THE CITY OF WINNIPEG

TENDER

TENDER NO. 1045-2019B

JEFFERSON EAST COMBINED SEWER RELIEF – CONTRACT 5 – SEMPLE TRUNK SEWER

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PART B - BIDDING PROCEDURES

B1. CONTRACT TITLE

B1.1 JEFFERSON EAST COMBINED SEWER RELIEF – CONTRACT 5 – SEMPLE TRUNK SEWER

B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 12:00 noon Winnipeg time, January 31, 2020.

B2.2 The Contract Administrator or the Manager of Materials may extend the Submission Deadline by issuing an addendum at any time prior to the time and date specified in B2.1.

B3. SITE INVESTIGATION

B3.1 Further to C3.1, the Bidder may view the Site without making an appointment.

B3.2 The Bidder is advised that before submitting a Bid, each Bidder may, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies and obtain any additional information and data which pertain to subsurface or physical conditions at or contiguous to the Site or otherwise, which may affect cost, progress, performance, or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

B4. ENQUIRIES

B4.1 All enquiries shall be directed to the Contract Administrator identified in D5.1.

B4.2 If the Bidder finds errors, discrepancies or omissions in the Tender, 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.

B4.3 Responses to enquiries which, in the sole judgment of the Contract Administrator, require a correction to or a clarification of the Tender will be provided by the Contract Administrator to all Bidders by issuing an addendum.

B4.4 Responses to enquiries which, in the sole judgment of the Contract Administrator, do not require a correction to or a clarification of the Tender will be provided by the Contract Administrator only to the Bidder who made the enquiry.

B4.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B4 unless that response or interpretation is provided by the Contract Administrator in writing.

B4.6 Any enquiries concerning submitting through MERX should be addressed to:
MERX Customer Support
Phone: 1-800-964-6379
Email: merx@merx.com

B5. CONFIDENTIALITY

B5.1 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.

B5.2 The Bidder shall not make any statement of fact or opinion regarding any aspect of the Tender to the media or any member of the public without the prior written authorization of the Contract Administrator.

B6. ADDENDA

B6.1 The Contract Administrator may, at any time prior to the Submission Deadline, issue addenda correcting errors, discrepancies or omissions in the Tender, or clarifying the meaning or intent of any provision therein.

B6.2 The Contract Administrator will issue each addendum at least two (2) Business Days prior to the Submission Deadline, or provide at least two (2) Business Days by extending the Submission Deadline.

B6.3 Addenda will be available on the MERX website at www.merx.com.

B6.4 The Bidder is responsible for ensuring that he/she has received all addenda and is advised to check the MERX website for addenda regularly and shortly before the Submission Deadline, as may be amended by addendum.

B6.5 The Bidder shall acknowledge receipt of each addendum in Paragraph 8 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B6.6 Notwithstanding B4, enquiries related to an Addendum may be directed to the Contract Administrator indicated in D5.

B7. SUBSTITUTES

B7.1 The Work is based on the Plant, Materials and methods specified in the Tender.

B7.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.

B7.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least five (5) Business Days prior to the Submission Deadline.

B7.4 The Bidder shall ensure that any and all requests for approval of a substitute:

(a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the Plant, Material or method as either an approved equal or alternative;

(b) identify any and all changes required in the applicable Work, and all changes to any other Work, which would become necessary to accommodate the substitute;

(c) identify any anticipated cost or time savings that may be associated with the substitute;

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

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

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

B7.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his/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.

B7.6 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.

B7.6.1 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.

B7.7 If the Contract Administrator approves a substitute as an "approved equal", any Bidder may use the approved equal in place of the specified item.

B7.8 If the Contract Administrator approves a substitute as an "approved alternative", any Bidder bidding that approved alternative may base his/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 B18.

B7.9 No later claim by the Contractor for an addition to the Total Bid Price because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.

B8. BID COMPONENTS

B8.1 The Bid shall consist of the following components:

(a) Form A: Bid;

(b) Form B: Prices;

(c) Form G1: Bid Bond and Agreement to Bond;

B8.2 Further to B8.1, the Bidder should include the written correspondence from the Contract Administrator approving a substitute in accordance with B7.

B8.3 All components of the Bid shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely.

B8.4 The Bid shall be submitted electronically through MERX at www.merx.com.

B8.4.1 Bids will **only** be accepted electronically through MERX.

B8.5 Bidders are advised that inclusion of terms and conditions inconsistent with the Tender document, including the General Conditions, will be evaluated in accordance with B18.1(a).

B9. BID

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

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

(a) if the Bidder is a sole proprietor carrying on business in his/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.

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

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

B9.4 Paragraph 11 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;

(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.

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

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

B10. PRICES

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

B10.1.1 Prices stated on Form B: Prices shall not include any costs which may be incurred by the Contractor with respect to any applicable funding agreement obligations as outlined in D30. Any such costs shall be determined in accordance with D30.

B10.2 The Bidder must complete the Approximate Quantity column for item C.1 Initial Span on Form B: Prices in accordance with D22.

B10.3 The quantities listed on Form B: Prices are to be considered approximate only. The City will use said quantities for the purpose of comparing Bids.

B10.4 The quantities for which payment will be made to the Contractor are to be determined by the Work actually performed and completed by the Contractor, to be measured as specified in the applicable Specifications.

B10.5 Payments to Non-Resident Contractors are subject to Non-Resident Withholding Tax pursuant to the Income Tax Act (Canada).

B10.6 The Bidder shall enter the Total Bid Price from Form B: Prices into the Total Bid Price field in MERX.

B10.6.1 Bidders are advised that the calculation indicated in B18.5 will prevail over the Total Bid Price entered in MERX.

B11. DISCLOSURE

B11.1 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.

B11.2 The Persons are:

(a) N/A

B12. CONFLICT OF INTEREST AND GOOD FAITH

B12.1 Bidders, by responding to this Tender, declare that no Conflict of Interest currently exists, or is reasonably expected to exist in the future.

B12.2 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 Tender 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 Tender process) of strategic and/or material relevance to the Tender 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.

B12.3 In connection with its Bid, each entity identified in B12.2 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 Tender 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.

B12.4 Without limiting B12.3, 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.

B12.5 Without limiting B12.3, 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 B12.4 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.

B12.6 The final determination of whether a perceived, potential or actual Conflict of Interest exists shall be made by the City, in its sole discretion.

B13. QUALIFICATION

B13.1 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.

B13.2 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 https://winnipeg.ca/finance/findata/matmgt/listing/debar.pdf

B13.3 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);

(d) The City has, through a Request for Qualification process, RFQ No. 1045-2019A, identified Tunneling Contractors who have successfully prequalified to participate in this project. Only submissions from one of the prequalified contractors will be accepted. Any Bidder submitting a tender who was not prequalified by this process will be rejected.

(e) A Bidder may only submit for the Tunneling method they have been prequalified for. If a Bidder has been prequalified for both methods (single-pass tunneling method with pipe jacking and two-pass tunneling method with grouted in place carrier pipe) they may submit on both methods, however a separate Bid is required for each method.

(f) The following Contractors have been prequalified for the single-pass method:

(i) Ward & Burke Microtunnelling Ltd.

(ii) Marathon Bessac JV

(iii) Technicore Underground Inc.

(iv) Shanghai Construction Group Canada

(v) Innovative Pipeline Crossings Inc.

(vi) Nelson River Construction Inc.

(g) The following Contractors have been prequalified for the two-pass method:

(i) McNally Construction Inc.

(ii) Dibco Underground Limited

(iii) C&M McNally Engineering Corp.

B13.4 Further to B13.3(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™) in the form of:

(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/).

B13.5 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.

B13.6 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, in form of resumes of the personnel and a letter of commitment from the Bidder, of the Construction Team key members listed on Form D: Construction Team in RFQ 1045-2019A. In the event these key members are no longer available, provide satisfactory evidence and experience of substitute members, fully compliant to the requirements of Section B27 of RFQ 1045-2019A. Failure to provide the listed personnel, or provision of alternate personnel with equivalent or higher experience, may be grounds for rejection of the Tender.

B13.7 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.

B14. BID SECURITY

B14.1 A sample Bid Bond and Agreement to Bond are available on The City of Winnipeg, Corporate Finance, Materials Management Division website at https://www.winnipeg.ca/MatMgt/templates/files/eBidsecurity.pdf.

B14.2 The Bidder shall provide digital bid security in the form of 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).

B14.3 Bid security shall be submitted in an electronic or digital format meeting the following criteria:

(a) The version submitted by the Bidder must be verifiable by the City with respect to the totality and wholeness of the bond form, including: the content; all digital signatures; all

digital seals; with the surety company, or an approved verification service provider of the surety company.

(b) The version submitted must be viewable, printable and storable in standard electronic file formats compatible with the City, and in a single file. Allowable formats include pdf.

(c) The verification may be conducted by the City immediately or at any time during the life of the bond and at the discretion of the City with no requirement for passwords or fees.

(d) The results of the verification must provide a clear, immediate and printable indication of pass or fail regarding B14.3(a).

B14.4 Bonds failing the verification process will not be considered to be valid and the bid shall be determined to be non-responsive in accordance with B18.1(a).

B14.5 Bonds passing the verification process will be treated as original and authentic.

B14.5.1 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.

B14.6 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 formed with the successful Bidder and the contract securities are furnished as provided herein. The bid securities of all other Bidders will be released when a Contract is awarded.

B14.7 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 Tender.

B15. OPENING OF BIDS AND RELEASE OF INFORMATION

B15.1 Bids will not be opened publicly.

B15.2 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 MERX website at www.merx.com.

B15.3 After award of Contract, the name(s) of the successful Bidder(s) and their Contract amount(s) will be available on the MERX website at www.merx.com.

B15.4 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).

B15.4.1 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.

B16. IRREVOCABLE BID

B16.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 9 of Form A: Bid.

B16.2 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 formed and the contract securities have been furnished as herein provided, but any Bid shall be deemed to have lapsed unless accepted within the time period specified in Paragraph 9 of Form A: Bid.

B17. WITHDRAWAL OF BIDS

B17.1 A Bidder may withdraw his/her Bid without penalty at any time prior to the Submission Deadline.

B18. EVALUATION OF BIDS

B18.1 Award of the Contract shall be based on the following bid evaluation criteria:

(a) compliance by the Bidder with the requirements of the Tender, or acceptable deviation there from (pass/fail);

(b) qualifications of the Bidder and the Subcontractors, if any, pursuant to B13 (pass/fail);

(c) Evaluated Total Bid Price;

(d) economic analysis of any approved alternative pursuant to B7.

B18.2 Further to B18.1(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.

B18.3 Further to B18.1(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 qualified.

B18.4 Further to B18.1(c), where the Total Bid Price exceeds the pre-bid estimate stated in D3.4, the City may determine that no award will be made in accordance with B19.2.1(a).

B18.5 Further to B18.1(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.

B18.5.1 Bidders are advised that the calculation indicated in B18.5 will prevail over the Total Bid Price entered in MERX.

B19. AWARD OF CONTRACT

B19.1 The City will give notice of the award of the Contract or will give notice that no award will be made.

B19.2 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 qualified, and the Bids are determined to be responsive.

B19.2.1 Without limiting the generality of B19.2, 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.

B19.3 If funding for the Work is provided to the City of Winnipeg by the Government of Manitoba and/or the Government of Canada, Bidders are advised that the terms of D30 shall immediately take effect upon confirmation of such funding, regardless of when funding is confirmed.

B19.4 Where an award of Contract is made by the City, the award shall be made to the qualified Bidder submitting the lowest evaluated responsive Bid, in accordance with B18.

B19.4.1 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.

B19.4.2 If no Contract is awarded, then the City of Winnipeg will pay the requested Bidder for each of the requested submissions listed in E4 for the preparation and delivery of Shop Drawings. Payment will be based on an agreed upon valuation of the actual costs associated with the preparation and delivery of the Shop Drawings in general accordance with the terms provided in C7.4. Delivery of the Shop Drawings to the City and payment of the above amounts will constitute full and final consideration of each party to the other and neither party will have any further liability to the other with respect to this Bid Opportunity.

PART C - GENERAL CONDITIONS

C0. GENERAL CONDITIONS

C0.1 The *General Conditions for Construction* (Revision 2019 09 01) 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 Tender 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.

D1.2 Further to C2.4,

(a) Specifications shall govern over the Geotechnical Baseline Report (GBR).

(b) The GBR shall govern over the Geotechnical Data Report (GDR).

D1.3 Notwithstanding C3.1(a)(ii), the nature of the surface and subsurface conditions at the Site, and reviewed the GBR and GDR appended to these Specifications.

D2. PROJECT BACKGROUND

D2.1 The Jefferson East Combined Sewer Relief project has been under construction since 2011. Contracts 1 through 3 involved relief of sewer catchments, east of Main Street. This work was completed in 2013. Contract 4 involved the construction of a new 2100 millimetre outfall and control chamber to the Red River, immediately north of Semple Avenue, and was completed in 2017. A connection stub to this outfall is located on Scotia Street at Semple Avenue.

D2.2 The existing combined sewers in the project area convey both wastewater and foundation drainage from sanitary services, and storm water from catch basins in the single pipe system. The design objective for this project is to improve the level of service by redirecting the storm water from road drainage to a new land drainage system. It is imperative that both the sanitary and storm services be maintained during construction, and in particular that the level of basement flooding protection not be negatively impacted during construction.

D3. SCOPE OF WORK

D3.1 The Work to be done under the Contract shall consist of the trenchless construction of a new 1800 mm (nominal) and 2100 mm (nominal) land drainage sewer (LDS), and associated sewer laterals on Semple Avenue from Scotia Street to McKenzie Street. Work will include mobilization, traffic control, construction of equipment launch and retrieval shafts, installation of pipe, installation of maintenance holes, street repairs and site restoration

D3.2 Trenchless installation methods used for installation of the trunk LDS sewer must be capable of long continuous drives as indicated on the Drawings, to minimize disturbance to the community. Installation may be made via one pass or two pass tunneling methods as indicated in RFQ 1045-2019A.

D3.3 The major components of the Work are as follows:

(a) Mobilization and site development.

(b) Development and implementation of traffic controls.

(c) Installation and monitoring of surface features, subsurface features, and buildings to identify potential settlements as a result of tunneling activities.

(d) Construction of shafts to facilitate tunneling.

(e) Trenchless installation of approximately 400 m of 1800 mm LDS piping utilizing either single-pass or two-pass tunneling methods.

(f) Trenchless installation of approximately 1150 m of 2100 mm LDS piping utilizing either single-pass or two-pass tunneling methods.

(g) Trenchless installation of sewer lateral stub-outs for future contracts.

(h) Installation of manholes on new sewer trunk.

(i) Connection of existing catch basins to new sewer trunk.

(j) Surface restoration and related works.

D3.4 The pre-bid estimate for this Contract is $22,700,000.

D4. DEFINITIONS

D4.1 When used in this Tender:

(a) "**ACI**" means American Concrete Institute;

(b) "**ASTM**" means American Society for Testing and Materials;

(c) "**AWWA**" means American Water Works Association;

(d) "**Benchmark**" means a permanent reference control point established by the Contractor;

(e) "**Building/Structure Monitoring Point**" (BMP) means a structural monitoring point used to monitor horizontal and vertical deformation of structures. BMPs shall consist of non-destructive and stable elements firmly attached to structures with locations clearly identified;

(f) "**Carrier Pipe**" means the permanent pipe for operational use that is used to convey flows;

(g) "**Casing Pipe**" means a permanent pipe installed by MTBM methods which serves as a casing or secondary pipe around a smaller diameter carrier pipe;

(h) "**Charged Days**" means the unit of measure for time of Site Occupancy. For the purpose of assessing Charged Days, a Charged Day will be equivalent to a Working Day as defined in C1.1 (nn) and amended in D18;

(i) "**CLSM**" means Controlled Low Strength Material;

(j) "**Contractor's Engineer**" means a Professional Engineer, registered in the Province of Manitoba and experienced in the design of tunnelling applications, construction shafts for tunnelling applications, pipe for tunnelling applications, and/or other aspects of the Work and hired by the Contractor to complete design work required to complete the Work and as specified herein;

(k) "**CSA**" means Canadian Standards Association;

(l) "**Fibreglass Pipe**" (FGP) means tubular product containing glass fiber reinforcements embedded in or surrounded by cured thermosetting resin. The composite structure may contain aggregate, granular or platelet fillers, thixotropic agents, pigments, or dyes;

(m) "**Final Span**" means the number of Charged Days assessed for Site Occupancy as calculated pursuant to D22.4;

(n) "**Geotechnical Data Report**" (GDR) means a document containing the results of geotechnical investigations carried out on the project site;

(o) "**Geotechnical Baseline Report**" (GBR) means a single source contract document containing measurable contractual descriptions of the geotechnical conditions to be anticipated or to be assumed to be anticipated during construction;

(p) "**Grout Port**" means a port located within the carrier pipe or steel lagging, fitted with a one-way valve, for injection of grout into the annular space between the lagging and the ground or between the carrier pipe and the excavation. Pipe plugs are inserted after grouting is completed;

(q) "**Initial Span**" means the number of Charged Days bid by the Contractor for Site Occupancy on Form B: Prices;

(r) "**Intermediate Jacking Station**" (IJS) means a fabricated steel cylinder fitted with hydraulic jacks, which is incorporated into a pipeline between two specially fabricated pipe segments. Its function is to provide additional thrust in order to overcome skin friction and distribute the jacking forces over the pipe string on long drives;

(s) "**Jacking Record**" means a manually or automatically recorded report that contains information on tunnelling operations as defined herein;

(t) "**Low-Density Cellular Concrete**" (Cellular Concrete) means a lightweight cementitious material that contains stable air or gas cells uniformly distributed throughout the mixture;

(u) "**Microtunnelling**" means a trenchless pipeline installation method utilizing a pipe jacking system to advance a continuous pipe string and remote controlled MTBM through in situ soil and rock to provide continuous support for the excavated face and tunnel bore;

(v) "**Micro Tunnel Boring Machine**" (MTBM) means a steerable tunnelling machine that achieves soil excavation by means of a rotating cutter-wheel. The MTBM is advanced by hydraulic jacking of a continuous pipe string behind the machine from the launching shaft. Excavated soil particles are returned to the surface via a pressurized slurry or belt conveyor system;

(w) "**NEWPCC**" means the City of Winnipeg's North End Wastewater Pollution Control Center;

(x) "**Radial Overcut**" means the radial overcut is determined as the difference between the maximum diameter created by the cutting teeth or overcut band on the TBM (whichever is greater) and the outer diameter of the tail shield, divided by two;

(y) "**Site Occupancy**" means a system for monitoring and administering progress of the Work. Site Occupancy involves the Contract Administrator setting a completion date for the Work along with a daily Contract Administration cost (Site Occupancy cost) for each Working Day the Contractor is able to work. The Contractor bids the number of anticipated Working Days to complete the Work, and depending on the actual Working Days to complete the Work, there may be a bonus payment or deduction applied to the final payment;

(z) "**Settlement Point**" means a point with elevation and spatial location established by survey prior to construction. The point is re-surveyed periodically to monitor ground movements. The point may be a nail, pin, subsurface settlement rod, borehole extensometer, or other device that can be readily located and surveyed;

(aa) "**Subsurface Monitoring Point**" (SSM) means a cased borehole settlement monitoring point located above the tunnel crown used for detecting settlement between the location of the settlement point and the tunnel excavation. This device serves as a simple borehole extensometer;

(bb) "**Surface Monitoring Point**" (SMP) means monitoring points established to measure elevation of the ground surface;

(cc) "**Tunnel Boring Machine**" (TBM) means a steerable tunnelling machine that achieves soil excavation by means of a rotating cutter-wheel. The TBM is advanced by hydraulic jacking of a continuous pipe string behind the machine from the launching shaft. Excavated soil particles are returned to the surface via buckets or a belt conveyor system;

(dd) "**Tunnel Face**" means the vertical (or near vertical) soil face at the end of the tunnel heading.

D5. CONTRACT ADMINISTRATOR

D5.1 The Contract Administrator is AECOM Canada Ltd, represented by:

Jordan Thompson, P. Eng
Contract Administrator

Telephone No. 204 477-5381
Email Address Jordan.Thompson@aecom.com

D5.2 At the pre-construction meeting, Mr. Thompson will identify additional personnel representing the Contract Administrator and their respective roles and responsibilities for the Work.

D6. CONTRACTOR'S SUPERVISOR

D6.1 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.

D7. OWNERSHIP OF INFORMATION, CONFIDENTIALITY AND NON DISCLOSURE

D7.1 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 Contractor's own use, or for the use of any third party.

D7.2 The Contractor shall not make any public announcements or press releases regarding the Contract, without the prior written authorization of the Contract Administrator.

D7.3 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.

D7.4 A Contractor who violates any provision of D7 may be determined to be in breach of Contract.

D8. NOTICES

D8.1 Except as provided for in C22.2.2, 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.

D8.2 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the City, except as expressly otherwise required in D8.3, D8.4 or elsewhere in the Contract, shall be sent to the attention of the Contract Administrator identified in D5.

D8.3 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

D8.4 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

D9. FURNISHING OF DOCUMENTS

D9.1 Upon award of the Contract, the Contractor will be provided with five (5) complete sets of the Tender. If the Contractor requires additional sets of the Tender, they will be supplied to him/her at cost.

SUBMISSIONS

D10. AUTHORITY TO CARRY ON BUSINESS

D10.1 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.

D11. SAFE WORK PLAN

D11.1 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 Documents, if applicable.

D11.2 The Safe Work Plan should 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

D11.3 Notwithstanding B13.4 at any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require an updated COR Certificate or Annual Letter of good Standing. A Contractor, who fails to provide a satisfactory COR Certificate or Annual Letter of good Standing, will not be permitted to continue to perform any Work.

D12. INSURANCE

D12.1 The City will provide and maintain the following owner controlled project insurance coverage to remain in place at all times during the performance of the Work:

(a) Wrap-up liability insurance in a minimum amount of no less than five million dollars ($5,000,000) inclusive per occurrence and five millions dollars ($5,000,000) general aggregate. The insured parties shall include the City, Contractor, and all subcontractors whether named or unnamed in the policy and all others having an insurable interest in the work. Wrap up liability insurance to also include but not limited to:

(i) Products and completed operations
(ii) Personal injury liability
(iii) City and Contractors protective coverage
(iv) Unlicensed motor vehicle liability
(v) Non-owned automobile liability
(vi) Cross liability clause
(vii) Blanket contractual liability
(viii) No XCU exclusion
(ix) Blasting, Tunnelling or the removal or weakening of support of any land, whether such support be natural or otherwise
(x) Sudden and accidental pollution (as per IBC 2313 or similar) (120 hours/120 hours)

(b) Wrap-up liability insurance shall be maintained from the date of the commencement of the Work until the date of Total Performance of the work and shall include an additional twenty-

four (24) months completed operation coverage which will take affect after Total Performance.

D12.2 The Contractor shall be responsible for deductibles up to $50,000 maximum of any one loss.

D12.3 The Contractor shall provide and maintain the following insurance coverage at all times during the performance of the Work and throughout the warranty period:

(a) Commercial general liability insurance, in the minimum amount of five million dollars ($5,000,000) inclusive per occurrence and five million dollars ($5,000,000) general aggregate. The said commercial general liability insurance shall include coverage for products and completed operations, blanket contractual, non-owned automobile, and unlicensed motor vehicle liability. Such policy shall include cross liability clause and shall not contain any XCU exclusions or limitations and will add the City as an additional insured.

(b) 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) Property insurance for equipment and tools used on the project that may be owned, rented, leased or borrowed.

(d) 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.

D12.4 Deductibles shall be borne by the Contractor.

D12.5 All policies must be taken out with insurers licensed to carry on business in the Province of Manitoba.

D12.6 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 seven (7) Calendar Days from notification of the award of the Contract. The evidence shall be in a form of a certificate of insurance and must be satisfactory to the city solicitor.

D12.7 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.

D12.8 All policies shall be in a form satisfactory to the City and shall be kept in full force during the Work and throughout the warranty period.

D12.9 The Contractor will be required to cooperate with the City and to provide their project experience and project claims history and any other information necessary to obtain the owner controlled project insurance as outlined in D12.1(a) within three (3) business days after notice of award.

D13. CONTRACT SECURITY

D13.1 The Contractor shall provide and maintain the performance bond and the labour and material payment bond 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; and

(b) a labour and material payment bond of a company registered to conduct the business of a surety in Manitoba, in the form attached to these Supplemental Conditions (Form H2: Labour and Material Payment Bond), in an amount equal to fifty percent (50%) of the Contract Price.

D13.2 The Contractor shall provide the City Solicitor with the required performance and labour and material payment bonds within seven (7) Calendar Days of notification of the award of the Contract by way of an award letter and prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract Documents, if applicable.

D13.3 The Contractor shall, as soon as practicable after entering into a contract with a Subcontractor:

(a) give the Subcontractor written notice of the existence of the labour and material payment bond in D13.1(b); and

(b) post a notice of the bond and/or a copy of that bond in a conspicuous location at the Site of the Work.

D14. SUBCONTRACTOR LIST

D14.1 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 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 C4.1 for the return of the executed Contract Documents, if applicable.

D15. EQUIPMENT LIST

D15.1 The Contractor shall provide the Contract Administrator with a complete list of the equipment which the Contractor proposes to utilize (Form K: Equipment List) at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract Documents, if applicable.

D16. DETAILED WORK SCHEDULE

D16.1 The Contractor shall provide the Contract Administrator with a detailed work schedule at least ten (10) 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 documents if applicable.

D16.2 The detailed work schedule shall consist of the following:

(a) a critical path method (CPM) schedule for the Work; and

(b) a Gantt chart for the Work based on the CPM schedule;

all acceptable to the Contract Administrator.

D16.3 Further to D16.2(a), the C.P.M. schedule shall clearly identify the start and completion dates of all of the following activities/tasks making up the Work as well as showing those activities/tasks on the critical path:

(a) Commencement Date;

(b) Mobilization;

(c) Site Preparation;

(d) Utility Locates;

(e) Utility Relocations (as required)

(f) Tunnel Shaft Construction (each shaft);

(g) Tunnel Drives (each drive);

(h) Installation of Carrier Pipe (each drive, if required);

(i) Lateral Sewer Construction;

(j) Manhole Construction;

(k) Shaft Backfill;

(l) Catch Basin Installation;

(m) Substantial Performance;

(n) Restoration; and

(o) Total Performance.

D16.4 The Contractor shall update the schedule and provide it to the Contract Administrator prior to each weekly construction site meeting for review and discussion at the meetings.

SCHEDULE OF WORK

D17. COMMENCEMENT

D17.1 The Contractor shall not commence any Work until he/she is in receipt of an award letter from the Award Authority authorizing the commencement of the Work.

D17.2 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 D10;

(ii) evidence of the workers compensation coverage specified in C6.15;

(iii) the Safe Work Plan specified in D11;

(iv) evidence of the insurance specified in D12;

(v) the contract security specified in D13;

(vi) the Subcontractor list specified in D14;

(vii) the equipment list specified in D15; and

(viii) the detailed work schedule specified in D16.

(b) the Contractor has attended a pre-construction meeting with the Contract Administrator, or the Contract Administrator has waived the requirement for a pre-construction meeting.

D17.3 The Contractor shall commence the Work on the Site no later than the date of Substantial Performance as indicated in D19, less the number of Working Days bid as Initial Span for Site Occupancy and indicated on Form B: Prices. For purposes of establishing this date, Charged Days will be applied assuming five (5) Charged Days per calendar week, and not including Statutory Holidays. If the Contractor has not commenced work by this date, Charged Days will be assessed for each day following this date, at the rate of five (5) Charged Days per calendar week, not including Statutory Holidays.

D17.4 The City intends to award this Contract by April 16, 2020.

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

D18. WORKING DAYS

D18.1 Notwithstanding C1.1(nn), a Working Day includes a Saturday, Sunday, or a statutory or civic holiday when the Contractor chooses to undertake work requiring the presence of the Contract Administrator and/or City resources.

D18.2 Further to C1.1(nn), the Contract Administrator's determination of whether or not atmospheric and Site conditions are such that a Working Day is deemed to have elapsed may be based at one time on one type of work while at another time a Working Day may be based on another type of work. When more than one type of major work is involved, the quantity of equipment that must be able to work in order to meet the requirements of a Working Day may vary considerably from that specified in the General Conditions.

D18.3 In the event that incidental work is behind schedule which, in the opinion of the Contract Administrator, should have been or could have been carried out by the Contractor in conjunction with or immediately following work of a major type, the City hereby reserves the right to charge Working Days on the incidental work until such time as it is up to schedule.

D18.4 When the major type of work involves restoration of the site to the condition it was prior to rainfall, Working Days shall not be charged.

D18.5 The Contract Administrator will furnish the Contractor with a daily record for each major type of work showing various information concerning the equipment, the time it worked, could have worked and Working Days charged. This report is to be signed each day by an authorized representative of the Contractor.

D19. SUBSTANTIAL PERFORMANCE

D19.1 The Contractor shall achieve Substantial Performance by June 30, 2021.

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 reinspected.

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 30, 2021.

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 reinspected.

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 Total Performance in accordance with the Contract by the days fixed herein for same, the Contractor shall pay the City the following amounts per Working Day for each and every Working Day following the days fixed herein for same during which such failure continues:

(a) Total Performance - eight hundred dollars ($800).

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 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. SITE OCCUPANCY

D22.1 General

D22.1.1 Completion of this project in a timely and efficient manner is a key driver on this project for both stakeholders and adjacent property users. The use of a Site Occupancy clause allows for evaluation of project schedule as part of the procurement process.

D22.2 Definitions

D22.2.1 Wherever the following terms are used, the intent and meaning will be interpreted as follows:

(a) Charged Days: Means the unit of measurement for time of Site Occupancy. For the purpose of assessing Charged Days, a Charged Day will be equivalent to a Working Day as defined in C1.1 (jj) and amended in D18.

