City of Winnipeg – Cell 35

Bid Opportunity 107-2025

Issued for Tender Specifications

Prepared by:

AECOM
101 – 18817 Stony Plain Road NW 780 486 7000 tel
Edmonton, AB, Canada T5S 0C2 780 486 7070 fax
www.aecom.com

Project Number: **60733855**

Date: **April 3, 2025**

Project Title: **Bid Opportunity – 107-2025**

DETAILED SPECIFICATIONS OF CONSTRUCTION

		No. of Pages
DIVISON 1 – GENERAL REQUIREMENTS		
01 33 00	SUBMITTAL PROCEDURES	9
01 45 00	QUALITY CONTROL	4
01 60 10	MATERIALS AND EQUIPMENT	2
01 65 00	EQUIPMENT INSTALLATION	5
01 73 00	OPERATION AND MAINTENANCE DATA	7
01 78 00	CLOSEOUT SUBMITTALS	7
DIVISION 26 – ELECTRICAL		
26 00 10	ELECTRICAL – GENERAL PROVISIONS	16
26 05 21	WIRE AND CABLE	3
26 05 26	GROUNDING – SECONDARY	3
26 05 31	SPLITTERS, JUNCTIONS BOXES, PULL BOXES AND CABINETS	2
26 05 32	OUTLET BOXES, CONDUIT BOXES AND FITTINGS	2
26 05 34	CONDUITS, FASTENINGS & FITTINGS	3
26 24 17	PANELBOARD – BREAKER TYPE	3
26 27 26	WIRING DEVICES	4
26 28 16.02	MOULDED CASE CIRCUIT BREAKER	2
DIVISION 31 – EARTHWORKS		
31 05 16	AGGREGATE MATERIALS	5
31 05 19.15	GEOTEXTILES	6
31 32 19.20	GEOCOMPOSITE	7
31 32 19.25	GEOSYNTHETIC CLAY LINER	7
31 23 33.01	EXCAVATION AND FILL	10
31 35 26.13	RECOMPACTED CLAY BASE	7
31 35 26.16	HDPE LINER	16
DIVISION 33 – UTILITIES		
33 11 30.01	LEACHATE PUMPING AND POWER SYSTEM	5
33 41 17	LEACHATE COLLECTION SYSTEM	8

Mladen Saric, P. Eng Electrical Engineer AECOM	**Sections:** 26 00 10 26 05 21 26 05 26 26 05 31 26 05 32 26 05 34 26 24 17 26 27 26 26 28 16.02 33 11 30.01	
Breanna Martin, P. Eng Solid Waste Engineer AECOM	**Sections:** 31 05 16 31 05 19.15 31 23 33.01 31 32 19.20 31 23 19.25 31 35 26.13 31 35 26.16 33 41 17	

1 GENERAL

1.01 DESCRIPTION

.1 Submit to the Contract Administrator the submittals required by individual Specification sections for review. Submit promptly and in an orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Submit Shop Drawings for 90% of the value of all materials within the first ten (10) weeks of Notice to Proceed and then remainder Shop Drawings within eight (8) weeks afterwards.

.3 Do not proceed with Work affected by the submittal until reviewed by the Contract Administrator.

.4 Present Shop Drawings, product data, and samples in SI Metric units.

.1 Where items or information is not produced in SI Metric units, converted units are acceptable.

.5 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents.

.6 The review by the Contract Administrator is for the sole purpose of ascertaining conformance with general concept. It does not provide 'approval' of the detail design inherent in Shop Drawings (which remains with the Contractor), nor does it relieve the Contractor of responsibility for errors or omissions in Shop Drawings or for meeting all requirements of the construction and Contract Documents.

.7 Verify that field measurements and affected adjacent Work are coordinated.

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

.9 After the Contract Administrator’s review and return of copies, distribute copies to sub-trades as appropriate.

.10 Keep one (1) reviewed hard copy of each submission on Site filed by Division.

1.02 SUBMITTAL PROCEDURES

.1 Direct submittals to the Contract Administrator.

.2 Hardcopy Submittals: Submit hard copies only where specifically required under individual Specifications sections.

.3 Electronic Submittals: Submittals made in electronic format shall be as follows:

.1 Each submittal shall be electronic file in Adobe Acrobat Portable Document Format (PDF), and native files (e.g. Word, Excel, AutoCAD, etc.). Use 2010 version or newer.

.2 Electronic files that contain more than ten (10) pages in PDF format shall contain internal book marking from index page to major sections of document.

.3 PDF files shall be set to open “Bookmarks and Page” view.

.4 Add general information to each PDF file, including title, subject, author, and keywords.

.5 PDF files shall be set up to print legibly at 215.9 mm by 279.4 mm (8.5" by 11"), 279.4 mm by 431.8 mm (11" by 17"), or ISO A1 (594 mm by 841 mm). No other paper sizes will be accepted.

.6 Submit new electronic files for each resubmittal.

.7 Include copy of transmittal of Contractor's submittal.

.8 Contract Administrator will reject submittals that are not accompanied by an electronic copy.

.9 Provide authorization for Contract Administrator to reproduce and distribute each file as many times as necessary for Project documentation.

.10 Detailed procedures for handling electronic submittals will be discussed at preconstruction meeting.

.11 Shop Drawings requiring an engineering seal shall be updated at project closeout and assigned a City of Winnipeg Water and Waste drawing number, sheet number, revision number and drawing size. Include fields in the Shop Drawing title block to incorporate the information.

.4 Schedule of Submittals:

.1 Prepare a table listing all anticipated submittals required to complete the Work.

.2 For each Specification Section show, at a minimum, the following:

.1 Specification Section.

.2 Total number of submittals for each Specification Section.

.3 Identify each submittal by its submittal number in accordance with a numbering and tracking system.

.4 Identify each submittal by its name or title.

.5 Identify the estimated date of submission to the Contract Administrator.

.6 State the revision number and status for each submittal.

.3 On a monthly basis, submit an updated schedule of submittals to the Contract Administrator if changes have occurred.

.5 Transmittal of Submittal:

.1 Stamp each submittal with uniform approval stamp before submitting to Contract Administrator.

.1 Stamp to include project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract.

.2 Contract Administrator will not review submittals that do not bear Contractor's approval stamp and will return them without action.

.3 Contract Administrator will not review submittals received directly from a Subcontractor and will return them without action.

.4 Complete, sign, and transmit with each submittal package, one (1) transmittal of Contractor's submittal form.

.2 Identify each submittal with the following:

.1 Numbering and tracking system:

.2 Sequentially number each submittal.

.3 Resubmission of submittal shall have original number with sequential alphabetic suffix.

.4 Specification Section and paragraph to which submittal applies.

.5 Project title and City Tender number (**107-2025**).

.6 Date of transmittal.

.7 Name of Contractor.

.3 Include Contractor's written response to each of Contract Administrator's review comments with resubmission of submittals stamped "Exceptions Noted, Resubmit".

.6 Format:

.1 Do not base Shop Drawings on reproductions of Contract Documents.

.2 Package submittal information by individual Specification Section. Do not combine different Specification Sections together in submittal package, unless otherwise directed in Specification.

.3 Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract.

.4 Index with labeled tab dividers in orderly manner.

.7 Timeliness:

.1 Schedule and submit submittals in accordance with schedule of submittals and requirements of individual Specification Sections.

.2 Submit Shop Drawings and samples well in advance of scheduled delivery date for associated equipment or material and in an orderly sequence so as to cause no delay in the Work.

.8 Processing Time:

.1 Time for review shall commence on Contract Administrator's receipt of submittal.

.2 Contract Administrator will act upon Contractor's submittal and transmit response to Contractor not later than ten (10) Business Days after receipt, unless otherwise specified.

.3 Resubmittals will be subject to the same review time.

.4 The review time required will not alleviate the Contractor of his responsibility to deliver the completed Work within the required time frame and schedule. Planning for submittal reviews and the risk to the construction schedule remains the Contractor's sole responsibility.

.9 Resubmittals:

.1 Clearly identify each correction or change made and include revision date.

.2 No adjustment of the schedule outlined in the Supplemental Conditions or Contract Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.

.10 Incomplete Submittals:

.1 The Contract Administrator will return the entire submittal for the Contractor's revision if preliminary review deems it incomplete.

.2 Incomplete Shop Drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.

.3 When any of the following are missing, the submittal will be deemed incomplete:

.1 Contractor's review stamp, completed and signed.

.2 Transmittal of Contractor's Submittal form, completed and signed.

.3 Insufficient number of copies.

.4 All requested information is not provided.

.5 Submittals missing Professional Engineer's seal and signature, where it is required.

.11 Submittals not required by Contract:

.1 Will not be reviewed and will be returned stamped "RECEIVED FOR INFORMATION".

.2 Contract Administrator will keep one (1) copy of all Shop Drawings and Product Data.

1.03 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "Shop Drawing" as defined in the City's General Conditions for Construction means all drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, Subcontractor, manufacturer, supplier, or distributor and which illustrate some portion of the Work.

.2 In general, all equipment to be installed at the Site will require Shop Drawings, which shall be submitted to the Contract Administrator.

.3 Sales bulletins or other general publications are not acceptable as submittals for review except where necessary to provide supplemental technical data.

.4 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If adjustments affect the value of the Work state such in writing to the Contract Administrator prior to proceeding with the Work. Failure to give such written notice shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

.5 All Shop Drawings are to include details as follows:

.1 Indicate dimensions, operating weights, materials, methods of construction, and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes, and other information necessary for completion of Work.

.2 Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to Drawings and Specifications.

.3 Indicate clearances for operation, maintenance, and replacement of operating equipment devices.

.4 Include a markup specification section for each item, showing compliance with the spec with a checkmark and any deviations need to be explained.

.6 Electrical and instrumentation and control system Shop Drawings to include additional details as follows:

.1 Elevation layouts, bill of materials (BOM), fuse charts, schematics, interconnections, point-to-point wiring diagrams, loop wiring diagrams, motor control diagrams, single line diagram,

3-line diagram, and CSA/cUL panel plates in addition to the other wiring and detail requirements of the Contract.

.1 Panel plates shall be included in submissions, to be affixed on the front exterior door of the enclosure. They shall contain all information required under CSA C22.1 and C22.2. At a bare minimum the short circuit current rating (SCCR) of panel plates shall be equal to the MCC or Panelboard from which they are fed from.

.2 Wiring diagrams shall mark conductor identification, field terminals, changes, etc.

.3 Detailed listing of all nameplates.

.2 Instrument Loop Diagrams (ILDs) – detailed drawings showing typical interconnections for the specified instrumentation and control devices. The Contractor is to reproduce an ILD for each device and record all relevant notes and installation-specific information on each sheet. Update the ILDs as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.1 Loop wiring diagrams shall follow ISA 5.4 for standard drawing layout, symbols, and wiring depictions.

.3 Motor Control Schematics (MCS) – when these are included, they are detailed drawings showing typical interconnections of motor control equipment. The Contractor is to reproduce a MCS for each motor and record all relevant notes and installation-specific information on each sheet. Update the MCS as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.4 Equipment descriptive data and detailed information for the system hardware and software (i.e., cutsheets or product literature). Failure to provide product literature or cutsheets with drawing submissions is grounds for marking the submission “Revise and Resubmit” without review.

.1 High-light only relevant information for the products provided. The intent of the literature is a technical review of the products suitability, technical ratings and limitations, and the installation/application. Do not include sales literature, or custom-made sheets, or sales declarations. Only manufacturer issued technical literature will be accepted.

.2 Where products have configurable part numbers, the part number options shall be broken down and either circled in red or highlighted in yellow.

.3 All cutsheets and product literature shall be provided showing CSA or cUL markings either circled in red or highlighted in yellow.

.4 Where hazardous location products are required, they shall also be submitted with their CSA or cUL certificates, and CSA or cUL required wiring diagrams for hazardous installations. The control system wiring diagrams shall capture these requirements, provide intrinsically safe barriers and methods as required, and provide notes for the electrical installer.

.5 Drawings for cabling:

.1 Provide Termination drawings with complete list of materials and nameplate engraving list.

.2 Provide Interconnection wiring diagrams for the complete system showing every fibre in each cable.

.6 Records of as-built information for the complete instrumentation and control system.

.1 Provide Enclosure/Cabinet temperature control calculations for heating and cooling loads. Appropriate temperature control shall be provided whenever required and maintain the enclosures CSA/NEMA rating.

1. Temperature calculations shall be provided whenever Variable Frequency Drives (VFD), Variable Speed Drives (VSD), internally mounted transformers, or other components/devices may produce sufficient heat within the enclosure, or as requested by the Contract Administrator.

.7 Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract.

.1 Contract Administrator will not assume the responsibility for searching out deviations in the Contractor's drawings.

.2 If works proceeds without notifying the Contract Administrator, the Contractor bears all responsibilities in regards to time and costs to rectify the issue at no cost to the City.

.8 Submit Shop Drawings stamped and signed by Professional Engineer registered or licensed in the Province of Manitoba as required in the Specifications. The following components require sealed Shop Drawings:

.1 Reinforcing steel.

.2 Metal fabrications.

.3 Pipe supports, hangers and anchors.

.9 The Contractor shall examine all Shop Drawings prior to submission to the Contract Administrator to ensure that all necessary requirements have been determined and verified and that each Shop Drawing has been checked and coordinated with the requirements of the Work and the Contract. Examination of each Shop Drawing shall be indicated by stamp, date, and signature of a responsible person of the Subcontractor for supplied items and of the Contractor for fabricated items. Shop Drawings not stamped, signed, and dated will be returned without being reviewed and stamped " REVISE AND RESUBMIT ". Ensure that the following are verified:

.1 Field measurements.

.2 Field construction criteria.

.3 Catalogue numbers and similar data.

.4 Coordination/confirmation between all Drawings and Specifications.

.5 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Works. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of where they are specified or on which drawings the work appears. Indicate cross-references to Contract Drawings and Specifications.

.10 Submittals shall be in one (1) of the following formats:

.1 Submit three (3) copies of white prints and three (3) copies of all fixture cuts and brochures.

.2 Submit one (1) electronic PDF copy.

.11 Shop Drawings will be returned to the Contractor with one (1) of the following notations:

.1 When stamped "REVIEWED" or "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS MODIFIED" or "MAKE NOTED CORRECTIONS", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".

.3 When stamped "REVISE AND RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract and submit again for review.

.4 When stamped "NOT REVIEWED" or "REJECTED", submit other Shop Drawings, brochures, etc., for review consistent with the Contract.

.5 Only Shop Drawings bearing "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS", or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.

.6 After submittals are stamped "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.

.7 Make changes in Shop Drawings, which the Contract Administrator may require, consistent with Contract. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.

.8 Only two (2) reviews of Shop Drawings will be made by the Contract Administrator at no cost. Each additional review will be charged to the Contractor at the Contract Administrator's scheduled rates. The Contract Administrator's charges for the additional Work will be deducted from the payment to the Contractor.

.9 All final reviewed Shop Drawings with red lines shall be drafted as original documents (CAD) with no red lines. These shall then be incorporated into the Operations and Maintenance Manuals.

1.04 DESCRIPTION OF CONSTRUCTION METHODS

.1 The Contractor shall, submit for the review of the Contract Administrator method statements which describe in detail, supplemented with Drawings where necessary, the methods to be adopted for executing any portion of Work.

.2 These statements shall also include details of constructional Plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

.3 Other Considerations:

.1 Fabrication, erection, installation, or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent Shop Drawings and resubmit.

1.05 REQUESTS FOR INFORMATION

.1 In the event that the Contractor or any Subcontractor involved in the Work, determines that some portion of the Drawings, Specifications, or other Contract documents requires clarification or interpretation by the Contract Administrator, the Contractor shall submit a Request for Information (RFI) Form in writing to the Contract Administrator.

.2 Submittal Procedure:

.1 Submit RFI's to the Contract Administrator on the "Request for Information" form appended to this Section. The Contract Administrator shall not respond to a RFI except as submitted on this form. The link to the City's RFI form is provided below:

https://www.winnipeg.ca/infrastructure/templates/ExecutionControl/Request_for_Information_(RFI)_v2.0.docx

.2 Number RFI's consecutively in one sequence in order submitted, in a numbering system established by the Contract Administrator.

.3 Submit one (1) distinct subject per RFI request. Do not combine unrelated items on one (1) form.

.4 Where RFI form does not have sufficient space, attach additional sheets as required.

.5 Submit with RFI form all necessary supporting documentation.

.3 In the RFI, the Contractor shall clearly and concisely set forth:

.1 The issue for which clarification or interpretation is sought and why a response is needed from the Contract Administrator; and

.2 An interpretation or understanding of the requirement along with reasons why such an understanding was reached.

.4 The Contract Administrator will review all RFIs to determine whether they are valid RFIs. If it is determined that the document is not a valid RFI, it will be returned to the Contractor not having been reviewed with an explanation why it was deemed not valid.

.5 An RFI response shall be issued within ten (10) Business Days of receipt of the request from the Contractor unless the Contract Administrator determines that a longer time is necessary to provide an adequate response. When the RFI submission is received by the Contract Administrator before noon, the review period commences on that Business Day. When the RFI submission is received by the Contract Administrator after noon, the review period commences on the subsequent Business Day.

.6 If, at any time, the Contractor submits a large number of RFI's or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFI's within ten (10) Business Days, the Contract Administrator shall confer with the Contractor within five (5) Business Days of receipt of such RFI's and the Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority among the RFI's submitted. The Contractor shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.

.7 If the Contractor submits a RFI on an activity with ten (10) Business Days or less of available time to the impacted activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Contractor Administrator to respond to the request provided that the Contract Administrator responds within the ten (10) Business Days set forth above.

.8 An RFI response from the Contract Administrator will not change any requirement of the Contract. In the event the Contractor believes that the RFI response from the Contract Administrator will cause a change to the requirements of the Contract, the Contractor shall within ten (10) Business Days give written notice to the Contract Administrator stating that the Contractor believes the RFI response will result in a change to the Contract and the Contractor intends to submit a change request. Failure to give such written notice of ten (10) Business Days shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

1.06 CLOSEOUT SUBMITTALS

.1 Refer to Section 01 78 00 - Closeout Submittals for closeout submittal requirements.

1.07 MISCELLANEOUS SUBMITTALS

.1 Prepare and submit submittals required Contract Documents.

.2 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit hazardous materials management plan to Contract Administrator that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

.4 Copies: Submit one (1) electronic copy to Contract Administrator. Method of electronic submission to be coordinated with Contract Administrator after execution of the Contract.

.1 Submit hard copies for paint samples and other submittals where specifically required under individual Specifications Sections.

.5 The Contract Administrator will review submittals for general conformance with design concept and intent, and general compliance with Contract.

.6 The Contract Administrator’s review does not relieve Contractor from compliance with requirements of Contract nor from errors in submittals or Contractor’s design.

.7 The Contractor is responsible for confirmation of dimensions at jobsite; fabrication processes; means, methods, techniques, sequences, and procedures of construction; coordination of work of all trades; and performance of Work in safe and satisfactory manner.

.8 At the Contract Administrator’s option, the Contract Administrator’s review comments and review stamp will be placed either directly on submitted copies of submittals or on separate submittal review comment form.

.9 Where work is to be designed by the Contractor, comply with applicable codes and furnish submittals signed and sealed by Professional Engineer licensed in Province of Manitoba, as required by Drawings. All calculations shall be submitted for review. Calculations shall also be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.08 GENERAL REQUIREMENTS FOR SUBMITTALS

.1 Details regarding submittals can be found in the individual Specification Sections.

2 PRODUCTS

.1 Not used.

3 EXECUTION

.1 Not used.

END OF SECTION

1 GENERAL

1.01 SUMMARY

.1 This Section describes administrative and procedural requirements for reactive activities to verify that completed Work conforms to Contract Documents requirements.

.2 Having inspection and testing agencies does not relieve the Contractor of their responsibility to perform Work in accordance with Contract Documents.

1.02 REFERENCES

.1 Within the text of the Specifications, reference may be made to the following standards:

.1	ACI	American Concrete Institute
.2	AISC	American Institute of Steel Construction
.3	ANSI	American National Standards Institute
.4	ASTM	American Society for Testing and Materials
.5	AWWA	American Water Works Association
.6	CANI	National Standard of Canada
.7	CEC	Canadian Electric Code (published by CSA)
.8	CGA	Canadian Gas Association
.9	CGSB	Canadian Government Specification Board
.10	CISC	Canadian Institute of Steel Construction
.11	CLA	Canadian Lumberman's Association
.12	CPCA	Canadian Printing Contractors Association
.13	CPCI	Canadian Pre-stressed Concrete Institute
.14	CRCA	Canadian Roofing Construction Association
.15	CSA	Canadian Standards Association
.16	EEMAC	Electrical and Electronic Manufacturer's Association of Canada
.17	EIB	Electrical Inspection Branch
.18	FMEC	Factory Manual Engineering Corporation
.19	IEEE	Institute of Electrical and Electronic Engineers
.20	IPCEA	Insulated Power Cable Engineers Association
.21	NAAMM	National Association of Architectural Metal Manufacturers
.22	NACE	National Association of Corrosion Engineers
.23	NBC	National Building Code
.24	NEMA	National Electric Manufacturers Association
.25	NFPA	National Fire Protection Association
.26	ULC	Underwriters Laboratories of Canada

.2 Conform to the latest version of such standards available at the time of tendering, in whole or in part, as specified.

.3 If there are questions as to whether any product or system is in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance with Construction Contract Documents, or by the Contractor in the event of non conformance.

1.03 INSPECTION

.1 Allow the Contract Administrator access to the Work. If part of the Work is in preparation at locations other than the Place of Work, allow access to such Work whenever it is in progress.

.2 Give minimum seventy-two (72) hours notice when requesting inspection if the Work is designated for special tests, inspections or approvals by the Contract Administrator, or law of Place of Work.

.3 If the Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work at no cost to the City.

The Contract Administrator will order part of the Work to be examined if Work is suspected to be not in accordance with the Construction Contract Documents. If, upon examination such Work is found not in accordance with the Construction Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with the Construction Contract Documents, the City shall pay cost of examination.

1.04 RELATED REQUIREMENTS

.1 Section 01 78 00 – Closeout Submittal.

1.05 ADMINISTRATIVE REQUIREMENTS

.1 Allow and coordinate access to Work on site for inspection and testing by Contract Administrator.

.2 Retain and pay for inspection and testing that are designated for Contractor's own quality control plan, and when testing and inspection are required by Contract Documents.

.3 Give advanced notice to Contract Administrator and to each inspection/testing agency for inspection and testing required by Contract Documents.

