- (e) Records showing details of members installed, temporary bracing installed or removed and weather conditions shall be kept daily and be available to the Contractor Administrator upon request.

E60.7 Measurement and Payment

E60.7.1 Supply of Precast Prestressed Concrete Slabs

- (a) Supply of precast concrete slabs will be measured on a unit basis and will be paid for at the Contract Unit Price per unit for "Supply Precast Prestressed Concrete Slabs," which price shall be payment in full for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E60.7.2 Erection of Precast Prestressed Concrete Slabs

- (a) Erection of precast concrete slabs will be measured on a unit basis and will be paid for at the Contract Unit Price per unit for "Erection of Precast Prestressed Concrete Slabs," which price shall be payment in full for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E61. MODULAR BLOCK RETAINING WALLS

E61.1 Description

- (a) This Specification shall cover all operations related to the design, supply and installation of modular block retaining walls, as herein specified.
- (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 other things necessary for and incidental to the satisfactory performance and completion of all work hereinafter specified.

E61.2 Materials

E61.2.1 Modular Blocks

- (a) Concrete blocks to be AB Classic 200 mm (H) x 300 mm (D) x 460 mm (L), natural concrete, by Allan Block Retaining Wall Systems available through Expocrete, or as approved by the Contract Administrator.

E61.2.2 Soil Reinforcement

- (a) Soil reinforcement to be Geogrid, or as approved by the Contract Administrator.

E61.2.3 Granular Base Material

- (a) Base material to consist of sound, hard, crushed rock in accordance with CW 3110 Base Course Material.

E61.2.4 Granular Free Draining Material

- (a) The draining material shall be Coarse Aggregate in accordance with the requirements of E40, "**Structural Concrete**".

E61.2.5 Granular Fill Material

- (a) The granular fill material shall be base material in accordance with E61.2.3.

E61.2.6 Material Limits

- (a) The material limits pertaining to the modular block retaining wall are as per the Drawings. All materials within the limits shown on the Drawings shall be considered incidental to the payment item for the modular block retaining wall.

E61.2.7 Drainage

- (a) Wall drainage shall be designed and implemented by the Contractor as accepted by the Contract Administrator.

E61.3 Submittals

E61.3.1 Contractor to submit design drawings and calculations, sealed by a Professional Engineer Registered in Manitoba experienced in the design of modular block retaining walls, to Contract Administrator for review no later than twenty (20) days prior to wall installation. Details to include:

- (a) Plan of entire length of wall;
- (b) Elevation of wall indicating top and bottom of wall elevations;
- (c) Sections through walls;
- (d) All vertical and horizontal break points and running dimensions to break points;
- (e) Designation of type and size of blocks including caps;
- (f) Limits and extent of reinforced fill volume;
- (g) Length, size, type and elevation of every layer of geogrid reinforcement;
- (h) Running dimension to changes in length of the geogrid reinforcement;
- (i) The original and final ground elevations;
- (j) Wall drainage plan and detail
- (k) Location of drain lines within geogrid reinforcement;
- (l) Without written consent from the Contract Administrator the modular block wall material shall be as noted in this Specification and on the Drawings. All other materials, type of materials, dimensions of materials and configurations shall be confirmed and determined by the Contractor. This information shown on the Drawings was determined through a preliminary design and shall not be considered final.
- (m) The Geotechnical Report will be supplied to Contractor such that the modular block wall design can be completed.
- (n) The top of wall elevations are to be as shown on the Drawings unless approved, in writing, by the Contract Administrator.

- (o) Construction methods required for the construction of the modular block wall.
- (p) General notes required for construction.

E61.3.2 Samples of modular concrete blocks and soil reinforcing materials to be submitted twenty (20) days prior to wall installation.