(b) Initial Span: Means the number of Charged Days bid by the Contractor for Site Occupancy to achieve Substantial Performance on Form B: Prices. Items identified as Provisional in Form B: Prices are not to be included in the initial Span bid.

(c) Final Span: Means the number of Charged Days assessed for Site Occupancy as calculated pursuant to D22.3(a).

D22.3 Measurement

(a) Time shall be of the essence of the Contract. The Contractor shall provide the necessary material, labour and equipment to ensure that the Works will be completed within the consecutive amount of Charged Days Bid for Initial Span for Site Occupancy, and in no case later than the date specified for Substantial Performance for all work excluding permanent restoration and in no case later than the date specified for Total Performance for all Works. Failure to complete the Work within the Bid number of Charged Days will result in the deduction of Site Occupancy costs, as further defined herein. The total amount of Charged Days will be measures in whole numbers.

(b) Charged Days will be assessed for every day until Substantial Performance is achieved, except for the following:

(i) Days prior to the Contractor starting work on site. The Contractor shall provide a minimum of ten (10) Business Days' notice to the City for commencement of the Work. Failure of the Contractor to commence work as indicated in D17.3, may result in the assessment of Charged Days equivalent to the estimated costs incurred to the City; and

(ii) Days not worked due to Force Majeure

(c) The total amount of Charged Days will be measured in whole numbers.

D22.3.1 Further to D22.3(b), the Contractor will be permitted one (1) suspension of on-site construction, to facilitate coordination of subcontractors, materials deliveries or seasonal weather, Charged Days will not be charged during this period. During this period, the Site must be made secure, roadways completely operational, and all existing facilities and work in progress be protected from weather or other potentially harmful effects. Changes to Contract Critical Stages or completion dates resulting from suspension of Charged Days, will not be considered.

(a) The suspensions of work cannot exceed 2 weeks while the Tunnel launch shaft or receiving shaft are in place and obstructing traffic flows.

D22.4 Final Span

D22.4.1 Extensions to the Initial Span will determine the Final Span and will be calculated as follows:

(a) Final Span = (F/A) x I

(b) Where: Final Span = adjusted number of Charged Days allowed (a fraction of a day will be rounded up to a full day)

(i) F = Applicable final contract amount equals the total final Contract amount minus:

- Site Occupancy (Form B: Prices);

(ii) I = Initial Span of the Contract as bid on Form B: Prices

(iii) A = Applicable total bid price equals the total bid price minus:

- Site Occupancy (Form B: Prices);
- Provisional Items
- Equipment Costs

D22.5 Site Occupancy Payment

D22.5.1 Payment for Site Occupancy for the Contract will be made as follows:

(a) If the number of Charged Days equals the Final Span, no payment or deduction will be made.

(b) If the number of Charged Days is less than the Final Span, a payment equal to the Contract Unit Price per Charged Day multiplied by the difference between the Final Span and the actual number of Charged Days, to a maximum amount of two percent (2%) of the Total Bid Price, will be made to the Contractor.

(c) If the number of Charged Days exceeds the Final Span, a deduction equal to the Contract Unit Price per Charged Day multiplied by the difference between the actual number of Charged Days and the Final Span will be made from the payment to the Contractor.

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 B13.4, 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 B13.4.

D26. GEOTECHNICAL BASELINE REPORT AND GEOTECHNICAL DATA REPORT

D26.1 The primary purpose of the GBR is to establish a contractual understanding of the geotechnical conditions anticipated to be encountered during construction of the project. The GBR sets baselines for geotechnical conditions and material behaviour anticipated to be encountered

during construction in order to provide a basis for bidding and assist in resolution of disputes that may arise over subsurface conditions. Secondarily, the GBR:

(a) Presents the geotechnical and construction conditions that formed the basis of design.

(b) Identifies important considerations, key project constraints, and select requirements that must be addressed by the Contractor during bid preparation and construction

(c) Provides information to assist the Contractor in evaluating requirements for excavating and supporting the ground.

(d) Provides guidance to the Contract Administrator in administering the contract and monitoring Contractor performance.

D26.2 The GBR provides the basis for identifying geotechnical and geologic conditions that qualify as a “substantial difference in the nature of the surface or subsurface conditions”, as defined herein. The geotechnical baseline conditions (baseline) contained within the GBR are not necessarily geotechnical fact. The baseline was developed using judgment to interpolate between borings and extrapolate beyond the boring logs and laboratory test data. The judgment applied in the interpolations and extrapolations reflects the view of the author of the report in describing the baseline. Bidders should use the baseline subsurface conditions and the surface conditions which can be observed during a site visit as the basis for bids. It should be noted that the project design was based on assumed construction methods and levels of workmanship. The behavior of the geologic materials present in the surface and subsurface excavations will be influenced by the Contractor’s selected equipment, means, and methods.

D26.3 The GDR provides a summary of results for the geotechnical testing undertaken along the pipe alignment.

D26.4 Bidders should have a geotechnical engineer and/or engineering geologist review and explain the information presented in the GBR and GDR to assure a complete understanding of the reported information as a basis for submitting a Bid. Additional documents used to develop the GBR are listed in the References section of the GBR.

(a) The GBR was developed in part from the GDR. The technical data contained within the GDR upon which Contractor may rely are: the boring method, the locations and logs of the borings, the levels of subsurface water (if any), laboratory test methods and results, and similar factual data. Bore hole information represents subsurface characteristics to the extent indicated, only for the point location of the bore hole and, with regard to the level of subsurface water (if any), only at the time the boring was made. Contractor is not entitled to rely upon other technical data.

D26.5 Risks associated with subsurface conditions consistent with, or less adverse than the baseline conditions are allocated to the Contractor. Those risks associated with subsurface conditions more adverse than the baseline condition are accepted by the City. The provision of a baseline condition in the Contract is not a warranty that the baseline condition will be encountered. The baseline condition is the contractual standard that the City and the Contractor will agree to use when interpreting D28.

D26.6 The City accepts the risks for subsurface conditions that are less favorable than the stated baseline conditions. The City will negotiate with the Contractor for additional reasonable compensation to the Contractor if these three conditions exist:

(a) The actual subsurface conditions encountered are more adverse than the baseline conditions.

(b) The Contractor can document that the subsurface conditions are more adverse than those described in the baseline and that the conditions materially and significantly increased the cost and/or time required to complete the work.

(c) The Contractor has made diligent efforts to complete the work described in the Contract Documents, including any changes to methods, equipment, labor, and materials made necessary by the adverse conditions using the most cost effective means.

If all of the foregoing conditions are satisfactorily met, additional compensation and schedule will be negotiated, based on the provisions described in D28 and E13.

MEASUREMENT AND PAYMENT

D27. PAYMENT

D27.1 Further to C12, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.

D27.2 Further to D22, no payment will be made for Site Occupancy other than as set out in D22.5. Site Occupancy Amount on Form B: Prices will be used for evaluation of Bids.

D28. CHANGES IN WORK

D28.1 Amend C7.2.1(a) to include the following additional clauses:

(a) Contractor shall notify the Contract Administrator promptly in writing of any changes in geotechnical, geologic or material behaviour conditions that the Contractor considers more adverse than the GBR baseline conditions upon discovery and before they are disturbed, in any event no later than five (5) calendar days after discovery.

(b) No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under the Contract Documents.

(c) No claim by the Contractor related to shaft excavation or tunnelling shall be allowed under D28 provisions unless the Contractor investigates and demonstrates that such alleged conditions are materially different from those conditions identified in the Geotechnical Baseline Report and results in an increase in the Contractor's cost of and/or time required for performance of the Work.

(i) Contractor shall, within 30 calendar days after notification to the City that Contractor believes a material difference exists, provide the documentation, backup, justification, and compensation for the alleged impact to Contractor's cost of and/or time required for performance of the Work.

(ii) Any and all costs incurred by the Contractor for demonstrating that a material difference exists shall be borne by the Contractor unless the City agrees that the material difference does have a cost and/or time impact. If City agrees that there is a material difference that impacts Contractor's cost and/or time, payment for geologic investigation(s) and testing of the material difference will be paid for by the City.

(iii) Payment will be made by the City for reasonable and customary prices for geologic investigation(s) and testing. Contractor is encouraged to review geologic investigations and/or testing planned to demonstrate a material difference with the Contract Administrator prior to execution of the same. The City will be sole judge of what is reasonable and customary.

(d) The Contractor expressly agrees to maintain detailed daily labor, material, production, and equipment logs defining hours and costs for all periods of Contractor performance representing claimed differing site conditions.

(i) These logs shall fully separate bid Contract Work from claimed differing site condition work, and the Contractor shall provide these documents to the Contract Administrator for review. These daily logs shall constitute documentation of performance, and must be signed on a daily basis both by the Contractor and Contract Administrator. Said signatures do not mean acceptance of the claim or value of adjustment of Contract Price and/or Time but will serve to document the Contractor's use of labor, material, and equipment.

(ii) If Contract Administrator and City agree that there is a material difference that impacts Contractor's cost and/or time, payment for the material difference in labour, material, production and equipment will be paid for by the City based on reasonable and customary prices, using the methods defined in C7.4. Equipment rates will be

established in accordance with the Daily Equipment Rate listed on the Form B and as defined in E13.

(iii) The failure of the Contractor to maintain said logs or to obtain signatures on the logs shall render the Contract Administrators daily records as definitive.

WARRANTY

D29. WARRANTY

D29.1 Warranty is as stated in C13.

THIRD PARTY AGREEMENTS

D30. FUNDING AND/OR CONTRIBUTION AGREEMENT OBLIGATIONS

D30.1 In the event that funding for the Work of the Contract is provided to the City of Winnipeg by the Government of Manitoba and/or the Government of Canada, the following terms and conditions shall apply, as required by the applicable funding agreements.

D30.2 Further to D30.1, in the event that the obligations in D30 apply, actual costs legitimately incurred by the Contractor as a direct result of these obligations ("Funding Costs") shall be determined by the actual cost to the Contractor and not by the valuation method(s) outlined in C7.4. In all other respects Funding Costs will be processed in accordance with Changes in Work under C7.

D30.3 For the purposes of D30:

(a) **"Government of Canada"** includes the authorized officials, auditors, and representatives of the Government of Canada; and

(b) **"Government of Manitoba"** includes the authorized officials, auditors, and representatives of the Government of Manitoba.

D30.4 Modified Insurance Requirements

D30.4.1 If not already required under the insurance requirements identified in D12, the Contractor will be required to provide wrap-up liability insurance in an amount of no less than two million dollars ($2,000,000) inclusive per occurrence. Such policy will be written in the joint names of the City, Contractor, Consultants and all sub-contractors and sub-consultants and include twelve (12) months completed operations. The Government of Manitoba and its Ministers, officers, employees, and agents shall be added as additional insureds.

D30.4.2 If not already required under the insurance requirements identified in D12, the Contractor will be required to provide builders' risk insurance (including boiler and machinery insurance, as applicable) providing all risks coverage at full replacement cost, or such lower level of insurance that the City may identify on a case-by-case basis, such as an installation floater.

D30.4.3 The Contractor shall obtain and maintain third party liability insurance with minimum coverage of two million dollars ($2,000,000.00) per occurrence on all licensed vehicles operated at the Site. In the event that this requirement conflicts with another licensed vehicle insurance requirement in this Contract, then the requirement that provides the higher level of insurance shall apply.

D30.4.4 Further to D12.3, insurers shall provide satisfactory Certificates of Insurance to the Government of Manitoba prior to commencement of Work as written evidence of the insurance required. The Certificates of Insurance must provide for a minimum of thirty (30) days' prior written notice to the Government of Manitoba in case of insurance cancellation.

D30.4.5 All policies must be taken out with insurers licensed to carry on business in the Province of Manitoba.

D30.5 Indemnification by Contractor

D30.5.1 In addition to the indemnity obligations outlined in C17 of the General Conditions for Construction, the Contractor agrees to indemnify and save harmless the Government of Canada and the Government of Manitoba and each of their respective Ministers, officers, servants, employees, and agents from and against all claims and demands, losses, costs, damages, actions, suit or other proceedings brought or pursued in any manner in respect of any matter caused by the Contractor or arising from this Contract or the Work, or from the goods or services provided or required to be provided by the Contractor, except those resulting from the negligence of any of the Government of Canada's or the Government of Manitoba's Ministers, officers, servants, employees, or agents, as the case may be.

D30.6 Records Retention and Audits

D30.6.1 The Contractor shall maintain and preserve accurate and complete records in respect of this Contract and the Work, including all accounting records, financial documents, copies of contracts with other parties and other records relating to this Contract and the Work during the term of the Contract and for at least six (6) years after Total Performance. Those records bearing original signatures or professional seals or stamps must be preserved in paper form; other records may be retained in electronic form.

D30.6.2 In addition to the record keeping and inspection obligations outlined in C6 of the General Conditions for Construction, the Contractor shall keep available for inspection and audit at all reasonable times while this Contract is in effect and until at least six (6) years after Total Performance, all records, documents, and contracts referred to in D30.6.1 for inspection, copying and audit by the City of Winnipeg, the Government of Manitoba and/or the Government of Canada and their respective representatives and auditors, and to produce them on demand; to provide reasonable facilities for such inspections, copying and audits, to provide copies of and extracts from such records, documents, or contracts upon request by the City of Winnipeg, the Government of Manitoba, and/or the Government of Canada and their respective representatives and auditors, and to promptly provide such other information and explanations as may be reasonably requested by the City of Winnipeg, the Government of Manitoba, and/or the Government of Canada from time-to-time.

D30.7 Other Obligations

D30.7.1 The Contractor consents to the City providing a copy of the Contract Documents to the Government of Manitoba and/or the Government of Canada upon request from either entity.

D30.7.2 If the Lobbyists Registration Act (Manitoba) applies to the Contractor, the Contractor represents and warrants that it has filed a return and is registered and in full compliance with the obligations of that Act, and covenants that it will continue to comply for the duration of this Contract.

D30.7.3 The Contractor shall comply with all applicable legislation and standards, whether federal, provincial, or municipal, including (without limitation) labour, environmental, and human rights laws, in the course of providing the Work.

D30.7.4 The Contractor shall properly account for the Work provided under this Contract and payment received in this respect, prepared in accordance with generally accepted accounting principles in effect in Canada, including those principles and standards approved or recommended from time-to-time by the Chartered Professional Accountants of Canada or the Public Sector Accounting Board, as applicable, applied on a consistent basis.

FORM H1: PERFORMANCE BOND
(See D13)

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

TENDER NO. 1045-2019B

JEFFERSON EAST COMBINED SEWER RELIEF – CONTRACT 5 – SEMPLE TRUNK SEWER

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: LABOUR AND MATERIAL PAYMENT BOND
(See D13)

KNOW ALL MEN BY THESE PRESENTS THAT

_____
his/its heirs, executors, administrators, successors or assigns (hereinafter called the "Principal"), and

_____ ,
his/its heirs, executors, administrators, successors or assigns (hereinafter called the "Surety"), are held and firmly bound unto **THE CITY OF WINNIPEG** (hereinafter called the "Obligee"), for the use and benefit of claimants as herein below defined, in the amount of

_____

_____ dollars ($_____.____)

of lawful money of Canada, for the payment whereof we, the Principal and the Surety jointly and severally bind ourselves firmly by these presents.

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

TENDER NO. 1045-2019B

JEFFERSON EAST COMBINED SEWER RELIEF – CONTRACT 5 – SEMPLE TRUNK SEWER

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 promptly make payment to all claimants as hereinafter defined, for all labour, service and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void, otherwise it shall remain in full force and effect subject, however, to the following conditions:

(a) A claimant is defined as one having a direct contract with the Principal for labour, service and material, or any of them, used or reasonably required for use in the performance of the contract, labour, service and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment (but excluding rent of equipment where the rent pursuant to an agreement is to be applied towards the purchase price thereof) directly applicable to the Contract;

(b) The above-named Principal and Surety hereby jointly and severally agree with the Obligee that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant’s work, labour or service was done or performed, or materials were furnished by such claimant, may sue on this bond, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon;

(c) No suit or action shall be commenced hereunder by any claimant

    (i) unless claimant shall have given written notice to the Principal and the Surety above-named, within one hundred and twenty (120) days after such claimant did or performed the last of the work, labour or service, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work, labour or service was done or performed. Such notice shall be served by mailing the same by registered mail to the Principal, and Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the Province of Manitoba;

(ii) after the expiration of one (1) year following the date on which Principal ceased work on said Contract; including work performed under the guarantees provided in the Contract;

(iii) other than in a court of competent jurisdiction in the Province of Manitoba.

(d) The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this bond.

(e) The Surety shall not be liable for a greater sum than the specified penalty of this bond.

The Principal and Surety hereby agree that The Guarantors' Liability Act (Manitoba) shall apply to this Bond.

IN TESTIMONY WHEREOF, the Principal has hereunto set its hand affixed its seal, and the Surety has caused these presents to be sealed and with its corporate seal duly attested by the authorized signature of its signing authority this

_____ 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 J: SUBCONTRACTOR LIST
(See D14)

JEFFERSON EAST COMBINED SEWER RELIEF – CONTRACT 5 – SEMPLE TRUNK SEWER

Name	Address

FORM K: EQUIPMENT
(See D15)

JEFFERSON EAST COMBINED SEWER RELIEF – CONTRACT 5 – SEMPLE TRUNK SEWER

1. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

2. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

3. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

FORM K: EQUIPMENT
(See D15)

JEFFERSON EAST COMBINED SEWER RELIEF – CONTRACT 5 – SEMPLE TRUNK SEWER

4. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

5. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

6. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

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 Tender shall govern over *The City of Winnipeg Standard Construction Specifications*.

E1.3 Bidders are reminded that requests for approval of substitutes as an approved equal or an approved alternative shall be made in accordance with B7. In every instance where a brand name or design specification is used, the City will also consider approved equals and/or approved alternatives in accordance with B7.

E1.4 The following are applicable to the Work:

Drawing No.	Drawing Name/Title
LD-9593	COVER SHEET
LD-9594	INDEX PAGE
LD-9595	GENERAL PLAN
LD-9596	McKENZIE STREET LAYDOWN AREA
LD-9597	McGREGOR STREET LAYDOWN AREA
LD-9598	ANDREWS STREET LAYDOWN AREA
LD-9599	POWERS STREET LAYDOWN AREA
LD-9600	SALTER STREET LAYDOWN AREA
LD-9601	AIKINS STREET LAYDOWN AREA
LD-9602	MAIN STREET LAYDOWN AREA
LD-9603	SCOTIA STREET LAYDOWN AREA
LD-9604	SEMPLE AVENUE – C.P.R. WINNIPEG BEACH SUBDIVISION R.O.W. TO 170m WEST OF McGREGOR STREET
LD-9605	SEMPLE AVENUE – 9m EAST OF McKENZIE STREET TO 71m WEST OF McGREGOR STREET
LD-9606	SEMPLE AVENUE – 108m EAST OF McKENZIE STREET TO 147m WEST OF ANDREWS STREET
LD-9607	SEMPLE AVENUE – 34m EAST OF McGREGOR STREET TO 22m WEST OF ANDREWS STREET
LD-9608	SEMPLE AVENUE – 160m EAST OF McGREGOR STREET TO 99m WEST OF POWERS STREET
LD-9609	SEMPLE AVENUE – 83m EAST OF ANDREWS STREET TO 175m WEST OF SALTER STREET
LD-9610	SEMPLE AVENUE – 6m EAST OF POWERS STREET TO 70m WEST OF SALTER STREET
LD-9611	SEMPLE AVENUE – 111m EAST OF POWERS STREET TO 147m WEST OF AIKINS STREET
LD-9612	SEMPLE AVENUE – 31m EAST OF SALTER STREET TO 27m WEST OF AIKINS STREET
LD-9613	SEMPLE AVENUE – 151m EAST OF SALTER STREET TO 123M WEST OF MAIN STREET

Drawing No.	Drawing Name/Title
LD-9614	SEMPLE AVENUE – 78m EAST OF AIKINS STREET TO 13m WEST OF MAIN STREET
LD-9615	SEMPLE AVENUE – 188m EAST OF AIKINS STREET TO 213m WEST OF SCOTIA STREET
LD-9616	SEMPLE AVENUE – 62m EAST OF MAIN STREET TO 88m WEST OF SCOTIA STREET
LD-9617	SEMPLE AVENUE – 187m EAST OF MAIN STREET TO SCOTIA STREET
LD-9618	McKENZIE STREET – KILBRIDE AVENUE TO SEMPLE AVENUE
LD-9619	MANHOLE CHAMBER – SCOTIA STREET AT SEMPLE AVENUE
LD-9620	FUTURE MANHOLE CONNECTIONS – VARIOUS LOCATIONS
LD-9621	STANDARD DETAILS – MONITORING AND INSTRUMENTATION
LD-9622	STANDARD DETAILS – TWO-PASS TUNNELING & PIPE INSTALLATION

Appendix	Title
A	Geotechnical Data Report
B	Geotechnical Baseline Report

E2. GEOTECHNICAL INVESTIGATION REPORT

E2.1 Geotechnical Data Report (GDR)

(a) The GDR summarizes the testing and geotechnical conditions observed at the project site and provides technical support for the GBR. This report includes geotechnical data collected at the project site and summary of anticipated subsurface conditions along the alignment. A copy of the GDR is included in Appendix A.

E2.2 Geotechnical Baseline Report (GBR)

(a) The GBR summarizes the geotechnical condition observed at the project site and provides construction considerations for use by Bidders for Bid preparation and administration of the Contract. Further information is provided in Clause D26 and a copy of the GBR is included in Appendix B.

GENERAL REQUIREMENTS

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 at a location approved by the Contract Administrator;

(c) the building shall have a minimum floor area of 25 m^2, a height of 2.4 m with two (2) 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 or 24-25 degrees Celsius;

(e) the building shall be adequately lighted with fluorescent fixtures and have a minimum of three (3) wall outlets;

(f) the building shall be furnished with one (1) desk, one drafting table, table 3 m X 1.2 m, one (1) stool, one (1) four-drawer legal size filing cabinet, and a minimum of 12 chairs;

(g) the building shall be equipped with one (1) microwave, one (1) fridge, and one (1) water cooler with pick up and deposit of water jugs on a weekly basis;

(h) 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; and

(i) 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 office facilities will be provided from the date of the commencement of the Work to the date of Substantial Performance.

E3.3 Parking for a minimum of three (3) vehicles shall be provided for the Contract Administrator in close proximity to the office trailer.

E3.4 Measurement and Payment

E3.4.1 Procurement, installation and removal costs, all operating costs, and the general maintenance of the office facilities will be considered incidental to "Site Development, Mobilization and Demobilization" on Form B: Prices and will not be measured for payment. No additional payment will be made.

E4. SHOP DRAWINGS

E4.1 Description

(a) This Specification shall revise, amend, and supplement the requirements of CW 1110 of the City of Winnipeg's Standard Construction Specifications.

(b) Submit all Shop Drawings in accordance with CW 1110 except as modified herein.

(c) The Contractor shall submit specified Shop Drawings to the Contract Administrator for review. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be shown on all submissions.

E4.2 Contractors Responsibility

(a) Review shop drawings, product data and samples prior to submission and stamp and sign drawings indicating conformance to the Contract requirements.

(b) Verify:

(c) Field Measurements

(d) Field Construction Criteria

(e) Catalogue numbers and similar data

(f) Coordinate each submission with requirements of Work and Contract Documents. Individual shop drawings will not be reviewed until all related drawings are available.

(g) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.

(h) 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.

(i) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.

(j) The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of Shop Drawings. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.

(k) After Contract Administrator's review and return of copies, distribute copies to Subcontractors s as appropriate.

(l) 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.

E4.3 Shop Drawings

(a) Original drawings are to be prepared by Contractor, Subcontractor, Supplier, Distributor, or Manufacturer, which illustrate appropriate portion of Work; showing fabrication, layout, setting or erection details as specified in appropriate sections.

(b) Shop drawings for the following structural components shall bear the seal of a Registered Professional Engineer in the Province of Manitoba.

(i) Shoring
(ii) Reinforcing steel
(iii) Metal Fabrications
(iv) Pre-cast concrete structures
(v) Pipe Design

(c) Additional submittal requirements for each component of Work may be listed within the relevant specification section.

E4.4 Submission Requirements:

(a) Schedule submissions at least 10 Calendar Days before dates reviewed submissions will be needed and allow for a 10 Calendar Day period for review by the Contract Administrator of each individual submission and re-submission, unless noted otherwise in the Contract Documents.

(b) Submit one (1) digital copy (PDF) of shop drawings.

(c) Accompany submissions with transmittal letter, containing:

(i) Date
(ii) Project title and Bid Opportunity number
(iii) Contractor's name and address
(iv) Number of each shop drawing, product data and sample submitted
(v) Specification Section, Title, Number and Clause
(vi) Drawing Number and Detail/Section Number
(vii) Other pertinent data

(d) Submissions shall include:

(i) Date and revision dates.
(ii) Project title and Bid Opportunity number.
(iii) Name of:
    (i) Contractor
    (ii) Subcontractor
    (iii) Supplier
    (iv) Manufacturer
    (v) Separate detailer when pertinent
(iv) Identification of product of material.
(v) Relation to adjacent structure or materials.
(vi) Field dimensions, clearly identified as such.
(vii) Specification section name, number and clause number or drawing number and detail/section number.
(viii) Applicable standards, such as CSA or CGSB numbers.
(ix) Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

(e) Shop Drawings not meeting the requirements of CW 1100 or the requirements specified herein will be returned to the Contractor without review for resubmission.

(f) Shop drawing submissions will be limited to two (2) reviews per shop drawing. This shall include a review of the initial submission and a review of the revised submission. Costs associated with subsequent reviews will be charged to the Contractor.

E4.5 Expedited Shop Drawings

(a) Further to CW 1100, in order to expedite Shop Drawings with critical timelines, the lowest responsive Bidder, as outlined in B18, will be required, after receiving a written request from the Contract Administrator, to arrange for the preparation of Shop Drawings for the following items with critical timelines:

(i) Shaft Plan, as per E17.3.1.

(b) Schedule to submit Shop Drawings listed in E4.8.1 within five (5) Business Days of a request as indicated in E4.5 or receipt of Notice of Award in accordance with B19, whichever is earlier.

E4.6 Measurement and Payment

(a) If Award is made to the lowest responsive Bidder, then the provision of Shop Drawings will be considered incidental to the Work and will not be measured for payment and no additional payment will be made. If no contract is awarded payment for Shop Drawings prepared will be paid in accordance with B19.4.2.

E5. ENVIRONMENTAL PROTECTION

E5.1 The Contractor shall plan and implement the Work of this Contract strictly in accordance with the requirements of the environmental protection measures as herein specified.

E5.2 The Contractor is advised that at least the following Acts, Regulations, and By-laws apply to the Work:

E5.2.1 Federal

(a) Canadian Environmental Protection Act (CEPA) c.16;

(b) Canadian Environmental Assessment Act (CEAA) c.37;

(c) Transportation of Dangerous Goods Act and Regulations c.34; and

(d) Migratory Birds Convention Act, 1994

E5.2.2 Provincial

(a) The Dangerous Goods Handling and Transportation Act D12;

(b) The Endangered Species Act E111;

(c) The Environment Act c.E125;

(d) The Fire Prevention Act F80;

(e) The Manitoba Heritage Resources Act H39.1;

(f) The Manitoba Noxious Weeds Act N110;

(g) The Manitoba Nuisance Act N120;

(h) The Public Health Act c.P210;

(i) The Workplace Safety and Health Act W120; and

(j) And current applicable associated regulations.

E5.2.3 Municipal

(a) The City of Winnipeg By-law no. 1/2008;

(b) The City of Winnipeg Waterway By-Law no. 5888/92; and

(c) Other applicable Acts, Regulations and By-laws.

E5.3 The Contractor is advised that the following environmental protection measures apply to the Work.

E5.3.1 Materials Handling and Storage

(a) Construction materials and debris shall be prevented from entering drainage pipes or channels.

(b) Construction materials and debris shall also be prevented from accumulating on local roadways and sidewalks when tracked out of the Site by trucks hauling excavated materials.

(c) The Contractor shall provide on-Site measures to mitigate the tracking of sediment off-Site and therefore reduce the amount of street cleaning required. These measures may take the form of a truck wheel wash (automated or manually operated) or other measures as approved by the Contract Administrator.

E5.3.2 Fuel Handling and Storage

(a) The Contractor shall obtain all necessary permits from Manitoba Conservation for the handling and storage of fuel products and shall provide copies to the Contract Administrator.

(b) 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.

(c) 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.

(d) The Contractor shall ensure that all fuel storage containers are inspected daily for leaks and spillage.

(e) Products transferred from the fuel storage area(s) to specific Work Sites shall not exceed the daily usage requirement.

(f) 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.

(g) Refuelling of mobile equipment and vehicles shall take place at least 100 metres from a watercourse.

(h) 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.

(i) A sufficient supply of materials, such as absorbent material and plastic oil booms to clean up minor spills shall be stores nearby on-site. The Contractor shall ensure that additional material can be made available on short notice.

E5.3.3 Waste Handling and Disposal

(a) The construction area shall be kept clean and orderly at all times during and at completion of construction.

(b) 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.

(c) 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 may require special disposal methods (see SC:21.4 D).

(d) Indiscriminate dumping, littering, or abandonment shall not take place.

(e) No on-site burning of waste is permitted.

(f) Waste storage areas shall not be located so as to block natural drainage.

(g) Run-off from a waste storage area shall not be allowed to cause siltation of a watercourse.

(h) 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.

(i) Equipment shall not be cleaned near watercourses; contaminated water from onshore cleaning operations shall not be permitted to enter watercourses.

E5.3.4 Dangerous Goods/Hazardous Waste Handling and Disposal

(a) Dangerous goods/hazardous waste are identified by, and shall be handled according to, The Dangerous Goods Handling and Transportation Act and Regulations.

(b) The Contractor shall be familiar with The Dangerous Goods Handling and Transportation Act and Regulations.