.4 Notify Contract Administrator a minimum of 48 hours prior to required testing in order that attendance arrangements can be made.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit schedule of testing and inspection activities to Contract Administrator, applicable Subcontractors, testing agencies, and other affected parties. Include the following:

.1 List each testing and inspection agency

.2 Identify types of tests and inspections for each agency, and cross reference to applicable specification Section number-title in Contract Documents

.3 Description of test and inspection

.4 Identify applicable reference standard

.5 Identify test and inspection method

.6 Indicate number of each test and inspection required

.3 Submit digital copy of each quality assurance inspection and test report to Contract Administrator, except where a technical specification Section indicates otherwise.

.4 Submit reports for inspection and testing required by Contract Documents and performed by Contractor-retained inspection and testing agencies within ten (10) days after inspection or test is completed, except where a technical specification Section indicates a different time period.

.5 Submit digital copy of each quality control inspection and test report to Contract Administrator, except where a technical specification Section indicates otherwise.

.6 Deliver copies of quality control reports to Subcontractor of work being inspected or tested.

1.07 SITE QUALITY CONTROL PROCEDURES

.1 Provide labour, and equipment to obtain and handle test samples and materials on site. Arrange for sufficient space to store and cure test samples.

.2 Deliver samples and materials required for testing, as requested in technical specification Sections. Submit with reasonable promptness and in an orderly sequence to avoid delays in Work.

1.08 TESTING AND INSPECTION SERVICES

.1 Contractor will retain and pay for independent inspection and testing agencies to inspect, test, or perform other quality control reviews of parts of the work, except where indicated otherwise.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Correct defects and deficiencies when they are revealed during inspection or testing as advised by Contract Administrator at no change to Contract Price or Contract Schedule.

.4 Quality control testing and inspection reports to include the following:

.1 Project name and number

.2 Testing/Inspection agency's name, address, telephone number, and website

.3 Date of issuing report

.4 Dates and locations of tests, inspections, or samples

.5 Description of the Work and test and inspection method

.6 Numbers and titles of associated specification Sections

.7 Test and inspection data and interpretation of test results (e.g., pass or fail)

.8 Ambient conditions at time of test, inspection, or sampling

.9 Recommendations on re-testing and re-inspecting, if applicable

1.09 REPORTS

.1 Submit one (1) electronic copy of inspection and test reports to the Contract Administrator.

.2 Provide copies to the Subcontractor of work being inspected or tested and to the manufacturer or fabricator of material being inspected or tested.

.3 Each report shall include:

.1 Date of issue.

.2 Construction Contract name and number.

.3 Name, address and telephone number of Inspection/Testing Agency.

.4 Name and signature of inspector and tester.

.5 Date of inspection or test.

.6 Identification of the Product and Specification Section covering inspected or tested Work.

.7 Location of the inspection or the location from which the tested product was derived.

.8 Type of inspection or test.

.9 Complete inspection or test data.

.10 Test results and an interpretation of test results.

.11 Ambient conditions at the time of sample taking and testing.

.12 The remarks and observations on compliance with the Construction Contract Documents.

.13 Recommendations on retesting or other corrective action where necessary.

.14 Signature of a qualified and authorized representative of the Agency.

.15 Submit reports within forty-eight (48) hours; notwithstanding, notify the Contract Administrator immediately if the test indicates improper conditions or procedures.

.16 Refer to Specification section for definitive requirements.

1.10 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for process, mechanical, electrical and building equipment systems as indicated in Section 01 33 00.

2 PRODUCTS

.1 Not used.

3 EXECUTION

.1 Not used.

END OF SECTION

1 GENERAL

1.01 PRODUCTS AND MATERIALS

.1 Quality:

.1 Products, materials, equipment and articles incorporated in the Works to be new, not damaged or defective, and of the best quality compatible with Specifications for the purpose intended.

.2 Defective products, whenever identified will be rejected, regardless of previous inspections. Remove and replace defective products and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to the quality or fitness of products, the decision rests solely with the Contract Administrator based upon the requirements of the Construction Contract.

.4 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Works.

.5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

.6 Preliminary acceptance of equipment or Products listed by supplier names will not in any way constitute a waiver of the Specifications covering such equipment; final acceptance will be based on full conformity with the Construction Contract.

.2 Availability:

.1 Review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify the Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

1.02 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the Specifications, install or erect products in accordance with Manufacturer's instructions.

.2 Notify the Contract Administrator a minimum of four (4) weeks prior to installation, in writing, of conflicts between the Specifications and Manufacturer's instructions.

.3 Improper installation or erection of products, due to failure in complying with these requirements, to be removed and reinstalled at no increase in Construction Contract Price.

1.03 WORKMANSHIP

.1 General:

.1 Employ only workers experienced and skilled in the respective duties for which they are employed to obtain workmanship of the best quality.

.2 Coordination:

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

.3 Coordinate all the Work of all Subcontractors.

.4 Confirm in writing that all Subcontractors examine the full set of Drawings and Specifications for other parts of the Works which may affect the performance of their work.

.5 Ensure that sleeves, openings and miscellaneous foundations are provided as required for the Works.

.6 Ensure that items to be built in are supplied when required with all necessary templates, measurements and Shop Drawings.

.3 Protection of Work in Progress:

.1 Protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced or repaired at no cost to the City.

.2 Prevent overloading of any structure.

.4 Remedial:

.1 Remedy, repair or replace the parts or portions of the Works identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Works.

1.04 QUANTITIES

.1 Schedules of equipment piping, fittings, or other materials indicating quantity and/or dimension, which are shown in the Construction Contract, are not guaranteed to be accurate and are to be checked by the Construction Contractor.

.2 Claims for additional payment resulting from variations between quantities shown and those actually installed will not be accepted.

1.05 METRIC PROJECT

.1 This Work is designed and is to be constructed in the SI Metric system of measurements.

2 PRODUCTS

.1 Not used.

3 EXECUTION

.1 Not used.

END OF SECTION

1 GENERAL

1.01 EXPERTISE AND RESPONSIBILITY

.1 The Contract Administrator recognizes the expertise of the Manufacturer.

.2 Should the Contract Administrator issue an Addendum, Field Order, Change Order, or Instruction to change the Work which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to notify in writing the Contract Administrator to this effect within two (2) days.

1.02 EQUIPMENT DELIVERY

.1 Ten (10) days before delivery, notice shall be given to the Contract Administrator so that arrangements for receipt and inspection can be made. The shipping lists of materials will be carefully checked by the Manufacturer's Representative in the presence of the Contract Administrator and the Contractor. When the Contractor accepts the equipment delivery, he shall certify the delivery by completing Form 100 – Certificate of Equipment Delivery, attached to this Specification.

.2 The Contractor shall be responsible for setting up and paying for alternate site storage if required. All storage shall meet the Pre-purchased Supplier's requirements for temperature and humidity and physical storage.

.3 The Contractor shall be responsible for all equipment at the Site or any alternative storage location.

.4 The Contractor shall ensure that he is fully informed of precautions to be taken in the unloading of the equipment and subsequent storage including any required maintenance.

.5 If off Site storage of equipment is required, then the second move of the equipment to the Site will be at the Contractor's cost.

1.03 INSTALLATION ASSISTANCE

.1 Before commencing installation of the equipment, the Manufacturer's Representative will provide to the Contractor, instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.

.2 When the Manufacturer's Representative is satisfied that the Contractor is aware of all installation requirements, he shall so certify by completing Form 101 – Certificate of Readiness to Install attached to this Specification.

.3 The completed form shall be delivered to the Contract Administrator.

.4 Installation of the equipment shall not commence until the Contract Administrator has advised that he has received the completed Form 101.

.5 Separate copies of Form 101 shall be used for different equipment.

1.04 INSTALLATION

.1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Contractor shall contact the Manufacturer's Representative to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

.2 If it is found necessary, or if so directed by the Contract Administrator, the Contractor shall arrange for the Manufacturer's Representative to visit the Site to provide assistance during installation, all at the Contractor's cost.

.3 Prior to completing installation, the Contractor shall inform the Manufacturer's Representative and arrange for the attendance at the Site of the Manufacturer's Representative to verify successful installation.

.4 The Manufacturer's Representative shall conduct a detailed inspection of the installation including alignment, electrical connections, belt tensions, rotation direction, running clearances, lubrication, workmanship and all other items as required to ensure successful operation of the equipment.

.5 The Manufacturer's Representative shall identify any outstanding deficiencies in the installation.

.6 The deficiencies shall be rectified by the Contractor and the Manufacturer's Representative will be required to re-inspect the installation, at the Contractor's cost.

.7 When the Manufacturer's Representative accepts the installation, he shall certify the installation by completing Form 102 – Certificate of Satisfactory Installation, attached to this Specification.

.8 Deliver the completed Form 102 to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.

.9 Provide separate copies of Form 102 for different equipment.

1.05 OPERATION AND PERFORMANCE VERIFICATION

.1 Equipment will be subjected to a demonstration, running test, and performance test after the installation has been verified and any identified deficiencies have been remedied.

.2 Inform the Contract Administrator at least fifteen (15) days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative.

.3 The Manufacturer's Representative shall conduct all necessary checks to the equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.4 The Contractor shall then operate the equipment to demonstrate the operation and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.

.5 The Contractor shall supply all water, chemicals, temporary power, heating, and/or any other ancillary equipment or services required to complete the initial operation of the equipment.

.6 Should the initial operation of the equipment reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Contractor, or the Contract Administrator, due to repeat initial operation shall be the responsibility of the Contractor.

2 PRODUCTS

.1 Not used.

3 EXECUTION

.1 Not used.

END OF SECTION

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

We certify that the equipment listed below has been received and delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

CERTIFICATE OF READINESS TO INSTALL
FORM 101

I have familiarized the Contractor of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

I certify that I have received satisfactory installation instructions from the equipment Manufacturer/ Supplier.

_____ _____
(Authorized Signing Representative of the Contractor) Date

CERTIFICATE OF SATISFACTORY INSTALLATION
FORM 102

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

OUTSTANDING DEFECTS: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

END OF SECTION

1 GENERAL

1.01 SECTION INCLUDES

.1 Detailed information for the preparation, submission, and Contract Administrator's review of operations and maintenance (O&M) data, as required by individual Specification sections.

1.02 DEFINITIONS

.1 Preliminary Data: Initial and subsequent submissions for Contract Administrator's review.

.2 Final Data: Contract Administrator-accepted data, submitted as specified herein.

.3 Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations include but are not limited to lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

.4 Operation and Maintenance Manual: An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual systems, subsystems and components, as specified in individual sections of this Specification.

1.03 SEQUENCING AND SCHEDULING

.1 Equipment and System Data:

.1 Preliminary Data:

.1 Do not submit until Shop Drawing for equipment or system has been reviewed and returned stamped "NO EXCEPTIONS TAKEN" or "EXCEPTIONS NOTED" by Contract Administrator.

.2 Submit prior to shipment date.

.2 Final Data:

.1 Submit an O&M Manual not less than thirty (30) days prior to equipment or system field Functional Testing.

.2 Final accepted O&M Manuals are a required prior to Substantial Performance being granted.

1.04 DATA FORMAT

.1 Preliminary Manual Format:

.1 Binder: Commercial quality, permanent, three-ring binders with durable plastic cover.

.1 Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.

.2 Size: 8-1/2 inches by 11 inches, minimum.

.3 Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO. OF_____"," and list:

.1 Project title.

.2 Contractor's name, address, and telephone number.

.3 If entire volume covers equipment or system provided by one supplier include the following:

1. Identity of general subject matter covered in manual.
2. Identity of equipment number and Specification section.

.4 Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

.5 Table of contents neatly typewritten, arranged in a systematic order:

.1 Include list of each product, indexed to content of each volume.

.2 Designate system or equipment for which it is intended.

.3 Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

.6 Section Dividers:

.1 Heavy, 80 pound cover weight, tabbed with numbered plastic index tabs.

.2 Fly-Leaf:

1. For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.
2. List with each product:

1. For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.

2. List with each product:

1. Name, address, and telephone number of Subcontractor, supplier, installer, and maintenance contractor, as appropriate.
2. Identify area of responsibility of each.
3. Provide local source of supply for parts and replacement.

3. Identity of separate structure as applicable.
4. Maintenance Summary (Format in accordance with paragraph 1.06.4)

.7 Assemble and bind material in same order as specified in the Contract Documents.

.8 Material shall be suitable for reproduction, with quality equal to original.

.2 Final Instructional Manual Format:

.1 Compile all Contract Administrator-accepted preliminary O&M data into a hard-copy, hard-bound set as detailed in Section 1.03.1 above and in electronic media format as described in paragraph 1.04.3.

.3 Electronic Media Format:

.1 Portable Document Format (PDF):

.1 After all preliminary data has been found to be acceptable to Contract Administrator.

.2 Files to be exact duplicates of Contract Administrator-accepted preliminary data. Arrange by specification number and name.

.3 Files to be fully functional and viewable in most recent version of Adobe Acrobat.

.4 PDF files to be indexed and searchable.

.5 Cover: Identify with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO. OF___"," and list:

1. Project title.
2. Contractor's name, address, and telephone number.
3. Identity of equipment number and Specification section.

1.05 SUBMITTALS

.1 Informational:

.1 Data Outline: Submit an electronic copy of a detailed outline of proposed organization and contents of final data prior to preparation of preliminary data.

.2 Preliminary Data:

.1 Submit for Contract Administrator's review.

1. If data meets conditions of the Contract, it will be forwarded to The City.
2. If data does not meet conditions of the Contract, it will be returned to the Contractor with Contract Administrator's comments (on separate document) for revision.

.2 Final Data: Submit two (2) hard copies in format(s) specified herein. No red lines on the documents are allowed in final submission.

1.06 DATA FOR SYSTEMS, SUBSYSTEM AND COMPONENTS

.1 Content for each unit (or common units) and system, including pre-purchased equipment, unless otherwise specified:

.1 Product Data:

.1 Include only those sheets that are pertinent to specific product.

.2 Clearly annotate each sheet to:

1. Identify specific product(s) or part(s) installed.
2. Identify data applicable to installation.
3. Delete references to inapplicable information.

.3 Function, normal operating characteristics, and limiting conditions.

.4 Serial Numbers.

.5 Performance curves, engineering data, nameplate data, and tests reports for all pumps.

.6 Complete nomenclature and commercial number of replaceable parts.

.7 Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.

.8 Spare parts ordering instructions.

.9 Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).

.2 As-installed, color-coded piping diagrams.

.3 Charts of valve tag numbers, with the location and function of each valve.

.4 Drawings: Supplement product data with Drawings as necessary to clearly illustrate:

.1 Format:

1. Provide reinforced, punched, binder tab; bind in with text.
2. Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 81/2 inches by 11 inches.
3. Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
4. Identify Specification section and product on Drawings and envelopes.

.2 Relations of component parts of equipment and systems.

.3 Control and flow diagrams.

.4 Coordinate drawings with Project record documents to assure correct illustration of completed installation.

.5 Instructions and Procedures: Within text, as required to supplement product data.

.1 Format:

1. Organize in consistent format under separate heading for each different procedure.
2. Provide logical sequence of instructions for each procedure.
3. Provide information sheet for The City's personnel, including:
    1. Proper procedures in event of failure.
    2. Instances that might affect validity of guarantee or Bond.

.2 Installation Instructions: Including alignment, adjusting, calibrating, and checking.

.3 Operating Procedures:

1. Startup, break-in, routine, and normal operating instructions.
2. Test procedures and results of factory tests where specified.
3. Regulation, control, stopping, and emergency instructions.
4. Description of operation sequence by control manufacturer.
5. Shutdown instructions for both short and extended duration.
6. Summer and winter operating instructions, as applicable.
7. Safety precautions.
8. Special operating instructions.

.4 Maintenance and Overhaul Procedures:

1. Routine maintenance.

2. Guide to troubleshooting.
3. Disassembly, removal, repair, reinstallation, and re-assembly.

.6 Guarantee, Bond, and Service Agreement: In accordance with Section 01 78 00, Closeout Procedures.

.2 Content for Each Electric or Electronic Item or System:

.1 Description of Unit and Component Parts:

.1 Function, normal operating characteristics, and limiting conditions.

.2 Performance curves, engineering data, nameplate data, and tests.

.3 Complete nomenclature and commercial number of replaceable parts.

.4 Interconnection wiring diagrams, including control and lighting systems.

.2 Circuit Directories of Panelboards:

.1 Electrical service.

.2 Controls.

.3 Communications.

.3 List of electrical relay settings, and control and alarm contact settings.

.4 Electrical interconnection wiring diagram, including control and lighting systems.

.5 As-installed control diagrams by control manufacturer.

.6 ISA S20 data sheets for all instruments.

.7 Operating Procedures:

.1 Routine and normal operating instructions.

.2 Sequences required.

.3 Safety precautions.

.4 Special operating instructions.

.8 Maintenance Procedures:

.1 Routine maintenance.

.2 Guide to troubleshooting.

.3 Adjustment and checking.

.4 List of relay settings, control and alarm contact settings.

.9 Manufacturer's printed operating and maintenance instructions.

.10 List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

.3 Content for Programmable Devices/Components/Sub-systems:

.1 The following requirements are minimum requirements applicable to programmable equipment such as VFDs, ASDs, microprocessor based devices, PLCs, HumanMachine-Interfaces, computers, and other programmable devices. Additional requirements may be specified elsewhere.

.2 As-Constructed version of Shop Drawings.

.3 Functional description.

.4 Wiring details.

.5 Configuration Records; record of switch settings, program listings and parameter settings, after commissioning.

.6 Maintenance manuals.

.7 User guides, technical reference and programming manuals.

.8 Cable and software for use on The City's notebook computer for revising/downloading the settings and software.

.4 Maintenance Summary:

.1 Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.

.2 Format:

.1 Use Maintenance Summary Form bound with this section or electronic facsimile of such.

.2 Each Maintenance Summary may take as many pages as required.

.3 Use only 8-1/2-inch by 11-inch size paper.

.4 Complete using typewriter or electronic printing. Hand-written and hand-printed entries are will not be accepted.

.3 Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.

.4 Recommended Spare Parts:

.1 Data to be consistent with manufacturer's bill of materials/parts list furnished in O&M manuals.

.2 "Unit" is the unit of measure for ordering the part.

.3 "Quantity" is the number of units recommended.

.4 "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

.1 Content for Architectural Products, Applied Materials, and Finishes:

.1 Manufacturer's data, giving full information on products:

.1 Catalog number, size, and composition.

.2 Color and texture designations.

.3 Information required for reordering special-manufactured products.

.2 Instructions for Care and Maintenance:

.1 Manufacturer's recommendation for types of cleaning agents and methods.

.2 Cautions against cleaning agents and methods that are detrimental to product.

.3 Recommended schedule for cleaning and maintenance.

.2 Content for Moisture Protection and Weather Exposed Products:

.1 Manufacturer's data, giving full information on products:

.1 Applicable standards.

.2 Chemical composition.

.3 Details of installation.

.2 Instructions for inspection, maintenance, and repair.

2 PRODUCTS

.1 Not used.

3 EXECUTION

.1 Not used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Not used.

1.02 REFERENCE STANDARDS

.1 Not used.

1.03 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:

.1 During Construction meeting, approximately one week before Contract completion with Contract Administrator, review the following:

.1 Verify Project requirements.

.2 Review manufacturer's installation instructions and warranty requirements.

.3 Review warranty requirements.

.2 Contract Administrator to establish communication procedures for:

.1 Notifying construction warranty defects.

.2 Determine priorities for type of defects.

.3 Determine reasonable response time.

.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Prepare instructions and data using personnel experienced in the maintenance and operation of described products.

.3 A Copy will be returned after final inspection with the Contract Administrator’s comments.

.4 Revise the content of the documents as required prior to final submittal.

.5 Four (4) weeks prior to Substantial Performance of the Work, submit to the Contract Administrator two (2) final paper copies of the Operating and Maintenance (O&M) Manuals and one (1) electronic copy (PDF).

.6 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.7 Provide evidence, if requested, for type, source and quality of products supplied.

.8 Defective products will be rejected, regardless of previous inspections.

1.05 FORMAT

.1 Organize data as instructional manual.

.2 Binders: Vinyl, hard covered, 3 'D' ring, loose leaf with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: Provide with reinforced punched binder tab.

.1 Bind in with text; fold larger drawings to size of text pages.

.9 Provide CAD files in dwg format.

1.06 CONTENTS-PROJECT RECORD DOCUMENTS

.1 For each product or system:

.1 Addresses, and telephone numbers of Sub-Contractor with name of responsible parties.

.2 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.2 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.3 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.4 Typewritten Text: As required to supplement product data.

.1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.

1.07 AS-BUILT DOCUMENTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to Contract.

.5 Reviewed shop drawings, product data, and samples.

.6 Site test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Store record documents and samples in site office apart from documents used for construction.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

.4 Maintain record documents in clean, dry and legible condition.

.1 Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Contract Administrator.

1.08 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of Issued for Construction Drawings.

.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress.

.1 Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Site changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 Referenced Standards to related shop drawings and modifications.

.5 Specifications: mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: Maintain manufacturer's certifications, inspection certifications, and site test records, required by individual specifications Sections.

.7 Provide digital photos, if requested, for site records.

1.09 FINAL SURVEY

.1 Submit final site survey certificate in accordance with these Specifications, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.10 EQUIPMENT AND SYSTEMS

.1 For each item of equipment and each system include description of unit or system, and component parts.

.1 Give function, normal operation characteristics and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

.1 Include regulation, control, stopping, shut-down, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified.

.15 Additional requirements: As specified in individual specification Sections.

1.11 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-Protection and Weather-Exposed Products: include the Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual Specifications Sections.

1.12 MAINTENANCE MATERIALS

.1 Spare Parts:

.1 Provide spare parts, in quantities specified in individual specification Sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site as directed; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Contract Administrator.

.2 Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit before final payment.

.2 Extra Stock Materials:

.1 Provide maintenance and extra materials, in quantities specified in individual specification Sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site as directed; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Contract Administrator.

.2 Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit before to final payment.

.3 Special Tools:

.1 Provide special tools, in quantities specified in individual specification Section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to site as directed; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Contract Administrator.

.2 Include approved listings in Maintenance Manual.

1.13 DELIVERY, STORAGE, AND HANDLING

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and for review by Contract Administrator.

1.14 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan, prior to construction close out meeting for Contract Administrator approval.

.3 Warranty management plan to include required actions and documents to assure that the City receives warranties to which it is entitled.

.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Submit, warranty information made available during construction phase, to Contract Administrator for approval before each monthly pay estimate.