E61.4 Construction Methods

- (a) Construction methods to be confirmed by the Contractor.
- (b) Compact subgrade to minimum 98% of standard proctor density prior to placement of wall foundation/base course material.
- (c) Granular base to be compacted to thicknesses and dimensions indicated on the Drawings in layers not exceeding 150 mm. Compact Granular Base to 98% of standard proctor density.
- (d) Moisture content of backfill material before and during compaction shall be uniformly distributed throughout each layer and shall be within about 3% of optimum.
- (e) Only lightweight, hand operated compaction equipment shall be allowed within 600 mm of the face of the concrete units.
- (f) Tracked construction equipment shall not be operated directly upon geogrid reinforcing on within 1 m of concrete units. Minimum fill thickness of 150 mm is required prior to operation of tracked vehicles over geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing fill and damaging the geogrid.
- (g) Any damage to the geogrid reinforcing or other components of the wall caused the Contractor shall be repaired at the Contractor's expense.
- (h) Minimize cutting block. Cut exposed block with power driven abrasive cutting disc or diamond cutting wheel for flush-mounted electrical outlets, grilles, pipes, conduit, leaving 3.0 mm maximum clearance.
- (i) Caps to be positively secured, with landscaping block adhesive.

E61.5 Measurement and Payment

E61.5.1 Modular Block Retaining Wall

- (a) The Design Supply and Installation of the modular block retaining wall will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for "Modular Block Retaining Walls", which price shall be payment in full for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E62. SLOPE PROTECTION PAVING

E62.1 Description

- (a) This Specification shall cover all operations related to slope protection paving Work as herein specified 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) The slopes to be covered by slope protection, unless otherwise specified, shall be trimmed or backfilled to the lines and grades specified on the Drawings, with a tolerance of plus or minus 150 mm. Concrete Slope Protections shall include fine-grading the slope surface to a plane 100 mm below the specified grades, filling with 200 granular backfill as specified herein, and placing 150 mm of reinforced concrete as specified below.

- (d) All thickness measurements indicated herein will be made perpendicular to the slop surface.

E62.2 Reference

E62.2.1 Referenced Specifications and Drawings

- (a) The latest version of the City of Winnipeg Standard Construction Specifications and the latest edition and all subsequent revisions of the following standards:
 - (i) CAN/CSA A23.1/A23.2 - Concrete Materials and Methods of Concrete; Construction/Methods of Test for Concrete;
 - (ii) CW 3310 - Portland Cement Concrete Pavement Works; and,
 - (iii) Specifications E40.

E62.3 Submittals

- E62.3.1 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E62.4 Materials

E62.4.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contractor as directed by the Contract Administrator.
- (b) The Contractor shall 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.

E62.4.2 Granular Backfill

- (a) Granular backfill shall conform to the requirements of the requirements of the latest version of the City of Winnipeg Standard Construction Specification CW 3110 for Sub-base material of maximum 50 mm size.

- E62.4.3 The provisions of the Specification E40 shall apply.

- E62.4.4 Concrete for slope protections shall meet all the requirements of Type 1 concrete, as defined in Specification E40.

- E62.4.5 Reinforcing steel shall be Pain Steel reinforcement as defined in Specification E42.

E62.5 Equipment

- E62.5.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E62.6 Construction Method

E62.6.1 Reinforced Concrete Slope Paving

- (a) Before starting concrete slope protection work, the Contractor shall submit a detailed layout and forming plan to the Contract Administrator for review.
- (b) The slopes to be covered by concrete slope protection shall be backfilled, trimmed and dressed by the Contractor to lines and grades acceptable to the Contract Administrator. The Contractor shall supply and place granular backfill to a minimum thickness of 100 mm over the trimmed slopes. If top and/or toe cup-off walls are specified on the Drawings, trenches shall be dug to suit. Granular fill shall conform to the requirements of the "Structural Backfill" Specification.
- (c) Reinforcing steel shall be placed in accordance with Specification E42. The method of securing and maintaining the reinforcement mat in its proper locations shall be reviewed and accepted by the Contract Administrator.