(c) 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.

(d) Different waste streams shall not be mixed.

(e) Disposal of dangerous goods/hazardous wastes shall be at approved hazardous waste facilities.

(f) Liquid hydrocarbons shall not be stored or disposed of in earthen pits on-site.

(g) 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.

(h) Used oil filters shall be drained, placed in suitable storage containers, and buried or incinerated at approved hazardous waste treatment and disposal facilities.

(i) Dangerous goods/hazardous waste storage areas shall be located at least 100 metres away from the high water line and be diked.

(j) Dangerous goods/hazardous waste storage areas shall not be located so as to block natural drainage.

(k) Run-off from a dangerous goods/hazardous waste storage area shall not be allowed to cause siltation of a watercourse.

(l) 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.

E5.3.5 Emergency Response

(a) The Contractor shall ensure that due care and caution is taken to prevent spills.

(b) The Contractor shall report all major spills of petroleum products or other hazardous substances with the potential for impacting the environment and threat to human health and safety to the Contract Administrator and Manitoba Environment, immediately after occurrence of the environmental accident, by calling the 24-hour emergency telephone phone number (204) 945-4888. The Contract Administrator shall also be notified.

(c) 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.

(d) 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
- proximity to waterways and the Aqueduct

(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
- dike spill material with dry, inert sorbent material or dry clay soil or sand
- prevent spill material from entering waterways and utilities by diking
- prevent spill material from entering manholes and other openings by covering with rubber spill mats or diking

(v) Resume any effective action to contain, clean up, or stop the flow of the spilled product.

(e) The emergency response coordinator shall ensure that all environmental accidents involving contaminants shall be documented and reported to the Manitoba Environment according to The Dangerous Goods Handling and Transportation Act Environmental Accident Report Regulation 439/87.

(f) 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.

(g) Minor spills of such substances that may be contained on land with no significant impact on the environment may be responded to with in-house resources without formal notification to Manitoba Environment.

(h) City emergency response, 9-1-1, shall be used if other means are not available.

E5.4 Vegetation

(a) Vegetation shall not be disturbed without written permission of the Contract Administrator. The Contractor shall protect plants which may be at risk of accidental damage. Such measures may include protective fencing or signage and shall be

(b) Herbicides and pesticides shall not be used adjacent to any surface watercourses.

(c) All landowners adjacent to the area of application of herbicides or pesticides shall be notified prior to the Work.

(d) Trees and shrubs shall not be felled into watercourses.

(e) Areas where vegetation is removed during clearing, construction, and decommissioning activities, shall be revegetated as soon as possible in accordance the requirements outlined herein, or as directed by the Contract Administrator.

E5.5 Measurement and Payment

(a) The work specified herein will be considered incidental to the Work and will not be measured for payment. No additional payment will be made.

E6. SITE DEVELOPMENT, MOBILIZATION, AND DEMOBILIZATION

E6.1 Description

(a) This Specification shall govern Mobilization and Demobilization from site, including temporary works necessary to access the site and complete the Work, office facilities, utility clearances, traffic control and signage, snow clearing, sewer flow diversion and control, site runoff and drainage, clean up and all site restoration.

E6.2 Site Development Plan

(a) The Contractor shall provide the Contract Administrator with a Site Development Plan at least ten (10) Business Days prior to the commencement of any Work on the Site.

(b) The Site Development Plan shall at a minimum include:

(i) Work areas showing location of all required elements to complete the Work including fencing, gates, drainage and tree protection;

(ii) Material staging and laydown areas, including fencing and gates;

(iii) Staging areas for other Work elements, including:

(i) Slurry separation plant (if required);

(ii) Crane Pads;

(iv) Material Storage

(v) Site access roads;

(vi) Office facility locations for Contract Administrator and Contractor;

(vii) Temporary vehicle access/egress locations.

E6.3 Security Fence

(a) The temporary security fencing shall meet the following requirements:

(i) Constructed of premanufactured steel panel sections;

(ii) Minimum height of 1.8 m in height;

(iii) Steel rails, posts, and fencing;

(iv) Non-Climbing fence ;

(v) Fence sections shall be clamped or bolted together to eliminate easy disassembly;

(vi) Fence sections shall be anchored to the ground and securely fastened to the existing fence at the termination points.

E6.4 Sound Attenuation

(a) The City recognizes that long trenchless drives may require continuous operations, 24 hours per day, seven days per week during tunneling operations. The City will provide exemption to Neighbourhood Livability By-Law No. 1/2008 for critical and necessary tunneling operations required for this work. Work outside the times outlined in the By-Law will be restricted, including, but not limited to;

(i) Operation of equipment only critical to tunnel operations;

(ii) Use of equipment meeting stringent noise output requirements;

(iii) Use of sound attenuation barriers and devices;

(iv) Use of equipment, trucks and other machinery that do not conform to the Livability By-law for removal of spoils from site, bringing materials to site, or other purposes not deemed essential for the tunneling operation, shall be prohibited.

(v) Monitor the ambient noise at the corner of the occupied building closest to noise generating equipment including but not limited to generators, cranes, and slurry separation equipment.

(vi) Provide equipment with enclosures or construct portable sound barriers to minimize noise impact.

(vii) Provide a generator and other equipment with a “residential” silencer and acoustic enclosure. Provide equipment that continuously meets the noise requirements.

(viii) Provide equipment with mufflers, as needed, to mitigate the noise produced from construction.

(ix) Contractor shall be required to rearrange equipment to minimize noise impact as necessary.

(x) Construct Slurry plant enclosure to mitigate noise and cold weather when and where needed.

(b) For the purposes of determining normal background noise, monitor nearest residential site for period of one week.

(c) For operations outside of restriction time frames set out in the By-Law (7:00 a.m. and after 9:00 p.m. on weekdays or before 9:00 a.m. and after 9:00 p.m. on Saturdays, Sundays and statutory holidays), the contractor shall maintain sound levels lower than;

(i) 50 dBA as measured on a one hour average;

(ii) 65 dBA as measured on a 15 minute average;

(iii) 5 dBA over the monitored average background levels.

E6.5 Use of CPR Winnipeg Beach Subdivision Right of Way

(a) The City has had preliminary discussions with the Canadian Pacific Railway (CPR) to utilize a portion of property located at the west end of Semple Avenue and adjacent to the CPR Winnipeg Beach Subdivision rail line for laydown, storage, and staging areas for construction. Approximately 100m x 7.62m are available to lease temporarily, should the Contractor require it to facilitate construction. CPR provided a preliminary lease rate of $10 per square foot per year. This lease rate is subject to confirmation by the Contractor.

(b) It shall be the Contractor's responsibility to enter into a lease directly with CPR, as required, to accommodate the Contractor's proposed schedule and means and methods for construction.

(c) Contact info for CPR:

(i) Name: Annick Kabeya
Email: Annick_Kabeya@cpr.ca
Phone: (403)-319-4923

(d) CPR requires that the area be fenced for the duration of the lease.

E6.6 Measurement and Payment

(a) Site Development, Mobilization and Demobilization

(i) Site development, mobilization and demobilization will be measured on a lump sum basis and paid for at the Contract Lump Sum Price for "Site Development, Mobilization and Demobilization" as listed in Form B: Prices. Payment for Mobilization and demobilization shall include but is not limited to the following:

(i) all costs associated with mobilization and demobilization;

(ii) development of site access roads;

(iii) development lay down areas;

(iv) CPR laydown area;

(v) removal of trees;

(vi) erection, maintenance, and removal of security fencing and gates;

(vii) installation, maintenance, and removal of silt fencing;

(viii) supply and maintenance of site office facilities;

(ix) supply and maintenance of sound control and sound attenuation devices;

(x) site cleanup;

(xi) restoration of fences; and

(xii) any other material and labour specified herein and required to complete the work.

(ii) Payment for Site Development, Mobilization and Demobilization will be made on the following schedule:

(i) 60% of the Site Development, Mobilization and Demobilization unit price will be paid on the first progress payment following commencement of the Work. For purposes of defining commencement of the work, major work such as utility relocation or shaft construction shall have commenced.

(ii) 10% of the Site Development, Mobilization and Demobilization unit price will be paid on the progress payment following completion of Substantial Performance.

(iii) 30% of the Site Development, Mobilization and Demobilization unit price will be paid on the progress payment following Total Performance.

(iv) Notwithstanding E6.6(a)(ii)(i), the initial payment for Mobilization and Demobilization will be limited to five percent (5%) of the total Contract value.

E7. CONFINED SPACE ENTRY

E7.1 Description

(a) This Specification shall outline minimum requirements for confined space operations and provision of support for third party inspections through the course of the work.

E7.2 General

(a) The Contractor shall be aware that Hydrogen Sulphide Gas is present in all underground structures connected to the City's sewer systems and has been known to accumulate in concentrations sufficient to cause serious harm or death to personnel who are not using adequate Personal Protective Equipment.

(b) The Contractor's attention is drawn to the Province of Manitoba Workplace Safety and Health Act ('the Act"), and the Regulations and Guidelines there-under pertaining to Confined Space Entry Work and in particular the requirements for conducting hazard/risk assessments and providing personal protective equipment (PPE).

E7.2.1 The Contractor is responsible for all safety and confined space support the Work.

E7.3 Methods

(a) Hazard Assessment

(a) In conjunction with securing the site and obtaining underground clearances, the Contractor shall conduct a hazard assessment for each site requiring work within a sewer or manhole. The assessment shall identify and evaluate the hazards, including but not be limited to review of the following as it pertains to the work to be performed:

(i) nature of the defect;

(ii) location of the defect in the sewer/manhole;

(iii) structural condition and amount of debris in the remaining sewer/manhole;

(iv) condition of the manholes up and downstream of the required repair;

(v) atmospheric conditions in the manholes up and downstream of the required repair;

(vi) condition of adjacent downstream sewers; and,

(vii) flow in the sewer.

(b) The hazard assessment shall be based on the Contractors review of the sewer(s) and site inspection of the manholes, sewers and external conditions. Prior to the inspection, the Contractor shall conduct the necessary atmospheric monitoring of the affected manholes and sewers to establish acceptable entry conditions.

(b) Safe Work Plan

(a) Subsequent to performing a hazard assessment the Contractor shall develop a safe work plan to address the potential hazards associated with each site. In addition to

addressing the potential hazards the safe work plan shall address but not be limited to the following:

(i) guidelines for confined space entry work established by The Manitoba Workplace Safety and Health Act;

(ii) provision for emergency response;

(iii) training and duties for entry personnel;

(iv) rescue and emergency services;

(v) requirement for purging, ingesting, flushing and/or continuous ventilation to eliminate or control atmospheric hazards;

(vi) requirement for and provision of supplied air;

(vii) communication between members of the repair crew in the pipe and on the ground's surface;

(viii) current and forecasted weather conditions;

(ix) isolating the workspace by plugging of upstream sewers and monitoring of upstream flow levels;

(x) provision of back-up equipment;

(xi) method of ingress into the sewer; and,

(xii) method of egress out of the sewer – forward and backwards.

(b) The Contactor shall not enter the sewer or manholes to begin the work until they have completed a hazard assessment and safe work plan for the specific work and reviewed the plans with their designated safety officer for acceptance. The safe work plan procedures and practices shall conform to all federal, provincial and municipal codes, regulations and guidelines including Manitoba Workplace Safety and Health Regulations.

(c) Enter the Manhole and Sewer

(a) The Contractor shall enter the manhole/sewer and complete the work in accordance with their safe work plan and requirements for the repair contained herein.

(b) If at any time during the repair the attendant and/or Contractor believes he cannot safely perform the work they shall immediately stop the work and evacuate the sewer and manholes. The Contractor shall re-assess their safe work plan considering the reason for the work stoppage. The work shall only be resumed when the Contractor has deemed it safe to return by completing a re-assessment and safe work plan revision, where necessary.

E7.4 Measurement and Payment

(a) Confined Space Entry

(i) Confined space entry support as outlined herein will be considered incidental to the Work and will not be measured for payment. No separate payment will be made.

E8. TRAFFIC MANAGEMENT

E8.1 Description

(a) This Specification shall govern the requirements for traffic management during the course of the Work.

E8.2 Further to Section 3.7 of CW 1130 of the General Requirements the Contractor shall be responsible to redirect and maintain traffic with appropriate signing in accordance with The City of Winnipeg, "Manual of Temporary Traffic Control in Work Areas on City Streets" at all times during construction.

E8.3 Maintain two way traffic on Salter Street, one lane in each direction, at all times.

E8.4 Maintain access and safety to bus stops. Request relocation if required.

E8.5 Maintain access for approaches, driveways, and public lanes.

E8.6 Maintain access at one end of any block on Semple Avenue for residential access and emergency use.

E8.7 Do not block more than one cross street across Semple Avenue at any time unless otherwise approved.

E8.8 The Contractor shall maintain access to all businesses during business hours, except where written authorization has been provided by the business.

E8.9 The Contractor shall maintain access to all schools, community centres, and other public buildings at all times.

E8.10 The Contractor shall not park company or private vehicles inside the barricaded work zone in a manner that will block sightlines for vehicles and pedestrians approaching and crossing intersections.

E8.11 The Contractor is responsible for maintaining safe vehicular and pedestrian traffic through their work site as identified herein. The Contractor shall rectify any unsafe conditions immediately upon notification. This could include but is not limited to, providing flag persons, clearing debris and snow from sites, moving equipment, and erecting additional signage.

E8.12 Flag persons shall be appropriate trained, certified and outfitted in accordance with applicable regulations and legislation in the Province of Manitoba.

E8.13 Measurement and Payment

(a) Traffic management as outlined herein will be considered incidental to the Work and will not be measured for payment. No separate payment will be made.

E9. PEDESTRIAN ACCESS

E9.1 Description

(a) This Specification shall govern the requirements for maintaining pedestrian access during the course of the Work.

E9.2 Further to Section 3.6 of CW 1130 of the General Requirements, the Contractor shall maintain safe pedestrian crossings at or within 40 metres of intersections at all times. If possible, only one pedestrian crossing at an intersection is to be blocked by construction at any one time. If more than one pedestrian crossing is blocked by construction at an intersection at the same time the Contractor shall provide flag persons to safely escort pedestrians across the intersection. The Contractor shall leave pedestrian crossing locations safe and free of equipment that may hamper pedestrians when no construction activities are being performed at a particular crossing location.

E9.3 Measurement and Payment

(a) Maintaining pedestrian access as outlined herein will be considered incidental to the Work and will not be measured for payment. No separate payment will be made.

E10. TREE PROTECTION, PRUNING, AND REMOVAL

E10.1 Description

(a) This specification covers the pruning and removal of existing trees as required to facilitate construction.

(b) This specification amends CW 3110 Clearing and Grubbing.

E10.2 Quality Control

(a) Person performing work shall possess a valid Manitoba Arborists License.

E10.3 Materials

(a) Wound Dressing

(a) Wound dressing shall be horticultural accepted non-hardening bituminous emulsion, free of materials toxic to callus formation, containing disinfectant for fungal and other diseases.

E10.4 Construction Methods

(a) The Contractor shall take the following precautionary steps to prevent damage from construction activities to existing boulevard trees within the limits of the construction area:

(i) The Contractor shall not stockpile materials and soil or park vehicles and equipment on boulevards within 2 metres of trees.

(ii) Trees 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.

(iii) 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), with the outcome read in feet, from the closest edge of the trunk. Where roots must be cut to facilitate excavation, they shall be pruned neatly at the face of excavation.

(iv) 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.

(v) 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.

(b) 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.

(c) Scheduling of Work

(i) The Contractor shall review work with Contract Administrator prior to starting work.

(ii) The Contractor shall schedule the work in accordance with the restrictions set out in the federal Migratory Birds Convention Act, 1994.

(d) Removal

(i) If the Contractor requires removing trees to access the Site or facilitate construction, the Contractor shall submit a plan to the Contract Administrator for review, a minimum of ten (10) Business Days prior to removal. No removals of trees shall be made without written acceptance by the Contract Administrator and the City of Winnipeg's Forestry Department. The plan shall at a minimum indicate:

(i) Trees requiring removal complete with size and species, and description of requirement for removal.

(ii) Replanting requirements will be determined by the level of tree removals proposed and accepted by the Contract Administrator and City of Winnipeg's Forestry Department.

(e) Pruning

(i) Prune individual trees as indicated by the Contract Administrator. Remove dead, dying, diseased, interfering, objectionable and weak growth in order to promote healthy development suitable to the purpose for which plant material is grown.

(ii) Prune in accordance with Agriculture Canada Publication 1505-1977, The Pruning Manual.

(iii) Employ clean sharp tools and make cuts flush with main branch, smooth and sloping as to prevent accumulation of water. Remove projecting stumps on trunks or main branches. Remove dead and injured branches and branches that rub causing damage to bark. Trim trees without changing their natural shape. Do not damage lead branches or remove smaller twigs along main branches.

(f) Cut Back

(i) Eliminate narrow crotches as much as possible; avoid cutting back to small suckers. Remove smaller limbs and twigs to leave foliage evenly distributed.

(ii) When reducing overall size, make symmetrical in appearance to maintain tree-like form typical of species.

(iii) Do not remove more than one-third of total branching at single operation.

(g) Repair and Protection

(i) Repair cuts and old scars in accordance with Agriculture Canada Publication 1505-1977, The Pruning Manual.

(ii) Paint new cuts 100mm in diameter and over with wound dressing.

E10.5 Method of Measurement and Basis of Payment

(a) Pruning and removal of trees will be considered incidental to "Site Development, Mobilization and Demobilization" and will not be measured for payment. No additional payment will be made.

E11. FLOW CONTROL

E11.1 Description

(a) This Specification shall cover flow control measures required to perform the work.

E11.2 Submittals

(a) Submit a written flow control plan for review by the Contract Administrator in accordance with E4, a minimum of ten (10) Business Days prior to undertaking connections to the existing sewer. Flow control plans shall be prepared and stamped by a Professional Engineer, registered in the Province of Manitoba and experienced in the design and implementation of temporary flow bypass works. Flow control plan shall include the following:

(i) A description and sketch detailing the arrangement of the proposed flow control measures.

(ii) A list of the key components required for the flow control measures, including but not limited to the following:

(i) Inflatable plugs

(ii) Cofferdams

(iii) Piping or hoses (where required)

(iv) Pumps (where required)

(iii) A detailed procedure for installation and removal of the flow control measures.

(iv) Monitoring plan and 24 hr contact person.

(v) Means and methods for dealing with excessive flows or wet weather events.

E11.3 Methods

(a) Provide necessary flow control measures for the interceptor sewer required to perform the work. Diversion of wastewater flow directly or indirectly to the environment, land drainage sewers, or storm relief sewers is not permitted.

(b) Maintain existing sewer flows from the upstream system during construction. Any flow control measures implemented must be capable of passing wet weather or high flow conditions through the site should they be encountered. Where complete blockage of the sewer is proposed (e.g. inflatable flow through plugs) the plugs must be readily deflated or removed from the pipe in an emergency situation.

(c) Provide security personnel for locations where by-pass pumping requires normally secure or locked doors and access areas to be left open or unlocked.

(d) Ensure all flow control components and materials are removed from the sewer system upon completion of the work.

(e) Mainline Sewer Flows

(a) The Contractor is responsible for bypassing or the temporary storage of all dry and wet weather flows.

(b) Flows have been provided for the purpose of developing flow management plans where it is anticipated that the Contractor will have modify the existing Combined Sewer (CS) system for the Work. Should the Contractor intend further modification of the existing system to complete the Work, the Contractor shall notify the Contract Administrator and provide a plan of the proposed modification, where the Contract Administrator will review and provide flows for development a plan flow management plan.

(c) The flow management plan to accommodate the dry weather flows shall ensure that the flows in the upstream sewer do not exceed the obvert of the pipe:

(i) 750 mm Andrews Street CS

- Average Dry Weather Flow (ADWF) = 5 l/s
- Peak Dry Weather Flows (PDWF) = 17 l/s

(ii) 450 mm Aikins Street CS

- ADWF = 0.5 l/s
- PDWF = 2 l/s

(d) The flow management plan to accommodate the wet weather flows shall ensure the flows can be passed under the following conditions:

(i) 750 mm Andrews Street CS

- Peak Wet Weather Flows (PWWF) = 680 l/s
- Allowable headloss across bypass system = 0.2 m

(ii) 450 mm Aikins Street CS

- Peak Wet Weather Flows (PWWF) = 180 l/s
- Allowable headloss across bypass system = 0.1 m

(e) Size on size gravity flow bypasses will be considered acceptable.

(f) Flow bypasses should be constructed during periods of DWF.

(f) Weather

(i) Review the Environment Canada weather forecast with the Contract Administrator before deploying bypass works.

(ii) Delay Work and/or secure Works when the anticipated weather conditions are such that anticipated sewer flow will exceed the flow control measures provided.

(iii) The Contractor shall advise immediately of any weather-related delays.

(iv) The Contractor to schedule Work according to the weather; the City is not responsible for delays due to weather.

E11.4 Measurement and Payment

(a) Flow control measures necessary to complete the work will be considered incidental and will not be measured for payment. No additional payment will be made.

E12. WATER SUPPLY

E12.1 Further to Section 3.14 of CW 2140 and Section 3.7 of CW 1120 of the General Requirements water supply for the Work may be taken from City of Winnipeg hydrants.

E12.2 The Contractor shall make the following arrangements for hydrant turn on and turn off.

(a) Contact City of Winnipeg Water Services Division (WSD) for hydrant turn on and turn off required between 0800 hours and 1500 hours Monday to Friday. Notice for turn on and turn off shall be provided a minimum of 24 hours in advance.

(b) Contact Emergency Services Branch (204-986-2626) with a minimum of 2 hours notice for hydrant turn on and turn off required outside of the above hours.

(c) The Contractor shall wait at the hydrant from the requested turn on or turn off time until City staff arrives to turn on or turn off the hydrant.

E12.3 Hydrants shall be considered to be “in the Contractor’s control” from the time the City has turned the hydrant on until the City has turned the hydrant off.

E12.4 Between November 1 and April 30 of any year, or whenever freezing temperatures are occurring or anticipated the Contractor shall take all necessary precautions to prevent freezing of hydrants and related appurtenances for hydrants in their control and shall be responsible to pump out hydrants turned off by Emergency Services.

E12.5 If a hydrant or appurtenance is damaged due to freezing or improper turn on or turn off procedures while in the Contractor’s control, WSD will assess the damage and determine if WSD will repair the damage or if the Contractor will be responsible to repair the damage. Costs for repairs completed by WSD will be deducted from payments owing the Contractor. Repairs completed by the Contractor will be at the Contractor’s expense.

E12.6 The Contractor shall provide a traffic ramp for hydrant connection hoses that cross roadways. The ramp shall be designed and constructed to not present a hazard to vehicles travelling over it and to ensure that no part of the hose is run over by a motor vehicle.

E12.7 Measurement and Payment

(a) Charges incurred for the permits and water meters shall be paid for by the Contractor when the permit is taken out. The Contractor shall forward the invoice to the Contract Administrator for reimbursement. The billing for water usage sent to the Contractor shall be forwarded to the Contract Administrator for payment. The Bid Opportunity number shall be noted on each permit.

(b) All other costs associated with sourcing construction water will be considered incidental to the Work and will not be measured for payment. No additional payment will be made.

E13. CHANGE IN CONTRACT CONDITIONS

E13.1 Description

(a) This specification covers changes identified to the scope of work including changes in geotechnical and geological conditions that may impact the construction of the tunnelling shafts and tunnelling operations.

(b) The basis for the geotechnical and geologic conditions are described in the GBR and GDR as defined in D26.

(c) If during the tunnelling shaft construction operations should geotechnical conditions differing from those defined in the GBR which prevent progress of the shaft construction, the Contractor shall notify the Contract Administrator immediately. The Contractor shall correct the condition or otherwise make it possible for the shaft construction to continue through removal of the obstruction or modification of the methods employed. Upon written notification by the Contract Administrator, the Contractor shall immediately proceed with object removal, remedial works, or equipment retrofit as necessary to permit continuation of the works.

(d) If the tunnelling operations should encounter geotechnical conditions differing from those defined in the GBR that prevent the forward progress of the MTBM, the Contractor shall notify the Contract Administrator immediately. The Contractor shall correct the condition or otherwise make it possible for the TBM to advance past any obstructions or conditions that impede forward progress of the TBM. Upon written notification by the Contract Administrator, the Contractor shall immediately proceed with object removal, remedial works, or equipment retrofit as necessary to permit continuation of the tunnelling works.

(e) The method for reviewing, recording and accepting a change to geotechnical and geologic conditions or obstructions is described in section D26

E13.2 Measurement and Payment

(a) The Contractor will receive compensation for encountered geotechnical conditions that are materially different than those identified in the Geotechnical Baseline Report and as defined in D26 and D28 during construction of tunnelling construction shafts and the tunnelling work.

(b) Compensation for delays and additional costs will be evaluated based on the type and extent of delay and the Equipment costs identified in Part C of Form B: Prices for the respective type of work being performed.

E14. PROVISIONAL ITEMS

E14.1 The Provisional Items listed on Form B: Prices are part of the Contract.

E14.2 The Contractor shall not perform Work included in the Provisional Items without prior authorization from the Contract Administrator. All Work included in the Provisional Items will be carried out within the construction areas shown on the Drawings.

E14.3 Notwithstanding GC:7, the City reserves the right to diminish all or any portion of the items of work listed in the Provisional Items and no claim shall be made for damages on the grounds of loss of anticipated profit or for any other reason.

E14.4 Provisional Items listed on Form B: Prices do not form part of the Initial Span calculations as identified in D22.

E15. SURVEY, INSTRUMENTATION AND MONITORING

E15.1 Description

(a) The work specified in this Section includes furnishing and installing geotechnical instrumentation to monitor ground water levels and potential movements to surface features, utilities, and ground around and above tunnelling operations, and all excavations. The work includes, but is not limited to installing: surface monitoring points, subsurface monitoring points, utility monitoring points, structure monitoring points, and video inspection of combined sewers. Also included are furnishing monitoring equipment before tunnelling and excavation work.

(b) The Contractor is responsible for surveying the elevations and locations of the instruments in accordance with the requirements herein. Baseline readings and elevations shall be determined before shaft or tunnel construction begins to establish a baseline, and during and after operations to monitor any movements related to the tunnelling and shaft construction.

(c) Further to CW 1130, the Contract Administrator will establish base line surveys, and pipe alignment at all shaft locations. The Contractor shall conduct all in tunnel surveys.

E15.2 Materials

(a) Surface Monitoring Points: Surface monitoring points shall be established by an inscribed marking or approved Surveyor's nail driven flush with the surface in asphalt or concrete paved areas. In landscaped areas, surface monitoring points shall be established by driving a 500-mm length of steel rebar or 50-mm by 50-mm timber stake flush with the ground. Each monitoring point shall have a tag or marking indicating the station and offset from centerline.

(b) Subsurface Monitoring Point: Install as identified herein. The settlement rod shall be secured to the PVC casing with a 300-mm length of loose cable or chain to prevent the rod from falling more than approximately 300 mm. The casing shall be flush with the surface or recessed, and capped and protected with a traffic rated road box.

(c) Utility Monitoring Point: Install as identified herein. Do not use drilling techniques. Vacuum excavation of the hole is acceptable. Do not damage the existing utility.

(d) Building/Structure Monitoring Point: Structural monitoring points shall be established by an inscribed marking or approved prism mounted securely to the structure. Each control point shall have a tag or marking indicating the identification number and offset from centerline.

E15.3 Submittals

(a) Submittals shall be made in accordance with the requirements identified in E4 and as listed below.

(b) Submit the following, at least ten (10) Business Days before scheduled installation of instruments:

(i) Instrumentation Installation Schedule: Submit the proposed schedule for installing the instruments.

(ii) Description of methods and materials for installing and protecting instruments.

(iii) Confirmation that monitoring points will be installed at locations as specified herein, or if deviations are proposed, submit Shop Drawings with locations of proposed monitoring points shown in plan and profile.

(c) Reports and Records:

(i) The Contractor shall submit all reports of monitoring data to the Contract Administrator within 24 hours.

(ii) Within 72 hours following installation of the instruments, submit drawings showing the actual as-built installed location, the instrument identification number, the instrument type, the installation date and time, and the tip elevation and instrument length where applicable. Include details of installed instruments, accessories and protective measures, including all dimensions and materials used.

(iii) Submit surveyed measurements of all instruments for at least fourteen (14) Calendar Days prior to commencing shaft excavation to establish baseline readings.

(iv) Submit pre and post construction surveys including photographs, video, field notes, and sketches along the entire alignment. Surveys should concentrate on significant man made features along the alignment including buildings, gutters, sidewalks, driveways, and other structures or improvements.

E15.4 Quality Control

(a) Settlement surveying shall be performed by a competent individual with previous experience surveying for the detection of surface deformations. Record the initial elevations of movement detection instruments to 0.001 meter.

(b) Install all monitoring points and instrumentation at locations identified in E15.5(b)(i), or as directed by the Contract Administrator.

(c) Should actual field conditions prevent installation of instruments at any of the locations identified in E15.5(b)(i), obtain acceptance from the Contract Administrator for new instrument location and elevation.

(d) Surveying of instrumentation shall be referenced to the same control points and benchmarks established for setting out the work. Control points shall be tied to benchmarks and other monuments outside of the zone of influence of the excavation.

(e) Installation of instrumentation shall, at all times, be performed in the presence of the Contract Administrator.

E15.5 Construction Methods

(a) General Requirements

(i) Instrumentation shall be installed at the locations identified on the Drawings, and as set out herein(b)(i). Instruments shall be installed in accordance with the submitted and reviewed installation schedule.

(ii) Record and report depth of utilities found during utility monitoring point installation.

(iii) The Contractor shall confirm locations of underground utilities in all areas where holes are to be drilled and instruments installed. Instrument locations shall be modified, as accepted by the Contract Administrator, to avoid interference with the existing utilities. Repair damage to existing utilities resulting from instrument installations at no additional cost to the City.