.6 Assemble approved information in binder, submit upon acceptance of work as follows:

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

.4 Verify that documents are in proper form, contain full information, and are notarized.

.5 Co-execute submittals when required.

.6 Retain warranties and bonds until time specified for submittal.

.7 Except for items put into use with the City's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.8 Conduct joint six (6) month warranty inspection, measured from time of acceptance, by Contract Administrator.

.9 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers, or suppliers involved.

.2 Listing and status of delivery of Certificates of Warranty for extended warranty items.

.3 Provide list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.4 Contractor's plans for attendance at six (6) month post-construction warranty inspections.

.5 Procedure and status of tagging of equipment covered by extended warranties.

.6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.10 Respond in timely manner to oral or written notification of required construction warranty repair work.

.11 Written verification to follow oral instructions.

.1 Failure to respond will be cause for the City to proceed with action against Contractor.

1.15 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil-and water-resistant tag approved by Contract Administrator.

.2 Attach tags with copper wire and spray with waterproof silicone coating.

.3 Leave date of acceptance until project is accepted for occupancy.

.4 Indicate the following information on tag:

.1 Type of product/material.

.2 Model number.

.3 Serial number.

.4 Contract number.

.5 Warranty period.

.6 Inspector's signature.

.7 Construction Contractor.

2 PRODUCTS

.1 Not Used.

3 EXECUTION

.1 Not Used.

END OF SECTION

1 GENERAL

1.01 CODES AND STANDARDS

.1 Manitoba Building Code (MBC)

.2 CSA C22.1, Canadian Electrical Code, Part 1 (CEC)

.3 CSA C22.2, No. 0 General Requirements, Canadian Electrical Code, Part 2

.4 CAN3-C235-83 Preferred Voltage Levels for AC Systems, 0 to 50,000 V

.5 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

.6 National Electrical Manufacturers Association (NEMA)

.7 Insulated Cable Engineers Association (ICEA)

.8 Canadian Standards Association (CSA)

.9 Underwriters Laboratories Canada (ULC)

.10 American National Standards Institute (ANSI)

.11 National Fire Protection Agency (NFPA)

.12 Comply with the most current locally enforced edition of CSA C22.1 Canadian Electrical Code - Part 1, Provincial Safety Electrical Authority Codes and Bulletins.

.13 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work. Where these regulations conflict, comply with the most stringent condition.

.14 Comply with latest editions of the CSA Certification Standards and Bulletins

1.02 DRAWINGS AND SPECIFICATIONS

.1 Prior to installing power and control cabling for process equipment, the Contractor shall review the equipment Shop Drawings, and to ensure that cabling requirements are understood. There may be variations in wiring requirements with process, that may require alternate wiring requirements from that shown on the Drawings. Include such wiring and connections in tender at no additional costs.

.2 The electrical Drawings in some cases indicate the size of cables, breakers, conduits, etc. These sizes are based on the supply sizes of equipment. For cases where the Contractor supplies equipment that varies from these assumptions it is the responsibility of the Contractor to provide the correct size of breaker, cable, etc. to suit the installation, at no additional cost to the Contract.

.3 The intent of the Drawings and Specifications is to indicate labour, products, and services necessary for a complete, installed, tested, commissioned, and functional installation.

.4 Electrical drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural, and mechanical details. In some cases, conduit or wiring is only show diagrammatically on the Drawings. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on site and coordinated with other trades.

.5 Where circuit numbers are shown adjacent to equipment, the Electrical Contractor shall provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment from the circuit indicated. Where circuit numbers are not shown adjacent to a piece of equipment, refer to the single line drawings for connections details. Provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment.

.6 To provide sufficient detail and maximum degree of clarity on the Drawings, symbols used for various electrical devices, particular wall mounted devices, take up more space on the Drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility and space utilization, rather than locating devices to comply with the exactly scaled locations of the electrical symbols.

.7 These Specifications along with the Drawings and Specifications of all other divisions shall be considered as an integral part of the Drawing package. Any item or subject omitted from the Specifications or the Drawings but which is mentioned or reasonably specified in the Drawings or Specifications of other divisions shall be considered as properly and sufficiently specified and shall be provided.

.8 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting a bid.

.9 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the work.

.10 Various package unit types of equipment are included in the work. It is the responsibility of the Contractor to familiarize himself with the requirements of the equipment vendor, and to include all materials and labour for a complete and working installation. In some cases, this means that motors, valves, actuators, etc. need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his tender submittal. Coordination between the equipment vendor and the Contractor shall be performed prior to tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.

.11 In some cases, the plan Drawings indicate the symbol for 1 motor – for package units – when in reality, there are multiple motors, valves, dampers, solenoids, etc. associated with the piece of equipment. It is the responsibility of the Contractor to understand the intricacies of the packaged equipment, and to perform all field connections for a complete and working system.

.12 Cables schedules/lists where shown do not include all cables required to perform the complete Facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility if the Contractor. Cable schedules only show cabling where specific cable tags are not available on the Drawings. Refer to the cable schedule for specific systems which are not included on the schedule, and include materials, and installation for all remaining cabling.

1.03 CARE, OPERATION AND START-UP

.1 Instruct the Contract Administrator's maintenance and operating personnel in the operation, care, and maintenance of systems, system equipment and components.

.2 Where services of a Manufacturer's Factory Service Engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide factory service engineer support for such a period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are familiar and fully trained with all aspects of its care and operation.

1.04 PERMITS, FEES, AND INSPECTION

.1 The Contract Administrator will submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of work.

.2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.05 DEFINITIONS

.1 Inspection Authority means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical site work.

.2 Supply Authority or Supply Utility means electrical power company or commission responsible for delivering electrical power to the project sire.

.3 Electrical Code or Code means the Electrical Code in force at the project location.

.4 CEC means Canadian Electrical Code (latest edition being enforced by law).

.5 Contractor and Electrical Contractor means the entity retained to perform the work listed herein.

.6 Contract Administrator means the person with the authority to make decisions and administer the Contract on behalf of the City of Winnipeg.

.7 Provide means to supply, install, wire, connect test, commission, and leave in complete and working order.

.8 The term “Shop Drawing” means Drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the work.

.9 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these Specifications, and on Drawings, are those defined by IEEE SP1122.

1.06 DESIGN REQUIREMENTS

.1 Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with MBC.

.2 Operating voltages to be within those defined in CAN3-C235.

.3 Verify before energization that equipment supplied under this Contract is compatible with the site electrical power supply system.

.4 All equipment, devices, and installation methods (even where not specifically expressed on the Drawings) shall comply with the Manitoba Energy Code for Buildings (MECB).

.5 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.6 Language operating requirements: provide identification nameplates and labels for control items in English.

1.07 ELECTRICAL COORDINATION

.1 Coordinate work with all other trades to ensure that conflicts do not occur.

.2 Coordinate requirement of mechanical equipment requiring electrical connection with the Mechanical Contractor. Pay specific attention to equipment full load amps, voltage, phase, and breaker size.

.3 Verify that all equipment ordered is compliant with the Manitoba Energy Code for Buildings.

.4 Coordinate work with utilities where appropriate, including but not limited to:

.1 Incoming overhead lines,

.2 Underground buried services,

.3 Transformer(s) supplying main electrical service to the Facility,

.4 Installation of Supply Authority meter,

.5 Installation of incoming telephone/data communication service conductors or cables.

1.08 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Permits, Fees, and Inspection:

.1 Furnish copies of all inspection reports and Certificate of Final Acceptance from Electrical Inspection Authority and any authorities having jurisdiction on completion of work to Contract Administrator and include copies in the O & M manuals.

.2 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material inspection authorities for special acceptance approval before delivery to Site.

.1 Submit test results of installed electrical systems and instrumentation.

.2 Permits and fees: in accordance with General Conditions of Contract.

.3 Submit, upon completion of Work, load balance report as described in Part 3.18.1 - Load Balance

.3 Site Documentation

.1 In each electrical room, provide power distribution system single line diagrams in glazed metal frames.

.2 Provide fire alarm riser diagram, plan, and building zoning in glazed metal frame at fire alarm control panel and annunciator to meet requirements of Fire Commissioner.

.4 Within 15 days of award of Contract, the Contractor shall submit a completed equipment procurement schedule, which lists the Manufacturer and model of equipment, indicating the projected ordering, Shop Drawing submittal date and delivery dates of all products to meet the required construction schedule.

.5 Prior to delivery of any products to the job site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 01.

.6 Submit Shop Drawings (including product data) for all equipment as required in each section of this Specification.

.7 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review, date and sign the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.8 Shop Drawings shall indicate materials, methods of construction and attachment of support, wiring diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of the work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to design Drawings and Specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the

Contract price. If adjustments affect the value of the work, state so in writing to the Contract Administrator prior to proceeding with the work.

.1 Submit drawings stamped and signed by professional Engineer registered or licensed in Province of Manitoba, Canada.

.2 Recommended installation details include but are not limited to: equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.9 Submit required number of copies of Drawings to authority having jurisdiction or/and inspection authorities.

.10 Keep one (1) complete set of Shop Drawings at job Site during construction.

.11 If changes are required, notify Engineer of these changes before they are made.

.12 Manufacture of products shall conform to the revised Shop Drawings. Failure to supply a product based on the revised, marked up Shop drawings may require on site product revisions or modifications, which will be at the cost of the Contractor.

.13 Prior to shipping pre-fabricated control panels, photos of completed panels shall be sent to the Contract Administrator for final review. The resolution of the photos should be such that individual wire tags can be read.

.14 Shop Drawings shall have the specific equipment numbers on all pages to clearly indicate which piece of equipment the Shop Drawing refers to. In addition, the entire product part number or catalog number should be adjacent to the tag.

1.09 Manufacturer's Field Reports: submit to Engineer Manufacturer's written report, within three (3) days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in Part 3 TRAINING

.1 Provide training of Facility personnel in all aspects of maintenance operation, and functionality for all systems.

.2 Training shall involve both classroom style of training, as well as practical training with the equipment present.

1.10 UTILITY SERVICES

.1 It is the responsibility of the Contractor to perform all work related to utility electrical service, and to coordinate this work with Manitoba Hydro. Coordinate the delivery of utility electrical power to the site with Manitoba Hydro.

.2 Arc flash labelling will be provided on power distribution equipment in accordance with CSA Z462 as part of this contract.

.3 Complete rating of equipment, including short circuit interruption ratings, to be provided.

.4 Install and terminate cabling indicated on Drawings.

.5 FIELD QUALITY CONTROL.

1.11 AS-BUILT DRAWINGS

.1 The contractor shall keep one (1) complete set of white prints at the site during work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of As-Built drawings. As the work on-sire proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract Documents. As-Built drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

.1 Indicate on the As-Built Drawings the exact location of underground services referenced to established survey benchmarks.

.2 On completion of the work, minimum of four (4) weeks prior to final inspection, submit As-Built drawings to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-built drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items. The Contractor shall stamp date these drawings as "Record Drawings".

.3 Record documents that are incomplete shall be returned to the Contractor for correction.

.4 The Contract Administrator shall recommend a suitable deficiency holdback until such time as the As-Built Drawings are submitted in an acceptable form.

1.12 OPERATION AND MAINTENANCE (O & M) MANUALS

.1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions. Refer to Section 01 78 00, Operations and Maintenance Data.

.2 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.3 Include in the operation and maintenance manuals a minimum of:

.1 Cover page including project name, year, name of owner and electrical consultant. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of manufacturers and supplier for all items.

.4 Names, address, and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes but is not limited to grounding system tests, battery bank test results, operation tests, cable tests, load balancing tests, Megger tests, factory tests of all major tests systems, etc.

.9 Panel schedules (hardcopy and Microsoft Excel format).

.10 Software copies of relay settings.

.11 As-Built drawings

.12 Signed and dated warranty certificate.

.13 Signed and dated approval by the local Electrical Inspections Department.

.14 All other requirements outlined in the Specifications.

.4 Deliver to the Contract Administrator prior to the scheduled takeover date five (5) sets of operation and maintenance manuals. Each operation and maintenance manual shall be contained within one or more three “D-ring” binder(s). Each binder shall be labled directly on the front cover as well as the spine (“ELECTRICAL MAINTENANCE MANUAL – PROJECT NAME – YEAR”). Include memory sticks for all required electronic media.

.5 Index plastic divider tabs (with type inserts) shall be provided for each Specification section. Paper dividers, with plastic tabs and typed insertions will not be accepted.

.6 Submit draft document prior to the start of Commissioning.

.7 Post instructions where directed.

.1 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.2 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.3 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.13 QUALITY ASSURANCE

.1 Supervision

.1 A responsible and competent supervisor to oversee the Work for the duration of the project.

.2 Full cooperation shall be shown with other trades to facilitate installations and to avoid delays in carrying out the work.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor licenses or apprentices in accordance with Authorities Having Jurisdiction.

.1 Employees registered in provincial apprenticeship program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.14 DELIVERY, STORAGE, AND HANDLING

.1 Material Delivery Schedule: provide Contract Administrator with schedule within two (2) weeks after award of Contract.

1.15 REQUESTS FOR CHANGE

.1 All quotations in response to request for change shall be submitted complete with an itemized cost breakdown of all materials and labour required for the change. Contract Administrator reserves the right to review costing using accepted Contractor's Pricing Standards.

1.16 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Collect and separate paper, plastic, polystyrene and corrugated cardboard packaging material for recycling.

.3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

.4 Fold up metal banding, flatten and place in designated area for recycling.

.5 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.6 Place materials defined as hazardous or toxic waste in designated containers.

.7 Ensure emptied containers are sealed and stored safely for disposal away from children and wildlife.

.8 Unused sealant material must not be disposed of into sewer system, streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.9 Do not dispose of preservative treated wood through incineration.

.10 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.11 Dispose of treated wood, end pieces, wood scraps, and sawdust at a sanitary landfill approved by Contract Administrator.

2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with this Section.

.2 Equipment and material to be CSA certified and manufactured to standard quoted.

.3 Factory assembled control panels and component assemblies.

.4 Bidders shall submit a tender based on the specified materials and equipment or approved equal material only.

.5 Factory assemble control panels and component assemblies.

.1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings

2.02 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Provide all power and control wiring and connections including mechanical control wiring as specified on mechanical, process, electrical, and instrumentation drawings.

.2 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.3 Control wiring and conduit in accordance with:

.1 Section 26 05 21 - Wire and Cables (0-1000V)

.2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings

2.03 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of Authority Having Jurisdiction, inspection authorities, and Engineer.

.2 Lamacoid, red with white lettering, minimum size 175 x 250 mm.

2.04 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.05 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment and devices with nameplates as follows:

.1 Nameplates: lamacoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 All essential power labelling to be red face nameplate with white letters.

.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on nameplates and labels to be approved by Engineer prior to manufacture.

.5 Allow for minimum of twenty-five (25) letters per nameplate and label.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. _____" as directed by Engineer.

.8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.9 Terminal cabinets and pull boxes: indicate system and voltage.

.10 Transformers: indicate capacity, primary and secondary voltages.

.11 All distributions, panelboards, splitters, transformers, VFD's, reactors, filters, etc. provide circuit panel designations and where fed from.

2.06 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders, branch circuit wiring and neutrals.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.07 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Item	Prime	Auxiliary
Up to 600V	Orange	Green
Up to 250 V	Yellow	
Telephone/LAN	Green	
Other Communication Systems	Green	Blue

2.08 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint outdoor electrical equipment light gray finish.

.2 Paint indoor switchgear and distribution enclosures light gray.

2.09 ELECTRICAL SINGLE LINE DIAGRAMS

.1 Provide electrical single line diagrams under plexiglass as follows:

.1 Drawings: 11 x17 size

3 EXECUTION

3.01 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

.3 Perform all work in accordance with local codes and by-laws.

3.02 CUTTING AND PATCHING

.1 Pay the costs of all cutting and patching required for the installation of electrical work.

.2 Obtain the approval of the Contract Administrator and/or the City before arranging for any cutting. Patching shall restore the affected area to the original condition.

3.03 EXCAVATION AND BACKFILLING

.1 Excavate and backfill as required for underground electrical services as indicated. Provide protective materials around and over services. Be present at all times during the excavation and backfilling to supervise work. Backfilling shall restore the excavated area to the original condition and shall include sodding, compacting, paving and asphalt finish where required. As underground services shall be dimensioned on electrical "Record Drawings" and shall be referenced to established survey benchmarks.

.2 Work shall be in accordance with the current CSA bulletin.

.3 Include all costs for excavation, backfilling, and surface restoration, for any secondary underground electrical installation.

.4 Obtain all clearances for Hydro, water, sewer, MTS, cable prior to digging.

.5 Electrical contractor shall conduct a private utilities line locate for existing utilities prior to any excavation work commencing.

3.04 GROUNDING

.1 All circuits shall be installed with dedicated insulated ground wire.

3.05 DEDICATED NEUTRALS

.1 Each circuit shall have its own dedicated neutral wire. Shared neutral for more than 1 circuit shall not be permitted.

3.06 ENCLOSURES

.1	Dry/General	NEMA 12
.2	Wet/Outdoor	NEMA 4X

3.07 NAMEPLATES AND LABELS

.1 Ensure Manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.08 FIREPROOFING

.1 Where cables or conduits pass through floors, block or concrete walls and fire-rated walls, seal openings with fire-stopping material with intumescent properties.

.2 Fire proofing of electrical cables, conduits, trays, etc. passing through fire barriers shall conform to local codes and inspection authorities.

.3 Fire Stop materials shall be asbestos free and have been tested in accordance with ASTM E-84 and E-814 and ULC-1479,

.4 Approved Manufacturer: 3M, Nelson Firestop Products or Spec Seal.

.5 Fire stopping shall be carried out by a fire stopping contractor, and the General Contractor shall carry the cost for these works.

3.09 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

.4 Do not mix wiring and/or cables from different panels within the same conduit runs or pull boxes. Provide equipment barriers where acceptable and where applicable.

3.10 SEPARATION OF SERVICES

.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Engineer and the ceiling installer, and approved clips or hangers are used.

3.11 LOCATION OF OUTLETS AND LUMINAIRES

.1 Electrical Drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural Drawings.

.2 Outlet and equipment locations shown on the Drawings are approximate. Locations may be revised up to 3000 mm to suit construction and equipment arrangements without additional cost, provided that the Contractor is notified prior to the installation of the outlets, or equipment.

.3 Maintain luminaire locations wherever possible. Notify the Engineer of conflicts with other services.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturers.

.5 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.6 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.7 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.8 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.12 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.

.2 Wall receptacles:

.1 General: 300 mm.

.2 Above top of continuous baseboard heater: 200 mm.

.3 Above top of counters or counter splash backs: 175 mm.

.4 In mechanical rooms: 1400 mm.

.3 Panelboards: as required by Code or as indicated.

.4 Telephone and LAN outlets:

.1 General: 300 mm.

.2 Above top of counters or desk: 175 mm.

.5 Wall mounted telephone outlets: 1500 mm.

3.13 HOUSEKEEPING PADS

.1 All floor mounted electrical equipment installed by this Division shall be mounted on concrete housekeeping pads which, unless otherwise noted, shall be the responsibility of the Contractor.

.2 The Contractor shall determine the extent of the housekeeping pads required and supply all information and details as to size and locations to the Engineer within thirty (30) days after the award of the Contract.

3.14 SLEEVES

.1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.

.2 For wall, partitions and ceilings the ends shall be flush with the finish on both sides but for floors they shall extend 4" above finished floor level.

.3 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.4 The space between the sleeve and the conduit shall be fire stopped in accordance with Section 07 84 00 and caulked around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound and ensure that the seal is compatible with the floor and ceiling finishes.

.5 Locate and position sleeves exactly prior to construction of walls, floors.

3.15 COORDINATION OF PROTECTIVE DEVICES

.1 Electrical Contractor shall field adjust and set breaker and relay settings for all breakers, relays, VFDs, etc. in accordance with the settings provided by the Contract Administrator. Settings will be provided to the Electrical Contractor after the submission and acceptance of Shop Drawings. Shop Drawing information will be used by the contract Administrator to calculate the appropriate settings.

3.16 TRAINING

.1 Provide training of Facility personnel in all aspects of maintenance operation, and functionality for all systems.

.2 Training shall involve both classroom style of training, as well as practical training with the equipment present.

3.17 UTILITY SERVICES

.1 It is the responsibility of the Contractor to perform all work related to utility electrical service, and to coordinate this work with Manitoba Hydro. Coordinate the delivery of utility electrical power to the site with Manitoba Hydro.

.2 Arc flash labelling will be provided on power distribution equipment in accordance with CSA Z462 as part of this contract.

.3 Complete rating of equipment, including short circuit interruption ratings, to be provided.

.4 Install and terminate cabling indicated on Drawings.

3.18 FIELD QUALITY CONTROL

.1 Load Balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed Part 1.02 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests:

.1 Point to point wire continuity test for all conductors.

.2 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.3 Circuits originating from branch distribution panels.

.4 Lighting and its control.

.5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.6 Systems: communications.

.7 Test resistance to ground of the completed grounding electrodes.

.8 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of the Engineer.

.4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from Manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Part 1.02 - Submittals.

.2 Provide Manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with Manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in Section 1.11 - AS-BUILT DRAWINGS

.6 The contractor shall keep one (1) complete set of white prints at the site during work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of As-Built drawings. As the work on-sire proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract Documents. As-Built drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

.1 Indicate on the As-Built Drawings the exact location of underground services referenced to established survey benchmarks.

.7 On completion of the work, minimum of four (4) weeks prior to final inspection, submit As-Built drawings to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-built drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items. The Contractor shall stamp date these drawings as "Record Drawings".

.8 Record documents that are incomplete shall be returned to the Contractor for correction.

.9 The Contract Administrator shall recommend a suitable deficiency holdback until such time as the As-Built Drawings are submitted in an acceptable form.

3.19 OPERATION AND MAINTENANCE (O & M) MANUALS

.1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions. Refer to Section 01 78 00, Operations and Maintenance Data.

.2 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.3 Include in the operation and maintenance manuals a minimum of:

.1 Cover page including project name, year, name of owner and electrical consultant. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of manufacturers and supplier for all items.

.4 Names, address, and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes but is not limited to grounding system tests, battery bank test results, operation tests, cable tests, load balancing tests, Megger tests, factory tests of all major tests systems, etc.

.9 Panel schedules (hardcopy and Microsoft Excel format).

.10 Software copies of relay settings.

.11 As-Built drawings

.12 Signed and dated warranty certificate.

.13 Signed and dated approval by the local Electrical Inspections Department.

.14 All other requirements outlined in the Specifications.