- (d) The concrete shall be handled and placed in accordance with Specification E40.
- (e) The concrete shall be placed in either horizontal or vertical courses, with one course being allowed to cure for at least 12 hours before the adjoining course is placed. Formwork shall be provided below and above the reinforcement mat to ensure proper slab thickness, correct positioning of the mat, and the formation of a proper cold joint between courses. Vertical or horizontal joints, as the case may be, shall be formed or grooved at 50 mm to the depth of the reinforcing mat. All joints shall be finished with a sidewalk type edging tool and left unfilled. The surfaces enclosed by joints shall be given a sidewalk surface (floated surface finish; grooved texture). Finishing work shall be carried out by competent, fully experienced personnel only.
- (f) Curing shall be performed as specified in Specification E40.
- (g) Backfill at the toe, top or edges shall be non-granular, and shall not be placed until the slope protection has been reviewed and accepted by the Contract Administrator.

E62.7 Quality Control

E62.7.1 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 the final acceptance of the specified Work.

E62.8 Measurement and Payment

E62.8.1 Slope Protection Paving

- (a) Supplying and placing structural concrete for slope protection paving will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for "Slope Protection Paving", which price shall be payment in full for supplying all materials and for completing all operations herein described and all other items incidental to the Work included in this Specification, and accepted by the Contract Administrator.
- (b) The supply and installation of all isolation joints and seals for slope pavement as indicated on the Drawings shall be considered incidental to the Work.
- (c) The Contractor is reminded that excavation and grading, supply and installation of geotech and placing granular backfill and heating and hoarding (if required), are incidental to the Work accordance with this Specification.

E63. ELECTROCHEMICAL CHLORIDE EXTRACTION (ECE)

E63.1 Description

- (a) This Specification shall cover the use of electrochemical treatment to remove chloride from salt-contaminated concrete and, thereby, prevent and /or halt reinforcement corrosion. This electrochemical chloride extraction (ECE) treatment is performed by applying an electrical field between the reinforcement and an anode mesh placed in a reservoir on the surface of the concrete
- (b) The ECE treatment shall be applied to the contaminated area of the structure as detailed in the contract drawings. Prior to performing ECE, all concrete repair work shall be completed as per the contract documentation. If any delamination's and spalls are discovered in the concrete, they shall be repaired allowing sufficient curing (minimum of 7 days) of the concrete, or utilizing rapid curing repair mortar before proceeding with the treatment.
- (c) The chloride contaminated areas to be treated are as follows:
 - (i) Exposed surfaces of the north and south abutments and wingwalls;
 - (ii) Exposed surfaces of the north and south pier caps and pier columns;
 - (iii) Centre pier cap.

E63.2 ECE Contractor Qualifications

- (a) A qualified specialty ECE contractor shall perform and monitor the ECE treatment.
- (b) The ECE contractor shall have successfully completed, at least five (5) previous ECE installation projects on concrete structures in Canada or the US within the last ten (10) years. Documentation verifying the description, location, agency, and agency representative contact details shall be submitted with the bid documents and with preconstruction project submittals.

E63.2.2 ECE Installation Personnel Qualifications

- (a) All subcontractor personnel engaged in the ECE works shall have satisfactorily completed an education and training program in the installation methods, monitoring, and removal procedures for ECE as provided by an ECE technology supplier with twenty (20) or more years of ECE project installation work experience. Training certification shall be submitted with bid documents and with preconstruction project submittals.

E63.2.3 ECE Project Management and Quality Control personnel Qualifications

- (a) The ECE contractor shall provide a Cathodic Protection (CP) Specialist accredited by the National Association of Corrosion Engineers (NACE) with a minimum of ten (10) years of ECE work experience. The CP Specialist, or a NACE CP Technician under their direction, shall supervise the overall installation of the ECE system, including the design of construction sequence and perform sufficient site visits to oversee all phases of the work.
- (b) The CP Specialist or the CP Technician under their direction shall be responsible for preparing and implementing a quality control plan for the project.
- (c) The Project Site Superintendent and the CP Technician shall each have a minimum of five (5) years ECE system installation work experience in a supervisory / quality control position.
- (d) Qualification of the Project Management / Quality Control personnel shall be submitted with the bid documents and with preconstruction project submittals.