(iv) The Contractor shall provide access and assistance to the Contract Administrator for obtaining supplemental monitoring data, as requested by Contract Administrator.

(b) Installation of Instruments

(i) Monitoring instrumentation shall be installed in the following locations:

(i) Utility Monitoring Points: Install utility monitoring points at locations indicated on the Drawings.

(ii) Surface monitoring points: Install surface monitoring points at locations indicated on the Drawings.

(iii) Building Monitoring Points: install building monitoring points as generally described below. Contact residence or business owner prior to installation for approval.

- At building point nearest to all shafts -minimum of three (3).
- Approximately every 200 metres, evenly dispersed on right-of-way on side of street nearest the tunnel, minimum of eight (8).
- At each business location adjacent to Main Street on side of street nearest the tunnel, minimum of two (2).

(iv) Perform pre-construction and post-construction video inspection of all combined sewers adjacent to proposed tunneling shafts in accordance with CW 2145. The limits of video inspection shall extend 10 meters beyond the length of the adjacent shaft wall. Coding of the video inspection is not required.

(c) Following completion of the work, all instrumentation shall be removed or abandoned according to applicable codes and standards and as described herein, unless otherwise noted.

(d) Instrument Protection, Maintenance, and Repair

(i) Protect the instruments and surface control points from damage. Damaged installations shall be replaced or repaired prior to continuing excavation, or tunnelling, unless permitted otherwise in writing by the Contract Administrator.

(e) Response Values

(i) The following response values shall be utilized for monitoring:

(i) Existing Buildings :

- Threshold Value: 1 mm
- Response Value: 3 mm

- Shutdown Value: 6 mm

(ii) Utility Monitoring Points:

- Threshold Value: 6 mm
- Response Value: 12 mm
- Shutdown Value: 25 mm

(iii) Surface Monitoring Points:

- Threshold Value: 12 mm
- Response Value: 20 mm
- Shutdown Value: 25 mm

(ii) When the instruments indicate movement equal to the Threshold Value, the Contractor shall meet with City to discuss his construction means and methods to determine what changes, if any, shall be made to better control ground movement. Instrument readings shall be required on a daily basis until readings remain unchanged for five (5) consecutive days.

(iii) When the instruments indicate movement equal to the Response Value, the Contractor shall actively control ground movement in accordance with the reviewed plan to prevent reaching the Maximum Allowable Value. Instrument readings shall be required on a daily basis until readings remain unchanged for five (5) consecutive days.

(iv) When the instruments indicate movement equal to the Shutdown Value, the Contractor shall stop all work immediately, and meet with the Contract Administrator to develop a plan of action before work can be resumed.

(f) Duration of Monitoring

(i) Settlement monitoring shall commence prior to excavation for the tunnelling shaft construction.

(ii) Settlement monitoring shall continue for thirty (30) Calendar Days following successful completion of the connection to the existing interceptor sewer, or as directed by the Contract Administrator.

(g) Abandonment of Instruments

(i) Control Points: All surface control points on public property shall remain in place at the completion of the work. Remove all surface control points on private property during the cleanup and restoration work, or as required by the Contract Administrator.

(ii) Monitoring Instruments:

(i) Surface monitoring points shall remain in place unless directed by the Contract Administrator to remove and dispose of the points.

(ii) Properly abandon all subsurface and utility settlement monitoring point boreholes by grouting drilled holes and casing with cement bentonite grout conforming to the requirements of Contact Grout.

(iii) Structural monitoring points shall be removed by the Contractor after completion of the Work and as allowed by the Contract Administrator. The sites shall be restored to the conditions existing prior to installation of the structural monitoring points.

E15.6 Measurement and Payment

(a) Supply, installation and execution of settlement monitoring and video inspection as specified herein shall be measured on a unit basis for each location and type of instrumentation installed, as listed in Form B: Prices. Payment will be made at the Contract Price for “Instrumentation and Monitoring” for each location and type of instrumentation as listed in Form B: Prices.

(b) Payment shall include but not be limited to the supply, installation and protection of the instruments, video inspection, replacement or repair of damaged utilities, performing

baseline measurements, ongoing monitoring, provision of electronic monitoring results, submission of data, and abandoning of the instruments.

(c) Payment for instrumentation and monitoring will be made on the following schedule:

(i) Fifty percent (50%) of the price will be paid following the installation of each instrument and establishment and provision of baseline measurements.

(ii) The remaining fifty percent (50%) will be paid upon completion of the monitoring program as specified herein.

(iii) Video inspection will be paid following the completion of Pre-Construction Sewer Inspection and Post-Construction Sewer Inspection at each location of inspection.

E16. BUILDING INSPECTIONS AND VIBRATION MONITORING

E16.1 Description

(a) The work specified in this Section includes furnishing of vibration monitoring instrumentation to monitor vibrations on nearby structures caused by construction activities.

(b) Depending on the means and methods chosen by the Contractor, implementation of vibration monitoring may or may not be necessary. Implementation of vibration monitoring will be at the discretion of the Contract Administrator, to be determined following submission and review of the Contractor's planned means and methods of executing the Work.

(c) The work executed under in this specification, if undertaken, shall include but not be limited to performing pre-construction surveys, supply and installation of vibration monitoring equipment, monitoring of vibration data, submission of vibration data and reports to the Contract Administrator, performing post-construction surveys, and abandonment of monitoring equipment.

(d) While a current by-law on acceptable vibrations does not exist for the City of Winnipeg, the monitoring data should be compared to the California Department of Transportation and Construction Guidance Manual (September 2013) which presents probabilistic damages thresholds.

E16.2 Submittals

(a) Upon request by the Contract Administrator, submit a Vibration Monitoring Plan in accordance with E4. The Vibration Monitoring Plan shall include, at a minimum:

(i) A description or sketch showing the proposed location for monitoring devices;

(ii) Make and model of vibration monitors to be installed;

(iii) Testing company contracted to perform the installation and monitoring;

(iv) Means and methods of collecting, storing and distributing vibration data; and,

(v) Schedule for execution of the Work.

(b) Submit Shop Drawings for proposed vibration monitoring equipment in accordance with E4 and meeting the requirements as specified herein.

(c) Reports and Records:

(i) The Contractor shall submit all reports of monitoring data to the Contract Administrator on a daily basis.

(ii) Within 72 hours following installation of the instruments, submit drawings showing the actual as-built installed location, the instrument identification number, the instrument type, and the installation date and time.

(iii) Submit pre and post construction surveys in accordance with E16.4(a), including photographs, video (as needed), field notes, and sketches. Surveys should provide a record of foundation, interior walls, door and window frames, existing cracks or other pre-existing damage, and any other relevant features.

(iv) The collected data shall be made available and be provided to the homeowners or business owners adjacent to the work upon request.

E16.3 Quality Control

(a) Vibration monitoring shall be installed and performed by a suitable testing company with previous experience in performing related work.

E16.4 Construction

(a) Building Inspection

(i) The Contractor or their designate shall complete a pre-construction photographic survey of the existing structures adjacent to the work.

(i) The pre-construction survey should provide a record of foundation, interior walls, door and window frames, existing cracks or pre-existing damage, and any other relevant features.

(ii) Pre-construction surveys shall be conducted in the presence of the Contract Administrator prior to commencement of construction activities.

(ii) Where the Contractor is entering properties to undertake the photographic survey, notices shall be provided to the businesses or homeowners in advance to arrange for interior inspections. Notices shall be reviewed and accepted by the Contract Administrator and the City prior to issuance.

(i) Any individuals entering into a private residence or meeting with citizens as part of this work shall have submitted security clearances to the Contract Administrator in accordance with Part F.

(iii) Where homeowners of businesses will not permit access to structures for inspection, the Contractor shall duly document attempts to arrange access. Inspections, insofar as possible shall be made from public right-of-way, noting any visual defects observed.

(iv) Following construction activities, the Contractor shall arrange for a post construction inspection of any business or residences where pre-construction inspections were undertaken. The post construction inspection shall be conducted in the presence of the Contract Administrator.

(b) Instrumentation

(i) Monitoring instruments shall be installed on structures at nearest point to the proposed shaft locations.

(ii) Vibration monitors shall meet or exceed the following requirements:

(i) Capable of measuring 0 – 400 mm/sec, continuously.

(ii) Capable of continuously recording monitoring data. Download data periodically as required by storage requirements.

(iii) Vibration monitoring shall be installed prior to commencement of construction activities identified as requiring vibration monitoring. Obtain baseline measurements for five (5) consecutive days prior to commencement of construction activities identified as requiring vibration monitoring.

E16.5 Remove monitoring instrumentation upon completion of work identified as requiring vibration monitoring.

E16.6 Measurement and Payment (Provisional Item)

(a) Building inspections as specified herein will be measured on a lump sum basis as listed in Form B: Prices. Payment will be made at the Contract Price for “Building Inspection and Vibration Monitoring”. Payment shall include but not be limited to the performance of pre-construction and post-construction surveys.

(b) Vibration monitoring as specified herein will be measured on a lump sum basis as listed in Form B: Prices. Payment will be made at the Contract Price for “Building Inspection and Vibration Monitoring”. Payment shall include but not be limited to the supply, installation and protection of the instruments, performance of baseline measurements, ongoing monitoring, submission of data, and abandoning of the instruments.

(c) Payment for vibration monitoring will be made on the following schedule:

(i) Twenty five percent (25%) of the lump sum price will be paid following the completion of the installation of the instrumentation and provision of baseline measurements.

(ii) The remaining seventy five percent (75%) will be paid upon completion of the monitoring program as specified herein.

TUNNELLING AND SHAFT CONSTRUCTION

E17. TUNNELING SHAFTS

E17.1 Description

E17.1.1 This Section includes excavation and initial support of shafts, including launch shafts and receiving shafts.

E17.2 General

E17.2.1 Performance Requirements

(a) Select methods of shaft excavation and initial ground support that are compatible with conditions described in the Geotechnical Baseline Report, and with requirements for placement of permanent structures, control of water, safety of personnel, and protection of adjacent property.

(b) Initial ground support systems shall maintain the safety of personnel, prevent damage to adjacent property, and maintain the inherent strength and stability of ground surrounding the excavation. Initial ground support systems shall prevent ground loading on the new Work until after design strength has been reached.

(c) Specific methods of initial ground support and groundwater control required in this Section or shown on the Drawings are to be considered minimum requirements. Contractor is solely responsible for any additional construction measures necessary to achieve the requirements of this Section, and is solely responsible for any damages resulting from failure to meet the requirements of this Section.

(d) Establish the size and configuration of shaft excavation to accommodate means and methods of construction, subject to minimum requirements and to any limitations shown on the Drawings and Specifications.

(e) Construction of shafts in addition to those shown on the Drawings, or in locations other than those shown on the Drawings, at the request of and for the convenience of Contractor, is subject to review and acceptance by the Contract Administrator.

(f) Should the Contractor be allowed to relocate a shaft from the position shown on the Drawings, any increase in the cost of relocating utilities above the estimated cost at the location shown on the Drawings, as determined by the Contract Administrator, shall be borne by the Contractor.

E17.2.2 Initial Ground Support System Design by Contractor

(a) Contractor shall be solely responsible for design of initial ground support systems, and for any revision of designs shown.

(b) Initial ground support systems should be designed to the recommended ground loads and surcharge loads provided in the Geotechnical Baseline Report. Contractor shall verify that ground loads and surcharge loads for design are adequate for the expected ground conditions, and are appropriate for the type of support system proposed. Contractor shall add construction loads appropriate to the means and methods of construction.

(c) Design of the initial ground support system shall consider:

(i) Ground conditions described in the Geotechnical Baseline Report.

(ii) Methods for control of water.

(iii) Maintenance of soil stability at the bottom of the excavation.

(iv) Deformation of the support system under load.

(v) The proximity of existing underground and above-ground structures, including buried water lines and the potential effect of their rupture on the support system.

(vi) Effects of vibration on adjacent structures, from driving and pulling sheeting and piling.

(vii) All loading conditions, including loading due to delay in adding support members, removal of support members, and dynamic loading.

(viii) Tunnel break-in and break-out procedures.

(ix) Placement of permanent lining and structures.

(x) Site and environmental conditions.

(d) Additional requirements for initial ground support systems for shaft excavations are shown on the Drawings.

E17.2.3 Utility Relocation

(a) Due to the wide variety of shaft configurations, number of shafts and construction methods, any required utility relocations as a result of the Contractors selection of shaft methodology, shall be designed and paid for by the Contractor. This includes all utilities shown on the drawings, including but not limited to;

(i) Natural Gas;

(ii) Telephone;

(iii) Other communication utilities;

(iv) Combined Sewers;

(v) Water Mains;

(b) On completion of construction, utilities shall be relocated to their initial position if requested by the utility company. Relocated sewers and watermains shall be restored to their initial position, unless otherwise permitted by the City. In no case, shall temporary vertically relocated sewers be permitted to remain (i.e. temporary siphons)

E17.2.4 Accommodation of Tunnelling Work

(a) The shafts used for launching and receiving shall be made fully adequate for the tunnelling and trenchless work. Contractor shall be responsible for providing each launching shaft and each receiving shaft with all of the provisions necessary to perform the tunnelling and trenchless operations. Furnish all labor, equipment, material, and additional design, as necessary, to meet the minimum requirements as contained herein.

(b) Contractor shall provide, as required, each launch shaft with thrust blocks, entrance seals, base slabs, pumping and drainage systems, ventilation systems, electrical systems, and lighting systems. Contractor’s Engineer shall design the thrust blocks, entrance seals, and base slabs including any necessary modifications to the shoring. Contractor’s Engineer shall also be responsible for developing a Fluid Control Plan to be implemented by Contractor at each of the launching shaft sites in accordance with the requirements as contained herein.

(c) Contractor shall provide, as required, each receiving shaft with exit seals, working floors, and, as necessary, a pumping and drainage system to maintain dry working conditions. Contractor’s Engineer shall design the exit seals including any necessary modifications to the shoring.

(d) Prevent the inflow of ground and/or groundwater into the shafts during the tunnelling and trenchless operations including but not limited to break-in and break-out of the shaft during the launching and receiving processes. The ground shall be improved, as necessary, to prevent any inflow of ground and/or groundwater in excess of specified tolerances as contained herein.

(e) Prevent the machine from sinking or otherwise veering off of the alignment during the launching and/or receiving process. The ground shall be improved, as necessary, to

prevent the machine from deviating along line and grade during the launching and receiving process in excess of the specified tolerances as contained herein.

(f) Contractor shall be responsible for ensuring that each of the shafts, including any modifications, used with the tunnelling and trenchless operations is fully adequate for installation of the structures as shown on the Drawings. Contractor shall modify these shafts as necessary to accommodate the construction of these structures. Furthermore, Contractor's Engineer shall provide any additional design necessary for completing this work.

(g) Contractor shall be responsible for conditions as defined in the Geotechnical Baseline Report.

(h) Contractor shall store, process, transport, and dispose of any muck and/or excavated material in accordance with environmental regulations.

E17.2.5 Experience Requirements

(a) Contractor's Engineer shall be licensed by the Province of Manitoba with at-least five (5) years of experience designing tunnelling and trenchless shafts.

E17.3 Submissions

E17.3.1 Shaft Plan

(a) The Contractor shall submit a construction shaft plan to the Contract Administrator a minimum of ten (10) Business Days prior to commencement of shaft construction works. If changes are made to the installation plan during construction, the Contractor shall submit these changes to the Contract Administrator for review in advance of implementation of the changes. The construction shaft plan shall include the following:

(i) Shop Drawings, in accordance with E4, showing the shaft construction. Shop Drawings shall be signed by a Professional Engineer Licenced to practice engineering in the Province of Manitoba and experienced in the design of shoring systems. Shop Drawings shall include the following minimum information:

- Dimensioned layout of support system including location of members (such as caissons, beams, columns, piles, walers, struts, sheeting and other supports);
- Member sizes and thickness, and bending tolerances of structural steel;
- Quality of materials to be used (by reference to recognized standards such as ASTM), including but not limited to timber structural members, sheeting, and blocking; steel structural members, sheeting, plates, and bars; concrete; and grout;
- Connection details;
- Maximum allowable spacing between bracing points on compression members to maintain stability and alignment;
- Requirements or limits on pre-loading braces;
- Sequence of erection and removal;
- Design loading conditions;
- Codes and reference standards used as a basis for design;
- Location, dimensions, and means of ensuring stability at openings;
- For initial support members installed in advance of excavation, describe methods of installation, of quality control, and of correcting support system defects exposed by subsequent excavation;
- Existing utilities with separation distances;
- Means of accommodating tunnelling and connection pipe installation;
- Means of accommodating construction of the final chambers and appurtenances;

- Where shafts are to form part of the final chamber, include sufficient details to demonstrate that the shafts meet the reinforcing requirements and design intent identified on the drawings and herein;
- Where shafts are to act as forming for the final chamber, include sufficient details to demonstrate the ability to accommodate final chamber construction;
- Any other details required to demonstrate the proposed shafts meet the requirements of the tunnelling work and associated piping and chamber construction works.

(ii) Shaft Excavation Plan, including the following information:

- Limits of shaft work sites.
- Location and dimensions of shaft excavations.
- Methods of excavation.
- Means of maintaining soil stability at the bottom of the shaft.
- Provisions for ventilating the excavation to prevent accumulations of hazardous gas.
- Measures employed at tunnel entry and exit points to stabilize the ground and to control groundwater.
- Site and shaft security arrangements.

(iii) Designers qualifications;

(iv) Sketch or sketches of the site clearing showing shafts, tunnelling and other equipment necessary to complete the Work;

(v) Dimensions for all swales and ditches to be used to control surface water;

(vi) Monitoring and maintenance plan including Contractor's designated contact person responsible for dewatering and drainage, inspection intervals and means for supervising and monitoring pumping activity;

(vii) Pump sizes, power source, and noise attenuation features; and

(viii) Any other related information reasonably requested by the Contract Administrator.

(b) Submit samples, certifications, and test results of imported shaft bottom preparation materials, geotextiles, and backfill materials.

(c) Coordinate the submittal requirements of this Section with submittals required under other Sections for control of water, and for backfill grouting.

E17.3.2 Fluid Control Plan

(a) Fluid Control Plan to ensure that the equipment operator maintains full control over fluid volumes and fluid pressures during tunnelling and trenchless operations including slurries and/or lubricants. Contractor shall determine the construction activities at each launch shaft site location and describe these in detail. Contractor's Engineer shall evaluate these activities and develop a plan including recommendations to ensure that fluid control is not impeded to any degree by any construction activity occurring at the site including but not limited to backfilling operations, leakage in the shoring, dewatering activities, and induced flow of groundwater. Consideration shall be given to the ground and groundwater conditions as defined in the GBR.

E17.3.3 Shaft Layout and Details

(a) For each tunnelling and trenchless shaft, provide complete details, drawings, and schematics, as applicable. Show layout of shaft, including equipment, drawn to scale. Demonstrate that proposed layout of shafts is adequate for sequence of construction, equipment operations, and means and methods of pipe installation including any required acceptance testing. Describe in detail provisions for the working slab, invert treatment, and pump and drainage systems. Include details of lighting, ventilation, hydraulic, and electrical systems.

E17.4 Materials

E17.4.1 General

(a) Materials shall be selected by the Contractor to meet the performance requirements of the shoring system.

(b) Incorporation of used prefabricated elements into initial support systems is permitted, provided the strength and stability of used elements is verified prior to incorporation, and allowances made for lost strengths, if any, due to existing damage or deterioration.

(c) Any portions of the shoring system that are to act as the final structure shall meet all of the requirements identified on the Drawings.

E17.5 Construction

E17.5.1 General

(a) Do not begin work on any of the tunnelling and trenchless shafts until all relevant submittals have been reviewed and accepted by the Contract Administrator.

(b) Furnish all necessary labor, material, equipment, power, water, and utilities to complete the work. Additionally:

(i) Select the means and methods for performing the work.

(ii) Select, design, and install the thrust blocks. The thrust blocks shall be sufficiently reinforced, isolated, and otherwise anchored, to include any necessary ground improvement measures, to prevent movement from occurring within the launching shaft and/or misalignment of the jacking frame.

(iii) Select, design, and install the entrance seals, including any necessary modifications to the shoring, for the launching shafts.

(iv) Select, design, and install the base slabs, including any necessary modifications to the shoring, for the launching shafts.

(v) Select, design, and install the exit seals, including any necessary modifications to the shoring, for the receiving shafts.

(c) Damaged and/or deficient materials shall be repaired and/or replaced as directed by Contract Administrator.

(d) Protect from damage all of the existing improvements at the site including but not limited to structures, utilities, and culverts.

(e) Perform work in accordance with the reviewed submittals.

(f) The Contractor’s surveyor shall be responsible for verifying any control points identified in the Contract Documents. Contractor’s surveyor shall check any baseline and/or benchmarks shown prior to starting and report any errors or discrepancies to Contract Administrator.

(g) Notify the Contract Administrator immediately upon detecting any larger than predicted deformation, distress, or damage to the excavation support system.

(h) Notify the Contract Administrator immediately of any structural element that is not in accordance with the reviewed design submittals.

(i) Do not resume construction activities until corrective measures have been fully implemented.

E17.5.2 Groundwater Dewatering

(a) The contractor shall undertake groundwater dewatering, as required to prevent basal instabilities in the shaft, as indicated in the GBR.

E17.5.3 Surface and Groundwater

(a) Inflow of Ground and Groundwater: If the groundwater is mixed with any slurry and/or lubricant, it shall be prevented from entering the shaft in accordance with Fluid Control Plan.

(b) Control water within excavations to prevent flowing conditions.

(c) Prevent piping and loss of fines from the surrounding soils.

(d) Contractor to utilize appropriate measures such as advance ground treatment and/or adequate wall toe-in depths to prevent the possibility of base heave or soil piping

(e) Take appropriate measures to prevent flooding of the shaft during periods of rainfall or overland flood.

(f) Prevent ice formation on shaft walls by groundwater cut-off, frequent scaling, heating of ventilation air, or other measures as necessary to eliminate the hazard of falling ice.

(g) The Contractor is responsible for the control, diversion, storage and pumping of all water including without limitation rain, snow melt, groundwater, leaking infrastructure and water in pipes throughout all stages of the Work.

(h) Do not pump or drain any water containing excessive suspended materials or harmful substances into waterways, sewers or other drainage systems. Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with the governing authority's limitations and requirements.

(i) The Contractor shall be responsible for all damages within or outside the Site directly resultant from the Contractor's actions, omissions or neglect which may be caused by or which may result from water backing up, flowing through, overflowing or excessive surcharge of drainage systems.

(j) The Contractor shall organize and bear all costs related to the effective dewatering of the excavations and all other pumping and drainage necessary for the proper execution of the Work, including keeping the pipes, structures, shafts, excavations and trenches free of undesirable accumulations of groundwater, seepage, surface water, melt water or rain water.

(k) All dewatering equipment and discharge hoses shall be protected from freezing and shall remain fully operational in freezing weather.

(l) Dispose of all water drained or pumped as above by discharging it into sewers, drainage ditches or natural water courses as reviewed by the Contract Administrator, and in compliance with all local, Municipal, Provincial and Federal environmental regulations, ordinances, bylaws, etc., and provide documentation indicating that authority has been granted to discharge effluent water into any drainage ditch, brook, creek or river. The Contractor shall develop and implement at their own cost any filtration, settlement or other acceptable treatment methods required prior to disposal.

(m) Keep all drainage channels, gutters, swales, ditches, sewers, culverts and disposal areas free of silt, sand, debris and gravel and remove such deposits as required.

E17.5.4 Initial Ground Support Systems - General

(a) Construct initial ground support systems to general line, grade, dimensions, and tolerances that allow permanent structures and pipes to be placed as shown on the Drawings and in accordance with specified tolerances.

(b) As the excavation progresses, perform periodic verification of shaft vertical alignment.

(c) Develop and maintain firm and uniform bearing of the support system against the ground by advancing the support system in advance of excavation, or by timely placement of internal supporting members, or by expanding the support system tightly against the ground, or by timely backfill grouting between a non-expanding support system and the ground.

(d) As the excavation progresses, perform periodic inspections for indications of loosening or instable ground; loss of ground through the support system; cracking and subsidence of ground near the excavation; or excessive deformation, overstress, or weakening of the initial support system.

(e) Maintain the initial ground support system in fully functional condition for the duration of its use. Promptly reset, repair, or replace support system elements that settle, become misaligned, were improperly installed, or become damaged.

(f) Utilize excavation methods which prevent basal heave or soil piping methods leading to instability of the shaft base.

E17.5.5 Initial Ground Support Systems in Soil

(a) Adopt adequate embedment depths to prevent basal heave or soil piping leading to instability of the shaft base, and adopt tremie concreting methods for construction of the shaft base where appropriate.

(b) Where precast or cast in place systems are used, utilize bentonite or other supporting mud to assist shaft sinking and minimize the movement of the ground surrounding the shaft.

(c) Coordinate the installation of initial support systems with excavation to prevent heaving or raveling of exposed soils.

E17.5.6 Backfill Grouting of Precast Concrete or Cast-In-Place Concrete Caisson Linings

(a) On completion of shaft sinking, grout behind the lining to displace annular bentonite, minimize ground movement into the annular space, and migration of fluids through the annular space.

(b) Inject grout in continuous progression of grout holes along the perimeter of the shaft, commencing from the bottom of the shaft and working upwards.

(c) Pump grout until material discharging from next hole in sequence is similar in consistency to that at the point of injection. Exercise care to completely fill voids around any obstruction to the natural flow of grout.

(d) Grouting pressure shall be established by the Contractor, but shall not exceed safe limits established by the Contractor in advance. Control grouting pressure to avoid distorting the shoring.

(e) Equip the grout plant with reliable pressure gauges at the point of injection and at the pump, to provide accurate pressure readings on a continuous basis.

(f) After completing the grouting of a hole, hold the grout by means of the stop valve until the grout has set to the extent that it will be retained in the hole.

E17.5.7 Removal of Initial Ground Support Systems

(a) Wall support shall be left in place as shown on the Drawings, unless otherwise accepted by the Contract Administrator. Bracing members shall be removed in a sequence that prevents and movement of the wall support.

(b) Sheeting shall be removed, where permitted, as the excavation is backfilled, and in a manner to maintain stability and strength of soils, and to avoid disturbing adjacent utilities and structures. Voids left on removal of sheeting shall be backfilled to prevent subsidence.

(c) Support systems that extend below the bottom of the excavation, such as sheeting, shall not be removed.

(d) Support systems that cannot be removed without causing damage to existing structures, utilities, or the Work, in the sole opinion of Contractor, shall be left in place at no additional cost to the project.

(e) Shoring systems shall be removed to a minimum depth of 1.5 metres below ground surface.

(f) Contractor to provide as-built of locations of shoring remaining in place.

(g) Repair any settlement or damage to the Work or adjacent property resulting from removal of initial ground support systems.

E17.5.8 Soil Excavation

(a) Adopt a shaft support system that maintains continuous ground support during excavation.

(b) Excavate in a manner to minimize loss of soil into the excavation, to minimize soil movement outside the excavation, to maintain stability of the excavation, and to preserve the existing strength of soils surrounding the excavation.

(c) Methods of ground stabilization and groundwater control employed at shaft entry and exit points, such as ground freezing or jet grouting, shall be compatible with methods of tunnel excavation.

E17.5.9 Shaft Bottom Stabilization

(a) Design and install a concrete base connecting to the wall support system, to prevent ground heave, loss of fines and water ingress.

(b) Use of foundation stabilization material shall conform to CW2030.

(c) Where ground and hydrostatic conditions require, utilize tremie concreting techniques for placement of shaft bases.

(d) Stabilize the foundations of structures not in the shaft as necessary to prevent damage from the proposed shaft installation.

(e) Where the existing material in the bottom of the excavation is unsuitable for supporting the structure, over-excavate and replace with suitable granular material compacted to 95% SPDD or cementitious material as shown on the Drawings. Any open graded material shall be wrapped in a non-woven geotextile fabric to prevent the transfer of fines.

(f) Use of foundation stabilization material made necessary by Contractor's failure to maintain bottom stability due to inappropriate means of ground support or groundwater control shall be the responsibility of the Contractor.

E17.5.10 Control of Vibrations

(a) Control of vibrations to prevent damage to the work or to adjacent property caused by vibrations from driving piles shall conform to the requirements of E16.

E17.5.11 Backfill of Shafts

(a) Remove all form materials and trash from the excavation before placing any backfill. Remove loose, sloughing, or caving soil from bottoms and sidewalls of excavation.

(b) Backfill around cast-in-place concrete only after concrete has attained 2/3 of the specified 28-day compressive strength. Review backfilling requirements of permanent construction with respect to attained concrete strength prior to backfilling.

(c) Backfill all shafts to CW 2030 Class 3 standards. Where sealed shaft construction is utilized, provide means of draining backfill such as a dewatering pump well. Weep holes in the LDS sewer will be permitted. Provide sediment traps and patch weep holes on completion of work.

(d) Changes to shaft backfill at request of the Contractor, such as use of cement stabilized fill, shall be borne by the Contractor, unless requested by the Contract Administrator.

(e) Raise backfill uniformly to prevent unbalanced lateral loading that could push the shaft structure out of vertical alignment.

(f) Limit lift heights to prevent hydrostatic loading that would overstress the shaft structure.

E17.5.12 Shaft Security

(a) Provide shaft security protection to a minimum height of 1 metre above grade.

(b) Secure shaft excavations deeper than 3 metres during all periods when shaft site is unoccupied by Contractor or security personnel, including routine absences such as lunch breaks, overnight, and weekends.