.4 Deliver to the Contract Administrator prior to the scheduled takeover date five (5) sets of operation and maintenance manuals. Each operation and maintenance manual shall be contained within one or more three “D-ring” binder(s). Each binder shall be labled directly on the front cover as well as the spine (“ELECTRICAL MAINTENANCE MANUAL – PROJECT NAME – YEAR”). Include memory sticks for all required electronic media.

.5 Index plastic divider tabs (with type inserts) shall be provided for each Specification section. Paper dividers, with plastic tabs and typed insertions will not be accepted.

.6 Submit draft document prior to the start of Commissioning.

.7 Post instructions where directed.

.1 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.2 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.3 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

.4 QUALITY ASSURANCE.

.8 Submit test results for Contract Administrator's review.

3.20 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

END OF SECTION

1 GENERAL

1.01 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 0.3-09 (R2014), Test Methods for Electrical Wires and Cables, and Update No. 1 (2010).

.2 CSA-C22.2 No. 131-14, Type TECK 90 Cable, and Update No. 1 (2016).

1.02 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Wire and Cable.

1.03 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 00 10.

1.04 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 01 and 26 00 10.

2 PRODUCTS

2.01 MATERIALS

.1 Armored Power Cable (TECK90).

.1 CSA Teck90 armored power cable 1000 V.

.2 Copper conductors, quantity and size as indicated, bonding conductor.

.3 1000 V XLPE Insulation.

.4 Aluminum Interlocked armor.

.5 PVC Jacket.

.6 HL rated for use in hazardous locations.

.7 -40 ^{0}C to +90 ^{0}C.

.8 Thomas & Betts Star-Teck extreme XP connectors in hazardous locations, Star-Teck connectors in ordinary locations.

.2 Armored Control Cable (AIA)

.1 CSA Teck90 armored control cable 600 V.

.2 Copper conductors, quantity and size as indicated, bonding conductor.

.3 600 V XLPE Insulation.

.4 Aluminum Interlocked armor.

.5 PVC Jacket.

.6 HL rated for use in hazardous locations.

.7 -40°C to +90°C.

.8 Thomas & Betts Star-Teck extreme XP connectors in hazardous locations, Star-Teck connectors in ordinary locations.

.3 Non-armored Power Cable (RW90)

.1 CSA single conductor, non-armored power cable.

.2 Copper conductors, size as indicated.

.3 600 V, 1000 V XLPE Insulation, as indicated.

.4 Armored Instrumentation Cable (ACIC).

.1 CSA ACIC multiconductor armored instrumentation cable.

.2 Copper conductors, quantity and size as indicated.

.1 Individual and overall shields, twisted pair.

.2 Individual and overall shields, twisted triad.

.3 600 V XLPE Insulation.

.4 Overall PVC Jacket.

.5 Interlocked aluminum armor.

.6 PVC Jacket.

.7 HL rated for use in hazardous locations.

.8 Thomas & Betts Star-Teck extreme XP connectors in hazardous locations, Star-Teck connectors in ordinary locations.

.5 Ethernet Cables (Cat 6)

.1 Cat 6 cable for Ethernet connections to equipment as indicated.

.2 4 twisted pairs, 23AWG solid strand conductors.

.3 600V insulation for 600V MCC Ethernet connections. 300V insulation for other Ethernet connections.

.4 Interlocked aluminum armor.

.5 PVC jacket.

.6 Thomas & Betts Star-Teck connectors.

2.02 WIRE GAUGE

.1 Where conductor sizes are not indicated on drawings, cable to be sized and installed or current carrying equal to or greater than the breaker or fuse protecting the cable. Size conductors for maximum 3% voltage drop.

3 EXECUTION

3.01 INSTALLATION

.1 Install non-armored cables in conduit systems in accordance with Section 26 05 34.

.2 Install armored cables in as indicated in drawings.

.3 Install lugs, stress relief tubes, tapes and any other materials required for correct installation and termination in accordance with manufacturer instructions. All termination kits and accessories shall be the proper equipment for the intended cable as indicated by the cable manufacturer.

.4 Cable bends shall be not less than manufacturer and CEC requirements.

.5 Connect shield of instrument cable to ground at one end only, preferably in the control panel. Do not ground instrument with shield wire, instead run a bonding conductor in the conduit.

.6 Identify cables with engraved stainless steel cable tags, on both ends of cables, tags per cable schedules.

.7 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.1 Maintain phase sequence and colour coding throughout.

.2 Colour code: to latest CSA C22.1.

.3 Use colour coded wires in communication cables, matched throughout system.

.4 Uniquely identify each control wire, using typed, heat shrink wire markers at each end.

.8 Lugs, terminals, screws used for termination of wiring to be suitable for - copper - conductors.

.9 Cable and connector types and installation methods as indicated and in accordance with area hazardous area classification and corrosive category.

.10 Seal conduit and penetrations when passing between area classifications and as otherwise required by code.

END OF SECTION

1 GENERAL

1.01 DESCRIPTION

.1 Supply and install a complete grounding system to include new equipment provided in this Contract. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Canadian Electrical Code, Local Building Code, and the local Electrical Inspection Branch.

.2 The system is to consist of cables, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the network shall not exceed 5 ohms.

1.02 REFERENCES

.1 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE 837 (2014), Qualifying Permanent Connections Used in Substation Grounding

.2 IEEE 80 (2013), IEEE Guide for Safety in AC Substation Grounding

.2 Canadian Standards Association (CSA)

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations

1.03 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Grounding systems.

1.04 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 00 10.

1.05 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 01 and 26 00 10.

2 PRODUCTS

2.01 MATERIALS

.1 Grounding equipment to: CSA C22.2 No. 41.

.2 Copper grounding conductors to: ASA G7.1.

2.02 EQUIPMENT

.1 Clamps for grounding conductor, size as required to electrically conductive underground water pipe.

.2 Rod electrodes for ground grid: copper clad steel, 19 mm dia by 6 m long with threaded couplers.

.3 Ground wells shall be polymer concrete construction, NVENT ERICO T422A or approved equal.

.4 System, circuit, and equipment grounding conductors: bare stranded copper, tinned, soft annealed.

.5 Ground bus: tinned copper, complete with insulated supports, fastenings, connectors.

.6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermal welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

2.03 MANUFACTURERS

.1 Acceptable manufacturers: Burndy Corp., Erico Inc or approved equal.

3 EXECUTION

3.01 INSTALLATION - GENERAL

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of Engineer, and local authority having jurisdiction over installation. Run ground wire in all conduits.

.2 Install connectors to manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections to continuously conductive water main or electrodes, using copper welding by thermal process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Protect exposed grounding conductors during and after construction.

.7 Soldered joints not permitted.

.8 All bolted connections must be accessible.

.9 All motors shall be grounded by means of an adequately sized ground wire contained within the feeder cable.

.10 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless hub, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.11 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.12 Use compression connectors for all grounding splices and terminations unless otherwise shown on the Drawings.

.13 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.

3.02 ELECTRODES

.1 Install rod electrodes and make grounding connections using compression methods.

.2 Make ground connections to continuously conductive underground water pipe.

.3 Make special provision for installing electrodes that will give less than 5 ohms resistance to ground value.

3.03 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections.

3.04 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to, the following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, generators, distribution panels.

3.05 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 00 10 – Electrical - General Requirements.

.2 Perform ground continuity and resistance tests using 3-point fall of potential method. Report results to Engineer.

.3 Perform tests before energizing electrical system.

END OF SECTION

1 GENERAL

1.1 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Splitters, Junction Boxes, Pull Boxes and Cabinets.

1.2 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 05 31.

1.3 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 1 and 26 00 10.

1.4 REFERENCES

.1 Canadian Standards Association (CSA)

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations

2 PRODUCTS

2.1 JUNCTION AND PULL BOXES

.1 All Areas: NEMA 4X, watertight and corrosion resistant with gasketed, screw covers for surface mounting.

.2 Hazardous Locations: Rated junction boxes for hazardous locations as defined in Section 33 11 30.01.

.3 Provide terminal rail, and terminal block kit assembly for each junction box.

.1 Feedthrough: Phoenix Contact UT4 or Weidmuller equal

.2 Fused Terminal: Phoenix Contact UT4 HESILED or Weidmuller equal

.3 Disconnect Terminal: Pheonix Contact UTS MT or Weidmuller Equal

3 EXECUTION

3.1 LEACHATE PUMP POWER PANEL INSTALLATION

.1 Install panel on the support structure as shown on drawings.

.2 Panel light shall be controlled by panel door limit switch.

3.2 JUNCTION BOXES, PULL BOXES AND CABINETS INSTALLATION

.1 Install junction boxes and pull boxes in inconspicuous but accessible locations.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 00 10 – Electrical-General Provisions.

.2 Identification labels to be size 2, or as indicated.

.3 Install identification labels indicating system name, voltage, and phase.

END OF SECTION

1 GENERAL

1.01 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Outlet Boxes, Conduit Boxes and Fittings.

1.02 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 05 32.

1.03 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 01 and 26 05 32.

1.04 REFERENCES

.1 Canadian Standards Association (CSA)

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations

2 PRODUCTS

2.01 OUTLET AND CONDUIT BOXES - GENERAL

.1 Size boxes in accordance with CSA C22.1, Section 12.

.2 102 mm square or large outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.02 PVC BOXES

.1 Use surface mounted PVC boxes wherever PVC conduit is used.

.2 NEMA 4X boxes shall be used in wet locations.

2.03 BOXES FOR RIGID METAL CONDUIT – EXPLOSION PROOF

.1 General Requirements:

.1 Rated for Hazardous Class I, Div. 1 & 2 (or Zone 0, 1 and 2)

.2 Acceptable materials:

.3 Cast copper free aluminum.

.4 Suitable for threaded rigid aluminum conduit.

.5 Mounting feet as required.

.2 Conduit Junction Boxes

.1 Cast copper free aluminum boxes with factory-threaded hubs for surface wiring pull points.

.2 Size boxes to comply with CEC requirements.

.3 Manufacturer / Model:
.1 Crouse Hinds GUA, GUR, EAB, EAJ series.

.3 Condulet Outlet Bodies

.1 Cast copper free aluminum condulet outlet bodies, with factory-threaded hubs for surface wiring pull points.

.2 Size outlet bodies to comply with CEC requirements.

.3 Manufacturer / Model:

.4 Crouse Hinds OE series, LBH series, LBY series to suit the application.
.1 Approved equal by Appleton or Killark.

.4 Device Boxes

.1 Cast aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of receptacles.

.2 Single gang, 2-gang, 3-gang as required.

.3 Manufacturer / Model:
.1 Crouse Hinds EDS or EDSCM series.

2.04 FITTINGS - GENERAL

.1 Connectors with nylon insulated throats.

.2 Knock out filters to prevent entry of foreign materials.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

3 EXECUTION

3.01 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam similar approved material to prevent entry of construction material.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connectors. Reducing washers not allowed.

.5 Provide boxes sized as required by the Canadian Electrical Code.

.6 Vacuum clean interior of outlet boxes before installation of wiring devices.

.7 Identify systems for outlet boxes as required.

END OF SECTION

1 GENERAL

1.01 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Conduits, Conduit Fastenings and Conduit Fittings.

1.02 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 00 10.

1.03 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 01 and 26 00 10.

1.04 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 18.1-13 Metallic Outlet Boxes.

.2 CSA C22.2 No. 18.2-06 (R2011) Non-metallic Outlet Boxes.

.3 CSA C22.2 No. 18.3-12 Conduit, Tubing, and Cable Fittings.

.4 CSA C22.2 No. 18.4-15 Hardware for the Support of Conduit, Tubing, and Cable.

.5 CSA C22.2 No. 18.5-13 Positioning Devices.

.6 CSA C22.2 No. 45.1-07 (R2012) Electrical Rigid Metal Conduit – Steel.

.7 CSA C22.2 No. 45.2-08 (R2013) Electrical Rigid Metal Conduit — Aluminum, Red Brass, and Stainless Steel.

.8 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.9 CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.

.10 CSA C22.2 No. 227.3-15, Mechanical Protection Tubing (MPT) and fittings.

2 PRODUCTS

2.01 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45.2, aluminum threaded. (galvanized steel threaded)

.2 Epoxy coated conduit: to CSA C22.2 No. 45.1, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

.4 Rigid PVC conduit: to CSA C22.2 No. 211.2

.5 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

.7 HDPE conduit, conductors-in-conduit and fittings: C22.2 No. 327-18

2.02 CONDUIT FASTENINGS

.1 One hole straps to secure surface conduits 53 mm and smaller. Two hole steel straps for conduits larger than 53 mm.

2.03 CONDUIT FITTINGS

.1 Fittings for raceways for CSA C22.2 No. 18.

.2 Fittings and bends manufactured for use with conduit specified.

2.04 PRODUCT DATA

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

.3 Submit manufacturing data.

.4 Quality assurance submittals:

.1 Test reports: submit certified test reports.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Instructions: submit manufacturer's installation instructions.

3 EXECUTION

3.01 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conduits shall be PVC type, surface mounted, unless otherwise indicated on the drawings or in this section.

.3 Conduit is not allowed in the hazardous or corrosive locations. Wiring shall be Teck90 as per cable schedule.

.4 Use rigid PVC conduit underground and in wet areas unless otherwise indicated on the drawings or in this section.

.5 Use liquid tight flexible non-metallic conduit for connection to instruments, motors, and HVAC equipment.

.6 Install polypropylene fish cord in empty conduits.

.7 Run ground wire in all conduits per CEC requirements.

3.02 SURFACE CONDUITS

.1 Conduit is to be neatly installed parallel to building lines on channel supports.

.2 Conduits shall have 1.5 m clearance (minimum) to infrared or gas fired heaters.

.3 Group conduits wherever possible on surface channels.

.4 Do not pass conduits through structural members except as indicated.

.5 Position conduits so that the markings on the conduit are facing the wall and are not visible.

.6 Where cables, cable tray or conduits pass through floors and walls to hazardous areas and through fire rated walls, sealing shall be by approved fire sealants.

3.03 CONDUITS IN POURED CONCRETE

.1 Located to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete. Apply coating of silicon caulking over steel conduit for a length of + 150 mm where it stubs out of concrete and install heat-shrink tubing over this area to prevent corrosion.

.3 Install sleeves where conduits pass through slab or wall.

.4 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Encase conduits completely in concrete.

3.04 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

1 GENERAL

1.01 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Panelboards.

.2 Refer to drawings for panelboards information.

1.02 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 00 10.

.2 Drawings to include electrical detail of panel, branch circuit type, quantity, ampacity, and enclosure dimension.

1.03 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 01 and 26 00 10.

2 PRODUCTS

2.01 PANELBOARD (PNL-100)

.1 Panelboard: to CSA C22.2 No. 29.

.2 Panelboard to be product of one manufacturer.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.

.4 Panelboard: mains, number of circuits, and number of size of branch circuit breakers as indicated.

.5 120/240V, single-phase, 3-wire system, 18 circuits, 100A bus.

.6 30AT/60AF, 80% rated main breaker.

.7 Silver plated copper bus with full size neutral.

.8 Panelboards shall have minimum interrupting capacity of 10kA symmetrical RMS.

.9 Supply type 2 surge protection device integral to the panelboard.

.10 Insulated, heated, NEMA 4X panel with pad lockable handle with three-point latch. Panel to house panelboard, panel light and panel heater.

.11 Provide terminal rail, and terminal block kit assembly for panel.

.12 Inner panel for equipment mounting.

.13 Provide wiring in the electrical panel as required.

.14 Provide thermostat-controlled panel heater and heater sizing shall be confirmed by enclosure manufacturer. Set the thermostat properly and maintain temperature in the panel that suits to equipment temperature rating installed in the panel. The heater shall ensure even distribution of heat and elimination of hot spots and condensation.

.15 Panel builder shall be CSA approved, panel to be CSA certified.

2.02 BREAKERS

.1 Bolt-on breakers with thermal magnetic tripping in panelboards except as indicated otherwise.

.2 Main breaker: separately mounted on top or bottom of panel to suit cable entry.

2.03 MAIN BREAKER

.1 Main breaker shall be electronic trip breaker type providing current and instantaneous tripping for short circuit protection.

.2 Main breaker shall be integrated to the panelboard.

.3 Minimum short circuit interrupting capacity shall be 10kA RMS symmetrical at 240V.

.4 30AT/60AF, 80% rated main breaker.

.5 Main breaker shall be pad lockable in “OFF” position.

.6 Breaker assembly to have neutral lug suitable for grounding.

2.04 SURGE PROTECTIVE DEVICE

.1 SPD type 2.

.2 SPD to be integrated to the panelboard with circuit protection.

.3 Connection: 120 / 240 V, 1 phase, 3 wire connection, 60 Hz.

.4 Nominal discharge current rating: 20 kA.

.5 Short circuit current rating: 200 kA.

.6 Voltage protection ratings: 1500 V L-G, 2500 V L-L.

.7 UL 1449 3rd Edition approved, CUL Listed.

.8 Approved Product:

.1 Square D I-Line.

.2 Eaton SPD.

.3 Approved Equal.

2.05 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 00 10.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.3 Nameplate for each panelboard size 4 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.06 APPROVED PRODUCT

.1 Schneider NQ.

.2 Eaton PRL-1.

.3 Approved equal.

3 EXECUTION

3.01 INSTALLATION

.1 Install circuit breakers in panelboards before shipment.

.2 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.

.3 Connect loads to circuits as indicated.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

1 GENERAL

1.01 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Wiring Devices.

1.02 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 00 10.

1.03 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 01 and 26 00 10.

1.04 REFERENCES

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association (CSA)

.1 C22.2 NO. 42-10 (R2015) - General use receptacles, attachment plugs, and similar wiring devices

.2 C22.2 NO. 42.1-13 - Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D)

.3 C22.2 NO. 55-15 - Special use switches

.4 C22.2 NO. 111-10 (R2015) - General-use snap switches (Bi-national standard, with UL 20)

2 PRODUCTS

2.01 SWITCHES

.1 15 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.

.2 Manually operated industrial spec. grade switches as indicated and with following features:

.1 Brass Robertson large head screws.

.2 Silver alloy contacts.

.3 Urea or melamine molding.

.4 Suitable for back and side wiring.

.5 Ivory toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Approved products:

.1 Arrow Hart No. 1201.

.2 Leviton No. 1201.

.3 Hubbell No. 1201.

.4 Approved equa.l

2.02 HAZARDOUS LOCATION SWITCHES

.1 Switches suitable for zone 1 and zone 2 areas, as defined in Section 33 11 30.01.

.2 Single gang switch.

.3 Copper free aluminum.

.4 Approved Product:

.1 Crouse-Hinds EDS.

.2 Approved equal.

2.03 RECEPTACLES

.1 Duplex receptacles, industrial, CSA Type 5-15 R, 125 V, 15 A, U ground, with following features:

.1 Nylon or Melamine base with impact resistant ivory nylon face.

.2 Suitable for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Brass Robertson large head screws.

.5 Double wipe contacts and riveted grounding contacts.

.6 Wrap-around mounting strap.

.2 Approved Products:

.1 Arrow Hart No. 5262.

.2 Leviton No. 5262.

.3 Hubbell No. 5252.

.4 Approved equal.

2.04 HAZARDOUS LOCATION RECEPTACLES

.1 Receptacles suitable for zone 1 and zone 2 areas, as defined in Section 33 11 30.01.

.2 125VAC, 15A.

.3 Receptacle housing, spring door and plug body to be copper-free aluminum.

.4 Approved Product:

.1 Crouse-Hinds Ark-Gard ENR.

.2 Approved Equal.

2.05 COVER PLATES

.1 Cover plates for wiring devices: PVC.

.2 Cover plates from one manufacturer throughout project.

.3 For exterior receptacles, use weatherproof double lift spring loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated. Hubbell 5206WO or equal.

.4 Use PVC cover plate for PVC outlet boxes.

.5 Use NEMA 4X boxes and in-use cover in Wet Locations and Corrosive Locations, as defined in Section 33 11 30.01.

.6 For switches in wet locations and exterior switches: use weatherproof toggle covers, complete with gaskets. Hubbell PTC100 or equal.

2.06 LOCAL DISCONNECT SWITCHES

.1 Heavy Duty non-fused disconnect.

.2 240V, 120V rated as required.

.3 30A, 60A, 100A as indicated.

.4 NEMA 1 enclosure for indoor ordinary areas.

.5 NEMA 4X for outdoor applications.

.6 CSA / cUL listed.

.7 Approved product:

.1 Hubbell HBLDS.

.2 Square D Heavy Duty Safety Switch.

.3 Eaton Heavy Duty Safety Switch.

.4 Pass & Seymour Non-Fusible Safety Switch.

.5 Siemens VBII

2.07 HAZARDOUS LOCATION DISCONNECT SWITCHES

.1 Copper-free aluminum enclosure.

.2 CSA / cUL listed for use in Zone 1 hazardous location as defined in Section 33 11 30.01.

.3 240V, 120V rated as required.

.4 30A, 60A, 100A as indicated.

.5 Non-fused.

.6 Approved Product:

.1 Hubbell B7NFD.

.2 Eaton Hazardous Location Safety Switch.

.3 Approved Equal.

3 EXECUTION

3.01 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height specified in Section 26 00 10 or as indicated.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height specified, Section 26 00 10 or as indicated.

.3 Install receptacle with ground pole "Down".

END OF SECTION

1 GENERAL

1.01 SCOPE

.1 This section covers work related to Section 26 00 10 for the provision of Molded Case Circuit Breakers.

1.02 SHOP DRAWINGS

.1 Submit shop drawings and installation instructions in accordance with Section 01 33 00 and 26 00 10.

1.03 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Division 01 and 26 00 10.

1.04 REFERENCES

.1 Canadian Standards Association (CSA)

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations

.2 CSA C22.2 No. 5-02, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

2 PRODUCTS

2.01 THERMAL MAGNETIC BREAKERS

.1 Molded case circuit breakers: to CSA C22.2 No. 5.

.2 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

.3 Bolt-on Molded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40ºC ambient.

.4 Common-trip breakers with single handle for multi-pole applications.

.5 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.

.6 Circuit breakers with interchangeable trips as indicated.

.7 Circuit breakers shall have a minimum symmetrical interrupting capacity of 10 kA. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to 10 kA, regardless of whether equipped with instantaneous trip protection or not.

.8 Approved manufacturers:

.1 Eaton Electric.

.2 Square D.

3 EXECUTION

.1 Install circuit breakers as indicated on drawings.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

1. Section 31 23 33.01 – Excavating, Trenching and Backfilling.
2. Section 31 35 26.13 – Recompacted Clay Base.
3. Section 33 41 17 – Leachate Collection System.