E63.3 Materials and Equipment

E63.3.1 Materials for Concrete Repair

- (a) Only Portland cement concrete or mortars having an appropriate electrical resistivity shall be used in repairs.

E63.3.2 Anode System

- (a) General
 - (i) The anode system shall consist of an anode mesh embedded in a reservoir on the concrete surface. The electrolyte reservoir shall consist of either cellulose fiber, or felt cloth, saturated with an electrolyte.
- (b) Anode Mesh
 - (i) The anode mesh to be utilized during the treatment shall be steel mesh. Any rust staining produced by the steel anode during the ECE treatment shall be removed using approved methods.
- (c) Cellulose Fibres
 - (i) For optimum spraying and moisture retention properties, Fosroc Norcure FG2000 fibre or approved equal shall be used. Prior to spraying of the cellulose fibres onto the concrete surface to be treated, wooden battens or suitable spacers shall be fixed to the concrete.
- (d) Felt Cloth
 - (i) In order to provide appropriate spacing and moisture retention, the felt cloth shall be no less than 3 mm thick, and shall be limited to use on horizontal or deck surfaces.

- (e) Electrolyte
 - (i) The electrolyte shall consist of potable water; Calcium Hydroxide may be added as proposed by the manufacturer and approved by the Contract Administrator.

E63.3.3 Electrical Insulating Material

- (a) The electrical insulating materials to be used to cover all electrical connections shall be waterproof.

E63.3.4 AC Power Supply

- (a) The Contractor will provide an appropriate AC power supply.

E63.3.5 DC Power Supply

- (a) General
 - (i) The DC power rectifiers supplied by the Contractor shall have a sufficient number of independent AC/DC converter circuits for the number of individual concrete zones to be treated.
 - (ii) Each AC/DC converter shall be rated to provide total output current and voltage to meet the current demand of the individual zone. A current distribution box shall be provided for each zone, so that each zone can be divided into subzones that can operate electrically in parallel. The voltage on the secondary side shall be limited to approximately 40 volts DC (VDC). These converters shall be rated to operate continuously at maximum output under site conditions of temperature and relative humidity.
- (b) Enclosures
 - (i) The converters shall be housed in vandal-proof enclosures suitable for site conditions.

E63.3.6 Tests for Monitoring Chloride

- (a) Chloride Analysis
 - (i) Sampling of concrete for chloride analysis is performed by the Contractor by drilling either cores or powder samples. Cores shall be cut into slices and crushed to fine powder.
 - (ii) Analyses to determine the residual water-soluble chloride content in the concrete shall be in accordance to CSA A23.2-4B.
- (b) Sampling Procedure
 - (i) Care shall be taken to prevent cross contamination between samples. As chlorides in unreinforced concrete do not cause any deterioration of the concrete, the main purpose of the Norcure process is to treat the concrete in the vicinity of the rebar. It is therefore important that this is the area which is tested (particularly post treatment samples).

E63.4 Installation Procedure

E63.4.1 Preparation of the Concrete for Treatment

- (a) Pre-Installation Survey
 - (i) Visual and sounding surveys shall be carried out by the Contractor over the full surface area of the structure to determine where delaminations and where previous repairs have been carried out. In addition, areas where concrete cover over the rebars is insufficient (i.e., less than 10 mm) shall be located, by means of a cover meter/pachometer survey and selective chip-outs. Also, a pretreatment corrosion potential survey shall be performed throughout the surface area which will be repeated within one (1) year after completion of the treatment.
- (b) Removal and Replacement of Delaminated Concrete