(c) Security measures shall be designed to deter vandalism, and to prevent unauthorized or accidental entry of persons, animals, or objects into the shaft. Minimum security measures shall consist of items (i) or (ii) below. Item (iii) is required at all locations:

(i) temporary shaft cover consisting of a rigid steel frame covered with steel mesh, expanded metal, or equal, with sufficient structural capacity to support persons standing on the cover;

(ii) temporary shaft cover consisting of steel or nylon netting, with sufficient structural capacity to support persons standing on the netting; fully secured to the extended shaft lining; and,

(iii) chain link security fence conforming to these Specifications, installed on the shaft work site perimeter; closed and locked whenever the site is unattended by Contractor's personnel.

(d) Excavations which are exposed to public vehicular traffic, including run-off-the-road traffic, shall be barricaded along the exposed side with portable concrete "Jersey barriers" designed and positioned to deflect errant vehicles.

E17.5.13 Line and Grade

(a) Line and Grade during the Launching and Receiving Operations: line shall be maintained within ± 100mm and grade shall be maintained within ± 50mm at any point.

E17.6 Measurement and Payment

E17.6.1 Construction of Tunnelling Shafts

(a) Construction of tunnelling shafts will not be measured for payment. Shafts will be considered incidental to the price of "Tunnel Construction".

(b) Cost of utility relocations to accommodate the Contractors selected shaft geometry or construction methodology shall be borne by the Contractor.

(c) Construction of tunneling shafts will be progressed as a percentage of tunnel construction, based on reasonable construction costs.

E18. DEPRESSURIZATION FOR CONSTRUCTION OF SHAFTS

E18.1 Description

(a) This specification covers the provision for drawdown and depressurization of the bedrock groundwater pressures, if necessary, due to elevated groundwater levels (GWLs), to facilitate the construction.

(b) Elevations defining the need for groundwater depressurization are listed within the GDR and GBR.

(c) The Contractor should be aware that the GWL varies seasonally.

(d) The Contractor is responsible to evaluate data provided within the GDR and GBR and determine what if any depressurization needs will be required to protect against basal heave of the foundation for any deep shaft excavation (including launch shaft and receiving shafts)

(e) Alternatively, the Contractor may elect to design their shafts to overcome construction issues associated with elevated groundwater levels. The Contractor must submit alternate methods of controlling groundwater to the Contact Administrator for review and approval in accordance with B7.

E18.2 Submittals

(a) (a) Shaft Excavation Depressurization System Plan: Submit the following describing the shaft excavation depressurization plan, designed and sealed by a Professional Engineer or Professional Geologist registered to practice in the Province of Manitoba and including:

(i) An evaluation of static groundwater conditions

(ii) Required drawdown elevations for successful completion of the Project excavations (if pumped depressurization is the selected method for depressurization).

(iii) Permissible groundwater levels (pressures) at various stages of excavation and backfill to prevent uplift of soil layers and to prevent any other disturbance to the insitu foundation soils due to any excess groundwater pressures.

(iv) Confirmation of the elevation to which the excavation may proceed before the well system (or alternate depressurization method) commences operation.

(v) Confirmation of the extent to which chamber construction and backfill must be completed before the well system can cease operation.

(vi) Number of wells, including location, size, pumps and installation details.

(vii) Schedule of monitoring, maintenance, manpower estimates, and interpreting of ground water levels throughout the duration of the Project.

E18.3 Methods

(a) The Contractor shall monitor the groundwater level (GWL) at each of their shaft locations to ensure that the potential for basal heave is controlled within the levels indicated in the Geotechnical Baseline Report.

(i) A Standpipe Piezometer shall be drilled into the till allowing for monitoring of the till pressures.

(ii) The piezometer shall be drilled within 1-3 m of edge of shaft/excavation.

(b) The Contractor is required to monitor the groundwater levels in accordance with the following monitoring schedule:

(i) If monitoring to ensure GWL are below threshold that requires depressurization – minimum one reading per day.

(ii) If monitoring active depressurization to determine impact of pumping on GWL – Minimum twice per day.

(c) Depressurization system shall control ground water levels and pressures and protect against excavation basal heave/blowout.

(i) The depressurized system shall include a well system or an alternate approved design in accordance with B7 and as approved by the Contract Administrator.

(ii) Once required, the well system will be required to operate continuously during excavation, construction and backfill activities.

(d) The Contractor shall be responsible for any permits necessary for operation of their depressurization system.

E18.4 Measurement and Payment

(a) The Work required for depressurization of the GWL, or alternate methods of controlling GWL to facilitate construction including, Tunnelling (launch, receiving and rescue shafts), as described herein is incidental to the Contract prices for the components of Work for which control of the GWL is required. No additional payment will be made for supplying materials, equipment and performing all operations herein described and all other items incidental to the Work included in this Specification.

(b) Costs for installation of Standpipe Piezometers and monitoring of the groundwater level are paid separately under E15.

E19. TWO-PASS TUNNELLING METHOD

E19.1 Description

(a) This Section includes the minimum requirements for the installation of primary Excavation Support prior to installation of grouted in place carrier pipe (2 pass tunneling).

(b) This Section includes additional shoring requirements to E17 for the shoring to be installed to support the Tunnelling works.

E19.2 Materials

E19.2.1 Contact Grout:

(a) As per E21.

E19.2.2 Excavation Support:

(a) Rib and Lagging

(i) Steel Rib Supports:

- Steel rib supports and other structural steel members shall be free of corrosion and defects that may impair or reduce their structural integrity. Ribs shall be accurately bent to approved shape for the proper radius of tunnel section. Rib segments shall fit closely and have bolted butt-plate joint connections.
- All steel appurtenances required for the installation of the ribs such as tie rods, collar braces, bolts, butt plates, wedges, shims, spacers, and other necessary accessories shall be provided with the ribs.
- Ribs, channels, plates, rods, and accessories shall be structural steel conforming to CSA G40.21. Bolts shall conform to ASTM A325.

(ii) Lagging:

- Timber for lagging shall be sound, well-seasoned, structural grade or better lumber of rectangular cross section.
- Timber for blocking shall be hardwood.

(b) Steel lining;

(i) Steel primary lining capable of supporting tunnel.

E19.3 Submittals

(a) General

(i) Submittals shall be made in accordance with E4, providing sufficient detail to allow the Contract Administrator to determine whether the proposed equipment, materials, and procedures will meet the Contract requirements.

(ii) Calculations shall be submitted in a neat, legible format. Assumptions used in calculations shall be consistent with information provided in the GBR. All calculations shall be prepared by a professional engineer licensed in the Province of Manitoba, who shall stamp and sign calculations.

(b) Qualifications: Submit personnel qualifications in accordance with Item Quality Control. Provide qualifications and training records for superintendent, TBM operator, site safety representative, personnel responsible for air quality monitoring, and surveyors.

(c) TBM Tunnelling Equipment: Submit the following describing the TBM and construction methods:

(i) A detailed description of the methods and equipment to be used in completing the tunnel drive.

(ii) The excavation diameter based upon the outermost dimensions of the gauge cutters or shield. Provide the Radial Overcut which shall be determined as the difference between the maximum excavation diameter and the outer diameter of the expanded Excavation Support, divided by two.

(iii) Manufacturer's literature describing the TBM and all ancillary equipment. If a used or refurbished TBM is proposed, list previous usage, modifications made and dates of modifications, and detailed description of the extent and dates of refurbishment for the past five (5) years. Include the following information concerning the TBM:

- Dimensions.
- Torque, rotation speed range.
- Cutter types, configuration, and gauge cutter setting for overcut.
- Excavation chamber.

- Articulation and steering capability.
- Capacity, number, and arrangement of TBM thrust jacks and push ring.
- Face accessibility and plate or flood door provisions.
- Tail or push ring seal or means to prevent contact grout from filling the annulus outside the TBM.
- Mucking system.

(iv) A description of the alignment control system. Provide manufacturer's literature and Drawings, showing setup and support provisions, and other details for the laser or theodolite system, including intermediate relay stations. Submit a description of surveying methods to set guidance system positions and a description of procedures to check and reset or realign guidance system during construction.

(v) Results of line and grade survey to ensure that the launch frame or cradle are installed properly, prior to launch.

(vi) Ventilation and air quality monitoring system, including monitors for TBM deactivation and alarm activation.

(vii) Details of spoil removal and handling systems, transport, and disposal equipment and procedures including spoil disposal sites.

(viii) Detailed procedure for preventing ground loss whenever the machine is stopped and restarted.

(ix) Winter Operations Plan – If Tunnelling operations are expected to occur between November and March of any given year, the Contractor shall submit a plan indicating how their proposed Tunnelling method will operate in the expected climate conditions.

(d) Excavation Support: Submit the following describing the Excavation Support and installation methods:

(i) A detailed description of the methods and equipment to be used in erecting Excavation Support, including means to expand the support to be in full contact with the ground immediately following exposure of the support to the ground.

(ii) Shop Drawings of the Excavation Support showing all dimensions.

(iii) Shop Drawings of modified Excavation Support, including, but not limited to: support at intermediate manhole shafts and support at stub-out connections.

(iv) Design calculations demonstrating that the proposed Excavation Support is capable of supporting the maximum stresses to be imposed during installation with the required factor of safety, per the support manufacturer. The calculations shall take into account earth and hydrostatic loads, thrust forces, external loads such as live loads due to traffic and construction equipment, grouting pressures, and any other loads that may be reasonably anticipated during construction. Loads shall be shown and described.

(v) Maximum predicted deflection of the primary tunnel support system and associated expected surface settlement

(vi) Design calculations for all modifications to the Excavation Support, including, but not limited to: support at intermediate manhole shafts and support at stub-out connections.

(e) Shafts

(i) As per E17.

(f) Daily Records

(i) Submit the following daily records to the onsite Contract Administrator for review, by noon on the next Working Day following the shift for which the data or records were taken:

(ii) Tunnelling Records: Provide complete records to the Contract Administrator. These records shall include, at a minimum: date, time, name of operator, tunnel identification, installed support number and corresponding tunnel length, cutterhead rotation speed and torque, use of any cutting or high-pressure nozzles, steering jack

positions, rate of advance for each support length, jacking forces, spoil feed rates, line and grade offsets, any movement of the guidance system, problems with the shield or other components or equipment, use of breasting boards, and durations and reasons for delays. Manually recorded observations should be made at intervals of not more than 3 metres of advance, as conditions change, and as directed by the Contract Administrator. Submit samples of the Tunnelling records at least 14 days prior to the start of Tunnelling.

(iii) Survey Measurements: Survey measurements of Excavation Support alignment.

(g) Safety Plan: A Safety Plan for the Tunnelling operations including air monitoring equipment and procedures and provisions for lighting, ventilation, and electrical system safeguards. Provide name of site safety representative responsible for implementing safety program.

E19.4 Design Criteria

(a) Tunnelling Equipment:

(i) The TBM shall be designed to support all ground loads which may be imposed upon it as well as any surcharge loads and loads imposed by the thrust jacks, steering mechanisms, and other appurtenances. The TBM shall be continuous around its full perimeter and shall have suitable breast tables, breast jacks, closable flood doors, or other such provisions to temporarily support the excavation face and prevent loss of ground during periods of shutdown or in the event of running/flowing ground conditions.

(ii) The TBM selected for the project shall be compatible with the geologic conditions defined in the Geotechnical Baseline Report, and the geologic conditions anticipated by the Contractor. The TBM shall be capable of excavating or handling boulders or other hard objects up to 30% of the outside diameter of the shield

(iii) The TBM shall have an articulation joint between two segments of the shield. The shield shall be steerable in both the vertical and horizontal directions to allow the operator to maintain line and grade within the specified tolerances listed in this Section. The shield shall be laser or theodolite guided and monitored continuously by the operator. The guidance system shall be designed to function at the maximum required drive length, around curves, without loss of accuracy or reliability of function. The cutterhead shall have a reversible drive system so that it can rotate in either direction to minimize rotation or roll of the TBM during installation.

(iv) The maximum Radial Overcut allowed shall be 30 mm. The minimum Radial Overcut shall be 12 mm.

(b) The spoil conveyance system shall be designed for the full range of ground conditions described in the GBR and anticipated by the Contractor. The system shall allow determination of muck volumes per ring of Excavation Support or per muck cart.

(c) Variations from Design Line (Alignment):

(i) Excavation Support and Carrier Pipe: 100 mm maximum.

(d) Variation from Design Grade:

(i) Initial Tunnel Support: 75 mm.

E19.5 Quality Control

(a) All Tunnelling and Pipe Jacking work shall be performed by a pre-qualified Contractor under City of Winnipeg RFQ 1045-2019A.

(b) The site safety representative and personnel responsible for air quality monitoring shall have verifiable experience in tunnel construction.

(c) The surveyor responsible for line and grade control shall have experience in similar underground Tunnelling projects of similar nature. The surveyor shall have experience with the proposed laser or theodolite, relays, and EDM guidance system.

(d) The Contractor shall provide written notice to the Contract Administrator at least 72 hours in advance of the planned launch of the TBM. All work by the Contractor shall be done in the presence of the Contract Administrator unless the Contract Administrator grants prior

written approval to perform such work in the Contract Administrator's absence. The Contractor shall immediately notify the Contract Administrator, in writing, when any problems are encountered with equipment or materials, or if the Contractor believes the conditions encountered are materially and significantly different from those represented within the Contract Documents.

(e) The Contractor shall allow access to the Contract Administrator and shall furnish necessary assistance and cooperation to aid the Contract Administrator in observations, measurements, data, and sample collection, including, but not limited to the following:

(i) The City and/or Contract Administrator shall have full access to the TBM for inspection of the excavation face.

(ii) The City and/or Contract Administrator shall have full access to the launch and receiving shafts prior to, during, and following all Tunnelling operations. This shall include, but not be limited to, visual inspection of installed Excavation Support, installed Carrier Pipes and verification of line and grade. The Contractor shall provide safe access in accordance with all safety regulations.

(iii) The City and/or Contract Administrator shall have full access to spoils removed from the tunnel excavation prior to, during, and following all Tunnelling operations. The Contract Administrator shall be allowed to collect soil samples from the muck buckets or spoil piles a minimum of once per every three (3) metres, whichever is more often, and at any time when changes in soil conditions or obstructions are apparent or suspected.

(iv) The City and/or Contract Administrator shall have full access to the tunnel prior to and during Carrier Pipe installation within the Excavation Support.

(v) City and/or Contract Administrator shall have the right and opportunity to visit the plant where the Tunnelling equipment is being manufactured or refurbished, prior to acceptance and shipping of Tunnelling equipment to Site. Notify Contract Administrator of schedule for manufacture or refurbishment at least 14 days before manufacturer/refurbishment work begins and coordinate visit with manufacturer if Contract Administrator indicates desire to visit plant.

(f) Steel Rib Fabrication Tolerances:

(i) Chord, Measured on Centerline of Rib: Theoretical length plus or minus 1.5 mm.

(ii) Face of Butt or Foot Plates: Within plus or minus 1.5 mm of theoretical plane.

(iii) Gap between ends of ribs and butt or foot plates prior to welding not exceeding 1.5 mm for at least 75% of the cross sectional area of the rib. Where gaps are in excess of 1.5 mm, fill by additional welding.

(iv) Tie Rod Holes in Rib Webs: Within plus or minus 10 mm of the locations shown in the submittals.

(v) Width or Length of Shear Plates: Within the theoretical dimensions plus or minus 3 mm.

(vi) Center to Center of Bolt Hole Dimensions on Butt or Splice Plates: Theoretical dimension plus or minus 1.5 mm.

(vii) Bolt Hole Groups in Butt or Splice Plates After Fabrication: Within plus or minus 1.5 mm of the theoretical location regardless of the variations in the rib resulting from other tolerances.

(g) Steel Rib Bending Tolerances:

(i) Conformance to True Template: Plus or minus 10 mm between end plates and plus or minus 3 mm in 1 m gauge depth.

(ii) Bending Curvature: Uniform.

(iii) After Bending:

- Outer flange will be permitted to deflect 3 mm maximum toward the inner flange for radii of bend less than 14 times the rib depth.

- Buckling of the web for a distance of 1/2 the rib depth from either end will be permitted with deviation from the flat no greater than plus or minus 3 mm for radii of bend equal to 14 times the rib depth or greater.
- Buckling of the web for a distance equal to the depth of the rib from either end will be permitted with deviation from the flat no greater than plus or minus 5 mm for radii of bend less than 14 times the rib depth.
- Rib Depth at the Web: Not less than the theoretical depth minus 6 mm.

E19.6 Construction Methods

E19.6.1 General Requirements

(a) Tunnelling shall not begin until the following tasks have been completed:

(i) All required submittals have been provided, reviewed, and accepted.

(ii) Launch shaft excavations and support systems have been completed for the planned drive in accordance with accepted submittals and the requirements of this Specification, E4 and CW 2030.

(iii) The location, orientation and grade of the launching cradle entry/exit seals for the planned drive have been surveyed to ensure they are on proper line and grade and to verify that they are properly supported. Special care shall be taken when setting the guide rails and launching frame to ensure stability and correctness of the alignment and grade. Guide rails or cradle shall be securely attached to the shaft supports or concrete working slab, with supplementary braces, concrete, or grout if necessary, to prevent movement or shifting during the launch of the TBM.

(iv) A start-up inspection of all mechanical and hydraulic systems associated with the Tunnelling operations has been completed. The system shall be tested to ensure that the TBM and supporting equipment is functioning properly. The Contract Administrator shall be notified at least 72 hours prior to the start-up inspection and a site inspector representing the City shall be present during the start-up inspection. Key TBM performance data shall be measured and recorded by the Contractor during this inspection, including cutterhead rotational torque, correct functioning of steering jacks, laser, EDM, and other components. The records of the start-up inspection shall be submitted to the Contract Administrator within 24 hours of the completed inspection.

(v) All specified geotechnical instrumentation for the planned drive has been installed, approved, and baselined.

(vi) Pre-construction survey and documentation of existing conditions, i.e., driveways, sidewalks, curb and gutter, structures, etc. has been completed and transmitted to City.

(b) The Contractor shall furnish all necessary equipment, power, water, and utilities for TBM, contact grout mixing and pumping, spoil removal and disposal, and other associated work required for the Contractor's methods of construction.

(c) Conduct all operations such that trucks and other vehicles do not interfere with traffic or create a mud, dust, or noise nuisance in the streets and to adjacent properties. Promptly clean up, remove, and dispose of mud or spoil spillage.

(d) Properly manage and dispose of ground and surface water inflows to the shafts and tunnel and incidental water in conformance with approved local and construction and discharge permits. Do not discharge groundwater inflows into storm sewers, sanitary sewers, drainage ditches, water bodies, or streets without an approved discharge permit.

(e) All work shall be done so as not to disturb roadways, railroads, canal channels, adjacent structures, landscaped areas, or existing utilities. Any damage shall be immediately repaired to original or better condition and to the satisfaction of Contract Administrator, at no additional cost to the City.

(f) Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, the Contractor shall operate with a full crew 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize the stability of the work.

E19.6.2 Tunnelling

(a) Tunnelling shall be completed in accordance with the accepted submittals, and all applicable permit conditions.

(b) Provide a suitable launch frame or cradle to launch the TBM.

(c) The TBM shall be operated to restrict the excavation of the materials to a volume equal to the shield with allowance for the Radial Overcut, to prevent loss of ground and settlement or possible damage to overlying structures. The Contractor shall monitor, measure, and report excavated spoil volume. If excavated spoil volume with proper bulking factors exceeds the theoretical volume of the shield and pipe being installed, the Contractor shall notify the Contract Administrator and promptly modify excavation procedures to prevent further overexcavation.

(d) Keep TBM buried and the machine pushed against the face firmly to support the ground at the heading at all times.

(e) Tunnelling operations shall control surface settlement and heave above the Excavation Support to prevent damage to existing utilities, facilities, and improvements. The Contractor shall repair any damage resulting from construction activities, at no additional cost to City and without extension of schedule for completion. The Contractor shall contact grout any voids caused by or encountered during the shaft construction or Tunnelling including the annular space created by the Radial Overcut of the shield. The Contractor shall modify equipment and procedures as required to avoid recurrence of excessive settlements or damage.

(f) During shutdowns or other interruptions in tunnel excavation work, temporarily support the excavation face and prevent loss of ground. The proposed method of support shall be presented to the Contract Administrator for review in accordance with E4. In addition, the TBM shall be shoved firmly against the soil at the tunnel face. Take all precautions necessary to prevent loss of ground at the tunnel heading during shutdown periods.

(g) Completely contain, transport, and dispose of all excavated materials away from the construction site. Use only the disposal sites identified in approved submittals for spoil disposal.

E19.6.3 Excavation Support

(a) General

(i) Design, furnish, install, and maintain tunnel Excavation Support systems in accordance with requirements specified herein to ensure stability and safety during construction. If ground movements indicate unstable conditions are developing, modify Excavation Support system or provide additional support, as required, to maintain stability.

(ii) Maintain an adequate supply of tunnel supports at the work site at all times.

(iii) Remove, replace or repair immediately any damaged, displaced, or improperly installed Excavation Support, in a manner acceptable to Contract Administrator.

(iv) Make provisions for the tie-in of catch basin inlet pipes at the locations shown on the Drawings and with E26.

(v) All elements of the Excavation Support system shall be maintained in good condition until construction of the final lining is complete.

(vi) When unstable ground conditions are encountered, and in the Contract Administrator's opinion, the Contractor has not sufficiently stabilized the ground to provide safe working conditions and prevent ground loss, The Contractor shall install additional support or undertake remedial measures to stabilize the ground, and to the satisfaction of the Contract Administrator. If settlement

limits are reached at monitoring points as specified in E15 the Contractor shall promptly act to mitigate settlements and minimize risk of additional excessive settlements. If inadequate Excavation Support is determined to be the primary cause of excessive settlements, mitigation shall include modifications to the Excavation Support system. If the Contractor and Contract Administrator cannot agree on the use of additional support, Contract Administrator will suspend inspection of such areas until safe conditions are restored. Payment for work performed during any period of suspended inspection will not be made and no time extensions will be granted for completing the work in accordance with the requirements of the Contract Documents.

(b) Installation of Expanded Circular Steel Ribs and Timber Lagging

(i) Erect the Excavation Supports within the tail of TBM to ensure that the ground is continuously supported.

(ii) Expand the Excavation Supports as soon as practical after passage of the TBM to minimize convergence, and in no case more than 1 metre behind the tail of the TBM.

(iii) Expand the ribs by jacking at two locations across the joints between adjoining rib segments. Upon completion of expansion, install steel shims, dutchmen, steel wedges or plates, and secure each joint before releasing the jacking load with bolts in a manner that will not allow relaxation or inward movement of the ribs.

(iv) Secure ribs against longitudinal movement or distortion and to provide additional resistance to jacking forces by the use of steel tie rods or collar braces. Maximum circumferential tie rod or brace spacing shall be 1.2 metres measured along rib centerline.

(v) Fit full-perimeter timber lagging between ribs so that no opening large enough to permit inflow of soil exists. Plywood backing, at least 6 mm thick, shall be installed at joints where separation between lagging occurs as the result of rib expansion, in such a manner as to provide continuous support at the outside circumference of the support system.

E19.6.4 Control of Line and Grade

(a) The Contract Administrator will establish Benchmarks on the site, for use during construction. The Contractor shall verify these Benchmarks by survey prior to the start of construction, and shall confirm positions or report any errors or discrepancies in writing to the Contract Administrator.

(b) After confirming that all established Benchmarks provided for the Contractor's use are accurate, use these Benchmarks to furnish and maintain all reference lines and grades for Tunnelling. The Contractor shall use these lines and grades to establish the exact location of the TBM using a laser or theodolite guidance system. Submit to the Contract Administrator copies of field notes used to establish all lines and grades and allow the Contract Administrator to check guidance system setup prior to beginning the Tunnelling. Provide access for the Contract Administrator to perform survey checks of the guidance system and the line and grade on a daily basis during Tunnelling operations. The Contractor shall be fully responsible for the accuracy of the work and the correction of it, as required.

(c) The TBM shall be steered to maintain line and grade within the tolerances specified. This shall be achieved by continuously monitoring and adjusting line, grade, roll, and steering attitude during the operation. If the installation deviates from line or grade, make the necessary corrections, and return to the design alignment and grade at a rate of not more than 1:300.

(d) The guidance system shall be mounted in a manner that allows it to maintain alignment if there is movement of equipment during launch. Stop Tunnelling operations and reset guidance system if its alignment shifts or is moved off design alignment and grade for any reason. Check guidance system setup at least once per

shift. Guidance system should only be reset by experienced, competent surveying personnel in accordance with acceptable procedures.

(e) Monitor line and grade continuously during Tunnelling operations. Record deviation with respect to design line and grade at least twice per shift and submit records to Contract Administrator as requested.

E19.6.5 Obstructions

(a) The Contractors responsibilities for dealing with obstructions are defined in E13.

E19.6.6 Safety

(a) The Contractor is responsible for safety on the job site. Methods of construction shall be such as to ensure the safety of the work, Contractor's and other employees on site, and the public. Perform all work in accordance with all current applicable regulations and safety requirements of Federal, Provincial and local agencies.

(b) When personnel are underground, furnish and operate a temporary ventilation system, and air monitoring system conforming to Federal and Provincial requirements. Operate and maintain a ventilation system that provides a sufficient supply of fresh air and maintains an atmosphere free of toxic or flammable gasses in all underground work areas.

(c) No gasoline-powered equipment shall be permitted in launch and receiving shafts. Diesel, electrical, hydraulic, and air powered equipment is acceptable, subject to applicable local, Provincial and Federal regulations.

E19.6.7 Cleanup and Restoration

(a) After completion of Tunnelling, remove all construction debris, spoils, oil, grease, and other materials from the Excavation Support, launch and receiving shafts, and all Contractor work areas. Cleaning shall be incidental to the construction. No separate payment shall be made for cleanup.

(b) Restoration shall follow construction as the work progresses and shall be completed as soon as possible. Restore and repair any damage resulting from surface settlement caused by shaft excavation, or Tunnelling. Any property damaged or destroyed, shall be restored to a condition equal to or better than existing prior to construction. Restoration shall be completed no later than thirty (30) days after the Tunnelling is complete. This provision for restoration shall include all property affected by the construction operations.

E19.7 Measurement and Payment

E19.7.1 Two-Pass Tunnelling – Tunnel and Excavation Support

(a) Construction of the tunnelled installation of the Excavation Support shall be measured on a linear metre basis and paid at the contract unit price of "Tunnel Construction" for the tunnel installed using this method. The price shall include all work described herein and includes Tunnelling, supply and installation of Excavation Support, shaft construction, bedding, backfilling, surface reinstatement, and all appurtenances and miscellaneous materials.

(i) Measurement for length of tunnel will be made horizontally at grade above the centreline of pipe through shafts from existing connection points to centre of manholes.

(ii) Repair of damage to underground and surface structures due to surface subsidence and soil heaving caused by Tunnelling methods will be at Contractor's expense.

(iii) Relocation of utilities to accommodate shaft construction or tunneling methodology shall be borne by the Contractor.

(iv) Installation and backfill of Carrier Pipe in Tunnel described in E20 will be incidental to "Tunnel Construction"

(v) Bedding and backfill will be incidental to "Tunnel Construction".

(vi) Surface restorations will be incidental to “Tunnel Construction”.

(vii) Costs for installation of Standpipe Piezometers and monitoring of the groundwater level are paid separately under E17.

E19.7.2 Payment Schedule

(a) Tunnel Construction listed on Form B:Prices for the Two-pass method will be paid out in accordance with the following payment schedule:

(i) 70% paid upon completion of the tunnel and Excavation Support, as described in E19.7.1.

(ii) 30% paid upon completion of the installation and backfill of the Carrier Pipe, as described in E20.6.1.

E19.7.3 Tunnelling Shafts

(a) Refer to Tunnelling Shafts in E17.

E20. INSTALLATION AND BACKFILL OF CARRIER PIPE IN TUNNEL (TWO-PASS METHOD)

E20.1 Description

(a) This Section includes the minimum requirements for the installation of Carrier Pipe within the Excavation Support and backfilling the annular space and any voids between the outside of Carrier Pipe and the Excavation Support with low density cellular concrete.

E20.2 Materials and Equipment

E20.2.1 Carrier Pipe

(a) Carrier Pipe shall be ;

(i) FGP pipe as specified in E25

(ii) Reinforced Concrete pipe as specified in E24.

E20.2.2 Carrier Pipe Supports

(a) For use in TBM tunnels: Timber blocking, of a type and size designed by the Contractor and approved by the Carrier Pipe manufacturer to safely support the pipe within the Excavation Support, prevent movement during backfilling, and avoid damage due to point- loading of the Carrier Pipe.

E20.2.3 Bulkheads

(a) Bulkheads shall be constructed so the annular space between the Carrier Pipe and the Excavation Support will be completely backfilled.

(b) Intermediate bulkheads shall be constructed to allow intermediate manhole risers to be backfilled with concrete.

(c) Incorporate a minimum 25-mm diameter drain pipe in the invert of the tunnel to facilitate drainage of water during backfilling. This pipe shall be securely capped and plugged once backfill begins to flow from the drain line.

(d) Provide an opening in the tunnel crown to allow entrapped air to escape. Vent outlets shall be provided as required.

(e) Spaced as required along the tunnel to allow backfilling and in consideration of the requirements and connections to the tunnel and catch basin pipes in E26.

E20.2.4 Low Density Cellular Concrete (LDCC)

(a) As per E22.

E20.3 Submittals

(a) Submittals shall be made in accordance with E4 and as listed below.

(b) Carrier Pipe Installation Work Plan: Description of the Carrier Pipe installation equipment, materials, and construction methods to be employed.

(c) Backfill Work Plan including:

(i) Sequence of work including sequence of placement and staging of backfill lifts and pumping.

(ii) Type(s) and locations of equipment.

(iii) Placing procedures, (i.e., batching, mixing, and pumping location and procedures).

(iv) Pump line arrangement.

(v) Maximum pipe length to be backfilled.

(vi) Maximum LDCC age before set initiation.

(vii) Method of determining LDCC levels placed or completion of void filling.

(viii) Communications provisions.

(ix) Pumping pressures, rates, and volumes to be placed per day.