1.02 MEASUREMENT AND PAYMENT

.1 Sand Protection Layer:

.1 Measurement Basis: By cubic meter of the in-place quantity. Survey for measurement will be from the top of the HDPE liner to the top of the 300 mm thick aggregate protection layer. Survey will be based on a 10 m x 10 m grid spacing.

.2 Payment Basis: Unit price. Includes the supply, loading, hauling and placement of aggregate material for the Sand Protection Layer.

.2 Bedding Sand:

.1 There will be no separate measurement or payment for the supply, hauling, placement and spreading for the bedding sand in the leachate collection trenches and leachate header trenches. This item will be paid for as part of the leachate collection trenches and leachate header trenches as per Section 33 41 17 – Leachate Collection System.

.3 Granular Drainage Layer:

.1 There will be no separate measurement or payment for the supply, hauling, placement and spreading for the granular drainage layer in the leachate collection trenches, leachate header trenches and sump. This item will be paid for as part of the leachate collection piping including the perforated 200 mm leachate collection pipe and the 600 mm leachate withdrawal pipe including the sump as per Section 33 41 17 – Leachate Collection System.

.4 Tireshred Drainage Layer:

.1 Measurement Basis: By cubic meter of the in-place quantity. Survey for measurement will be from the top of the sand protection layer to the top of the 600 mm thick Tireshred Drainage Layer. Survey will be based on a 10 m x 10 m grid spacing.

.2 Payment Basis: Unit price. Includes the loading, hauling and placement of tireshred from on-site stockpiles for the Tireshred Drainage Layer.

1.03 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.2 ASTM D1140-17, Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No.200) Sieve in Soils by Washing.

.3 ASTM D2487-17e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

.4 ASTM D4318–17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.5 ASTM D4791-19(2023), Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

.6 ASTM D6270-20 (2020), Standard Practice for Use of Scrap Tires in Civil Engineering Applications.

.2 City of Winnipeg Standard Construction Specifications:

.1 CW2030 – Excavation Bedding and Backfill.

.2 CW3110 - Sub-Grade, Sub-base and base course construction.

.3 CW3120 – Installation of Subdrains.

.4 CW3610 – Installation of Culverts.

.5 CW3615 – Riprap.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit sieve analysis indicating that each type of imported aggregate material meets specified requirements.

.2 Submit at least 7 days prior to commencing transport to Site.

.2 Provide additional sieve analysis upon any change in source or appearance of materials.

.3 Samples:

.1 Allow continual sampling by Contract Administrator during construction.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Segregation, contamination, and degradation of aggregates during handling and transportation is not permissible.

.2 Store washed materials or materials excavated from underwater for a minimum of 24 hours to allow for free drainage of water and for materials to reach uniform water content.

2 PRODUCTS

2.01 MATERIALS

.1 Aggregate Quality: Sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, and adherent coatings or other deleterious substances.

.2 Granular Drainage Layer:

.1 Granular Drainage Layer is Contractor supplied.

.2 The Granular Drainage Layer as required for the leachate collection trenches, leachate header trench and sump shall be washed 12.5 mm to 40 mm rock that meets the following gradation:

Sieve Size	Percent Passing (%)
40 mm	100
25 mm	60 - 100
20 mm	0-75
12.5mm	<7

.1 Granular Drainage Layer material shall be uniform gravel consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.3 Sand Protection Layer/Bedding Sand Layer:

.1 Sand required for the protection layer or bedding sand layer is Contractor supplied.

.2 Sand quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended. The sand material will generally meet the following gradation:

Sieve Size (mm)	Percent Passing (%)
10.00	100
5.00	95-100
2.50	80-100
1.25	50-90
0.63	25-65
0.315	10-35
0.160	2-10
0.080	0-4

.4 Tireshred Drainage Layer:

.1 The City will provide the tire shred drainage layer material on-site within designated stockpiles.

.2 The Contractor will maintain the tire shred free of soil, debris or contaminants such as oil and grease while loading, transporting, placing and spreading.

2.02 SOURCE QUALITY CONTROL

.1 Inform Contract Administrator of proposed source of aggregates and provide access for sampling a minimum 4 weeks before starting production. Provide and pay for laboratory testing to confirm quality of materials.

.2 If materials from proposed source do not meet or cannot reasonably be processed to meet specified requirements then locate alternative source.

.3 Advise Contract Administrator a minimum 4 weeks in advance of proposed change of material source.

.4 Provide Contract Administrator with access to source and processed material for sampling.

.5 Acceptance of material at source does not exclude it from potential future rejection if it fails to conform to specified requirements, lacks uniformity, or if its site performance is found to be unsatisfactory.

.6 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

3 EXECUTION

3.01 PROCESSING

.1 Process aggregates uniformly using methods that prevent contamination, segregation, and degradation.

.2 Blend aggregates as required, including reclaimed materials that meet specified requirements in order to satisfy gradation requirements or specified particle shapes.

.1 Use methods and equipment reviewed in writing by Contract Administrator.

.3 When operating in stratified deposits use excavation equipment and methods that produce uniform and homogeneous aggregate gradation.

3.02 STOCKPILING AGGREGATES

.1 Stockpile aggregates on site in locations as indicated by the City.

.2 Stockpile aggregates in sufficient quantities to meet project schedules.

.3 Use stockpile sites that are level, well-drained and have adequate bearing capacity to support the weight of stockpiled materials and handling equipment.

.4 Except where stockpiled on acceptably stabilized areas:

.1 Stockpile aggregates on ground but do not incorporate bottom 300 mm of stockpile into Work.

.5 Divide different aggregates by strong, full depth bulkheads, or separate each stockpile by a sufficient distance to prevent intermixing.

.6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials by means acceptable to Contract Administrator within 48 hours of rejection.

.7 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.8 Do not cone piles or spill material over edges of piles. Keep the completed stockpiles neat, regular in form and occupying the smallest possible area.

.9 During winter operations, prevent penetration of ice and snow into stockpile or in material being removed from stockpile.

3.03 SAND PROTECTION LAYER AND TIRESHRED DRAINAGE LAYER INSTALLATION

.1 Equipment ground pressures correspond to minimum thicknesses used to spread the sand protection layer and tireshred drainage layer as provided below:

Equipment Ground Pressure		**Minimum Lift Thickness**
kPa	psi	Metre (m)
<70	<10	0.30
70-140	10-20	0.60
>140	>20	0.90

.2 The equipment shall not push materials such that the tracks spin. No sharp turns shall be allowed.

.3 No wheeled vehicles allowed over geosynthetic liner without approval from the Contract Administrator.

.4 Any damage to the geosynthetic liner or geotextiles by equipment will be repaired at the Contractors expense.

.5 Thickness checks are required by Contractor at a 10 m x 10 m grid spacing

.6 The sand protection layer material shall be placed to lines and grades as shown on the Construction Drawings, within +50 mm in the vertical direction and ±100 mm in the horizontal direction.

.7 The tireshred drainage layer material shall be placed to lines and grades as shown on the Construction Drawings, within –50/+100 mm in the vertical direction and ±100 mm in the horizontal direction.

3.04 CLEANING

.1 Upon completion of work, remove surplus materials and debris, trim slopes, and correct defects noted by the Contract Administrator.

.2 Leave stockpile sites in tidy, well-drained condition, free of standing surface water.

.3 Leave any unused materials in neat compact stockpiles in locations indicated by the City of Winnipeg.

.4 Waste Management: Perform in accordance with the City of Winnipeg.

.5 Restrict public access to temporary or permanently abandoned stockpiles by means acceptable to the City of Winnipeg.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Section 31 05 19.20 – Geocomposite.

.2 Section 31 05 19.23 – Geosynthetic Clay Liners.

.3 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

.4 Section 31 35 26.16 – HDPE Liner.

.5 Section 33 41 17 - Leachate Collection System.

1.02 MEASUREMENT AND PAYMENT

.1 Non-Woven 16 oz/syd Protection Geotextile:

.1 Measurement Basis: Area of material shall be measured in square meters (m^2) of surface area supplied and installed, measured by 10 m x 10 m grid spacing. Only the area approved for geotextile will be measured.

.2 Payment Basis: Unit rate for the supply and installation of geotextiles will be measured in square metres (m^2) of surface covered.

.1 No allowance will be made for seams, material testing, repairs, or manufacturer's field services. Overlap, wastage, and anchor trench material will not be measured for payment and are considered incidental to geotextile installation.

.2 There will be no separate measurement or payment for the supply or installation of the protection geotextile placed in the leachate collection trenches, header trench or sump. This item is included in the individual bid items and is considered incidental to the leachate collection piping including the perforated 200 mm leachate collection pipe and the 600 mm leachate withdrawal pipe as per Section 33 41 17 – Leachate Collection System.

.2 Non-Woven 8 oz/syd Separation Geotextile:

.1 Measurement Basis: Area of material shall be measured in square meters (m^2) of surface area supplied and installed, measured by 10 m x 10 m grid spacing. Only the area approved for geotextile will be measured.

.2 Payment Basis: Unit rate for the supply and installation of geotextiles will be measured in square metres (m^2) of surface covered.

.1 No allowance will be made for seams, material testing, repairs, or manufacturer's field services. Overlap, wastage, and anchor trench material will not be measured for payment and are considered incidental to geotextile installation.

.2 There will be no separate measurement or payment for the supply or installation of the separation geotextile placed in the leachate collection trenches, header trench or sump. This item is included in the individual bid items and is considered incidental to the leachate collection piping including the perforated 200 mm leachate collection pipe and the 600 mm leachate withdrawal pipe as per Section 33 41 17 – Leachate Collection System.

.3 Non-Woven 8 oz/syd Culvert Geotextile:

.1 There will be no separate measurement or payment for the supply, and placement of the culvert geotextile. This item will be paid for as part of the leachate collection trenches and leachate header trenches as per CW 3610 – Culverts.

1.03 REFERENCE STANDARDS

.1 Definitions:

.1 Geotextile: Synthetic fabric for use in geotechnical filter, separation, stabilization, or erosion control applications.

.2 ASTM International (ASTM):

.1 ASTM D3787-16, Standard Test Method for Bursting Strength of Textiles—Constant-Rate-of-Traverse (CRT) Ball Burst Test

.2 ASTM D4533-15, Test Method for Trapezoidal Tearing Strength of Geotextiles

.3 ASTM D4533-15, Test Method for Trapezoidal Tearing Strength of Geotextiles

.4 ASTM D4491/D4491M-21, Standard Test Methods for Water Permeability of Geotextiles by Permittivity

.5 ASTM D4595-24, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Method

.6 ASTM D4632-15a, Test Method for Grab Breaking Load and Elongation of Geotextiles

.7 ASTM D4716/D4716M-22, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

.8 ASTM D4751-21a, Standard Test Method for Determining Apparent Opening Size of a Geotextile

.9 ASTM D5261-10, Test Method for Measuring Mass per Unit Area of Geotextiles

.10 ASTM D6241-22a, Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Product Using a 50-mm Probe

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-4.2 No. 11.2-M89, Textile Test Methods-Bursting Strength-Ball Burst Test

.2 CAN/CGSB-148.1, Methods of Testing Geosynthetics

.1 No. 2-M85, Mass per Unit Area.

.2 No. 3-M85, Thickness of Geotextiles.

.3 No. 6.1-93, Bursting Strength of Geotextiles Under No Compressive Load.

.4 No. 7.3-92, Grab Tensile Test for Geotextiles.

.5 No. 10-94, Geotextiles - Filtration Opening Size.

.4 City of Winnipeg Standard Construction Specifications:

.1 CW3110 - Sub-Grade, Sub-Base and Base Course Construction.

.2 CW3120 – Installation of Subdrains.

.3 CW3130 – R5 – Supply and Installation of Geotextile Fabrics.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the following action submittals a minimum 4 weeks before starting work of this Section:

.1 Material origin including supplier's name and production plant and identifications including brand name and number of geotextile rolls.

.2 Specification for geotextile which includes properties published by manufacturer measured using specified test methods.

.3 Written certification that minimum average roll values stated in manufacturer's specification are guaranteed by geotextile manufacturer.

.4 Quality control certificates signed by geotextile manufacturer. The certificates shall include roll identification numbers, testing procedures, and results of quality control tests.

.2 Coordinate the installation of geotextile with geomembrane installer, sand protection layer, tireshred drainage layer, and leachate trench and sump granular drainage layer installation.

.3 Obtain approval from the Contract Administrator and HDPE Liner manufacturer's representative or installer, prior to placing Non-Woven 16 oz/syd Protection Geotextile and Non-Woven 8 oz/syd Separation Geotextile.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with product requirements following manufacturers recommendations:

.1 Inspect geotextiles, upon delivery, to confirm materials have good appearance qualities and are free from defects that might affect their specific properties.

.1 Surface observations will be conducted during acceptance of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.

.2 Damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.

.3 Rolls or portions of rolls without identification labelling at the time of delivery will be rejected and shall be removed from site.

.2 During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 160°F (71°C), and any other environmental condition that may damage the property values of the geotextile.

.3 The Contractor shall be responsible to ensure the storage area and surface is kept in a condition acceptable for the storage of rolls.

.4 Rolls damaged from the mismanagement of the storage area by the Contractor shall be replaced at the Contractor's expense.

.2 Product labels shall clearly show the manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.

.1 Handle geosynthetics shall be handled with equipment that will not make contact with damage the material. Rolls damaged due to mishandling by the Contractor shall be replaced at the Contractor's expense.

1.06 WARRANTY

.1 Refer to Part D- Supplemental Conditions: Warranty

.2 Provide 1 year manufacturer's warranty.

.3 Include coverage for:

.1 Defective product found to be not in compliance with the requirements of this specification.

.2 Replacement of the geotextile with new material including costs associated with geotextile installation

2 PRODUCTS

2.01 MATERIALS

.1 Non-Woven 16 oz/syd Protection Geotextile:

.1 The protection geotextile shall consist of a non-woven synthetic fibre fabric manufactured from polypropylene staple or continuous fibre and shall conform to the following: requirements:

Property	Test Method	Value
Mass/Area	ASTM D5261	542 g/m^2 16 oz/yd^2
Tear Resistance	ASTM D4533	644 N 145 lbs
Puncture Resistance	ASTM D6241	>4561 N >1025 lbs
UV Resistance	ASTM D5035 ASTM D7238	70% per 500 hours
Grab Tensile Strength	ASTM D4632	1690 N 380 lbs
Apparent Opening Size (AOS)	ASTM D4751	0.150 mm #100 US Sieve
Permittivity	ASTM D4491	0.7 sec^{-1}

.2 The protection geotextile shall be manufactured from first quality virgin polymer. No reclaimed or recycled material shall be added to the formulation.

.3 The protection geotextile shall be free of all metal pieces and sharp objects.

.2 Non-Woven 8 oz/syd Separation Geotextile:

.1 The separation geotextile shall consist of a non-woven synthetic fibre fabric manufactured from polypropylene staple or continuous fibre and shall conform to the following requirements:

Property	Test Method	Value
Mass/Area	ASTM D5261	271 g/m^2 8 oz/yd^2
Tear Resistance	ASTM D4533	356 N 80 lbs
Puncture Resistance	ASTM D6241	>2224 N >500 lbs
UV Resistance	ASTM D5035 ASTM D7238	70% per 500 hours
Grab Tensile Strength	ASTM D4632	911 N 205 lbs
Apparent Opening Size (AOS)	ASTM D4751	0.180 mm #80 US Sieve
Permittivity	ASTM D4491	1.4 sec^{-1}

.3 The separation geotextile shall be manufactured from first quality virgin polymer. Reclaimed or recycled material shall not be added to the formulation.

.4 The geotextile(s) shall consist of a non-woven synthetic fibre fabric manufactured from polypropylene staple or continuous fibre.

.5 The separation geotextile shall be free of all metal pieces and sharp objects.

.6 Seams shall have equal or better resistance to chemical and biological degradation than the geotextile.

3 EXECUTION

3.01 INSTALLATION

.1 The Contractor shall not remove the protective wrapping from the geotextile until the surface it is to be deployed on has been approved and documented.

.2 Install geotextile in accordance with the manufacturer's recommendations.

.3 Place geotextile material by unrolling onto the underlying surface. Avoid trapping soil, stones or excessive moisture.

.4 Place geotextile material smooth and free of tension stress, folds, wrinkles, and creases.

.5 Place geotextile material by unrolling onto graded surface in orientation, manner, and locations indicated on Drawings.

.6 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.7 Overlap each successive strips of geotextile 300 mm over previously laid strip. Complete seams as per recommendation of the manufacturer.

3.02 PROTECTION

.1 Protect installed geotextile material from displacement, damage, or deterioration before, during, and after placement of material layers.

.1 Vehicular traffic is not permitted directly on geotextile.

.2 Avoid overloading soil or aggregate on geotextile.

.1 After installation, cover with overlying layer within 4 hours of placement or add weighted objects as approved by the Contract Administrator to secure in place and avoid wind uplift.

.2 Replace damaged or deteriorated geotextile to acceptance of the Contract Administrator.

3.03 CLEANING

.1 Separate waste materials for reuse and recycling.

.2 Upon completion of the work, the Contractor shall remove from the site surplus or discarded materials and dispose at location designated by the City.

.3 Clean and reinstate the site affected by work to a condition that existed prior to commencement of work, or City's satisfaction.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Section 31 05 19.15 – Geotextiles.

.2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

.3 Section 31 35 26.13 - Recompacted Clay Base.

.4 Section 31 35 26.16 – HDPE Liner.

.5 Section 33 41 17 - Leachate Collection System.

1.02 MEASUREMENT AND PAYMENT

.1 Geocomposite:

.1 Measurement Basis: Area of material shall be measured in square meters (m^2) of 3-dimensional surface area supplied and installed, measured by 10 m x 10 m grid spacing. Only the area approved for geocomposite will be measured.

.2 Payment Basis: Unit rate for the supply and installation of geocomposite will be measured in square metres (m2) of surface covered.

.1 No allowance will be made for seams, material testing, repairs, or manufacturer's field services. Overlap, wastage, and anchor trench material will not be measured for payment and are considered incidental to geocomposite installation.

.3 There will be no separate measurement or payment for the supply or installation of the geocomposite placed in the leachate collection trenches, header trench or sump. This item will be paid for as part of the leachate collection piping including the perforated 200 mm leachate collection pipe and the 600 mm leachate withdrawal pipe as per Section 33 41 17 – Leachate Collection System.

1.03 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM D1238-23a, Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.

.2 ASTM D1505-18, Standard Test Method for Density of Plastics by the Density-Gradient Technique.

.3 ASTM D4533-15, Test Method for Trapezoidal Tearing Strength of Geotextiles.

.4 ASTM D4533-15, Test Method for Trapezoidal Tearing Strength of Geotextiles.

.5 ASTM D4491/D4491M-22, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.6 ASTM D4632-15, Test Method for Grab Breaking Load and Elongation of Geotextiles.

.7 ASTM D4716/D4716M-22, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

.8 ASTM D4751-21a, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.9 ASTM D5261-10, Test Method for Measuring Mass per Unit Area of Geotextiles.

.10 ASTM D6241-22a, Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Product Using a 50-mm Probe.

.2 Geosynthetic Institute (GSI):

.1 GRI GN4, Test Methods, Required Properties and Testing Frequency for Biplanar Geonets and Biplanar Geonet Composites.

.2 GRI GT7-[12], Determination of the Long-Term Design Strength of Geotextiles.

.3 GRI GT12(a), Test Methods and Properties Nonwoven Geotextiles Used as Protection (or Cushioning) Materials.

.3 City of Winnipeg Standard Construction Specifications:

.1 CW3110 - Sub-Grade, Sub-Base and Base Course Construction.

.2 CW3120 – Installation of Subdrains.

.3 CW3130 – R5 – Supply and Installation of Geotextile Fabrics.

.4 CW3135 – Supply and Installation of Geogrid.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the following action submittals a minimum 4 weeks before starting work of this Section:

.1 Material origin including supplier's name and production plant and identifications including identifications (brand name and roll number) of geotextile and geonet used to manufacture geocomposite rolls.

.2 Specification for geocomposite which includes properties published by manufacturer measured using specified test methods.

.3 Written certification that minimum average roll values stated in manufacturer's specification are guaranteed by geotextile manufacturer.

.4 Quality control certificates signed by manufacturer of both products.

.5 Quality Control certificates signed by geocomposite manufacturer. The certificates shall include roll identification numbers, testing procedures, and results of quality control tests.

.6 Source Quality Control Submittals as per Section 2.02.

.7 Field Quality Control Submittals as per Section 3.05.

.2 Coordinate the installation of geocomposite with geomembrane and granular drainage layer installation.

.3 Obtain approval from the Contract Administrator and HDPE Liner manufacturer's representative or installer, prior to placing geocomposite.

.4 The liner leak location services shall be coordinated after the installation of the geocomposite material.

.5 Provie panel layout and installation quantities one week following completion of installation.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with product requirements and manufacturer's recommendations:

.1 Inspect geotextiles, upon delivery, to confirm materials have good appearance qualities and are free from defects that might affect their specific properties.

.2 During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 160°F (71°C), and any other environmental condition that may damage the property values of the geotextile.

.2 Surface observations will be conducted during acceptance of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.

.3 Damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.

.4 Product labels shall clearly show the manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.

.1 Rolls or portions of rolls without identification labelling at the time of delivery will be rejected and shall be removed from site.

.5 The geocomposite shall be handled with equipment which does not make contact with the geocomposite material.

.6 The City will provide on-site storage area for geocomposite rolls from the time of delivery until installation.

1.06 WARRANTY

.1 Refer to Part D- Supplemental Conditions: Warranty.

.2 Provide 1 year manufacturer's warranty.

.3 Include coverage for:

.1 Defective product found to be not in compliance with the requirements of this Section.

.2 Replacement of the geocomposite with new material including costs associated with geocomposite installation.

2 PRODUCTS

2.01 MATERIALS

.1 Double-Sided Geocomposite:

.1 The geonet core of the geocomposite shall be manufactured from polyethylene resin with the following properties:

.1 Density greater than or equal to 0.94 g/cm3 as per ASTM D1505 sampled once per resin lot.

.2 Melt index less than or equal to 1.0 g/10min as per ASTM D1238 sampled once per resin lot.

.2 The geonet core of the geocomposite shall comprise of bi-planar core with ribs providing channelized flow.

.3 Geocomposite material shall meet or exceed the values listed in the table below, or as approved by the Contract Administrator.

.4 Geocomposite shall be free of defects.

.5 Geocomposite shall have non-woven geotextile bonded to both sides of the geonet core.