- (i) Delaminated and spalled concrete areas shall be repaired by the Contactor before treatment in accordance with E12 "Concrete Repairs", before applying the ECE treatment.
- (c) Remediation for Insufficient Concrete Cover
 - (i) A cement-based screed (grout) shall be applied by the Contractor over all areas determined to have insufficient concrete cover until the total cover at each area is at least 10 mm.
- (d) Insulation of Visible or Shallow Metal Components
 - (i) Any tie wires, nails, or other metal components, that are close to the surface or visible on the surface of the concrete, shall be removed or insulated by the Contractor, with silicone rubber or non-conductive epoxy. If necessary, these may be cut back to not less than 10 mm below the surface, then patched with a cement-based grout.
- (e) Reinforcement Continuity
 - (i) The Contactor shall ensure that the top-layer rebar in the structure are electrically continuous prior to treatment. This can be done either at existing spall locations, or at cathode (rebar) connection points. If necessary additional holes can be drilled or chipped. If the voltage difference between any 2 rebars (from different locations in the structure) is no more than 1.0 mV (when measured with a high input impedance voltmeter with a resolution of no less than 0.1 mV), or resistance is less than 5 Ohms (when measured with a Ohm/multi-meter) these rebars are considered to be continuous.
 - (ii) Drawings of the structure showing reinforcement details shall be inspected to locate areas where continuity might not exist, and direct measurements of voltage differences or resistance between rebar in these areas and other areas in the structure shall be made. In addition, measurement points shall include the perimeters and the middle of each structural component. Records of the locations of measurement points and the measured voltage/resistance differences shall be submitted to the Contract Administrator with the final report, or sooner if requested.
 - (iii) Where any electrical discontinuity is identified, proposals for providing continuity shall be submitted to the Contract Administrator for approval before proceeding.
- (f) Reinforcement (Negative) Connections
 - (i) There shall be at least 1 rebar connection per 50 m² of concrete surface area, and never less than 2 connections per zone. Rebar connections shall be made by drilling a 19 mm (3/4") hole down to the rebar, ensuring that the rebar surface is cleaned by the action of the drill. Then insert a lead plug connected to the cathode wire into the hole, and compress the lead plug against the rebar with the use of the setting tool. Immediately after a connection has been made, the connection shall be coated with a non-conductive material by the Contractor, such as silicon rubber, or the hole may be sealed with an approved patch repair mortar.
- (g) Connection of metal fixtures
 - (i) Any metal fixtures attached to the concrete structure must be protected against corrosion by electrical connection to the reinforcement. Exposed steel shall also be masked and protected from contact to the anode mesh.

E63.4.2 Installation of the Anode System

- (a) Preparation of the Concrete Surface
 - (i) The surface of the concrete shall be cleaned of any grease, coating, etc., that may interfere with the passage of electrical current, to ensure optimum treatment efficiency. Sandblasting or water jetting may be required to achieve this.

- (ii) To prevent short circuits, any exposed steel, in or on the surface of the concrete, shall be adequately masked and, if necessary, connected to the reinforcement or removed, before applying the anode system.

(b) Electrolytic Reservoir

- (i) The reservoir shall consist of any anode mesh embedded within electrolyte-saturated material (cellulose fibre or felt cloth).
- (ii) The fibres and the electrolyte shall be delivered through separate hoses, then mixed at a nozzle and sprayed directly onto the surface of the concrete. The anode mesh shall be securely fixed using wooden batten or suitable plastic spacers. (Plastic screws and plugs must be used with wooden battens). The distance between the wooden battens shall depend upon the geometry of the structure and the dimensions of the anode meshes proposed for use. There shall be at least 2 wooden battens for each face of any pier cap and square column (that is no more than 1200 mm wide), and at least four batten for each cylindrical column.
- (iii) The fibre-electrolyte mixture shall be applied only after the anode mesh is securely installed. The fibre-electrolyte mixture shall be installed in 2 layers, with the anode mesh installed in between. The total fibre electrolyte layer shall be approximately 10 mm to 50 mm thick.
- (iv) For horizontal applications, felt cloth shall be implemented as the electrolyte reservoir. Felt shall be laid on the surface, followed by placement of the anode mesh and a topped with a final layer of felt; such that a felt/anode/felt "sandwich" is formed.
- (v) After the anode and reservoir have been stalled, the entire area shall be wrapped with plastic and secured to reduce dehydration. Throughout the ECE treatment, the reservoir shall be wetted with electrolyte and kept saturated. The Contractor shall provide the necessary water supply and containers.
- (vi) Any waste water generated from the ECE process shall be filtered to collect any debris or deleterious material from entering the watercourse.