(x) Maximum injection pressures injection locations.

(xi) Methods for monitoring mix.

(xii) Method of surveying or monitoring Carrier Pipe for movement during LDCC placement.

(xiii) Methods and approaches to prevent deformation of Carrier Pipe during LDCC placement.

(xiv) Testing procedures.

(xv) Cleanup procedures.

(d) Safety plan for the Carrier Pipe installation operations including air monitoring equipment and procedures and provisions for lighting, ventilation, and electrical system safeguards. Provide name of Site Safety Representative responsible for implementing safety program. Notify Contract Administrator if safety plan is the same as for Tunnelling operations.

(e) Shop Drawings of Carrier Pipe supports.

(f) Shop Drawings of bulkheads, grout pipes, vent pipes, and drain lines. Indicate the specific chainage at which they will be used.

(g) Daily reports and records of LDCC placement, including but not limited to:

(i) A delivery ticket with the information stated in Section “Delivery Ticket” of CSA 23.1; except actual scale weights of materials shall be furnished to the Contract Administrator with each batch of concrete before unloading at the Site.

(ii) A printout of the actual scale weights for all loads batched shall be submitted to the Contract Administrator at the end of each working day.

(iii) Volumes placed and lift (stage) heights achieved.

(iv) Stationing of LDCC placement.

(v) Injection locations and pressures.

(vi) Unit weight and air content testing results.

(vii) Time of placement.

(viii) Designation of cylinder samples prepared that day.

(ix) Compressive strength tests reports from a certified testing laboratory.

E20.4 Quality Control

E20.4.1 Qualifications

(a) Carrier Pipe Placement

(i) The foreman responsible for Carrier Pipe placement shall have at least three (3) years of experience supervising pipe in tunnel construction. The Contractor shall submit a description of referenced projects including owner’s name and contact information, project superintendent, and pipe type.

(ii) The site safety representative and personnel responsible for air quality monitoring shall have verifiable experience in tunnel construction.

(iii) The surveyor responsible for line and grade control shall have experience in similar underground Tunnelling projects. The surveyor shall have experience with the proposed laser or theodolite and EDM guidance system to be used for the curved tunnel.

(iv) Tolerances: The Carrier Pipe shall be installed in accordance with the following tolerances:

- Variations from Design Line and Grade: Horizontally 100mm, vertically 50 mm.

E20.5 Construction Methods

(a) General Requirements

(i) Do not begin Carrier Pipe installation until the following is completed:

- Tunnelling specified in E19.
- The Excavation Support has been cleaned of tunnelled materials and debris.
- The intrados of the Excavation Support has been surveyed for the full length of the tunnel to confirm that the Carrier Pipe and pipe transporter have the necessary clearance.

(ii) Where the Carrier Pipe installation does not meet the specified tolerances, correct the installation including any necessary redesign of the pipeline, the Excavation Support, or structures and acquisition of necessary easements. All corrective work shall be performed by the Contractor at no additional cost to the City and without schedule extension and is subject to the written approval of the Contract Administrator.

(iii) LDCC shall be properly placed as specified E22.

(iv) Methods for completely filling the annular space between Carrier Pipe and the Excavation Support shall be utilized in accordance with submittals that are reviewed and approved by the Contract Administrator.

(v) No standing water shall be allowed where LDCC is to be placed.

(vi) Construct bulkheads at the end of each reach of pipe to be backfilled.

(vii) Inform the Contract Administrator at least 24 hours in advance of the times and place where placement of LDCC is anticipated.

(b) Installation of Carrier Pipe

(i) Pipe Installation: Install Carrier Pipe as shown on the Drawings in accordance with specified tolerances and approved submittals. Remove loose soil, grout spillage, and debris from Excavation Support. Provide Carrier Pipe supports, as required, to prevent flotation, movement, or damage to the pipe during pipe installation and backfilling. Support every individual Carrier Pipe section by at least two sets of supports. Install Carrier Pipe without sliding or dragging it on the ground or in the Excavation Support in a manner that could damage the pipe.

(ii) Move each pipe section into the tunnel longitudinally. Block each section of pipe in the tunnel in accordance with specified line and grade tolerances.

(iii) Repair damage to the pipe during transport and installation to the Contract Administrator's satisfaction.

(iv) Install to line and grade.

(v) Secure pipe section by tie downs, blocking, or by other means, to prevent flotation, settlement, or lateral or axial movement of the Carrier Pipe during placement of backfill around pipe.

(c) Install of bulkheads

(i) In accordance with accepted submittals.

(ii) Batching and Mixing

(iii) General: Conform to the requirements of accepted submittals and the foaming agent manufacturer's recommendations.

(d) Protection and Clean Up

(i) Take all necessary precautions to protect and preserve the Carrier Pipe from damage.

(ii) Spills shall be minimized and shall be cleaned up immediately. Any damage to the Carrier Pipe caused by or occurring during the backfilling operations shall be repaired by a method approved by the Contract Administrator, at no additional cost to the City.

E20.6 Measurement and Payment

E20.6.1 Two-Pass Tunnelling – Installation and Backfill of Carrier Pipe in Tunnel

(a) Supply, Installation, support, and backfilling of the CCFRPM Carrier Pipe and associated work and materials described within this Specification shall be incidental to the Contract unit price of "Tunnel Construction".

(b) The price shall include but not be limited to the supply and installation of the CCFRPM Carrier Pipe, the CCRFPM reducer, making connections to the stub outs installed under Trenchless Sewer Construction, bulkheads, grouting pipes, and backfilling of the Carrier Pipe and all other Work described herein and shown on the Drawings including any appurtenances and miscellaneous materials.

(c) See E19.7.2 for payment schedule.

E21. CONTACT GROUTING FOR TUNNELLING INSTALLATION

E21.1 Description

(a) This specification describes the minimum requirements for providing the contact grouting to be used with primary support tunnelling (Two Pass or Pipe Jacking)

E21.2 Submissions

(a) Submit the following in accordance with E4.

(i) Grouting equipment to include layout of equipment during grouting operations.

(ii) Calibration certificates for gauges, flow meters, and regulators.

(iii) Applied pressure and estimated volume of grout per pipe or casing segment.

(iv) Procedure to fill the annular space to help limit settlement and reduce long term embedment loads on the pipe. Provide procedure, schematic, equipment, layout, injection pressures, and design calculations.

(v) Provide estimated injection volumes and pressures, supported by calculations, for the anticipated soil conditions as well as control measures to prevent damage to the pipe or casing.

(vi) MSDS for grout mix additives.

(vii) Grout mix.

(viii) Daily production records submitted no later than the beginning of the following work day.

E21.3 Materials

(a) Cement: Cement shall be HS Portland cement conforming to ASTM C 150 and CSA A3000-08.

E21.4 Construction

(a) Design

(i) Grout mix shall be designed by the Contractor's Engineer.

(ii) Calculate grout pressures and determine effects of fluid pressure on pipe using a minimum factor of safety of 2.0.

(iii) Stiffness, strength, injection pressure, and volume of the contact grout mix shall be compatible with the ground and groundwater conditions as described in the GBR as well as the pipe that is being grouted.

(b) Quality Control

(i) Contractor shall maintain logs of all grouting operations, including pressures, grout volumes, QA/QC testing. The Contractor shall submit all grouting logs and testing results within ten (10) Business Days of completion of the grouting works or upon receipt of testing results from the testing lab.

(ii) Provide access to during contact grouting operations to record the pressure gauge, volumetric gauge, and position of the shut-off valve.

(c) Packaging, Handling, Shipping, Storage and Site Transport

(i) Packaging, handling, shipping, storage, and site transport of materials shall be done in accordance with the manufacturer's instructions.

(d) Execution

(i) Inject grout at all of the ports in the new pipe string to completely fill the annular space between the pipe or casing and the ground.

(ii) Perform contact grouting in accordance with reviewed submittals.

(iii) Use calibrated flow meters, gauges, and regulators.

E21.5 Measurement and Payment

(a) Supply and installation of contact grouting will be considered incidental and will not be measured for payment. No additional payment will be made.

E22. LOW DENSITY CELLULAR CONCRETE

E22.1 Description

(a) This Specification covers materials, design and installation of annular grouting of pipe slip liners using Low Density Cellular Concrete (LDCC)

E22.2 References

(a) WRC Sewerage Rehabilitation Manual Fourth Edition.

(b) ASTM C796-04 Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam.

(c) ASTM C869-11 Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete.

(d) ACI 523.3R Guide for Cellular Concretes Above 50 pcf, and for Aggregate Concretes Above 50 pcf with Compressive Strengths Less Than 2500 psi.

E22.3 Submittals

(a) Submittals shall be made in accordance with E4 and as listed below.

(b) Submit Mix Design to the Contract Administrator a minimum of 14 Business Days prior to preparing Trial Mix.

(c) Submit Equipment proposed and foam generator test data.

(d) Submit credentials of design, mixing and installation supervisors to the Contract Administrator.

(e) Submit Trial Mix Test results within 5 Business Days of completion of testing.

(f) Submit grouting plan and Quality Control Plan to Contract Administrator for review. Plan shall describe grouting system layout, grouting verification procedures, grouting tube close off procedures.

E22.4 Materials

(a) Cement: Cement shall be MS or HS Portland cement conforming to ASTM C150 and CSA A3000. MS cement shall meet false set requirements of ASTM C150 and CSA A3000.

(b) Fly Ash: Type F, CSA A3001.

(c) Water: Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the backfill grout.

(i) Admixtures: Admixtures may only be used when specifically approved by foaming agent Supplier in writing.

(d) Foaming Agent:

(a) Foaming Agents shall conform to ASTM C869 and be tested in accordance to ASTM C796.

(b) Foaming agents shall be closed cell non pervious foams

(c) Type and Manufacturer:

(i) Mearl Geofoam Non-Pervious by Cellular Concrete Solutions

(ii) AddCell by Multiurethanes

(iii) Cematrix CF-1

(iv) Or Approved Equal in accordance to B7.

E22.5 Mix Design

(a) General: LDCC mix shall be designed in accordance with the requirements of ACI 523.IR and ACI 523.3R, and the additional requirements herein. Mixes shall be adjusted in the field as necessary to meet the requirements of these Specifications. The foaming agent material manufacturer's field services representative shall approve all changes to the mix designs.

(b) Properties

(i) Minimum 28-Day Compressive Strength in accordance with ASTM C495: 2 MPa.

(ii) Wet Density: Wet density (unit weight) of the foam grout shall not be less than 8 kN/m^3 at the point of placement.

(c) Trial Mix

(d) A tentative mix shall be designed and tested in accordance with ASTM C796 for each consistency intended for use. These results will be compared with field test results to confirm consistent properties are obtained in the field. Testing for each mix shall be as follows:

(e) Two sets of compression test cylinders (75 mm by 150 mm), three cylinders per set, shall be made from each proposed backfill grout mix. One set of three cylinders shall be tested at an age of 7 days and the other set shall be tested at an age of 28 days. Foam grout specimens shall be made, cured, stored, and tested in conformity with ASTM C495.

(f) Determine total air content of each proposed foam grout mix in accordance with ASTM C796.

(g) Determine unit weight of each proposed foam grout mix in accordance with ASTM C567.

E22.6 Equipment

(a) General:

(i) Use equipment for mixing and injecting foam grout, which is designed for underground backfill grouting service. Maintain equipment in good operating condition, capable of satisfactorily mixing, agitating, and forcing LDCC into injection ports at a uniform flow rate under the required constant pressure.

(ii) Backfill grouting equipment shall be configured so flushing can be accomplished with grout intake valves closed, with water supply valve open, and with grout pump running at full speed.

(iii) An adequate inventory of spare parts or backup equipment shall be provided to ensure that operable backfill grouting equipment is available at all times during the work. Maintain sufficient quantities of spare pressure gauges, stop valves, and other wear parts on Site.

(iv) A foam generator shall be used to produce a predetermined quantity of preformed foam, which shall be injected into the mixer and blended with the cement slurry. A foam generator shall be used to produce a predetermined quantity of foam, which shall be injected into the mixer and blended with the cement slurry. The foam generator shall be timer-controlled to repetitively discharge a preselected quantity or to discharge continuously at a fixed rate. Foam generating equipment shall be tested and calibrated for dilution percentage, density, and volume output. Two types of foam generating systems, batch and continuous generating, are acceptable.

E22.7 Quality Control

(a) Backfill Placement

(i) The Contractor or Subcontractor supplying and placing LDCC shall be capable of developing a mix design, and batching, mixing, handling and placing LDCC under tunnel conditions; shall have furnished and placed LDCC on at least three tunnels of the general type and the size specified herein which have been in successful operation; and shall have a record of experience and quality of work using foam grout that is satisfactory to the Contract Administrator.

(ii) As an alternative, the Contractor may employ a manufacturer's representative to supervise supplying and placing of LDCC. The manufacturer's representative shall be capable of complying with the qualifications specified for the Contractor and shall be acceptable to the Contract Administrator. The manufacturer's representative shall supervise all LDCC operations including training the Contractor's personnel, mixing designs, and placement of LDCC in the tunnel.

(iii) Personnel Qualifications: Workers, including the LDCC Contractor's superintendent and foreman, shall be fully qualified to perform the Work. The LDCC Contractor's superintendent shall have had previous experience under similar ground and tunnel conditions, or the foam grout supplying and placing shall be under the supervision of the foaming agent Supplier's representative.

(iv) Field Services: The foaming agent material manufacturer shall provide engineering field services to review the Project and the material application prior to any preparation; to approve the applicator, the material used, the equipment, and the procedure to be used; to approve setup before production of LDCC; and to observe during initial application. The field representative of the material manufacturer shall submit, in writing, approvals of proposed material, equipment, application procedures, applicator, and setup before production.

(b) Field Quality Control

(i) General: Field control tests, including unit weight (wet density), air content test, and compression tests shall be performed by the Contractor and the results submitted to the Contract Administrator.

(ii) The frequency specified herein for each field control test is approximate. A greater or lesser number of tests may be made, as required by the Contract Administrator.

(iii) Test specimens shall be collected within the shaft at or near the connection where the LDCC is being injected.

(iv) The Contractor shall assist the Contract Administrator in obtaining additional test cylinders. Supply all materials necessary for fabricating the test cylinders.

(v) Provide at or very near the point of injection, a system of valves in the line transporting the LDCC, which will allow easy access for collection of test specimens without disconnecting the line from the outlet. Submit the valve arrangement to the Contract Administrator for review at least 15 days prior to commencing LDCC backfilling operations.

(vi) Unit Weight: Unit weight (wet density) tests shall be made from the first batch mixed each day, after a change in mix design, every 30 minutes during pumping, and from

each batch of LDCC from which compression test cylinders are made. Unit weight shall be determined in accordance with ASTM C567. Unit weight at the point of placement shall be within plus or minus 5 percent of the unit weight established for the mix design being placed. Adjust mix as required to obtain the specified wet density.

(vii) Air Content: An air content test shall be made from the first batch mixed each day, and from each batch of LDCC from which concrete compression test cylinders are made. Air content at the point of placement will be the difference between the wet density at the point of placement less the wet density at the point immediately before the addition of preformed foam. Air content shall be determined in accordance with ASTM C138 except there shall be no vibration or rodding of the sample.

(viii) Compression Tests: One set of four test cylinders shall be made for each shift when LDCC is placed. One additional set shall be made from each additional 150 cubic metres, or major fraction thereof, placed in any one shift. Two cylinders from each set will be tested at an age of 28 days.

(ix) Compressive strength of LDCC shall be considered satisfactory if both of the following requirements are met:

- Average of three consecutive compressive strength tests equal or exceed the specified unconfined compressive strength.
- No individual compressive strength test (average of two cylinders) is below the specified unconfined compressive strength by more than 20 percent.

(x) A strength test shall be the average of two compressive strengths of two cylinders made from the same concrete sample and tested at 28 days.

(xi) Test cylinders shall be made in the field, cured and stored in the laboratory, and tested in accordance with ASTM C495.

(xii) Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the LDCC represented by the cylinder was placed, batch number, unit weight (wet density), and the air content.

E22.8 Construction Methods

(a) Placing Low-Density Cellular Concrete

(i) General Requirements: All void space outside of the Carrier Pipe shall be completely filled with LDCC. Provide air release piping in the crown of the tunnel to allow displaced air and air lost from LDCC to escape and be replaced with LDCC. Place LDCC in accordance with approved submittals.

(ii) Backfilling of the annular space between the pipe and the Excavation Support shall be accomplished by placing LDCC in one or more stages (lifts). Monolithic placements (one stage) may be acceptable, provided the Contractor can demonstrate that his placement techniques will not induce movement of the pipe, pipe overstressing, or excessive deformation. The LDCC shall be placed through grout ports within the Carrier Pipe or pipes installed within the annular space between the Carrier Pipe and Excavation Support. Multiple grout pipes should be installed to provide redundancy.

(iii) Locate pressure gauges of appropriate range for monitoring the backfill grout injection pressures in the line transporting the LDCC, at the point of injection. Injection pressure shall be low enough to prevent pipe movement and/or damage and shall not exceed 100 kPa at the point of injection for stages below the crown of the pipe. Injection pressure shall not exceed 200 kPa or 10 kPa per metre of earth cover, or a lower limit as submitted and approved by the Contract Administrator at the point of injection for stages above the crown of the pipe.

(iv) Volume of LDCC injected shall be measured, recorded and compared with the anticipated volume per foot of pipe backfilled.

(v) Provide a means of direct communication between the injection point and the pump operator.

(b) Protection and Clean Up

(i) Take all necessary precautions to protect and preserve the Carrier Pipe from damage.

(ii) Spills shall be minimized and shall be cleaned up immediately. Any damage to the Carrier Pipe caused by or occurring during the backfilling operations shall be repaired by a method approved by the Contract Administrator, at no additional cost to the City.

E22.9 Measurement and Payment

(a) LDCC will not be measured for payment. It is considered incidental to carrier pipe installation.

E23. TUNNELLING AND PIPE JACKING

E23.1 Description

(a) This specification describes the requirements for installation of pipe by pipe jacking using a tunnel boring machine (TBM).

E23.2 General

(a) Furnish all labor, equipment, materials and incidentals necessary to install the sewer pipeline in accordance with the requirements of this specification. Be responsible for the special requirements, as defined herein.

(b) Provide a Tunnel Boring Machine (TBM) that meets the requirements of this specification.

(c) Construct the tunnelling shafts in accordance with E17.

(a) Furnish and install product pipe to include conducting the required acceptance testing in accordance with this specification and product pipe specification.

(i) Reinforced Concrete Pipe as per E24

(ii) Fiberglass pipe as per E25

E23.3 Definitions

(a) Refer to ASCE 36 and D4.

E23.4 References

(a) Province of Manitoba, Occupational Health and Safety Act, revised Oct 1, 2013.

(b) American Society for Civil Engineering (ASCE), 36-01. Standard Construction Guidelines for Tunnelling.

E23.5 Submittals

E23.5.1 Submit the following in accordance with E4 a minimum of ten (10) Business Days prior to commencement of tunnelling work:

(a) Construction Method and Sequence of Operations:

(i) Provide a description of the proposed method of construction and the sequence of operations to be performed during construction. A general description and schedule of the tunneling procedure, including but not limited to, construction of the shafts, set-up of tunneling equipment, muck disposal, methods of protection and maintenance of project site, and ground and groundwater control methods.

(b) Site Layout:

(i) As per E6.

(ii) Typical layout of launching and receiving shaft work sites showing equipment locations, materials storage, muck storage, site offices and facilities, worksite access and egress.

(iii) Source of potable water to be used at each location.

(c) TBM Equipment

(i) Provide manufacturer information, including preprinted machine specifications, installed options, operating instructions, and manuals.

(ii) Additionally for a used TBM, prior to starting this project, provide a certification in writing that the TBM has been certified fit for use based on the anticipated project conditions.

(iii) Detailed shop drawings of the TBM, including configuration of cutter wheel along with details of the tools and hard facing.

(iv) TBM grade and alignment control system details to include type of guidance system and/or enhanced guidance systems with complete details on equipment capabilities and limitation.

(v) Electrical system, lighting system, and on-site power generation. Also provide details of power supplied by utility provider.

(vi) Details of overcut to include size of overcut, which is not to exceed 25 millimetres or the pipe manufacturer overcut recommendation. The submitted overcut shall be reviewed and accepted by the Contract Administrator prior to implementation.

(d) Launch Procedures:

(i) Complete launch procedure. Describe any modifications to the designed shoring for launching the TBM and when these modifications are to be in place. Describe any the ground stabilization adjacent to the shoring and when the stabilization methods are to be in place.

(ii) Complete receiving procedure for the TBM. Describe any modifications to the designed shoring for receiving the TBM and when these modifications are to be in place. Describe any ground stabilization adjacent to the shoring and when the stabilization methods are to be in place.

(e) For Slurry-MTBM, submit details of slurry system and soil separation methods including slurry formulations by soil type, and calculations of the system capacity to handle flows at all proposed distances and changes of elevations to and from the face of the MTBM and to and from the slurry separation plant.

(i) Submit Material Safety Data Sheet (MSDS) for slurry additives.

(ii) Use of NSF/ANSI Standard 60 Certified materials only, or approved equal in accordance with B7.

(iii) Calculations and operating information to be controlled with the intent of preventing inadvertent returns and balancing face pressure.

(iv) Sample slurry log sheet including time, date, sample, shaft location, pipe number, slurry additives, quantity added, soil type, viscosity, specific gravity, water added, and operating pressure.

(v) Account for ground characteristics to include equipment wear, high permeability and slurry loss, and fine grain content with difficult separation.

(vi) Indicate limits of target control of sediment content within the slurry.

(f) For EPB-MTBM or rotary TBM, submit details of complete muck transport system from tunnel face to muck storage locations. Provide detailed procedures for determining conditioning agents by soil type to be used to assist in maintaining earth pressure balancing and relief for the anticipated soil conditions and test measurements to ensure acceptable performance of conditioning agents. Details of proposed conditioning agent formulations by soil type, and calculations of the system capacity to handle flows at all proposed distances and changes of elevations to and from the TBM.

(i) Submit Material Safety Data Sheet (MSDS) for conditioning agents.

(ii) Use NSF/ANSI Standard 60 Certified materials only, or approved equal in accordance with B7.

(iii) Sample conditioning agent log sheet including time, date, sampler, shaft location, pipe number, conditioning agents, quantity added, soil type, viscosity, specific gravity, water added, and operating pressure.

(g) Description of automatic lubrication mix equipment and procedures for lubricating the pipe during the jacking operations to include the estimated volume for the anticipated site conditions. Account for ground characteristic to include any swelling clay and highly permeable ground.

(i) Submit Material Safety Data Sheet (MSDS) for lubricant additives.

(ii) Use NSF/ANSI Standard 60 Certified materials only, or approved equal in accordance with B7.

(iii) Details that demonstrate that the lubrication delivery system shall have sufficient pressure and volume to perform as intended. Calculations shall demonstrate adequate volume and pressure of the lubricant to completely fill the annular space with considerations for overcoming ground water pressures and any fluid loss in permeable soil.

(iv) Sample lubrication log sheet including time, date, sample, shaft location, pipe number, slurry additives type, quantity added, soil type, viscosity, specific gravity, water added, and system operating pressures and volumes.

(h) Jacking system details, IJS and their proposed spacing, method of operation, thrust capacity, and sleeve details, plus method of control to prevent exceeding the maximum allowable jacking force, as defined herein, on the jacking pipes.

(i) Theoretical jacking force calculations and pipe material calculations shall be prepared and submitted in accordance with Specifications E24 and E25. If the jacking force calculations are based upon the use of a lubricant and/or IJS, then the lubricant and/or IJS shall be used in accordance with the submitted calculations.

(ii) Contractor shall furnish product pipe submittals in accordance with appropriate pipe specifications.

(iii) Thrust block details at each launching shaft location.

(iv) Submit IJS design and details including number of stations, location, and jacking force.

(i) Proposed contingency plan for potential issues regarding tunneling operations shall be provided for the following scenarios:

(i) The TBM encounters an unmovable obstruction manmade and/or natural.

(ii) The jacking pressures start to increase rapidly and reasonable concern exists for completing the pipe jacking installation process to the receiving shaft. Include discussion on pipe damage, lubrication aspects, implementation of IJS, and, in the extreme case, the use of rescue pits.

(iii) Pipe suffers severe damage or exceeds 90 percent of its maximum allowable jacking force and the structural pipe monitoring system is required. Describe process for implementing structural pipe monitoring systems on each subsequent drive. Provide the schedule for the monitoring system to be on-site, installed, tested, and in proper working order.

(j) Survey plans including, but not limited to, the following:

(i) Settlement surveying and monitoring plan.

(ii) Initial survey.

(iii) Final survey.

(iv) Verification of line and grade for TBM operations.

(v) As-built survey for each installed length of the sewer pipe within 24 hours of the completion of each drive or reach.

E23.5.2 Submit tunnelling operations log(s) in accordance with E4:

(a) Provide a sample of logging reports and daily reports prior to beginning tunnelling.

(b) Transcribe to paper and submit to Contract Administrator at the end of each shift a jacking operations log completed by the TBM operator complete with the date and names of TBM operator and project superintendent. Both TBM operator and Project superintendent shall initial and date. The jacking operations log shall include the following:

(i) Provide starting and finish times for each crew shift.

(ii) Observations of settlement or heaving.

(iii) Sampling interval shall produce at least three measurements per pipe and shall not exceed a 15 minute time duration to include:

- Time of measurement.
- Position of the TBM in relation to design line and grade. Include the distance of the MTBM from the launching shaft.
- Number of each pipe installed and length of pipe.
- Position of IJS in the installed pipeline. Include maximum jacking forces exerted on the pipe from each of the IJS.
- Maximum jacking forces exerted on the pipe from the main jacking system.
- Position of steering jacks.
- Inclination of TBM and torque of cutter wheel.
- Hydraulic pressures.
- Volume of pipe lubricant used, viscosity, pumping pressure, and name of the operator of the lubrication plant. Provide lubrication details.
- Provide output from the automatic lubrication plant in approved format.
- For Slurry-TBM, face pressure and volumetric flow rate of slurry.

(c) Automated data recording system for tunnelling:

(i) Submit a sample of all information available for recording, variations in sampling frequency, and the formats in which these data can be recorded and presented.

(ii) The Contract Administrator will then select the information, sampling frequency, and format of the data based on these samples.

(iii) The sampling interval selected by the Contract Administrator will produce at least three measurements per pipe, and it will not exceed 1 minute time durations.

(iv) At a minimum the automated data recording system shall record the time; date; distance; and hydraulic pressures for the main jacking system and the IJS; torque at the cutter wheel; pressure at the face; extension of each of the steering cylinders; machine orientation to include pitch, roll, and yaw; deviations from alignment line and grade; and the rate of pipe advancement.

(v) This information shall be submitted on a daily basis using an electronic thumb drive or other approved device.

(d) For Slurry-MTBM, results from sediment content tests to monitor plant efficiency.

(e) Manual Jacking Records: Provide complete written Jacking Records to the Contract Administrator. These records shall include for each pipe, at a minimum: date, time, name of operator, tunnel drive identification, installed pipe number and corresponding tunnel length, start and end time of each jacked pipe, time required to set subsequent pipe, spoil volumes (muck carts per pipe joint), soil conditions including occurrences of unstable soils and estimated groundwater inflow rates if any, jacking forces, steering jack positions, line and grade offsets, any movement of the guidance system, TBM roll, intermediate jacking station use and jacking forces, volume and location of

lubricant pumped, problems encountered with the TBM or other components or equipment, and durations and reasons for delays. Recorded observations should be made at intervals of not less than 2 metres of advance, whenever conditions change, and as directed by the Contract Administrator. At least seven (7) days prior to the launch of the TBM, submit samples of the jacking logs or records to be used.

E23.5.3 Contractor's Qualifications:

(a) Project Manager and Superintendent shall be as prequalified under B13.3.

(b) TBM Operator: Experience TBM Operator: Experience requirements include the construction and completion of a minimum of seven pipeline projects installed by tunnelling methods, each with a drive length of at least 60 percent of the proposed maximum drive length for installed pipe 1800 mm or larger. The reference projects shall have been completed in the previous 5 years prior to the bid date. At least one of the referenced projects shall include the installation and use of an IJS. The MTBM operator shall also have:

(i) Operated an TBM similar to the one proposed.

(ii) Utilized the same type of pipe material as that used for the jacking pipe on this project.

(iii) Successfully completed a project in similar ground conditions to those contained in the GBR.

(iv) Operator for drives using a structural pipe monitoring system, if required, shall demonstrate experience with the system, else documentation of manufacturer recommended training will be required at no additional cost to City.

E23.6 Tunnelling Design

E23.6.1 Design Requirements

(a) Every design submitted as part of this specification shall be signed, sealed, and dated by the Contractor's Engineer registered in the Province of Manitoba.

(b) Use recognized standards to the extent possible.

(c) Provide comments, assumptions, symbols, units, sketches, and input parameters as necessary to convey the design intent.

E23.6.2 Jacking Thrust

(a) Determine size of thrust wall at each launching shaft location. Demonstrate that ground has sufficient reaction without excess deformation using not less than 300% of the maximum anticipated jacking loads. Fully describe any mitigation measures to be implemented, as necessary, such as IJS and/or isolation of thrust wall.

(b) Intermediate Jacking Stations (IJS) shall be required when:

(i) The maximum anticipated jacking force exceeds 70% of the maximum allowable jacking force exerted on the pipe;

(ii) The capacity of main jacks does not exceed the maximum anticipated jacking force by at least 50%; or

(iii) To prevent movement of thrust wall or misalignment of jacking frame.

(c) IJS shall be capable of withstanding the jacking forces with a minimum factor of safety of 2.0.

E23.6.3 Existing Project Conditions

(a) The Contractor is responsible for the ground, groundwater, and gas conditions defined in the GBR.

(b) Comply with applicable codes, standards, and regulations.

(c) Assess existing conditions, including property rights of adjacent properties whether private or public, for the possible effects of proposed temporary works and construction methods.