.6 Geocomposite shall meet the following requirements:

Property	Test Method	Minimum Average Value
Geocomposite		
Transmissivity at 480 kPa stress	ASTM D4716	$3x10^{-3}$ m^2/sec
Ply Adhesion	ASTM D7005	178 g/cm 1.0 lb/in
Geonet Core		
Density	ASTM D1505	0.94 g/cm^3 (min.)
Carbon black	ASTM D1603	2% (min.)
Thickness	ASTM D5199	5.08 mm (min.) 200 mil (min.)
Tensile strength	ASTM D5035	7.87 N/mm (min.) 45 lb/in (min.)
Geotextile (bonded to both sides)		
Mass/unit area	ASTM D5261	270 g/m^2 (min.) 8 oz/yd^2 (min.)
Grab Tensile Strength	ASTM D4632	1001 N (min.) 225 lb (min.)
Grab Elongation	ASTM D4632	50%
CBR Puncture Strength	ASTM D6241	2670 N (min.) 600 lb (min.)
Apparent Opening Size	ASTM D4751	0.18 mm (max.) 80 US Sieve
Water Flow Rate	ASTM D4491	4075 lpm/m^2 (min.) 100 gmp/ft^2 (min.)
UV resistance	ASTM D4355 (after 500 hours)	70% retained

2.02 SOURCE QUALITY CONTROL

.1 Geocomposite shall be tested by geocomposite manufacturer to evaluate characteristics for quality control. At minimum, following tests shall be performed for quality control in accordance with test methods specified.

.2 Perform the following test for every 40,000 m2 of geocomposite produced:

.1 Mass per unit area.

.2 Thickness.

.3 Geotextile-geonet peel adhesion.

.4 Transmissivity.

.3 At geocomposite manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify noncomplying rolls and to qualify individual rolls.

.4 Geocomposite components shall be evaluated by component manufacturers to determine characteristics for quality control.

3 EXECUTION

3.01 INSTALLATION

.1 The Contractor shall not remove the protective wrapping from the geocomposite until the surface it is to be deployed on has been documented.

.2 The geocomposite material shall only be deployed on approved surfaces to the limits as shown on the drawings.

.3 The Contractor shall deploy geocomposite panels in accordance with Manufacturer's recommendation. The geocomposite shall be deployed in the direction of the slope and the intended direction of flow.

.4 Place geocomposite in locations and orient as detailed on the Drawings.

.5 Maintain the geocomposite material free from all dirt, dust and debris during the installation process.

.6 Avoid operating equipment, deemed by the Contract Administrator to be unacceptable, on the surface of the geocomposite.

.7 Geocomposite material deployed on the slopes shall be secured in the anchor trenches.

.8 The Contractor shall secure the deployed geocomposite panels with sandbags or equivalent to prevent wind uplift. The Contractor shall only remove ballasting after completion of seaming of the geocomposite panels.

.9 The Contractor shall employ cutting techniques that ensure no damage to the underlying geomembrane liner during cutting of the geocomposite material.

.10 The Contractor shall adopt geocomposite deployment methods that prevent damage to the underlying geomembrane liner.

.11 During deployment, care shall be taken not to entrap in or beneath geocomposite, stones or lumps of dirt that have the potential of damaging the geomembrane, cause clogging of geonet, or hamper subsequent seaming.

.12 If dirt or excess dust is entrapped within the geocomposite, it shall be washed clean prior to placement of next layer of material.

.13 The Contractor shall visually examine entire geocomposite surface for potentially harmful foreign objects such as stones/woodchips. The foreign objects encountered shall be removed.

3.02 GEOCOMPOSITE SEAMS AND OVERLAP

.1 The Contractor shall complete seaming of adjacent panels of geocomposite material by overlapping adjacent edges a minimum of 150 mm.

.2 The end of roll edges of the geocomposite shall be overlapped a minimum of 200 mm.

.3 The Contractor shall bind the geonet together with plastic ties installed every 1.5 m along the edges and every 0.15 m in anchor trench, and along end of roll seams.

.4 The Contractor shall use white or yellow tying devices for easy inspection.

.5 In general, horizontal seams will not be allowed on the side slopes of the berms.

.6 In corners of the landfill cell, geocomposite installation shall be completed by overlapping the perpendicular panels of the geocomposite and placing another layer of geocomposite material on top of the deployed perpendicular panels from the anchor trench to the bottom.

.7 The Contractor shall stagger joints when more than one (1) layer of geocomposite is installed.

.8 Field seams shall be completed in a manner to provide continuous flow through the geocomposite.

.9 Extend geocomposite 1.0 m into the base of the cell.

3.03 GEOCOMPOSITE FIELDS SEAMS

.1 In general, no horizontal seams or splices will be allowed on side slopes except as part of a patch. Splice is defined as seam connecting ends of two (2) rolls.

.2 The Contractor shall overlap geocomposite a minimum of 150 mm prior to seaming.

.3 The Contractor shall complete seaming of the geotextiles by thermal bonding or as per the recommendations provided by the Manufacturer.

.4 Field seams shall be assembled to provide continuous flow through the geonet.

.5 Join geonet using ties every 1.5 m in the machine direction and every 30 cm in the transverse direction. Select a contrasting colour for ties. Minimize the number of seams required.

3.04 FIELD REPAIR PROCEDURES

.1 The Contractor shall repair defects smaller than 1 m by 1 m of the geocomposite by the following method:

.1 Remove damaged geotextile.

.2 Place a patch of new geotextile providing a minimum of 300 mm overlap.

.3 Thermally bond geotextile patch to existing geocomposite.

.2 Geocomposite geonet damage repair method:

.1 Remove damaged geocomposite material.

.2 Place and thermally bond the geotextile patch having 300 mm overlap with the lower geotextile of the geocomposite material.

.3 Install a geonet patch by tying the two geonet materials together every 0.15 m using plastic ties. The geonet patch shall have a minimum overlap of 300 mm.

.4 Place and thermally bond another geotextile patch having 300 mm overlap with the upper geotextile of the geocomposite material.

.5 Replace geocomposite if defect is determined to be larger than 3 ft by 3 ft (1 m by 1 m).

.3 Geocomposite geonet damage repair method:

.1 Remove and repair any rips, tears or damaged areas.

3.05 FIELD QUALITY CONTROL

.1 The Contractor shall collect samples, no less than one per 10,000 m^2 of geocomposite to be installed for conformance testing. Testing shall include, at the Contractor's expense:

.1 Mass per unit area.

.2 Transmissivity.

.3 Geotextile-geonet peel adhesion.

3.06 PROTECTION

.1 Protect installed geocomposite from displacement, damage, or deterioration before, during, and after placement of material layers.

.2 Vehicular traffic is not permitted directly on geocomposite.

.3 After installation, cover with overlying layer within 4 hours of placement or add weighted objects as approved by the Contract Administrator to secure in place and avoid wind uplift.

.4 Replace damaged or deteriorated geocomposite to acceptance of the Contract Administrator.

3.07 BACKFILLING OF ANCHOR TRENCH

.1 The anchor trench shall be backfilled and compacted by the Installer or by the Contractor under the Supervision of the Installer. Trench backfill material shall be placed in 150 mm thick lifts and compacted by light compaction equipment.

.2 Care shall be taken backfilling the trenches to prevent any damage to the geomembrane or geotextiles. At no time shall construction equipment come into direct contact with the geomembrane or geotextiles. If damage occurs, it shall be repaired by the Installer prior to the completion of backfilling.

3.08 CLEANING

.1 Separate waste materials for reuse and recycling.

.2 Upon completion of the work, the Contractor shall remove from the site surplus or discarded materials and dispose at location designated by the City.

.3 Clean and reinstate the site affected by work to a condition that existed prior to commencement of work, or City's satisfaction.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Section 31 05 19.15 – Geotextiles.

.2 Section 31 05 19.20 – Geocomposite.

.3 Section 31 23 33.01 – Excavation and Fill.

.4 Section 31 35 26.13 - Recompacted Clay Base.

.5 Section 31 35 26.16 – HDPE Liner.

.6 Section 33 41 17 - Leachate Collection System.

1.02 MEASUREMENT AND PAYMENT

.1 Geosynthetic Clay Liner (GCL)

.1 Measurement Basis: Area of material shall be measured in square meters (m^2) of 3-dimensional surface area supplied and installed, measured by 10 m x 10 m grid spacing. Only the area approved for GCL will be measured.

.2 Payment Basis: Unit rate for the supply and installation of GCL will be measured in square metres (m^2) of surface covered.

.1 Overlap or seaming is considered incidental, and no extra payment will be made.

1.03 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM D3776, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.

.2 ASTM D4643, Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating.

.3 ASTM D5887, Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.

.4 ASTM D5888, Practice for Storage and Handling of Geosynthetic Clay Liners.

.5 ASTM D5889, Practice for Quality Control of Geosynthetic Clay Liners.

.6 ASTM D5890, Test Method for Swell Index of the Clay Mineral Component of Geosynthetic Clay Liners.

.7 ASTM D5891, Test Method for Fluid Loss of the Clay Component of Geosynthetic Clay Liners.

.8 ASTM D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

.9 ASTM D5993, Standard Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners.

.10 ASTM D6243, Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.

.2 City of Winnipeg Standard Construction Specifications:

.1 CW3110 - Sub-Grade, Sub-Base and Base Course Construction.

.2 CW3120 – Installation of Subdrains.

.3 CW3130 – R5 – Supply and Installation of Geotextile Fabrics.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the following action submittals minimum 4 weeks before starting work of this Section:

.1 Material origin including supplier's name and production plant and identifications including brand name and number of GCL.

.2 Identification of Bentonite used for production of GCL.

.3 Specification for GCL which includes properties published by manufacturer measured using specified test methods.

.4 Written certification that minimum values given in Specification are guaranteed by Manufacturer.

.5 Quality Control (QC) certificates, signed by manufacturer. The certificates shall include roll identification numbers, testing procedures, and results of quality control tests.

.6 QC tests shall be performed in accordance with test frequencies listed below:

Test Method	Test Method Property	Test Frequency
ASTM D5890	Bentonite Free Swell	50 tons
ASTM D5891	Bentonite Fluid Loss	50 tons
ASTM D6496	GCL Peel Strength	4,000 m^2
ASTM D5887	GCL-Index Flux	25,000 m^2
ASTM D5887	CGL-Hydraulic Conductivity	25,000 m^2
ASTM D5993	Benotonite Mass/Area	4,000 m^2
ASTM D6768	GCL Grab Strength	20,000 m^2

.7 Proposed installation panel layout identifying seams and details. The working drawings shall be in the form of an overlay to the construction drawings and shall indicate roll number, sizes, and positioning of rolls.

.8 Resume of the qualifications of the Installation Supervisor to be assigned to the proposed project.

.9 Verification that needle-punched non-woven geotextiles have been inspected continuously for broken needles.

.2 Submit the following action submittals during the completion of the Work as outlined in this Section:

.1 Daily reports shall be submitted by the Contractor, documenting work accomplished the previous day including all personnel and equipment on site, quantities of materials received, panels placed, seams completed, tests performed, repairs made, weather conditions and other applicable comments relevant to the progress of the work. The identification number, location, date and roll number of each panel deployed should be noted.

.2 Prior to field installation of the GCL, the Contractor shall submit a written acceptance - indication that the surface on which the GCL is to be placed is acceptable. Installation shall not commence until this certification is submitted to and approved by the Contract Administrator.

.3 Submit Field Quality Control submittals as per Section 3.05.

.4 The following items are to be submitted at the completion of Work:

.1 All quality control destructive and non-destructive test results indicating the installed materials have passing results.

.2 As-built drawings (panel layout), quantities and record of repairs one week after completion of install.

.3 Written 1-year warrantee that the entire work constructed by the Contractor and Supplier is free of defects in materials and workmanship.

.5 Coordinate the installation of GCL with geomembrane and granular drainage blanket installation.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's recommendations:

.1 Inspect GCL, upon delivery, to confirm materials have good appearance qualities and are free from defects that might affect their specific properties.

.2 During storage, GCL rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 160°F (71°C), and any other environmental condition that may damage the property values of the GCL.

.2 Surface observations will be conducted during acceptance of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.

.3 Damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.

.4 Product labels shall clearly show the manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.

.1 Rolls or portions of rolls without identification labelling at the time of delivery will be rejected and shall be removed from site.

.5 The GCL shall be handled with equipment which does not make contact with the material.

.6 The City will provide on-site storage area for GCL rolls from the time of delivery until installation.

1.06 WARRANTY

.1 Refer to Part D- Supplemental Conditions: Warranty.

.2 Provide 1 year manufacturer's warranty.

.3 Include coverage for:

.1 Defective product found to be not in compliance with the requirements of this Section.

.2 Replacement of the GCL with new material including costs associated with GCL installation.

2 PRODUCTS

2.01 MATERIALS

.1 Geosynthetic Clay Liner

.1 GCL: Geotextile outer layers with core of natural sodium bentonite clay. The top layer consists of a staple fiber non-woven geotextile. The bottom layer consists of a woven geotextile. The product must be chemically resistant to landfill leachate to maintain hydraulic conductivity performance.

Property	Test Method	Minimum Average Value
Geotextile		
Top Layer	-	Nonwoven
Top Mass/Unit Area	ASTM D5261	200 g/m^2
Bottom Layer	-	Scrim Nonwoven
Bottom Mass/Unit Area	ASTM D5261	200 g/m^2
Bentonite		
Swell Index	ASTM D5890	24 ml/2g (min.)
Fluid Loss	ASTM D5891	18 ml (max.)
Moisture Content	ASTM D5993	35 % (max.)
GCL		
Bentonite Mass (0% moisture)	ASTM D5993	3.66 kg/m^2
Tensile Strength	ASTM D6768	8.8 kN/m (min. avg.)
Peel Strength	ASTM D6496	928 N/m (min. avg.)
Hydraulic Conductivity	ASTM D5887	5x10^{-9} cm/s (max.)
Index Flux	ASTM D5887	1 x 10^{-8} m^3/m^2/s (max.)
Internal Shear Strength	ASTM D6243	24 kPa

3 EXECUTION

3.01 INSTALLATION

.1 The Contractor shall not remove the protective wrapping from the GCL until the surface it is to be deployed on has been documented.

.2 The GCL shall be installed in accordance with the manufacturer's instructions, project plans and approved installation drawings.

.3 Before the work begins, the Contractor shall inspect all GCL rolls for damage during transit. Damaged materials that can be repaired may be used when approved in writing by the Contract Administrator.

.4 The Installer, on a daily basis, shall inspect and certify that the surface on which the GCL will be installed is acceptable. After the supporting soil surface has been accepted, it shall be the Installer's responsibility to indicate to the Contract Administrator any change to its condition due to natural causes or occurrences that may require repair work.

.1 The surfaces to be lined shall be smooth and free of any debris, vegetation, roots, sticks, sharp rocks, or other deleterious materials larger than 25 mm as well as free of any voids, large cracks or standing water or ice.

.2 Prior to deployment of the GCL, the recompacted clay base shall be final graded to fill remaining voids or desiccation cracks, and smooth-drum-rolled to eliminate sharp irregularities or abrupt elevation changes. The surfaces to be lined shall be maintained in this smooth condition.

.5 While unwrapping the GCL material for use and placement, the Contractor shall visually inspect all materials, particularly surfaces for imperfections and faulty areas. All such defective places shall be marked and recorded. Inspection and approval by the Contract Administrator shall be obtained prior to any repair work, which shall be conducted in accordance with the approve methods.

.6 Only GCL materials, which can be installed during the same day's work, shall be unwrapped.

.7 GCL panels should be placed with the non-woven side up on slopes to maximize the shear strength characteristics.

.8 Where possible, all slope panels should be installed parallel to the maximum slope while panels installed in flat areas require no particular orientation.

.9 The Contractor shall shingle the GCL panels down the slope.

.10 Reinforced GCL shall be used on slopes as well as the flat areas to ensure the GCL withstands the rigors of the installation and subsequent low load hydration.

.11 Deployments should proceed from the highest elevation to the lowest to facilitate drainage in the event of precipitation.

.12 Overlap GCL seams a minimum of 300 mm on panel edges and 600 mm on panel ends after shrinkage and free of wrinkles, folds or "fish mouths" before placing cover. All joints shall be sealed with granular bentonite as per manufacturer's recommendations.

.13 All GCL materials shall be placed to the limits as shown in the construction drawings.

.14 The Contractor shall only deploy GCL material in one day that can be covered by the end of that day. No GCL shall be left exposed overnight. The exposed edge of the GCL shall be covered by a temporary tarpaulin or other such water-resistant sheeting until the next working day.

.15 Repair perforations or cuts in GCL with additional GCL layer extending 300 mm past edge of perforation or cut in each direction.

.16 Handle rolls to minimize loss of Bentonite along edges during deployment.

.17 Remove GCL exposed to moisture and prematurely hydrated prior to placement of overlying material and replace with new GCL.

3.02 RESPONSIBILITIES OF CONTRACTOR

.1 No equipment or tools shall damage the GCL by handling, trafficking or other means.

.2 No personnel working on the GCL shall wear damaging shoes or engage in other activities that could damage the GCL.

.3 The methods used to unroll the panels shall not cause damage to the GCL and shall not damage the supporting soil or underlying recompacted clay liner.

.4 The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Locations of any wrinkles shall be identified on the Contractor's and Inspector's drawings. All defects shall be marked and documented for repairs. The total number of defects shall not exceed ten (10) per 500 m^2. If greater than 10 defects exist, the panel shall be rejected. Defects are defined as any abnormalities that affect the physical properties of the GCL material.

.5 Adequate loading (e.g. sandbags or similar items that will not damage the GCL) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

.6 Direct contact with the GCL shall be minimized, i.e. the GCL in traffic areas shall be protected by geotextiles, extra geomembrane or other suitable materials.

.7 Proper data sheets are to be completed as per manufacturer's instructions.

.8 Final placement of material shall be surveyed by the Contractor and approved by the Contract Administrator.

3.03 GCL ACCEPTANCE

.1 The Contractor shall retain all ownership and responsibility for the installed GCL until acceptance by the Contract Administrator. The GCL shall be accepted by the Contract Administrator when all of the following conditions are met:

.1 Installation is completed;

.2 Verification of the adequacy of all field seams and repairs is complete;

.3 Documentation of completed installation, including all submittals and reports, is complete.

3.04 WEATHER CONDITIONS

.1 GCL deployments shall proceed between ambient temperatures of 5 degrees C to 35 degrees C. Placement can proceed below 5 degrees only after it has been verified by the Installer and the Inspector that the material can be seamed according to the specifications. GCL seaming shall not be done during any precipitation, in the presence of excessive moisture (e.g. fog, rain, dew) or in the presence of excessive winds as determined by the Installation Supervisor.

.2 Weather will be recorded during all installation operations.

.3 Data sheets are to be completed as per manufacturer's instructions.

3.05 FIELD QUALITY CONTROL

.1 Contractor shall inventory GCL rolls and obtain laboratory samples.

.2 Two samples of GCL shall be collected during the project and shall be tested for:

.1 Moisture Content: ASTM D4643.

.2 Bentonite Mass per unit area: ASTM D5993.

.3 Permeability: ASTM D5887.

.4 Fluid Loss of Clay Component of GCL: ASTM D5891.

.5 Swell Index of Clay Mineral Component of GCL: ASTM D5890.

.3 Material not meeting Specification shall be rejected and removed from site at Contractor's expense. Retesting at Contractor's expense may be performed to limit rejection to specific rolls.

.4 The Contractor shall be responsible for the quality of all furnished items, including the complete documentation and record of the field QA/QC program. The program shall cover all the items intended for shop inspection, field supervision and the procedures for carrying out the same. The program shall define a system for identification of all materials through manufacture to delivery at site.

.5 The GCL shall be comprised of materials manufactured of new, first quality products designed and manufactured specifically for the purpose of the Work and shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

.6 The GCL materials shall be produced to be free of holes, tears or any sign of contamination by foreign material.

.7 Visual inspection of the GCL placement and seams shall be made by the Contractor as the installation progresses and again on completion of the installation. Defective and questionable areas shall be clearly marked, repaired and recorded.

3.06 CLEANING

.1 Upon completion of the work, the Contractor shall remove from the site surplus or discarded materials and dispose at location designated by the City.

.2 Clean and reinstate the site affected by work to a condition that existed prior to commencement of work, or City's satisfaction.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Section 31 05 16 – Aggregates Materials

.2 Section 31 32 19.16 – Geotextiles

.3 Section 31 35 26.13 – Recompacted Clay Base

.4 Section 31 35 26.16 – HDPE Liner

.5 Section 33 41 17- Leachate Collection System

1.02 MEASUREMENT AND PAYMENT

.1 Topsoil Stripping

.1 Measurement Basis: By cubic meters (m^3) of the in-place quantity removed. Survey will be based on a 10 m x 10 m grid spacing between the original ground and post-stripping surfaces. The clearing and disposal of shrubs and ground cover is incidental to this payment item.

.1 Relocation of Contractor generated stockpiles will not be measured for separately. Should the Contractor choose to stockpile the stripped topsoil and subsoil materials, there will be no separate measurement for excavation from the Contractor generated stockpile.

.2 Payment Basis: Unit price. Includes general excavation, hauling, and stockpiling material in areas as designated by the City.

.2 Rough Grading:

.1 Measurement Basis: By cubic meters (m^3) of the in-place quantity removed. Surveys will be based on a 10 m x 10 m grid spacing between the pre-excavated surface and finished rough grade surface. Only cut areas will be measured for payment. Existing stockpiles are not included in the original ground surface comparison.

.1 Relocation of Contractor generated stockpiles will not be measured for separately. Should the Contractor choose to stockpile the rough grading materials, there will be no separate measurement for excavation and hauling form the Contractor generated stockpile.

.2 There will be no separate measurement and payment for the Contractor to load, haul, stockpile, and trim excess rough grading soils from the site areas to locations on site approved by the City.

.2 Payment Basis: Unit price. Includes general excavation, hauling, placing, moisture conditioning, compacting, and trimming to the lines, grades, slopes and elevations shown on the drawings.

.1 The Contractor shall be aware that the subsurface soils on site are mixed and will include clay soil and silt. The Contractor is required to separately manage soils by material type, and stockpile in locations directed by the City.

.2 No payment will be made for over-excavated work or for replacement materials.

.3 Over-Excavation and Replacement Due to Unsuitable Material:

.1 Measurement Basis: Measurement will be based on the cubic meters (m^3) of the quantity removed for replacement as approved by the Contract Administrator.