E63.4.3 Inspection of the Installation

- (a) The installed anode system, its electrical connections, and power cables shall be fully inspected by the Contractor's technician to the satisfaction of the Contract Administrator prior to the initiation of the ECE treatment. AC power shall be connected by a certified electrician as per relevant codes.

E63.5 System Operation and Maintenance

E63.5.1 System Start-up

- (a) Circuit verification
 - (i) Prior to start-up or energization of power, tests shall be undertaken to ensure that all measurements and power distribution circuits are correctly wired, connected and labeled. Where appropriate, the circuits shall have the expected resistances.
 - (ii) Using a suitable voltmeter, the negative polarity of the reinforcement shall be confirmed when the power sources are switched on.
- (b) Adjustment of current output
 - (i) Initial energizing of the system shall be undertaken only upon completion of the procedures described in clause E63.4.1(a) "Pre-Installation Survey".
 - (ii) The current used for the chloride removal treatment shall generally be between 1 A/m² to 2 A/m² and shall not exceed 5 A/m².
 - (iii) During the treatment, the current output shall be measured individually in each anode cable (as detailed in Section E63.5.2, "Monitoring of the System Operation". The total current can be adjusted by decreasing or increasing the applied voltage. If the results indicated an unexpected current distribution, an

inspection shall be carried out to determine the reason, and remedial action shall be taken and documented.

E63.5.2 Monitoring of the System Operation

(a) Inspections

- (i) During the treatment, the operation of the system shall be checked daily by the Contractor and the following records shall be made:
 - Date and Time
 - Current (to each zone and subzone)
 - Voltage (to each zone)
 - Amp-Hour (calculate for each zone)
- (ii) If a problem develops the Contractor shall determine the cause, rectify the problem, and report it to the Contract Administrator.
- (iii) In addition, visual inspection of cable connections, cable insulation, and anode meshes; and wetting of the cellulose fibre shall be conducted daily.
- (iv) Any interruption in the operation shall be recorded and reported to the Contract Administrator.

(b) Determination of chloride content

- (i) In addition to the regular inspection, determination of the residual water soluble chloride shall be carried by the Contractor during the ECE treatment. The determination shall be conducted on concrete samples to be taken at predetermined points at the level of the rebar. The Contractor shall provide these locations to the Contract Administrator, in the Quality Management Plan, and approved by the Contract Administrator prior to commencement of treatment.
- (ii) If the results of any of these analyses indicate that the system is not operating properly, the Contractor shall determine the cause and rectify the situation.

E63.6 Termination of the Electrochemical Chloride Extraction (ECE) Treatment

(a) The ECE treatment shall be performed:

- (i) For approximately 60 days; or
- (ii) Until a total of 600 A-hrs/m² of current has been passed; or
- (iii) Until the chloride in the concrete in the vicinity of the reinforcing steel has decreased to 0.03% by weight of concrete after correction for background chlorides; whichever is the earliest.

E63.7 Dismantlement and Disposal of the System

- (a) After the system is turned off, the Contractor shall remove all electrical cables, conduits hangers, and power supplies from the site. The cellulose fibre, anode mesh and wooden battens shall also be removed from the site or be disposed in accordance with applicable disposal regulations.