(d) Reports: GDR and GBR.

E23.7 Quality Control

E23.7.1 Defective materials: Any material found to be defective shall be immediately marked "DEFECTIVE – NOT FOR USE". This marking shall be clear from any point of view and shall be permanent. The defective material shall then be transported off-site and properly disposed in a time period not to exceed 24 hours.

E23.7.2 Provide access to Contract Administrator at all time during construction operations to perform inspections and to observe quality.

E23.7.3 The Contract Administrator shall be allowed access to manually record the operating parameters during the tunnelling operations such as pitch, roll, yaw, guidance system information, valve positions, thrust force, cutter wheel torque, rate of advance, and installed length of pipe. Access to this information shall be provided either by admitting the Contract Administrator into the control cabin to record the data or else by setting up a remote electronic display monitor that contains the same information as that displayed on the operator control console in real time. This remote monitor shall be located in a suitable shelter in the vicinity of the launching shaft.

E23.7.4 Provide the Contract Administrator with access to manually record the pressure gauge, volumetric gauge, and position of the shut-off valve for the lubrication system during the tunnelling operations.

E23.7.5 Survey the tunnel not less than once daily.

E23.8 Equipment

E23.8.1 TBM: Provide a TBM with the following features:

(a) General: The tunnelling system selected shall be specifically designed for excavating, transporting, and separating the materials encountered along the sewer alignment as defined in the GBR. This equipment shall be capable of satisfactorily installing the jacking pipe as contained herein.

(b) Requirements for the MTBM include:

(i) Pressurized face support. The MTBM shall maintain the tunnel face under wet, dry, and adverse soil conditions. The MTBM shall provide pressurized support of the excavated face at all times including temporary shutdowns during operations. Carefully controlled face pressure for supporting the excavation face as well as to prevent inflows of ground and/or groundwater. The system shall maintain control during both excavation and shutdown periods.

(ii) Articulated steering. The TBM shall be able to maintain the alignment within the specified tolerances for the anticipated ground at tunnel level as contained in the GBR.

(iii) Seal mechanism between the TBM and the leading pipe.

(iv) Water damage protection for electric and hydraulic motors and operating controls.

(v) Bi-directional drive on the cutter wheel to control roll. Other measures such as adjustable fins and/or other means shall be used, as necessary.

(vi) Back loading cutting tools replacement.

(vii) Synchronized control of the excavated material volume with the advance rate of the machine to limit ground loss and/or heave during operation.

(viii) The overcut of the shield shall not exceed the value submitted with overcut details.

(ix) Tunnel face access to the cutterhead to permit man access for obstruction removal and tool maintenance.

(c) Accepted Manufacturers:

(i) As per prequalification RFQ 1045-2019A

(ii) approved equal in accordance with B7.

E23.8.2 Pipe Launching Equipment: Provide a pipe jacking system with the following features:

(a) Main hydraulic cylinders mounted in a jacking frame located in the launching shaft used to push the TBM and pipe through the ground. Jacking frame shall be sufficiently anchored/braced to prevent any misalignment.

(b) Jacking system that successively pushes the TBM along with a string of connected pipes towards a receiving shaft.

(c) Sufficient jacking capacity to push the TBM and the pipe string between the shaft locations as identified on the Drawings.

(d) Hydraulic cylinder extension rates shall be synchronized with the excavation rate of the TBM and be compatible with the ground conditions.

(e) Uniform distribution of jacking forces on the end of the pipe by use of thrust ring and packers.

(f) Monitored hydraulic pressure and cylinder extension. The system shall have automatic shut off to prevent overstressing of the pipe being jacked.

E23.8.3 Active Direction Control: Guidance systems that do not perform adequately shall be immediately replaced.

(a) Provide an active direction control system that is fully compatible with the TBM; this system shall have the following features:

(i) Controls line and grade by a guidance system.

(ii) Equipped with a high intensity laser (maximum legal limit). The laser shall be securely mounted and protected from disturbance by personnel working within the launching shaft. When laser capacity is exceeded enhanced guidance systems shall be incorporated.

(iii) Capable of maintaining line and grade to the tolerances specified.

(iv) Provides active steering information that is monitored and transmitted to the operating console in real time. At a minimum, this information shall include location of the laser beam on the target and location of the cutter-head.

(v) Provides positioning and operation information to the operator on the control console.

(vi) Provides a reference laser, or other submitted device, that indicates visually in the launching shaft that the directional control laser has not been accidentally moved.

(vii) Provide ventilation to maintain temperature control within tunnel to minimize laser projection disturbance onto the target.

(b) Enhanced Guidance System:

(i) Furnish and operate an acceptable enhanced guidance system whenever the drive length exceeds the manufacturer rated capability of the laser guidance equipment or whenever the guidance system becomes unstable and cannot be seen clearly on the steering target, whichever condition is the more restrictive.

(ii) Any enhanced guidance system used shall be on-site, installed, tested, and in working order prior to implementation as verified in writing by authorized representative for systems manufacturer.

(iii) For enhanced guidance systems, provide complete manufacturer recommended system. Perform manual surveys in accordance with written recommendations of supplier not to exceed intervals of 30 m.

E23.8.4 Slurry separation equipment for use with Slurry-MTBM: Provide a slurry separation system that is capable of the following:

(a) Provide adequate separation of the muck from the slurry to maintain microtunnel operation with no suspension of activities due to issues with separation of fine contents such that the slurry has sediment content below the limits set by the submitted Work Plan and can be returned to the cutting face for reuse. Test sediment content daily. Use a mechanical separation plant, including scalping screens, shaker screens, de-sanding and de-silting cones, and centrifuge as deemed necessary. Contain the muck at the site prior to disposal as submitted in the Work Plan.

(b) Use the type of separation process suited to the size of the tunnel being constructed, the soil type being excavated, and the workspace available at each launching shaft location for operating the plant.

(c) Carefully monitor the composition of the slurry to maintain the slurry weight, gel strength, and viscosity limits defined by the submitted Work Plan.

E23.8.5 Muck transport equipment for use with EPB-MTBM or rotary TBM: Provide a muck transport system that is capable of the following:

(a) Transporting the muck throughout the tunnel length from the TBM up the shaft to the muck storage site.

(b) The muck transport equipment shall accommodate the guidance system and not interfere with its operation.

E23.8.6 Safety Equipment: Provide all appropriate safety equipment as necessary and as required by all applicable Laws and Regulations.

E23.8.7 Structural Pipe Monitoring System: Any structural pipe monitoring system used shall be on-site, installed, tested, and in working order prior to implementation as verified in writing by authorized representative for systems manufacturer.

E23.9 Construction

E23.9.1 General

(a) Limit ground movements and vibrations to those specified in E15 and E16.

(b) The Contractor is responsible for any additional requirements to include impacts to cost and schedule for operating in “hazardous gas” conditions to include monitoring, ventilating, operating in an explosion proof environment, if encountered.

(c) Use equipment that is in proper working order without excessive equipment wear and/or malfunction history as defined herein.

(d) Confine the tunnelling operations to the limits as shown on the Contract Drawings. Minimize impacts to surroundings.

(e) Employ measures to reduce noise and vibrations to comply with applicable regulations and noise By-Laws.

(f) Restore the site conditions in accordance with the Contract Documents.

E23.9.2 Preconstruction Meeting

(a) The Contractor shall prepare and provide a presentation for the Pre-Construction meeting or for a mutually agreed upon separate meeting to review and discuss the following items with the Contract Administrator at a minimum of fifteen (15) Business Days prior to commencement of the tunnelling work. Provide handouts to go along with Contractor presentation.

(i) Scope of work to be performed.

(ii) Construction methods and constraints overview.

(iii) TBM operating parameters, equipment capabilities, condition assessment of equipment, and required support equipment.

(iv) GBR to include ground, groundwater, and hazardous gas conditions.

(v) Special measures for long drives.

(vi) Surveying equipment, methods, and techniques.

(vii) Guidance system, steering, mixed ground conditions, recovery to line and grade, field verification, and tolerances.

(viii) Settlement, mitigation measures, mixed ground conditions, and the potential for damage to structures and facilities.

(ix) Pipe damage, packer cushions, lubrication, steering, jacking forces, and intermediate jacking stations.

(x) Instrumentation program to include installation, monitoring, and reporting.

(xi) Impacts to structures, buildings, and properties.

(xii) Launch shaft sites as well as machine launching process to include layout of site, parking, and security measures.

(xiii) Receiving shaft sites as well as machine receiving process.

(xiv) Rescue pits, machine failures, and man-made and natural obstructions.

(xv) Pipe materials, manufacturer, shipping, storage, handing, and installation.

(xvi) Job site safety procedures.

(xvii) Quality Control procedures and Quality Assurance measures.

(xviii) Acceptance testing.

(xix) Reporting requirements.

(xx) Submittals drive schedule, and production.

(xxi) Other issues as may be raised by either party.

E23.9.3 Launching and Receiving

(a) Shafts: Construct the launching and receiving shafts for tunnelling in accordance with E17 and as specified on the Drawings.

(b) Process: If the inflow of ground and/or groundwater exceeds the specified limit during the launching or receiving process or if the machine deviates from the alignment more than the specified limit for horizontal alignment and/or for vertical elevation during the launching and/or receiving process, do not begin a new drive until ground improvement, as defined herein, has been implemented at the break-out and break-in locations at each of the launching and receiving shafts for each of the subsequent drives.

E23.9.4 Work Area Preparation and Maintenance

(a) Contractor shall be responsible for the following:

(i) Means and methods: Select the means and methods in accordance with this specification.

(ii) Safety: Provide and maintain safety to include but not limited to construction personnel, the public, and adjacent property, whether public or private.

(iii) Clean working conditions: Remove muck, debris, equipment, and other material that is not required for operations. Pipe shall not be stored on any city streets unless given written permission by the Contract Administrator. Streets shall be kept clean at all times. Complaints shall be addressed to maintain appropriate community relations especially with respect to noise, dust, debris, parking, mowing, snow removal, and lighting to the fullest extent reasonable.

(iv) Organization: The construction equipment shall be organized to enable efficient operation at all times.

(v) Provide suitable oil and gas containment basins made of plastic lining and sand bags to ensure no loss of oil to drains, water courses, or ground contamination.

(vi) All equipment shall be maintained and kept in proper working order. All oil, hydraulic, or fuel leaks shall be repaired immediately. Any leak shall be cleaned up immediately and disposed of properly.

(vii) All lubricant and slurry spills shall be immediately contained, cleaned up, and disposed of properly.

(viii) All work to be completed in accordance with E4.6(a).

E23.9.5 Installation

(a) Prior to commencing any drive, The Contractor shall demonstrate that:

(i) The jacking loads can be safely maintained on the pipe using actual drive data.

(ii) Intermediate jacking stations (IJS) have performed successfully.

(iii) The guidance system(s) is functioning properly and meets the requirements, as specified herein, for the longer drive length.

(iv) The automatic lubrication system has performed successfully.

(v) Any contingency measures that were implemented by the Contractor are working effectively.

(b) Do not damage the product pipes during the installation process.

(c) Establishing the Alignment: Contractor shall be responsible for adherence to the following requirements and conditions:

(i) Qualified surveyor for the Contractor shall perform all of the surveying and check baseline and benchmarks prior to any tunneling work and report any errors or discrepancies to the Contract Administrator.

(ii) Use the baseline and benchmarks shown on the Drawings to furnish and maintain reference control lines and grades for the sewer pipe construction. Use these lines and grades to establish the exact location of the pipeline excavation and structures.

(iii) Establishing and maintaining the accuracy of control work to included alignment and grade of the sewer pipe.

(iv) Establishing control points sufficiently far from the tunnel operation so as not to be affected by ground movement.

(v) Check the primary control for the tunnelling system against an above ground undisturbed reference at least once each week or not greater than 75 m intervals of pipeline being constructed.

(vi) Perform survey traverse as per reviewed submittals when implementing enhanced guidance systems.

(d) Maintaining the Alignment: Contractor shall adhere to the following requirements and conditions:

(i) Pipe installation shall not vary by more than the allowable alignment deviations as specified herein.

(ii) Record the exact position of the TBM at 2.5m intervals or a minimum of once per pipe segment, whichever is more often, to ensure the alignment is within the specified tolerances. The tunnel guidance system may be used; however, select times to measure and record this information after the air temperatures have stabilized throughout the pipe to ensure accurate readings.

(iii) Immediately correct any misalignment. When the excavation is off line or grade, return to the design line and/or grade over the remaining portion of the drive and at a rate of not more than that specified.

(iv) If alignment deviations are exceeded, Contractor shall pay all costs for correction (redesign, reconstruction, and re-inspection). If redesign is required, Contractor shall obtain the services of a Professional Engineer licensed in the Province of Manitoba for the redesign. The installed pipe must be capable of meeting the design flow. Plans showing the changes shall be submitted to the Contract Administrator for review.

(v) Perform a verification survey with a transit or total station of each of the installed pipe lengths from launching shaft to receiving shaft within 24 hours after the completion of the removal of the TBM. Document measured

conformance to design line and grade of the pipe together with locations and deviation (distance and direction) of any out-of-tolerance locations.

(e) Launch and Retrieval: The Contractor shall implement appropriate procedures and notify the Contract Administrator immediately upon implementation of any contingency plan.

(f) Tunnelling Operations: Contractor shall read all of the reports listed in the Project Conditions before commencing tunnelling operations. A copy of each report contained in the Project Conditions shall be maintained in a secured location near the launch shaft. Contractor shall adhere to the following requirements and conditions:

(i) Conduct tunnelling operations in accordance with applicable safety rules and regulations, and use methods that include due regard for safety of workers and protection for adjacent structures, utilities, and the public.

(ii) Monitor for hazardous gas conditions; if encountered, take appropriate steps to ventilate the work area.

(iii) Keep tunnel excavation within the rights-of-way indicated on the Drawings, within the lines and grades designated on the Drawings, and within the specified tolerances.

(iv) Equipment powered by combustible fuels shall be located at suitable distances from the shafts as per written instructions from the dedicated site safety representative. These instructions shall be made immediately available to the Contract Administrator upon request.

(v) Synchronize the rate of advance of the TBM with the rate of spoil removed to limit ground loss or heave.

(vi) Operate the tunnelling system within the operating parameters established in the specifications and accepted submittals.

(vii) Make the excavation of a minimum sufficient size to permit pipe installation by jacking in accordance with project conditions with allowance for injection of the lubricant.

(viii) Maintain an envelope of lubricant around the exterior of the pipe during jacking and excavation operation to minimize potential surface settlements as the ground squeezes into the annular space and to reduce the exterior friction acting against the pipe with the possibility of the pipe seizing in place.

(ix) Fluid jetting to advance the pipe is prohibited.

(x) If the pipe “freezes” and the TBM and/or pipeline are unable to be moved, a rescue pit may be allowed with the location subject to review and acceptance by the Contract Administrator. Rescue pit construction shall be performed as specified herein.

(xi) In the event a section of pipe is damaged during the jacking operation or joint failure occurs, as evidenced by visible groundwater inflow or other observations, use one of the following procedures to correct the damage at no additional cost:

- Slightly damaged pipe that passes the specified leak acceptance testing and maintains pipe barrel and joint structural integrity may, if access is possible, be repaired in place with a method approved by the pipe supplier and if the proposed technique is accepted by the Contract Administrator. These actions shall be performed at the expense of the Contractor.
- Severely damaged pipe, or pipe where joint failure is evident, shall be removed from the excavation by surface excavation, by jacking the damaged pipe through the excavation and removing it at the receiving shaft, or by sinking a rescue shaft and removing and replacing damaged pipe. Do not begin a new drive until structural pipe monitoring system is implemented on all remaining drives. These actions shall be performed at the expense of the Contractor.

(xii) Perform contact grouting of the annular space as required to fill annular space, reduce embedment loads, and control settlement.

(g) Obstructions and Rescue Pits during Tunnelling:

(i) Remove, clear, or otherwise make it possible for the tunnelling equipment and pipe to progress past or through objects in accordance with the submitted contingency plan.

(ii) The object blocking the forward motion of the TBM shall meet the definition of an obstruction and the following requirements shall be met:

- Notify Contract Administrator immediately upon encountering an object that prevents the forward progress of the TBM.
- Proceed with removal of the object by means of obstruction removal procedures in accordance with the submitted contingency plan.
- The Contract Administrator shall be provided access to document the obstruction. No excavation within 5 feet of the tunnelling equipment cutter wheel is to take place without the Contract Administrator being present.
- The Contractor shall have on hand at all times and readily available: equipment, tools, materials, and labor appropriate for the effective and efficient work related to obstruction removal.

(iii) The proposal of alternative methods for removing, clearing, or otherwise making it possible for the tunnelling equipment to progress past objects that do not allow for the visual observation and measurement of the nature of the object shall not be considered for additional payment.

(h) Rescue pit:

(i) If a rescue pit is requested, obtain written authorization from the Contract Administrator before beginning construction of this pit. Contractor's request shall include all necessary permits and approvals, minimize public inconvenience, and minimize impacting existing facilities. Additional ground monitoring instrumentation shall be required.

E23.9.6 Noise Monitoring and Abatement

(a) As per E6.4

E23.9.7 Disposal of Muck and Excess Material

(a) Remove muck and excavated material from the project site and dispose of spoil as noted below.

(b) Locate and acquire a site for the legal disposal of muck and excess excavated material and dispose of same in accordance with all applicable laws and regulations.

E23.9.8 Site Cleanup

(a) Restore the site in accordance with the Contract Documents.

E23.9.9 Settlement/Heave

(a) Settlement/Heave: Ground deformations from tunnelling shall be in accordance with the requirements contained in E15.

E23.9.10 Inflow through Entrance and Exit Seals

(a) Loss of seal at entrance and/or exit shall be characterized by leaking water, lubricant, or slurry through the seal in excess of 3 litres per minute and/or inflow of ground in excess of 0.025 m^3.

E23.9.11 Allowable Alignment Deviations and Return to Line and/or Grade

(a) Horizontal (Line): Do not exceed more than 100 mm from that depicted on the Drawings at any point along the alignment.

(b) Elevation (Grade): Do not exceed more than 50 mm from that depicted on the Drawings at any point along the alignment.

(c) When the excavation is off line or grade, return to the design line and/or grade over the remaining portion of the drive and at a rate of not more than 25 mm per 8 m.

E23.9.12 Surveys

(a) The qualified surveyor for the Contractor shall conduct all of the surveys required for the Work. The Contract Administrator will provide location coordinates shown on the Drawings within five (5) days' notice of request for these coordinates. Attend a survey coordination meeting and adhere to the schedule established at that meeting.

E23.10 Measurement and Payment

E23.10.1 Tunneling and Pipe Jacking

(a) Construction of the pipe jacked installation of the sewer shall be measured on a linear metre basis and paid at the contract unit price of "Tunnel Construction" for the tunnel installed using this method. The price shall include all work described herein including, but not limited to Tunnelling, pipe, shafts, IJS's, contact grouting, bedding, backfilling, surface reinstatement, and all appurtenances and miscellaneous materials.

(i) Measurement for length of tunnel will be made horizontally at grade above the centreline of pipe through shafts from existing connection points to centre of manholes.

(ii) Repair of damage to underground and surface structures due to surface subsidence and soil heaving caused by Tunnelling methods will be at own expense.

(iii) Relocation of utilities to accommodate shaft construction or tunneling methodology shall be borne by the Contractor.

(iv) Bedding and backfill will be incidental to "Tunnel Construction".

(v) Surface restorations will be incidental to "Tunnel Construction".

(vi) Costs for installation of Standpipe Piezometers and monitoring of the groundwater level are paid separately under E17.

E23.10.2 Tunnelling Shafts

(a) Refer to Tunnelling Shafts in E17.

E24. REINFORCED CONCRETE PIPE FOR TRENCHLESS INSTALLATIONS

E24.1 Description

(a) This Specification shall cover the minimum requirements for Reinforced Concrete Pipe (RCP) to be installed using trenchless methods, including placement in shafts and connection sections.

(b) Reinforced concrete pipe meeting the requirements identified herein may be used for the following applications:

(i) Trenchless Jacked Installations

(ii) Carrier pipe in Two pass tunnels

E24.2 General

(a) Prior to selecting RCP for installation, the Contractor shall take into account the properties of RCP, the means and methods that will be used to install the pipe, the specified leakage criteria as contained herein, and the ground and groundwater conditions as defined in the Geotechnical Baseline Report (GBR).

(b) The Contractor is responsible for selecting an acceptable pipe material to be installed without damage to either the pipe or the pipe joints using equipment selected by the Contractor for use in the ground and groundwater conditions as defined in the GBR that meets the specified leakage test requirements.

(c) Designs for RCP shall be produced, signed and sealed by a Professional Engineer licenced to practice in the Province of Manitoba. The Contractor is responsible for the work produced by this engineer.

(d) Contractor's Engineer shall evaluate the pipe design against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation. Design and furnish this pipe with additional strength, reinforcement, and wall thickness as necessary to withstand all temporary load conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage.

(e) Contractor's Engineer shall evaluate the joint design/configuration against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation as well as ensuring that the joints meet the specified leakage criteria after installation. Design and furnish joints in this pipe that meet the specified leakage criteria and that safely withstand all temporary loading conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage to the joints, and upon installation, the specified leakage criteria shall be met. Furnish joint cushions that meet or exceed pipe manufacturer recommendations.

(f) Minimum pipe internal diameters shall be as per the Drawings. The Contractor will be permitted to upsize pipe diameter to accommodate tunneling equipment or to facilitate construction in a single drive. All costs for increasing pipe size to accommodate Contractors selection of tunneling equipment or methods of installation shall be borne by the Contractor.

E24.3 Submittals

E24.3.1 Submit RCP designs in accordance with E4 a minimum of ten (10) Business Days prior to manufacturing or shipping of the RCP, whichever should come first and no later than twenty (20) Business Days prior to commencement of tunnelling works. RCP designs shall include the following information and shall be sealed and signed by a Professional Engineer, registered in the Province of Manitoba and experienced in the design of RCP for tunnelling applications. RCP design submissions shall include the following:

(a) Pipe thickness and reinforcing design computations including all specified design checks identified in E24.4. Designs to be provided for all pipe and specials required to complete the installation. Identify design assumptions based on the GBR;

(b) Name and manufacturer of the RCP;

(c) Material properties used for design. Include relevant historical and demonstration testing data to confirm material properties used in design;

(d) Certification by Contractor's Engineer that the pipe is sufficient for installation, as indicated on the Drawings using trenchless installation methods as selected by Contractor for the ground and groundwater conditions as defined in the GBR.

(e) Other information that may reasonably be required by the Contract Administrator to confirm the RCP design proposed conforms to the specified requirements and design intent.

E24.3.2 Submit the following Shop Drawings in accordance with E4 a minimum of ten (10) Business Days prior to commencement of pipe manufacturing or shipping, whichever should come first and no later than twenty (20) Business Days prior to commencement of tunnelling works: Shop Drawings shall contain the following minimum information:

(a) Shop Drawings showing pipe construction details to include length, wall thickness, reinforcement, manufacturing tolerances, pipe joint design and configuration, allowable angular deflection, compression rings, specials, location of grout ports, and other pipe appurtenances. Show method for closure of ports.

(b) IJS Specials: The lead and trailing pipe in front of and behind an IJS. Supply shop drawings each type of IJS Special to be used, complete with shop drawings that show details.

(c) Qualifications of the pipe manufacturer.

(d) The pipe manufacturer shall certify that the ground and groundwater conditions, as defined in the GBR, as well as the installation methods, as selected by Contractor, have been reviewed prior to manufacturing the pipe.

(e) Manufacturer literature stating the handling, shipping, storage, transport, and installation recommendations for the pipe.

E24.3.3 Submit Quality Control Records in accordance with ASTM C1417 and E4 within ten (10) Business Days of manufacturing or completion of testing. In addition to the requirements of ASTM C1417, submit the following:

(a) Mill tests for reinforcing steel and steel joint components

(b) External joint bands conforming to ASTM A36;

(c) Cement conforming to ASTM C150;

(d) Aggregates conforming to ASTM A1064/1064M, and A615 as applicable;

(e) Pipe conforming to ASTM C1417

(f) Pipe joints conforming to ASTM C443

(g) Submit pipe manufacturer's recordkeeping for maintaining quality control of the pipes during the fabrication and curing processes in accordance with E4, including but not limited to:

(i) Tracking methods;
(ii) Serial numbers;
(iii) Inspections;
(iv) Physical test results.

(h) Submit pipe manufacturer's control measures and manufacturing tolerances for:

(i) Straightness of pipe;
(ii) Squareness of pipe ends;
(iii) Smoothness of outside surface;
(iv) Inside and Outside diameter of pipe;
(v) Circumferential Uniformity;
(vi) Roundness

E24.3.4 Submit results from proof of design test(s) results in accordance with E4.

E24.3.5 Submit an affidavit of compliance in accordance with E4.

(a) An affidavit of compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification and ASTM C1417.

E24.3.6 Submit a hydrostatic leakage testing plan in accordance with E4.

E24.4 Design of Reinforced Concrete Pipe

E24.4.1 RCP shall be designed using direct design methods in accordance with the latest edition of ASCE 27 meeting the following requirements. Pipe installed in open installations (if required) shall be designed in accordance with ASCE 15 assuming a minimum Type 2 SIDD as shown on the Drawings:

(a) Pipe shall be designed for the following minimum failure modes under both long term and temporary loads including: handling, shipping, storage, transport, and installation of the sewer pipe in accordance with established practices, national standards, and the requirements as contained herein.

(b) Pipe designs shall consider the following failure modes:

(i) Flexural strength
(ii) Crack control

(iii) Diagonal tension

(iv) Radial tension

(c) Additional reinforcement, strength of pipe, wall thickness, and provisions for joints shall be designed by Contractor and furnished as necessary to ensure the adequacy of the pipe for all temporary load conditions.

E24.4.2 Jacking forces:

(a) Assess and design the pipe for imparted axial forces due to the tunnelling operations in accordance with ASCE 27.

(b) Imparted axial forces shall be evaluated based on the anticipated installation methods and the potential for eccentric loading. At a minimum, the following conditions shall be assessed:

(i) Full concentric contact;

(ii) Eccentric loading with full contract on bearing pad; and,

(iii) Additional checks if partial contact is anticipated

E24.4.3 The pipe shall be additionally designed by the Contractor to safely withstand all anticipated temporary loads due to handling, shipping, storage, transport, and installation of the sewer pipe in accordance with ASCE 27 and the requirements contained herein. Also account for contact grouting of the pipe after trenchless operations have been completed.

E24.4.4 If this pipe material cannot be manufactured with sufficient strength and/or wall thickness to withstand all of the handling, shipping, storage, transport, and trenchless installation loads, then this product shall not be considered suitable for installation on this project by trenchless methods. Furthermore, if the joints lack sufficient strength to withstand all of the handling, shipping, storage, transport, and trenchless installation loads or if the joints lack sufficient water tightness to meet the specified leakage criteria after installation, then this product shall not be considered suitable for installation on this project by trenchless methods.

E24.5 Materials

E24.5.1 Reinforced Concrete Pipe

(a) Reinforced Concrete Pipe shall be manufactured in accordance with ASTM C1417, ASCE 27, CW 2130 and the minimum requirements as contained herein. The more restrictive of these criteria shall apply.

(b) Concrete Requirements

(i) A minimum 28 day concrete compressive strength: 41.4 MPa.

(ii) Pozzolan shall conform to ASTM C618.

(iii) Type HS cement shall be used

(c) Reinforcement Requirements

(i) Reinforcement for pipe intended for trenchless installations must take into account the potential for the pipe to rotate during installation. The design of stirrups and circumferential reinforcement must not result in a preferential installation orientation for the pipe unless appropriate controls are put in place, precluding rotation of the pipe during installation.

(d) Joint Requirements

(i) Pipe joints shall conform to ASTM C443.

(ii) If required for development of sufficient concrete area for jacking forces, a steel bell shall be used. The external steel bell shall not protrude past the outside of the pipe barrel.

(iii) For normal jacking pipe, a steel reinforcement band shall be used as per CW 2030.

(e) Joint Bands

(i) External joint bands shall conform to ASTM A36.

(ii) External joint bands shall meet the following dimensions:

- Minimum width: 220mm.
- Minimum bell depth: 113mm.

(iii) Where the RCP is intended to act as the permanent carrier pipe, steel bells shall be protected from corrosion with a minimum of 16 mils of epoxy, as per AWWA C210.

(iv) Fusion bonded epoxy may be used as an alternative to a liquid epoxy for steel bells. Fusion bonded epoxy must conform to AWWA C213. The final minimum coating thickness shall be 16 mils

(v) Steel bells exposed to abrasive soils shall be additionally coated with sacrificial abrasion resistant overlay of a minimum of 0.75 mm (30 mil) polymer epoxy concrete or approved equal in accordance with B7.

(f) Lubrication ports, at a minimum, shall be located every 10 m. Stagger ports at 12:00, 3:00, and 9:00 o'clock positions.

(g) Dimensions

(i) The pipes and joints shall be in accordance with the permissible variations contained in Appendix A of the ASCE 27, ASTM C361, and ASTM C1417 except as required below. The more restrictive of these criteria shall apply.

(ii) Pipe shall be supplied in nominal lengths. At least 90% of the total footage, excluding special order lengths, shall be furnished in nominal length sections.

(iii) The minimum wall thickness, measured at the bottom of the spigot gasket groove where the wall cross-section has been reduced, shall be determined from the maximum jacking loads.

E24.5.2 Quality Control

(a) The pipe manufacturer shall be a company that specializes in the production of reinforced concrete jacking pipes with at least ten (10) continuous years manufacturing reinforced concrete jacking pipe.

(b) Contractor's Engineer shall be a licensed Professional Engineer with registration in the Province of Manitoba having at least five (5) years of demonstrable experience in the design of reinforced concrete jacking pipe to include the various pipe joint assemblies used with jacking pipe.