.2 Payment Basis: Unit Price. Includes general excavation, hauling, and replacing with suitable material, moisture conditioning, compacting, and trimming to the lines, grades, slopes and

elevations shown on the drawings.

.4 Perimeter Berm:

.1 Measurement Basis: By linear meter of perimeter berm constructed.

.2 Payment Basis: Unit price. Includes general hauling, placing, moisture conditioning, compacting, and trimming to the lines, grades, slopes and elevations as indicated on the drawings.

.1 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, Contractor shall pay costs for additional tests or inspections as required by Contract Administrator to verify acceptability of corrected work.

.2 No payment will be made for unauthorized over-excavated work or for replacement materials.

.5 Perimeter Ditch and Containment Berm:

.1 Measurement Basis: By linear meter of ditching and containment berm constructed.

.2 Payment Basis: Unit price. Includes general ditch excavation, hauling, placing, moisture conditioning, compacting, and trimming to the lines, grades, slopes and elevations shown on the drawings.

.1 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, Contractor shall pay costs for additional tests or inspections as required by Contract Administrator to verify acceptability of corrected work.

.2 No payment will be made for unauthorized over-excavated work or for replacement materials.

.6 Access Approaches and Road:

.1 Measurement Basis: By square meter (m^2) of the approved access approaches and road surface area. The area shall be measured by 10 m x 10 m grid spacing. Only the area approved for the access approaches and roads will be measured.

.2 Payment Basis: Unit price. Includes general hauling, placing, moisture conditioning, compacting, grading road ditches, and trimming to the lines, grades, slopes and elevations shown on the drawings.

.1 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, Contractor shall pay costs for additions tests or inspections as required by Contract Administrator to verify acceptability of corrected work.

.7 Intermediate Berm:

.1 Measurement Basis: By linear metre of intermediate berm constructed.

.2 Payment Basis: Unit price. Includes general excavation, hauling, placing, moisture conditioning, compacting, and trimming to the lines, grades, slopes and elevations shown on the drawings.

.8 Topsoil Placement

.1 Measurement Basis: By square meters (m^2) of topsoil placed in 150 mm thick layer in ditches.

.2 Payment Basis: Unit price. Includes hauling from on-site stockpiles and placing to the lines, grades, slopes and elevations shown on the drawings. Payment will only be made for the areas approved for topsoil placement.

1.03 DEFINITIONS

.1 Common Excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Rock Excavation: defined as all individual boulders, concrete masses over 1 m3 in volume, or bedrock, including concrete and masonry structures, concrete pavement, concrete curb and sidewalks which does not require for its removal drilling, blasting, wedging, sledging, or barring or breaking with a power operated hand tool.

.3 Unclassified Excavation: excavation of deposits of whatever character encountered in Work.

.4 Topsoil:

.1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.

.5 Waste Material: Excavated material other than organic material that the Contract Administrator deems unsuitable for use in Work or surplus to requirements. Includes soft and yielding material, refuse/garbage and debris.

.6 Borrow Material: Material obtained from locations outside area to be graded and required for construction of fill areas or for other portions of Work.

.7 Recycled Fill Material: Material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.8 Unsuitable Materials:

.1 Frozen, wet, weak, chemically unstable, and compressible common materials which may include stumps, trees, roots, rubbish, sod, topsoil or other organic materials.

.2 Materials that cannot be compacted to the specified degree of compaction or have the potential for changing geotechnical properties.

.9 SMDD: Standard Maximum Dry Density and in the context of this Contract means the maximum dry unit weight determined according to ASTM D698.

.10 Select Compacted Backfill: Clean excavated clay soil, free of organics including roots, weeds, topsoil, foreign material, and stones greater than 150 mm; and approved by Contract Administrator. To be used as backfill, as approved by Contract Administrator.

.11 Uncompacted Clay Cover: Clean excavated clay soil, free of organics including roots, weeds, topsoil, foreign material, and stones greater than 150 mm; and approved by Contract Administrator to be placed uncompacted over leachate cleanout pipes and leachate withdrawal pipes.

1.04 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM C117-23, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in

Mineral Aggregates by Washing

.2 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

.3 ASTM D698-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (600 kN-m/m^3)

.4 ASTM D1557-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (2,700 kN-m/m^3)

.5 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

.2 City of Winnipeg Standard Construction Specifications:

.1 CW1120 - Existing Services, Utilities and Structures

.2 CW2030 – Excavation Bedding and Backfill

.3 CW3110 – Sub-Grade, Sub-Base and Base Course Construction

.4 CW3130 – Supply and Installation of Geotextile Fabrics

.5 CW3135 – Supply and Installation of Geogrid

.6 CW3170 - Earthwork and Grading

.7 CW3540 – Topsoil and Finish Grading for Establishment of Turf Areas

1.05 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling:

.1 Topsoil Layer placement shall commence as soon as possible following survey and acceptance by the Contract Adminstrator of the underlying graded surface of the placement areas.

.2 Schedule seeding survey of HDPE liners immediately following completion. The HDPE may not be covered by subsequent layers until survey has been completed.

.2 Coordination:

.1 Coordinate seeding topsoil placement with the seeding of ditches and berms.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

.1 Contract Administrator Submit Quality Control documentation a minimum 4 weeks before starting work of this Section including the following:

.1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.

.2 Submit for review by Contract Administrator proposed dewatering methods as described in PART 3 of this Section.

.3 Submit to Contract Administrator written notice at least 7 days prior to excavation work, to ensure cross sections are taken.

.4 Submit to Contract Administrator written notice when bottom of excavation is reached.

.2 Preconstruction Submittals:

.1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.

.2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field, clearance record from utility authority, location plan of relocated and abandoned services, as required.

.3 Health and Safety Requirements:

.1 Complete health and safety in accordance with Section B13.4 – Qualifications and Section D13 – Safe Work Plan of the City's Tender document.

.4 Qualification Statement: submit proof of insurance coverage for professional liability.

.5 Surveys for Quality Assurance shall be carried out by the Contractor for monitoring lift thickness and constructing to the design grades, and to establish positive drainage. Tolerance of +/-50 mm vertical and +/- 100 mm horizontal control.

.6 Quality Assurance testing of materials and compaction testing records will be carried out by the Contract Administrator.

.1 The Contractor shall make the Contract Administrator's test locations available and shall keep equipment away from the test location for the duration of tests.

.2 Failure to Meet Specified Requirements: If tests indicate that material specifications have not been achieved or cannot be obtained with equipment in use, procedure being followed, or material being incorporated, remove and replace work and modify operations so that equipment, procedures, and materials will produce required results. Additional testing required by Contract Administrator will be at no additional cost to the City.

.7 Construction Quality Assurance testing will be completed at intervals as follows:

Test	Test Method	Minimum Testing Frequency	Responsible Party
Construction Procedures	Observation	Continuous	Contract Administrator/Contractor
Number of Passes of Compaction Equipment	Observation	Continuous	Contract Administrator/Contractor
Pulverization of Clods	Observation	Continuous to less than 5 cm	Contract Administrator/Contractor
Water (Moisture) Content (Nuclear)	ASTM D6938-23	10/hectare/lift or 1/50m/lift to meet +/-2% Optimum Moisture Content (OMC) or 1/50m/lift	Contract Administrator
Density (Nuclear)	ASTM D6938-23	10/hectare/lift or 1/50m/lift to meet 98% Standard Maximum Dry Unit Weight (SMDD)	Contract Administrator
Grading and Uniformity	Survey controls and observations	Continuous laser control, verified daily by survey, 200 mm loose thickness, or 20 x 20 m survey grid	Contractor, note survey for payment is required to be on a 10 m x 10 m grid

1.07 EXISTING CONDITIONS

.1 Examine soil report "City of Winnipeg Brady Road Resource Management Facility Area B Design – Geotechnical Report" available from the City.

.2 Buried services:

.1 Before commencing work establish location of buried services on and adjacent to site.

.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work. Pay costs of relocating services.

.3 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.4 Before beginning excavation Work, notify applicable authorities having jurisdiction; establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during Work.

.5 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.6 Where utility lines or structures exist in area of excavation, obtain direction of Contract Administrator before removing or re-routing.

.7 Record location of maintained, re-routed and abandoned underground lines.

.8 Confirm locations of recent excavations adjacent to area of excavation.

2 PRODUCTS

2.01 MATERIALS

.1 Low permeable soil for construction of the Perimeter Berm and Intermediate Berm is to be obtained from excavation of the Works or on-site stockpiles.

.2 Low permeable soil material shall be excavated and temporarily stockpiled, if necessary, and hauled to the work area in volumes required to construct the Recompacted Clay Base or excavated and placed directly for construction of the Recompacted Clay Base.

.3 Use low permeable soil that is free of unsuitable materials, is of sufficient low permeability, and is stable when placed and compacted as specified.

.4 Topsoil is to be obtained from on-site stockpiles.

2.02 SITE PREPARATION

.1 Remove obstructions, ice, and snow from surfaces to be excavated within limits indicated.

2.03 PREPARATION / PROTECTION

.1 Locate, identify, and protect utilities that remain from damage. Confirm locations of buried utilities and structures by careful test excavations or other suitable means.

.2 Arrange for utility company to identify utilities.

.3 Identify required lines, levels, contours, and datum locations.

.4 Keep excavations clean, free of standing water and loose soil.

.5 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Contract Administrator approval.

.6 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.7 Protect buried services that are required to remain undisturbed.

2.04 STRIPPING OF TOPSOIL

.1 Begin topsoil stripping of areas of Work as indicated on the Drawings.

.1 Do not mix topsoil with subsoil.

.2 Stockpile in locations as directed by the City.

.1 Stockpile height not to exceed 2 m and should be protected from erosion.

2.05 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.

.2 Provide for Contract Administrator's review details of proposed dewatering of excavations, as applicable.

.3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water as directed by the City to approved collection or runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

2.06 EXCAVATION

.1 Advise Contract Administrator at least 7 days in advance of excavation operations to ensure the existing conditions survey is taken.

.2 Excavate to lines, grades, elevations and dimensions as indicated by Drawings.

.3 Excavations shall be shored, braced or cutback to ensure safe entry into excavation.

.4 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Contract Administrator.

.5 Restrict vehicle operations directly adjacent to open trenches.

.6 Do not obstruct flow of surface drainage or natural watercourses.

.7 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.8 Notify Contract Administrator when bottom of excavation is reached.

.9 Obtain Contract Administrator approval of completed excavation.

.10 Remove unsuitable material from side slopes, cell base, and trenches including those that extend below required elevations to extent and depth as directed by Contract Administrator.

.1 Inform Contract Administrator of unacceptable conditions immediately upon discovery. Excavate unsatisfactory material to a maximum depth of 1.0 m measured perpendicular to the surface, or until suitable material is encountered as directed by the Contract Administrator. All backfilled over excavation shall be recompacted in lifts not exceeding 150 mm compacted material to a minimum SMDD of 98%.

.11 Correct unauthorized over-excavation as follows:

.1 Fill compacted to not less than 98% of corrected SMDD.

.12 Hand trim, make firm and remove loose material and debris from excavations.

.1 Where material at bottom of excavation is disturbed, compact soil to density at least equal to undisturbed soil.

2.07 FILL TYPES AND COMPACTION

.1 Use types of fill as indicated by Drawings. Compaction densities are percentages of SMDD obtained from ASTM D698-12(2021).

.2 Trenches:

.1 Contractor shall be responsible for compaction of backfill in trenches to a minimum of 95%

of the SPMDD and +/- 2% of the Optimum Water Content (OWC) unless otherwise indicated by contract documents as well as the correction of settlement during the maintenance period of the Contract. Mechanical compaction equipment shall not be used until there is sufficient cover to prevent damage to the pipe.

.2 Contractor to place backfill in lifts not exceeding 150 mm compacted thickness.

.3 Compaction results shall be based on a minimum of two density tests per 50 metres of trench for each lift of compacted vertical backfill, with the exception of granular backfill if used. Additional tests may be called for by the Contract Administrator as deemed necessary.

.4 If a density test fails, the trench shall be moisture conditioned and re-compacted to meet the specified density.

.3 Embankments, Perimeter Berms, Roads and Containment Berms:

.1 All material in embankments shall be spread and bladed smooth in successive layers, not exceeding 150 mm compacted thickness and to the full width of the cross section.

.2 Contractor shall be responsible for compaction of embankments and berms by means approved by the Contract Administrator to a minimum of 95% of the SPMDD and +/- 2% of the Optimum Water Content (OWC) unless otherwise indicated by contract documents. The Contractor shall be responsible for the correction of settlement during the maintenance period of the Contract.

.3 Materials placed in the upper 300 mm of embankments shall not contain rock which has a diameter larger than half the lift thickness.

.4 Compaction over the entire surface area of each layer shall be obtained by equipment to meet the specified density requirements. Hauling equipment will not be accepted in lieu of compaction equipment. Compaction to the specified density shall be obtained uniformly throughout each layer.

.5 Where water content tests indicate that the material is above the allowable OWC, the material shall be thoroughly worked until its OWC is reached or as directed by the Contract Administrator.

.6 Where water content tests indicate that the material is below the allowable OWC, the material shall be thoroughly disked and broken down, water added in amounts as required, and the material thoroughly worked to mix the water uniformly throughout the material prior to commencing compaction operations. The type of water hauling, and spraying equipment used shall be satisfactory to the Contract Administrator.

.4 This testing in no way relieves the Contractor of maintenance responsibilities with respect to settlements as specified. The Contractor shall repair any settlement and damaged surface improvements due to settlement which occurs until final acceptance of the Works.

.5 The cost of all initial testing will be borne by the Contract Administrator. Non-conformity with the specified density or moisture content shall constitute sufficient grounds for rejection of the Work.

2.08 TOPSOIL PLACEMENT

.1 Contract Administrator will verify that the grades are correct prior to Contractor commencing placement of topsoil.

.2 Ground shall be free of standing water and frozen material prior to placement of topsoil.

.3 Do not place topsoil during a rainfall event.

.4 Special care shall be taken to avoid mixing topsoil with the underlying soil.

.5 Place topsoil to a minimum depth of 150 mm in all areas, measured perpendicular to the surface.

.6 Finish grade the Topsoil Layer surface to a tolerance of plus 75 mm to minus 0 mm of the grades shown on the Construction Drawings and to eliminate rough and low areas and provide positive drainage, taking care to avoid further compacting the emplaced Topsoil Layer.

.7 Avoid operating heavy equipment on Topsoil Layer that has been placed and finish-graded.

.8 Topsoil layer must be harrowed prior to commencing seeding.

.9 Texture Topsoil Layer on slopes in a cross-slope fashion to prevent downslope preferential channels that could promote erosional rill or gully formation.

.10 Control dust, as required, to mitigate the impact of ambient dust generated on site.

2.09 FIELD QUALITY CONTROL

.1 Monitor weather conditions during construction to avoid placing fill during adverse weather such as heavy rain, snow, or freezing temperatures which could affect compaction or moisture content.

.2 Adjust the moisture content of the fill using water trucks or allowing to dry in the sun to reach specified water content ranges.

.3 Implement measures to prevent erosion or desiccation of the fill due to high wends or high temperatures.

.4 Ensure the layers of embankments bond properly at interfaces to avoid voids and gaps.

2.10 BACKFILLING

.1 The type of compaction equipment shall be chosen with regard to minimizing the vibration effect on nearby buildings and utilities. The Contractor shall inspect the condition of buildings prior to construction. The Contract Administrator shall have the right to request the Contractor to replace any damage caused to buildings and utilities due to construction.

.2 Do not proceed with backfilling operations until completion of the following:

.1 Contract Administrator has inspected and approved installations.

.2 Contract Administrator has inspected and approved of construction below finish grade.

.3 Inspection, testing, approval, and recording location of underground utilities.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material which is frozen or contains ice, snow, boulders, rock, organic material or debris.

.5 Backfill areas to contours and elevations as shown on the Drawings. Use unfrozen and unsaturated materials.

.6 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated by Construction Package. Compact each layer before placing succeeding layer.

.7 Protect geomembrane and geotextiles during placement operations.

.8 Remove sheeting and shoring required during excavation during backfilling operations. Do not remove bracing until backfilling has reached the respective level of such bracing. Pull sheeting in increments that will ensure compacted backfill is maintained at an appropriate elevation above toe of sheeting

2.11 PROTECTION

.1 Prevent displacement or loose soil from falling into excavation; maintain soil stability.

.2 Protect bottom of excavations from freezing.

.3 Protect structures, utilities, and other facilities from damage caused by settlement, lateral

movement, undermining, washout, and other hazards created by earth operations.

.4 Verify that survey benchmarks and intended elevations for Works are as shown on the Drawings.

.5 Reshape and re-compact fills subjected to vehicular traffic.

.6 Protect pipe and bedding from damage or displacement until backfilling operation is complete.

2.12 CEANING

.1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Contract Administrator.

.2 Clean and reinstate areas affected by Work as directed by Contract Administrator.

.3 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

.4 Upon completion of backfilling, remove excess material and debris from work areas and travel routes

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Section 31 05 19.23 – Geosynthetic Clay Liners.

.2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

.3 Section 31 35 26.16 – HDPE Liner.

.4 Section 33 41 17 - Leachate Collection System.

1.02 MEASUREMENT AND PAYMENT

.1 Recompacted Clay Base:

.1 Measurement Basis: Recompacted Clay Base (RCB) smooth-drummed areas measured in a 10 m by 10 m 3-dimensional survey grid in place using the surface area to the inside of the crest of the perimeter berm slopes. All other surveys requested by the Contract Administrator are considered incidental.

.2 Payment Basis: Unit price per metre (m^2) of actual area measurements computed by the Contractor for the RCB. As specified in the contract, which includes the cost of scarifying recompacting, smooth drumming, grading, and trimming of 150 mm of clay to meet required specifications as shown in the Drawings.

.1 Payment includes any aeration and/or moisture conditioning of soil to achieve satisfactory compaction conditions.

.2 Payment includes removal of unsuitable soil material and removal of rocks exceeding 75 mm in diameter.

1.03 REFERENCE STANDARDS

.1 Definitions:

.1 SMDD: Standard Maximum Dry Density and in the context of this Contract means the maximum dry unit weight determined according to ASTM D698.

.2 Unsuitable Material: materials which are not approved for use as determined by the Contract Administrator and include the following:

.1 Refuse, asphalt, concrete, or granular materials.

.2 Material containing loam, roots, or organic matter.

.3 Frozen material or material containing snow or ice.

.4 Clays which are classified as inorganic clays of high plasticity in accordance with applicable ASTM specifications.

.5 Soft and/or organic clays and silts of low strength.

.6 Swelling clays.

.7 Rock and lumps of material with dimensions greater than 12.5 mm.

.8 Wire, steel, cast iron, cans, drums, or other foreign material.

.2 ASTM International (ASTM):

.1 ASTM D698-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

.2 ASTM D1557-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

.3 ASTM D4318-17el, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.4 ASTM D6938-23, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

.5 ASTM D4643-17, Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating.

.6 ASTM D6913/D6913M-17, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

.7 ASTM D2216-19, Standard Test Methods for Laboratory Determination of Water (Moisture) Soil and Rock by Mass.

.8 ASTM D5084-24, Standard Test Methods for measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter.

.3 City of Winnipeg Standard Construction Specifications:

.1 CW3110 – Sub-Grade, Sub-Base and Base Course Construction.

1.04 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling:

.1 Sequence and schedule RCB activities with Work of other Sections.

.2 Perform construction of the RCB subsequent to excavation and approval of cell excavation by the Contract Administrator.

.3 Schedule RCB compaction when frost is not present in ground or stockpiled material.

.4 Schedule survey of RCB immediately following completion. The RCB may not be covered until survey has been verified by the Contract Administrator that design grades are met, and the final surface is smooth for geomembrane installation.

.5 Construct and maintain the RCB surface finishing in such a manner to facilitate installation of the HDPE liner over the completed RCB as soon as practicable.

.6 Do not allow or cause any of the Work performed to be covered up or enclosed prior to required inspections, tests, or approvals.

.2 Coordination:

.1 Obtain approval from Contract Administrator and HDPE Liner manufacturer's representative or installer, for acceptance of the RCB surface finishing prior to placing of Geosynthetic Clay Liner and HDPE Liner.

.2 Verify rough grading work is coordinated with erosion and sedimentation control measures in outlined in Section E4 – Site Development and Restoration.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit surveys for the RCB on a 10 m x 10 m grid spacing.

.2 Submit Construction Execution Plan. The Construction Execution Plan shall detail the following information at a minimum:

.1 Scope of Work.

.2 Summary of each task to complete the work with details including but not limited to equipment, means of execution, estimated production per day, target schedule (days), materials, and sub-contractors (if applicable).

.1 Tasks to be listed in order of execution start dates.

.3 Reference to construction schedule Bar (GANTT) Chart.

1.06 QUALITY ASSURANCE

.1 Survey controls established by Contractor to be used for monitoring lift thicknesses, lateral and vertical dimensions of the RCB construction.

.2 Surveys for Quality Assurance shall be carried out by the Contractor. Tolerance of +25 mm vertical and +/- 10 mm horizontal control **MUST** be met. The Contractor is solely responsible for correcting grade alignments that do not meet the design intent.

.3 Quality Assurance testing of materials and compaction testing records will be carried out by the Contract Administrator.

.4 The Contractor shall make Contract Administrator's test locations available and shall keep equipment away from the test location for the duration of tests.

.5 The Contract Administrator shall be permitted to collect Shelby Tube samples from the completed Compacted Clay Liner for hydraulic conductivity analysis. Analysis results confirming achievement of a hydraulic conductivity of 1×10^{-7} cm/s or less is recommended prior to covering the Compacted Clay Liner with the HDPE Liner.

.6 Construction Quality Assurance testing will be completed at intervals as follows:

Test	Test Method	Minimum Testing Frequency	Responsible Party
Construction Procedures	Observation	Continuous	Contract Administrator/Contractor
Number of Passes of Compaction Equipment	Observation	Continuous	Contract Administrator/Contractor
Pulverization of Clods	Observation	Continuous to less than 5 cm	Contract Administrator/Contractor
Water (Moisture) Content (Nuclear)	ASTM D6938-23	13/hectare/lift to meet +2% to +4% Optimum Water Content (OWC)	Contract Administrator
Density (Nuclear)	ASTM D6938-23	13/hectare/lift to meet 95% Standard Maximum Dry Density (SMDD)	Contract Administrator
RCB Thickness	Survey Controls	Visual assessment	Contract Administrator
RCB Grade and Uniformity	Survey controls and observations	Continuous laser control, verified daily by survey, 200 mm loose thickness, or 20 x 20 m survey grid	Contractor, note survey for payment is required to be on a 10 m x 10 m grid
Grain Size Analysis	ASTM D4318-17	Once per 4,000 m3 or with a change in material type.	Contract Administrator
Proctor Test	ASTM D698-12	Once per 4,000 m3 or with a change in material type.	Contract Administrator

1.07 EXISTING CONDITIONS

.1 Examine soil report “City of Winnipeg Brady Road Resource Management Facility Area B Design – Geotechnical Report” available from the City.