E63.8 Post Treatment Cleaning and Patching of the Concrete

- (a) The surface of all treated concrete shall be cleaned using a light abrasive blast to remove stains left by the corroded mesh.
- (b) The entire treated structure shall then be inspected; the occurrence, location, and extent of any physical damage or changes to the concrete shall be noted. Any such defects such as holes made on the concrete (to install wooden battens, conduit hangers, system negative connections, etc.) shall then be repaired by the Contractor.
- (c) The site shall be completely clean at the end of the job.

E63.9 Documentation

- (a) Within one-hundred (100) days upon completion of the surface treatment, the Contractor shall submit a written final report to the Contract Administrator detailing the installation and all operating data for the system. This shall include records of all tests and measurements made before and during treatment, including those listed in "Inspections".
- (b) The final report shall include, and describe in detail, at least the following information:
 - (i) locations of previous repairs and new damages (found and repaired before the treatment in as-built drawings and descriptions of such;
 - (ii) rebar continuity on the structure and locations of any continuity bondings made;
 - (iii) surface preparation performed before treatment;
 - (iv) description of the ECE installation and procedure used;
 - (v) materials used with manufacturers' data sheets;
 - (vi) distribution of test locations and test procedures'
 - (vii) current and voltage readings during treatment;
 - (viii) all test results including pre and post Cl- levels;
 - (ix) pre corrosion potential survey readings;
 - (x) locations and repair of any damage to the concrete arising from the treatment;
 - (xi) discussion of results, including consideration of any local anomalies or variations in results; and
 - (xii) statement on effectiveness of the treatment
- (c) The Contractor shall undertake the post treatment corrosion potential survey within one (1) year from the completion of the treatment. The final report shall be resubmitted, including the post treatment corrosion potential survey reading, to the Contract Administrator within thirty (30) days.

E63.10 Measurement and Payment

E63.10.1 Electrochemical Chloride Extraction

- (a) Electrochemical chloride extraction will not be measured. This Item of Work shall be paid for at the Contract Lump Sum Price for "Electrochemical Chloride Extraction" which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.

E64. PENETRATING CONCRETE SEALER

E64.1 Description

- (a) This Specification shall cover all specifications relating to the supply and installation of penetrating concrete sealer as specified here in and as shown on the Drawings.
- (b) The work to be done under this specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

E64.3.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials shall be new and within the recommended shelf-life, as approved by the Contract Administrator.

E64.3.2 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 be accepted by the Contract Administrator at least five (5) 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 material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

E64.3.3 Penetrating Concrete Sealer

- (a) An approval Type IC silicone sealer Sikagard SN100 or equal as accepted by the Contract Administrator, in accordance with B6.

E64.4 Equipment

- E64.4.1 All equipment shall be a type approved by the Contract Administrator and shall be kept in good working order.

E64.5 Construction Methods

E64.5.1 Type IC Sealer

- (a) An approved Type IC silicone sealer shall be applied to all exposed concrete surfaces of the Empress Street Overpass Piers and Abutments.
- (b) The sealer shall be applied in accordance with the Manufacturer's recommendations; however the application rate shall be increase be 30% from that indicated on the approved Product Sheet. Before applying the sealer, the concrete shall be cured for at least 28 days. The concrete surface shall be dry, and air blasted to remove all dust and accepted by the Contract Administrator prior to applying sealer. In order to ensure uniform and sufficient coverage rates the Contractor shall apply measured volumes of sealing compound to appropriately dimensioned areas of concrete surface, using a minimum of 2 coats. Asphalt concrete pavement surfaces shall be adequately protected from overspray and runoff during sealer application.

E64.6 Quality Control

- E64.6.1 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 materials through to final acceptance of the specified Work. The Contractor shall be wholly responsible for the control of all operations incidental hereto notwithstanding any inspection or acceptance 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.

E64.7 Measurement and Payment

- E64.8 The supply and installation of penetrating concrete sealer will be measured on an area basis and paid for at the Contract Unit Price per square metre for "Penetrating Concrete Sealer" which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification and accepted by the Contract Administrator.