(c) Do not manufacture any pipe until all relevant submittals have been reviewed and accepted by the Contract Administrator. Mark all pipe at the place of manufacture in accordance with Appendix A of the ASCE 27 and ASTM C1417. Place serial numbers on the pipe for unique identification.

(d) Inspect pipe as it is delivered from manufacturer. Immediately reject any pipe that has not been properly marked, shipped, or handled in accordance with the reviewed submittals or that does not meet the requirements as contained herein.

(e) Allow Contract Administrator access to inspect the shipping, handling, storage, transport, and installation of each pipe.

(f) Testing

(i) Pipes shall be tested in accordance with ASTM C1417. The compressive strength of the concrete shall be tested in accordance with ASTM C39. Evaluate the properties of the pipe using ASTM C1417. Provide the results of this testing.

(ii) Pipe joints shall be tested in accordance with ASTM C443. Provide the results of this testing.

(iii) In addition to testing required by ASTM C1417, a proof of design tests shall be undertaken for each class of pipe produced for the project. The proof of design tests shall consist of testing a minimum of five (5) pipes per class of pipe to

ultimate failure in a three edge bearing test machine in accordance with ASTM C497. The tests shall be performed in the presence of the Contract Administrator. The pipe supplier shall provide a minimum of ten (10) Business Days advance notice to the Contract Administrator prior to undertaking the proof of design testing. The pipe supplier shall endeavour to maximize the number of proof of design tests to be undertaken on one occasion in order to limit the number of visits to the plant by the Contract Administrator.

(g) Plant Inspections

(i) The Contractor shall afford the Contract Administrator every facility to access and inspect all plant to be provided, work to be performed, materials to be supplied and equipment or machinery to be installed.

(ii) Provide notice a minimum of ten (10) Business Days prior to manufacturing of pipe.

E24.6 Construction

E24.6.1 Packaging, Handling, Shipping, Storage and Site Transport

(a) Packaging, handling, shipping, storage, and site transport shall be done in accordance with the manufacturer's instructions and reviewed submittals. Do not ship until the pipe is marked in accordance with the requirements as contained herein. The pipes must be stored in accordance with reviewed submittals.

(b) Care shall be exercised in handling, storing, transporting and placing pipe to prevent damage. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or other device acceptable to the Contract Administrator.

(c) All rubber gaskets shall be stored in as cool a place as practicable, preferably at 20º C or less, and in no case shall the rubber gaskets be exposed to the direct rays of the sun for more than 72 hours.

E24.6.2 Installation

(a) The installation of pipe and fittings shall be the responsibility of Contractor in accordance with the minimum requirements as established in the project plans, specifications, pipe manufacturer's recommendations, and reviewed submittals. Do not damage pipe or pipe joints.

(b) Installation of pipe using open cut methods shall conform to the CW2130 and ASTM C1479 Type 2 installation except as modified herein:

(i) The pipe shall be laid and fitted together so that when complete, the pipe will have a smooth and uniform invert. The trench shall be free of water while the pipe is being installed. The excavation of the trench shall be fully completed a sufficient distance in advance so as not to interfere with the laying of the pipe.

(ii) Once the pipe is placed, the bedding layer shall be compacted (except the middle third). Subsequent layers shall then be placed and compacted to meet the installation requirements.

(iii) Selection, placement and compaction of bedding materials shall conform to ASTM C1479, and the Construction Drawings. The Contractor shall ensure that disturbance of the pipe or damage to the pipe coating does not occur during sand bedding and backfilling operations.

E24.6.3 Pipe Handling

(a) Use methods in accordance with reviewed submittals and requirements as contained herein.

E24.6.4 Pipe Jointing

(a) Inspect pipe end, gasket, and sealing surfaces for damages.

(b) Clean ends of pipe and joint components.

(c) Apply joint lubricant to the bell interior surface and the rubber seals. Use only lubricants approved by the pipe manufacturer.

(d) Use suitable equipment and end protection to push the pipes together.

(e) Do not exceed forces as recommended by the manufacturer for joining or pushing the pipe.

E24.6.5 CCTV Inspection

(a) Where the RCP pipe is intended to act as the permanent carrier pipe, a post installation CCTV inspection shall be undertaken of the installed carrier pipe in accordance with CW 2145

E24.7 Measurement and Payment

E24.7.1 Reinforced Concrete Pipe for Trenchless Installations

(a) 1050mm, 1650mm Reinforced Concrete Pipe

(i) Measurement and payment for supply and installation shall be in accordance with CW 2130.

(b) 1800mm, 2100mm Reinforced Concrete Pipe

(i) Supply and installation of 1800mm and 2100mm RCP and any other labour and materials required to complete the work as specified herein will be considered incidental to “Tunnel Construction” and will not be measured for payment.

E25. FIBREGLASS PIPE FOR TRENCHLESS INSTALLATIONS

E25.1 Description

(a) This specification describes the minimum requirements for Fiberglass Pipe (FGP) to be installed using trenchless methods, including placement in shafts, and as a carrier pipe for two pass tunneling. FGP that meets the requirements as contained herein will be considered acceptable for use on this project.

E25.2 General

(a) Prior to the selecting FGP for installation, Contractor shall take into account the properties of FGP, the means and methods that will be used to install the pipe, the specified leakage criteria as contained herein, and the ground and groundwater conditions as defined in the Geotechnical Baseline Report (GBR).

(b) Contractor is responsible for selecting an acceptable pipe material to be installed without damage to either the pipe or the pipe joints using the tunnelling equipment selected by Contractor for use in the ground and groundwater conditions as defined in the GBR that meets the specified leakage test requirements.

(c) Contractor shall hire a Professional Engineer registered in the Province of Manitoba meeting the requirements as contained herein. Contractor is responsible for the work produced by this engineer.

(d) Contractor’s Engineer shall evaluate the pipe design against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation. Design and furnish this pipe with additional strength, reinforcement, and wall thickness as necessary to withstand all temporary load conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage.

(e) Contractor’s Engineer shall evaluate the joint design/configuration against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation as well as ensuring that the joints meet the specified leakage criteria after installation. Design and furnish joints in this pipe that meet the specified leakage criteria and that safely withstand all temporary loading conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed

without damage to the joints, and upon installation, the specified leakage criteria shall be met. Furnish joint cushions that meet or exceed pipe manufacturer recommendations.

(f) Minimum pipe internal diameters shall be as per the Drawings. The Contractor will be permitted to upsize pipe diameter to accommodate tunneling equipment or to facilitate construction in a single drive. All costs for increasing pipe size to accommodate Contractors selection of tunneling equipment or methods of installation shall be borne by the Contractor.

E25.3 Submissions

E25.3.1 Submit FGP designs for review by the Contract Administrator in accordance with E4 a minimum of ten (10) Business Days prior to manufacturing or shipping of the CCFRPMP whichever should come first and no later than twenty (20) Business Days prior to commencement of tunnelling works. FGP designs shall be signed by a Professional Engineer, registered in the Province of Manitoba and experienced in the design of FGP for tunnelling applications. GRP design submissions shall include the following:

(a) FGP thickness computations including all specified design checks identified in E25.4. Designs to be provided for all pipe and specials required to complete the installation. Identify design assumptions based on the GBR.

(b) Name and manufacturer of the FGP.

(c) FGP material properties used for design. Include relevant historical and demonstration testing data to confirm long term material properties used in design.

(d) Certification by Contractor's Engineer that the pipe is sufficient for installation, as indicated on the Drawings using trenchless installation methods as selected by Contractor for the ground and groundwater conditions as defined in the GBR.

(e) Qualifications of Contractor's Engineer.

(f) Other information that may reasonably be required by the Contract Administrator to confirm the FGP design proposed conforms to the specified requirements and design intent.

E25.3.2 Submit the following Shop Drawings in accordance with E4 a minimum of ten (10) Business Days prior to commencement of pipe manufacturing or shipping, whichever should come first and no later than twenty (20) Business Days prior to commencement of tunnelling works: Shop Drawings shall contain the following minimum information:

(a) Product Data: Manufacturer's product data describing materials, composite design, casting process, and testing process. Provide laboratory test results for the materials to show that the pipe conforms to ASTM D3262 and D3681, the pipe joints conform to ASTM D4161, and the elastomeric gaskets conform to ASTM F477.

(b) Shop Drawings showing pipe fitting and wall construction details to include length, wall thickness, reinforcement, manufacturing tolerances, pipe joint design and configuration, allowable angular deflection, packer (joint) cushions, compression rings, specials, location of grout ports, and other pipe appurtenances. Show method for closure of ports.

(c) IJS Specials: The lead and trailing pipe in front of and behind an IJS. Supply shop drawings each type of IJS Special to be used, complete with shop drawings that show details. The Special "A" is the pipe leading an IJS and the Special "B" is the pipe trailing the IJS during the jacking process.

(d) Qualifications of the pipe manufacturer.

(e) The pipe manufacturer shall certify that the ground and groundwater conditions, as defined in the GBR, as well as the installation methods, as selected by Contractor, have been reviewed prior to manufacturing the pipe.

(f) Manufacturer literature stating the handling, shipping, storage, transport, and installation recommendations for the pipe.

E25.3.3 Submit Quality Control Records in accordance with ASTM 3262 and E4 within ten (10) Business Days of manufacturing.

E25.3.4 Submit an affidavit of compliance in accordance with E4.

(a) An affidavit of compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification and ASTM 3262.

E25.3.5 Submit pipe manufacturer's recordkeeping for maintaining quality control of the pipes during the fabrication and curing processes in accordance with E4, including but not limited to:

(a) Tracking methods;

(b) Serial numbers;

(c) Inspections;

(d) Physical test results.

E25.3.6 Submit pipe manufacturer's control measures and manufacturing tolerances for:

(a) Straightness of pipe;

(b) Squareness of pipe ends;

(c) Inside and Outside diameter of pipe;

(d) Circumferential Uniformity;

(e) Roundness

E25.4 Design of FGP

E25.4.1 General

(a) The pipe shall be designed in accordance with the latest edition of AWWA M45, and consider the requirements for installation accommodate the Contractor's means and methods, and the long term installation condition for both open cut installation in the shaft, and final tunnelled installation, where contact grouting should be accounted for.

(b) Additional reinforcement, strength of pipe, wall thickness, and provisions for joints shall be designed by the Contractor and furnished as necessary to ensure the adequacy of the pipe for all temporary load conditions.

E25.4.2 Tunnel Carrier Design

(a) Nominal Pipe Stiffness: Minimum SN shall be 248 KPa (SN36 psi).

E25.4.3 Jacking Pipe Design

(a) Nominal Pipe Stiffness: Minimum SN shall be 965 KPa (SN140 psi).

(b) Assess imparted axial forces due to the tunnelling operations in accordance with ASCE 27 and evaluated against the allowable compressive strength of the proposed pipe material.

(c) Imparted axial forces shall be evaluated based on the anticipated installation methods and the potential for eccentric loading. At a minimum, the following conditions shall be assessed:

(i) Full concentric contact;

(ii) Eccentric loading with full contract on bearing pad; and,

(iii) Additional checks if partial contact is anticipated

(d) The minimum factor of safety for axial jacking forces shall be:

(i) Full concentric contact: 3.0

(ii) Eccentric loading contact: 2.0

E25.4.4 Minimum Pipe Stiffness for Jacking installation

(a) If this pipe material cannot be manufactured with sufficient strength and/or wall thickness to withstand all of the handling, shipping, storage, transport, and trenchless installation loads, then this product shall not be considered suitable for installation on this project by trenchless methods. Furthermore, if the joints lack sufficient strength to withstand all of the handling, shipping, storage, transport, and trenchless installation loads or if the joints lack sufficient water tightness to meet the specified leakage criteria after installation, then this product shall not be considered suitable for installation on this project by trenchless methods.

E25.5 Materials

E25.5.1 The pipes and joints shall meet the requirements of ASTM D3262 and ASTM D2381, the manufacture's literature, and requirements stated herein. The more restrictive of these criteria shall apply.

E25.5.2 Furnish and install FGP that meets or exceeds the criteria for fibreglass in accordance with ASTM D3262 and the minimum requirements as contained herein:

(a) Minimum internal diameter in accordance with the drawings.

(b) Pipes shall be manufactured by the centrifugal casting process to result in dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes shall be manufactured using a resin with not less than 50 percent elongation when tested in accordance with ASTM D638. The interior surface shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall be comprised of a sand and resin layer which provides UV protection to the exterior. Pipes shall be Type 1, Liner 2, Grade 3, as per ASTM D3262.

(c) Pipe shall be supplied in nominal lengths as dictated by the selected installation methods.

(d) Lubrication ports, at a minimum, shall be located at the midpoint of each jacking pipe but not less than one set of ports every 3m or every pipe section, whichever is less. Stagger ports at 12:00, 3:00, and 9:00 o'clock positions unless otherwise accepted by the Contract Administrator.

(e) Pipe ends shall be perpendicular to the pipe axis with a maximum tolerance of 1.5mm.

E25.5.3 Pipe Materials:

(a) The manufacturer shall use only polyester resin systems design with a proven history of performance for use with jacking pipe. Pipe shall not contain Portland cement or other corrodible elements.

(b) Glass reinforcing fibers used shall be the highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnation resins.

(c) Sand shall be minimum 98 percent silica with a maximum moisture content of 2 percent.

(d) Resin additives, such as curing agents, pigments, dyes, fillers, and thixotropic agents, when used, shall not be detrimental to the pipe.

E25.5.4 Joints

(a) The pipe shall be field connected with fiberglass sleeve coupling utilizing elastomeric sealing gaskets as the sole means to maintain water tightness. Pipe joints shall conform to ASTM D4161.

(b) Elastomeric gaskets shall conform to ASTM F477.

(c) Joints shall be flush with the exterior of the pipe.

(d) Lubrication ports, at a minimum, shall be located at the midpoint of each jacking pipe but not less than one set of ports every 3m or every pipe section, whichever is less. Stagger ports at 12:00, 3:00, and 9:00 o'clock positions unless otherwise accepted by the Contract Administrator.

E25.5.5 Quality Control

(a) The pipe manufacturer shall be a company that specializes in the production of fiberglass jacking pipes with at least ten continuous years manufacturing fiberglass jacking pipe.

(b) Contractor's Engineer shall be a licensed Professional Engineer with registration in the Province of Manitoba having at least five (5) years of demonstrable experience in the design of fiberglass jacking pipe.

(c) Do not manufacture any pipe until all relevant submittals have been reviewed and accepted.

(d) Mark all pipe at the place of manufacture to include internal diameter of pipe, jacking pipe rating, minimum and maximum height of cover, classification of pipe, date of manufacture, name or trademark of manufacturer, and plant identification. Place serial numbers on the pipe for unique identification.

(e) Inspect pipe as it is delivered from manufacturer. Immediately reject any pipe that has not been properly marked, shipped, or handled in accordance with the reviewed submittals or that does not meet the requirements as contained herein.

(f) Allow the Contract Administrator to inspect the shipping, handling, storage, transport, and installation of each pipe.

(g) Plant Inspections

(i) The Contractor shall afford the Contract Administrator every facility to access and inspect all plant to be provided, work to be performed, materials to be supplied and equipment or machinery to be installed.

(ii) Provide notice a minimum of ten (10) Business Days prior to manufacturing of pipe.

(h) Testing

(i) Pipes shall be tested in accordance with ASTM D3262 and D2412. Provide the results of this testing.

(ii) Pipe joints shall be tested in accordance with ASTM D4161. Provide the results of this testing.

(iii) The extrapolated 50-year strain corrosion value shall not be less than 0.9 percent as determined in accordance with ASTM D3681 and D3262.

E25.6 Construction

E25.6.1 Packaging, Handling, Shipping, Storage and Site Transport

(a) Packaging, handling, shipping, storage, and site transport shall be done in accordance with the manufacturer's instructions and submittals. Do not ship until the pipe is marked in accordance with the requirements as contained herein. Store pipe in accordance with submittals.

(b) Care shall be exercised in handling, storing, transporting and placing pipe to prevent damage. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or similar device designed to not damage the pipe.

(c) All rubber gaskets shall be stored in as cool a place as practicable, preferably at 21º C or less, and in no case shall the rubber gaskets be exposed to the direct rays of the sun for more than 72 hours.

E25.6.2 Installation

(a) The installation of pipe and fittings shall be the responsibility of Contractor in accordance with the minimum requirements as established in the project plans, specifications, pipe manufacturer's recommendations, and reviewed submittals. Do not damage pipe or pipe joints.

(b) Pipe Handling: Use methods in accordance with reviewed submittals and requirements as contained herein.

(c) Pipe Jointing:

(i) Inspect pipe end, gasket, and sealing surfaces for damages.

(ii) Clean ends of pipe and joint components.

(iii) Apply joint lubricant to the bell interior surface and the rubber seals. Use only lubricants approved by the pipe manufacturer.

(iv) Use suitable equipment and end protection to push the pipes together.

(v) Do not exceed forces as recommended by the manufacturer for joining or pushing the pipe.

(d) Installation of pipe by trenchless methods shall conform to E23.

E25.6.3 CCTV Inspection

(a) A post installation CCTV inspection shall be undertaken of the installed pipe in accordance with CW 2145. CCTV inspection shall occur after completion of the grouting operation.

(b) Following any repairs and/or cleaning, the lines shall be retested and re-inspected.

E25.7 Measurement and Payment

(a) Supply and installation of FGP pipe and any other labour and materials required to complete the work as specified herein will be considered incidental to "Tunnel Construction" and will not be measured for payment. No additional payment will be made.

E26. CONNECTION OF CATCH BASIN LEADS TO LDS PIPE

E26.1 Description

(a) This specification supplements the City of Winnipeg Specification CW 2130.

E26.2 Materials

(a) Materials used to make the connection shall be in accordance with CW 2130, as listed on the Drawings or an approved equivalent in accordance with B7.

E26.3 Construction Methods

(a) General

(i) The means and method for the installation are the responsibility of the Contractor.

(b) FGP Sewer

(i) The connection of the catch basin leads shall be installed as shown on Drawings. LD-8902.

(c) RCP Sewer

(i) The connection of the catch basin leads shall be installed in accordance with CW 2130 and SD-015.

E26.4 Measurement and Payment

(a) The connection of the catch basin leads to the trunk sewer shall be paid under the Contract unit price for "Connection of Catch Basin Lead to LDS Pipe" and will be measured on a unit basis for each connection made. The price shall be payment in full for performing all operations herein described and all other items or accessories incidental to the Work included in this Specification and shown on the Drawings.

(b) Supply and Installation of the service riser section is incidental to this Work.

(c) The cost of any shaft and associated shoring required to undertake the Work described herein is considered incidental to the Connection of Catch Basin Lead to Trunk Sewer.

(d) Repairs of any damage to the trunk sewer resulting from the Work shall be made at no additional cost.

E27. PRECAST CONCRETE BOX MANHOLES

E27.1 Description

(a) This specification shall cover the supply and installation of precast concrete box manholes and shall supplement CW 2130.

E27.2 Submittals

(a) Submit shop drawings in accordance with CW 1110 and E4 of this specification showing pipe openings, reinforcing, and joint details, signed and stamped by a Professional Engineer registered in the Province of Manitoba.

E27.3 Materials

(a) Precast concrete box sections to ASTM C1433 complete with slab top and base.
  (i) Minimum Length: 3500 mm
  (ii) Minimum Width: 3500 mm
  (iii) Height: As indicated on the Drawings.
  (iv) All costs for increasing manhole size to accommodate upsizing of the pipe shall be borne by the Contractor.

(b) Precast concrete circular sections, benching, frames, covers, and rungs as per CW 2130.

(c) Tolerance: Within 150 mm of design, as indicated on the Drawings.

E27.4 Construction Methods

(a) Construct in accordance with CW 2130 and manufacturer's recommendations.

E27.5 Measurement and Payment

(a) Manhole installation including frames, covers, box sections, risers, base, and other accessories and appurtenances shall be paid under the Contract unit price for "New Box Manhole" and will be measured on a unit basis for each manhole installed.

E28. TEMPORARY SURFACE RESTORATION

E28.1 General

(a) This specification applies to temporary surface restoration Work.

(b) Further to clause 3.3 of CW 1130 where permanent surface restorations cannot be made due to cold weather, the Contractor shall temporarily restore surfaces as follows:

E28.2 Construction Methods

(a) Backfill under Temporary Surface Restoration
  (i) Backfill and level boulevards and grassed areas to match existing surface elevations,
  (ii) Use Class 2 backfill in excavation under temporary street pavement and sidewalk where Class 3 backfill cannot be jetted and flooded due to cold weather.
  (iii) Class 2 backfill may be compacted in 600 mm lifts where backhoe operated pneumatic plate compactors are used.
  (iv) Jet and flood Class 2, Class 3 and Class 5 backfilled excavations in spring when ground is not frozen prior to permanent restoration.

(b) Temporary Surface Restoration
  (i) Cap excavations in concrete pavement with a 100 mm layer of concrete for "Temporary Restoration of Utility Pavement Cuts" as specified in CW 3310.

(ii) Cap excavations in sidewalk pavement with a 50 mm layer of concrete for "Temporary Restoration of Utility Pavement Cuts" as specified in CW 3310.

(iii) Insulate temporary concrete as required during 48 hour curing period.

(iv) Where curb has been removed as part of the pavement cut pour temporary curb using "Concrete for Temporary Restoration of Utility Pavement Cuts" as specified in CW 3310.

(v) Remove all temporary pavements prior to permanent restorations.

(c) Maintenance

(i) The Contractor shall monitor and maintain temporarily restored surfaces as required until permanent restoration is complete.

(ii) If, in the opinion of the Contract Administrator, temporarily restored surfaces are not being adequately maintained or were not properly constructed and pose a danger to the public, maintenance or reconstruction will be done by the City forces with no advance notification the Contractor.

(iii) All costs associated with the maintenance or reconstruction of temporary pavement incurred by the City shall be deducted from future payments to the Contractor.

E28.3 Measurement and Payment

(a) Temporary restoration associated with the Work will be considered incidental to Site Development, Mobilization and Demobilization.

(b) No extra payment will be made for the installation of Class 2 backfill under temporary street pavement and sidewalk.

(c) No measurement or payment will be made for the temporary restoration of barrier or lip curb.

(d) No measurement or payment will be made for the temporary restorations of boulevards and grassed areas.

(e) No measurement or payment will be made for the removal of temporary pavement prior to permanent restoration.

E29. PERMANENT RESTORATION

E29.1 Description

(a) This specification identifies the requirements for permanent surface restorations.

(b) The specification amends the Surface Restorations defined in CW 2130 and places the cost of permanent surface restorations upon the particular Work item being undertaken.

E29.2 General

(a) The Contractor will follow the City's Street By-law No. 1481/77 and Street Cuts Manual (2017) for all pavement restoration unless otherwise shown on the drawing or specifications or as directed by the Contract Administrator.

(b) The Street Classification and Surface Type within the project work area are classified as follows:

Street Name	Segment	Priority	Pavement Type	General Condition
Semple Ave	McKenzie St to End	P3	Concrete	Fair
Semple Ave	McKenzie St to McGregor St	P3	Concrete	Fair
Semple Ave	McGregor St to Andrews St	P3	Asphalt over Concrete	Fair
Semple Ave	Andrews St to Powers St	P3	Asphalt over Concrete	Fair
Semple Ave	Powers St to Salter St	P3	Asphalt over Concrete	Fair
Semple Ave	Salter St to Aikins St	P3	Asphalt over Concrete	Poor

Street Name	Segment	Priority	Pavement Type	General Condition
Semple Ave	Aikins St to Main St	P3	Asphalt over Concrete	Poor
Semple Ave	Main St to Scotia St	P3	Asphalt over Concrete	Good
McKenzie St	Kilbride Ave to Semple Ave	P3s	Concrete	Poor
McKenzie St	Semple Ave to Burrin Ave	P3s	Concrete	Poor
McGregor St	Kilbride Ave to Semple Ave	P1	Asphalt over Concrete	Fair
McGregor St	Semple Ave to Burrin Ave	P1	Asphalt over Concrete	Fair
Andrews St	Kilbride Ave to Semple Ave	P3	Concrete	Poor
Andrews St	Semple Ave to Burrin Ave	P3	Concrete	Poor
Powers St	Kilbride Ave to Semple Ave	P3	Asphalt over Concrete	Good
Powers St	Semple Ave to Burrin Ave	P3	Asphalt over Concrete	Good
Salter St	Kilbride Ave to Semple Ave	P1	Asphalt over Concrete	Fair
Salter St	Semple Ave to Burrin Ave	P1	Asphalt over Concrete	Poor
Aikins St	Kilbride Ave to Semple Ave	P3	Asphalt over Concrete	Fair
Aikins St	Semple Ave to Burrin Ave	P3	Asphalt over Concrete	Fair
Main St NB	Kilbride Ave to Semple Ave	P1	Concrete	Poor
Main St NB	Semple Ave to Burrin Ave	P1	Concrete	Poor
Main St SB	Kilbride Ave to Semple Ave	P1	Asphalt over Concrete	Good
Main St SB	Semple Ave to Burrin Ave	P1	Asphalt over Concrete	Good
Scotia St	Kilbride Ave to Semple Ave	P3	Asphalt	Good
Scotia St	Semple Ave to Burrin Ave	P3	Asphalt over Concrete	Good
Note: Values obtained from City of Winnipeg Street Conditions Map available at: https://winnipeg.ca/publicworks/maps/streetconditions.asp Conditions reported at the time of posting may not reflect existing conditions.				

(c) All street segments within the work area impacted by the Work as determined by the Contract Administrator shall be maintained and restored with the following additional requirements.

(i) Review and record the condition of each street segment with the Contract Administrator and a City Representative from Public Works prior to the initiation of Work.

(ii) Review and record the condition of each street segment with the Contract Administrator and a City Representative from Public Works prior to surface restoration. The surface restoration required for each street segment will be agreed upon at this review meeting.

(iii) Pavement Restoration Guidelines can be found in the City of Winnipeg Street Cuts Manual.

E29.3 Methods

(a) The Contractor shall permanently restore all existing surface areas disturbed by construction activities including but not limited to areas disturbed by; construction equipment, placement of equipment trailers and where construction materials were stockpiled, shall be restored as follows:

(i) Boulevards, ditches and grassed areas - sodding using imported topsoil in accordance with CW 3510. The Contractor shall restore all areas disturbed during construction to existing condition or better, using topsoil and sod at its own cost.

(ii) Asphalt surfaces – match existing base course and asphalt thickness or a minimum of 150 mm of base course and 75 mm of Type 1A Asphaltic Concrete, whichever is greater, in accordance with CW 3410.

(iii) Miscellaneous concrete slabs, including sidewalk - in accordance with CW 3235

(iv) Interlocking stones – in accordance with CW 3330.

(v) Concrete curb and gutter – in accordance with CW 3240.

(vi) Trees - requiring replacement due to construction activities (as directed by the Contract Administrator) shall be installed in accordance with CW 3510 and E7. The Contractor will not be reimbursed under a separate pay item for replacing trees damaged by construction activities. The work will be considered incidental to Site Development, Mobilization and Demobilization.

(vii) Topsoil - All Topsoil Work shall be performed in accordance with CW 3510. Topsoil Work shall include all existing grassed areas disturbed by the Contractor during construction. The Contractor shall restore all areas disturbed during construction to existing condition or better, using topsoil and sod at its own cost.

E29.4 Measurement and Payment

(a) This specification amends CW 2130 such that:

(i) All costs associated with Permanent Restoration as a result of “Tunnel Construction”, including but not limited to the construction of the 1800mm and 2100mm sewer trunk, shafts, box manholes, and other related Work, will be considered incidental to “Tunnel Construction” and will not be measured for payment. No additional payment will be made.

(ii) All costs associated with Permanent Restoration as a result of Work unrelated to “Tunnel Construction”, including but not limited to trenchless sewer construction, installation of manholes not construction on the main sewer trunk, catch basins, catch basin lead, and other related Work, will be measured and paid in accordance with CW 2130.

E30. FULL DEPTH PARTIAL SLAB PATCHES

E30.1 General

(a) Construct full depth partial slab patches in accordance with CW 3230.

E30.2 Measurement and Payment

(a) Full depth partial slab patches as a result of “Tunnel Construction”, including but not limited to the construction of the 1800mm and 2100mm sewer trunk, shafts, box manholes, and other related Work, will be considered incidental to “Tunnel Construction” and will not be measured for payment. No additional payment will be made.

(b) Full depth partial slab patches as a result of Work unrelated to “Tunnel Construction”, including but not limited to trenchless sewer construction, installation of manholes not construction on the main sewer trunk, catch basins, catch basin lead, and other related Work, shall be measured on an area basis and paid for at the Contract Unit price per square meter for “Partial Slab Patches” for each type of pavement.

(c) No differentiation will be made for class of patch.

(d) No separate measurement or payment will be made for Drilled Dowels or Tie Bars, the cost for which shall be included in the prices for “Partial Slab Patches”.

PART F - SECURITY CLEARANCE

F1. SECURITY CLEARANCE

F1.1 Each individual proposed to perform the following portions of the Work:

(a) any Work on private property;

(b) any Work within City facilities other than:

(i) an underground structure such as a manhole;

(ii) in areas and at times normally open to the public;

(c) communicating with residents and homeowners in person or by telephone;

(d) performing inspections of buildings on private property;

F1.1.1 Each Individual shall be required to obtain a Police Information Check from the police service having jurisdiction at his/her place of residence. Or

(a) Sterling BackCheck – for existing account holders, log into your account to send individual invitations to employees requiring security clearance. For those that do not have an account, click on the following link to open an account: https://forms.sterlingbackcheck.com/partners/platform2-en.php?&partner=winnipegcity; or

(b) Commissionaires (Manitoba Division), forms to be completed can be found on the website at: https://www.commissionaires.ca/en/manitoba/home; or

(c) FASTCHECK Criminal Record & Fingerprint Specialists, forms to be completed can be found on the website at: https://myfastcheck.com