2 PRODUCTS

2.01 MATERIALS

.1 Material for the recompacted clay base is to be native material at the design elevations.

.2 If the clay found at the design elevations of Cell 35 is found to be unsuitable for a recompacted clay base, the native material will need to be excavated and replaced with low permeability clay material sourced from the excavation of Cell 35 and/or on-Site stockpiles and may require processing/segregation. The Contractor will be required to use this soil and identify their selected method(s) for processing/segregation in the detailed Construction Execution Plan.

.1 Clay material must be free of unsuitable materials, is of sufficient low permeability, and is stable when placed and compacted as specified. Material that is unsuitable for RCB construction to be excavated and stockpiled in locations approved by the City.

.3 RCB shall be constructed from on-site low permeability clay as designated in the Drawings. The Contract Administrator shall determine the suitability of materials for use as the RCB. The Contract Administrator will generally use the following criteria to determine the suitability of the compacted clay material:

.1	Liquid Limit	min 30% - max 50% (30% < LL < 50%).
.2	Plastic Index	min 15%.
.3	% Passing 0.080 mm Sieve	min 50%.
.4	Clay Fraction	min 25%.

.4 Contractor shall not reject the use of clay material on the basis of water content. The water content shall be modified on-site by approved mechanical means and/or approved water supplies as required.

.5 Contractor shall remove unsuitable materials including sand, silt and gravel layers, if encountered in the on-site stockpiles, and use in the rough grading layer, or stockpile in a separate location approved by the City. There shall be no separate payment for material separation in the on-site stockpiles by the Contractor.

.6 Contractor shall remove rocks larger than 75 mm in maximum diameter from the clay material prior to compaction. There shall be no separate payment for rock removal for clay cover construction.

.7 There is no water available on-site for Contractor use. It is the responsibility of the Contractor to source and haul all water required for moisture conditioning, dust control and general construction.

3 EXECUTION

3.01 EXAMINATION

.1 Verify that survey benchmarks and intended elevations for Works coincide with those shown on the Drawings.

.2 Do not allow or cause any of the Work performed to be covered up or enclosed prior to required inspections, tests, or approvals.

.3 Obtain approval from the Contract Administrator for completed excavations and previously placed material prior to placement of initial and successive lifts.

.4 Verify that excavations, dimensions, and elevations are as shown on the Drawings

.5 Verify conditions of substrate installed are acceptable for rough grading.

.1 Examine clay material for unsuitable conditions such as clods, rocks, snow, frost, frozen, muddy, large roots, litter, toxic substances, and unstable material.

.2 Verify locations of all underground utilities.

.6 Inform Contract Administrator of unacceptable conditions immediately upon discovery. Excavated unsatisfactory material shall be removed to a maximum depth of 1.0 m measured perpendicular to the surface, or until suitable clay material is encountered as directed by the Contract Administrator. Measurement and payment as per Section 31 23 33.01 – Excavation and Fill.

.7 Proceed with the Work after unacceptable conditions have been remedied.

.8 Provide surveys from RCB surfaces as soon as possible so that the Contract Administrator may verify the grading of the RCB.

3.02 PREPARATION

.1 Remove litter, unsatisfactory and unstable materials.

.2 Protect excavations and trenches from contamination.

.3 Dewatering before or during construction as required.

3.03 GRADING AND COMPACTION

.1 Earthwork operations shall be suspended when the Work cannot be done in accordance with the specifications due to inclement weather. The RCB surface may require reworking as the result of such conditions. No extra payment will be made to the Contractor as a result of such reworking or for suspension of Work activities.

.2 Care shall be taken to prevent clay material from being saturated or contaminated with unacceptable materials. Contaminated material shall be removed and replaced as directed by the Contract Administrator.

.3 The Contractor shall be responsible for loading and hauling water from off-site required for moisture conditioning and compaction purposes. Watering shall be carried out by means of tank trucks or water wagons equipped with spray bars, by hose and nozzle, or by any other means which will provide uniform and controlled application subject to the approval of the Contract Administrator.

.4 RCB material shall be scarified and recompacted in place. In locations where fill is required to meet design grades lift must not exceed 200 mm in loose thickness.

.5 RCB shall be constructed to the lines, grades and dimensions shown in the Drawings. RCB shall be installed, graded and the top surface trimmed to a tolerance of +0 to 75 mm vertical and +/- 100 mm horizontal control. Minimum RCB thickness of 150 mm shall be maintained throughout.

.6 RCB shall consist of stable, homogeneous, low permeability, compacted clay material, and shall not contain stratifications, lenses or pockets. All rocks larger than 75 mm diameter shall be removed from the RCB material prior to compaction of each lift.

.7 RCB material shall be compacted to a minimum of 95% of the Standard Maximum Dry Density (SMDD) between 2% and 4% above the material's optimum water content (OWC).

.8 Compaction of the RCB shall be carried out using large enough compaction equipment to achieve compaction with tamping feet providing full penetration depth through each lift as approved by the Contract Administrator. Hauling equipment will not be accepted in lieu of compaction equipment.

.9 The Contractor shall scarify, and moisture condition the surface of the previous lift of RCB prior to placing the next lift, to achieve proper bonding between lifts as required. The extent of scarification and moisture conditioning shall be to the satisfaction of the Contract Administrator.

.10 Construct RCB to levels, profiles, and contours preparing for post grading processes as indicated on Drawings.

.11 Removal and replacement of areas that do not meet Quality Assurance requirements, at no additional costs.

.12 Removal of sharp protruding rocks from the final surface of the Clay Liner.

3.04 MOISTURE CONTENT

.1 Maintain the moisture content throughout the RCB as uniformly as practicable.

.2 In the case of RCB material, which is too dry or too wet, including uncompacted RCB material, adjust the moisture content by methods approved by Contract Administrator.

.3 The RCB must be watered as required to prevent shrinkage cracks greater than 50 mm in depth. This condition shall be maintained until the HDPE and GCL Liner is installed over the smooth drummed RCB.

3.05 SMOOTH DRUMMING

.1 The completed surface of the RCB must be smooth drum rolled and be free of any rutting or machine tracks.

.2 Appropriate measures must be applied to the finished RCB surface to prevent deterioration such as shrinkage cracks due to drying of the soil prior to installation of subsequent layer.

3.06 FIELD QUALITY CONTROL

.1 Monitor weather conditions during construction to avoid placing clay during adverse weather such as heavy rain, snow, or freezing temperatures which could affect compaction or moisture content.

.2 Adjust the moisture content of the clay using water trucks or allowing to dry in the sun to reach specified water content ranges.

.3 Implement measures to prevent erosion or desiccation of the clay due to high wends or high temperatures.

.4 Ensure the layers of the compacted clay cap bond properly at interfaces to avoid voids and gaps.

.5 Contractor shall provide assistance to Contract Administrator to collect hydraulic conductivity samples for the RCB. Copies of test reports will be supplied to Contractor on request.

.6 Contractor shall repair all locations sampled, at no expense to the City.

.7 Testing by Contract Administrator in no way relieves Contractor of his responsibility to test all material prior to notifying Contract Administrator of the materials' suitability for the Work

.8 Rework and recompact areas which do not meet the specified hydraulic conductivity, as directed by Contract Administrator, at no additional cost to the Contract.

.9 Failure to Meet Specified Requirements: If tests indicate that material specifications have not been achieved or cannot be obtained with equipment in use, the procedure being followed, or the material being incorporated, remove and replace work and modify operations so that the equipment, procedures, and materials will produce the required results. Additional testing required by Contract Administrator will be paid for by Contractor.

3.07 PROTECTION

.1 Protect RCB from damage and desiccation prior to placing subsequent material.

.2 Protect existing monitoring wells, landscaping, natural features, benchmarks, buildings, pavement, surface or underground utility lines from damage. If damaged, restore to original or better condition, unless directed otherwise.

.3 Maintain access roads to prevent accumulation of construction related debris on roads.

3.08 CLEANING

.1 Upon completion remove surplus materials, rubbish, tools, and equipment.

.2 Trim slopes, and correct defects noted by Contract Administrator.

.3 Regrade and trim stockpiles for positive drainage to the satisfaction of the Contract Administrator.

.4 Clean and reinstate all affected areas affected by Work as directed by the Contract Administrator.

.5 Remove and dispose of surplus material and material that is unsuitable for fill, for grading purposes, or for landscaping purposes.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Section 31 05 16 – Aggregates Materials.

.2 Section 31 05 19.15 – Geotextiles.

.3 Section 31 05 19.20 – Geocomposite.

.4 Section 31 05 19.25 – Geosynthetic Clay Liner.

.5 Section 31 35 26.13 – Recompacted Clay Base.

.6 Section 33 41 17 - Leachate Collection System.

1.02 MEASUREMENT AND PAYMENT

.1 High Density Polyethylene Liner (HDPE) Geomembrane Liner:

.1 Measurement Basis: Area of material shall be measured in square meters (m^2) of the 3-dimensional surface area supplied and installed, measured by 10 m x 10 m grid spacing. Measurement shall be taken from the top of the anchor trench. Only the area approved for HDPE geomembrane will be measured.

.2 Payment Basis: Unit price bid per square metre (m^2) of actual area measurements. All items to complete this work are considered incidental. This includes but is not limited to supply, transportation and installation of all required materials and equipment, including seaming, destructive and non-destructive testing for all field seams, and all materials, labour, inspection, quality assurance and quality control testing, equipment and documentation necessary to complete the work specified.

.1 No additional payment will be made for unloading, loading, or transporting the supplied materials from the designated storage location. No allowance will be made for seams, material testing, repairs, or manufacturer's field services. Overlap, wastage, and anchor trench material will not be measured for payment and are considered incidental to HDPE installation.

.2 Leak location survey by a qualified third-party leak location subcontractor will be paid as a lump sum upon the completion of testing and all repairs. Testing includes all equipment, materials, and labour to complete the testing.

1.03 REFERENCE STANDARDS

.1 Definitions:

.1 HDPE: High Density Polyethylene Liner (HDPE) Geomembrane Liner.

.2 Subgrade: Recompacted clay base for Cell 35.

.3 SMDD: Standard Maximum Dry Density and in the context of this Contract means the maximum dry unit weight.

.4 Extrusion Weld: A bond between two HDPE materials, which is achieved by extruding a bead of HDPE over the leading edge of the seam between the upper and lower sheet using a hand-held apparatus.

.5 Fusion Weld: A bond between two HDPE materials which is achieved by fusing both HDPE surfaces in a homogeneous bond of the two surfaces using a power-driven apparatus capable of heating and compressing the overlapped portions of the geomembrane sheets

.2 ASTM International (ASTM):

.1 ASTM D792-20, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

.2 ASTM D1004-21, Standard Test Method for Tear Resistance (Graves Tear) of Plastics Film and Sheeting.

.3 ASTM D1238-23a, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

.4 ASTM D1505-18, Standard Test Method for Density of Plastics by the Density-Gradient Technique.

.5 ASTM D4218-20, Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

.6 ASTM D4437/D4437M-16(2023), Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

.7 ASTM D4833/D4833M-07(2020), Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.

.8 ASTM D5397, Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix.

.9 ASTM D5596-03(2021), Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.

.10 ASTM D5721-22, Practice for Air-Oven Aging of Polyolefin Geomembranes.

.11 ASTM D5885/D5885M-20, Standard Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

.12 ASTM D5994/D5994M-10(2021), Standard Test Method for Measuring the Core Thickness of Textured Geomembranes.

.13 ASTM D6693/D6693M-20(2024), Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

.14 ASTM 7238-20, Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.

.15 ASTM D7466/D7466M-23, Standard Test Method for Measuring the Asperity Height of Textured Geomembranes.

.16 ASTM D8117-21, Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by Differential Scanning Calorimetry.

.3 GRI Standards

.1 Test Method GM6 - Pressurized Air Channel Test for Dual Seamed Geomembranes.

.2 Test Method GM9 - Cold Weather Seaming of Geomembranes.

.3 Test Method GM10 – Specification for Stress Crack Resistance of HDPE Geomembrane Sheet.

.4 Test Method GM13 - Test Methods, Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

.5 Test Method GM14 – Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes.

.6 Test Method GM19 – Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers

.7 Test Method GM20 - Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using Control Charts.

.8 Test Method GM29 - Field Integrity Evaluation of Geomembrane Seams (and Sheet) using Destructive and/or non-destructive testing.

1.04 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling:

.1 Schedule the Recompacted Clay Base (RCB) survey prior to HDPE placement. Obtain Contract Administrator approval of RCB prior to commencing HDPE placement.

.2 Schedule survey of HDPE liners immediately following completion. The HDPE may not be covered by subsequent layers until survey has been completed.

.2 Coordination:

.1 Verify HDPE liner installation is coordinated with geocomposite and geotextile installation in accordance with Section 31 32 19.15 – Geotextiles and Section 31 32 19.20 - Geocomposite as well as the leachate collection and drainage system requirements in Section 33 41 17 – Leachate Collection System.

.2 Verify HDPE liner installation is coordinated with third-party leak location survey.

.3 Installation of HDPE liner shall be coordinated with site weather conditions as described in Part 3.04.2.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the following action submittals a minimum 4 weeks before starting work of this Section:

.1 Material origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture geomembrane.

.2 Copies of dated quality control certificates issued by resin supplier.

.3 Results of tests conducted by HDPE Manufacturer to verify that resin used to manufacture geomembrane meets Specifications.

.4 Statement that amount of reclaimed polymer added to resin during manufacturing did not exceed 2% by weight.

.5 List of materials which comprise geomembrane, expressed in following categories as percent by weight: polyethylene, carbon black, and total additives.

.6 Manufacturer's specification for HDPE which includes properties listed and measured using appropriate test methods.

.7 Written certification that minimum values given in Manufacturer's specification are guaranteed by HDPE Manufacturer.

.8 Quality control certificates signed by HDPE Manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.

.1 Quality control testing tests and frequency as described in Section 2.04.2.

.9 Proposed installation panel layout identifying seams and details. The working drawings shall be in the form of an overlay to the construction drawings and shall indicate roll number, sizes, and positioning of rolls.

.10 Installation schedule.

.11 Resume of the qualifications of the Installation Supervisor and Master Seamer to be assigned to the proposed project, meeting the requirements of Section 1.07. List of personnel performing seaming operations including experience information.

.12 Resume of the qualifications for the leak location surveyor meeting the requirements of Section 1.07.

.13 Certificate that extrudate to be used is comprised of same resin as geomembrane to be used.

.14 List of seaming devices and identification numbers.

.15 Liner Installer's detailed *Installation, Seaming and Quality Control Plan* which adheres to standard industry procedures, test methods, and in accordance with the manufacturer's recommendations. Liner installation shall not proceed prior to submission of the plan. Information to include in the *Installation, Seaming and Quality Control Plan* is further detailed in Section 3.05.

.2 The following items are to be submitted as installation proceeds:

.1 Subgrade surface acceptance certificates signed by the earthworks Contractor and HDPE Installer for each area that will be covered directly by geomembrane. Submit prior to geomembrane deployment.

.1 Deployment of HDPE geomembrane will be considered as acceptance of subgrade by earthworks Contractor and HDPE Installer if certificate is not submitted.

.2 QC documentation recorded during installation for panel seaming, non-destructive, and destructive seam testing.

.3 Third-party QC sampling and test results with a frequency as directed in Section 3.02.1.1.

.4 Third-party destructive seam test results with a frequency as directed in Section 3.05.2.

.3 The following items are to be submitted at the completion of the Work:

.1 Record Documents: Indicate panel layout, including panel identifier, date placed, installer's name, location of seams, and location and details of repairs.

.2 Warranty: A written Warranty shall be obtained from the Manufacturer (for material) and the Installation Contractor (for workmanship). These documents shall warrant both the quality of the material for a minimum of 5 years and workmanship for a minimum of 1 year.

.3 Submit surveys for HDPE Liner installation area as indicated in the Drawings.

.4 Report summarizing the work results of the third-party leak location survey. The report should include methodology of testing, weather conditions, the location of deficiencies, dates identified, repairs and repair dates, and re-survey results.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Packing and Shipping:

.1 Manufacturer shall identify each roll delivered to site with following:

.1 Manufacturer's name.

.2 Product Identification.

.3 Thickness.

.4 Roll number.

.5 Roll dimensions.

.2 Protect geomembrane from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.

.2 Acceptance at Site:

.1 Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.

.2 Defected or damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.

.3 Rolls or portions of rolls without identification labeling will be rejected and shall be removed from site.

.3 Storage and Protection:

.1 The City will provide on-site storage area for geomembrane rolls from time of delivery until deployment.

.2 Contractor shall, protect geomembrane from puncture, dirt, grease, mud, water, mechanical abrasions, excessive heat and other sources of damage.

.3 The geomembrane shall be handled with equipment which does not contact the geomembrane itself or with clean fabric.

.4 Rolls shall be off-loaded in a single step at a location such that only one more handling step is required to move the roll to the location of installation.

.5 The rolls shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than two rolls high.

.6 Preserve integrity and readability of geomembrane roll labels.

.7 Rolls which do not have proper identification at delivery will not be accepted.

1.07 PRE-QUALIFICATIONS

.1 Manufacturer:

.1 Manufacturer shall have a minimum of 5 years continuous experience in manufacturing HDPE geomembranes or experience totalling 200,000 m^2 of manufactured HDPE geomembranes for a minimum of 10 completed facilities.

.2 Installer:

.1 Installer shall have minimum 5 years continuous experience in manufacturing HDPE geomembranes or experience totalling 200,000 m^2 of manufactured HDPE geomembranes for a minimum of 10 completed facilities.

.2 Personnel performing seaming operations shall be qualified by experience or successfully passing seam tests. A minimum of one seamer shall have experience seaming a minimum of 10,000 m^2 of HDPE geomembrane using the same type of seaming apparatus that is to be used to complete the Work. Most experienced seamer (Master Seamer) shall provide direct supervision as required over less experienced seamers.

.3 Leak Location Surveyor:

.1 Surveyor shall have a minimum 5 years experience completing leak location surveys.

.2 Provide a resume showing recent and relevant projects.

1.08 WARRANTY

.1 Refer to Part D- Supplemental Conditions: Warranty.

.2 Provide a Manufacturer's warranty against manufacturing defects of the membrane for a period of five (5) years from the date of installation.

2 PRODUCTS

2.01 GENERAL

.1 The geomembrane shall be double surfaced double-sided textured with a nominal gauge of 60 mil. Double-sided textured sheets shall be used for all surfaces within Cell 35 as detailed in the Construction Drawings.

.2 The geomembrane shall be manufactured of new, first quality resin and shall be compounded and manufactured specifically for the intended purpose. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance. The Manufacturer shall acquire enough resin of the same quality to produce the required amount of geomembrane to ensure uniform composition.

.3 The surface of the geomembrane shall not have striations, pinholes or bubbles and shall be free of holes, blisters, undispersed raw materials or any contamination by foreign matter; except that if, in the opinion of the inspector, the blemish will not adversely affect properties and use of the geomembrane, the inspector may accept the geomembrane after sufficient laboratory test data are provided to support such acceptance and provided that all such testing is done at the expense of the installer.

.4 The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, batch and roll numbers and name of Manufacturer.

2.02 MATERIAL PROPERTIES

.1 The geomembrane shall contain maximum of 1% by weight of additives, fillers or extenders (not including carbon black) and contain between 2% and 3% by weight of carbon black for ultraviolet light resistance.

.2 Textured HDPE Geomembrane Properties:

PROPERTY	METHOD	SUB-PROPERTY	VALUE
Thickness	ASTM D5994	nom.	60 mils 1.50 mm
		min. average	57 mils 1.425 mm
		lowest individual for 8 out of 10 values	54 mils 1.35 mm
		lowest individual for any of the 10 values	51 mils 1.275 mm
Asperity Height	ASTM D7466	min. average	16 mils 0.40 mm
Density (geomembrane)	ASTM D1505/D792	min. average	0.94 g/cm^3
Melt Index (resin)	ASTM D1238	less than	1.0 g/10 min.
Tensile Properties (min. avg.)	ASTM D6693 Type IV	Yield strength (min.)	126 lb/in 22 kN/m
		Break strength (min.)	90 lb/in 16 kN/m
		Elongation at yield (min.)	12%
		Elongation at break (min.)	100%
Modifications to ASTM D6693: Machine direction and cross machine direction average values should be on the basis of 5 test specimens each direction. Gauge length of 1.3 in. (33 mm) for yield values, and 2.0 in. (50 mm) for break values may be used to calculate elongation from grip movement.			
Tear Strength	ASTM D1004	min. average	42 lb 187 N
Puncture Resistance	ASTM D4833	min. average	90 lb 400 N
Stress Crack Resistance	ASTM D5397 Appendix	N/A	500 hr.
Carbon Black Content	ASTM D4218	range	2.0 to 3.0%
Carbon Black Dispersion	ASTM D5596		See note
Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3. P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.			
Oxidative Induction Time (OIT) (min. avg.)	ASTM D8117	Standard OIT	100 min.
	ASTM D5885	Or High Pressure OIT	400 min.
Oven Aging at 85ºC (min. avg.)	ASTM D5721		
	ASTM D8117	Standard OIT - % Retained after 90 days	55%
	ASTM D5885	Or High Pressure OIT - % retained after 90 hours	80%
UV Resistance (min. avg.)	ASTM D7238		
	ASTM D5885	High Pressure OIT – % retained after 1,600 hours	50%
20-hr UV cycle at 75ºC followed by 4-hr condensation at 60ºC. UV resistance is based on percent retained value regardless of the original HP – OIT value.			

2.03 SEAMING AND TESTING EQUIPMENT

.1 Welding:

.1 Obtain Contract Administrator's and Manufacturer's approval in writing prior to installing HDPE liner and prior to placing subsequent layers on HDPE liner.

.2 Maintain on-site a minimum of 2 spare operable seaming apparatus, unless otherwise agreed upon at pre-construction meeting.

.3 Seaming equipment shall not damage geomembrane.

.4 Use extrusion welding apparatus equipped with gauges giving temperature of extrudate at nozzle of apparatus or utilize hand-held gauges to measure extrudate temperatures.

.5 Use fusion welding apparatus which are self-propelled devices equipped with following:

.1 Gauge indicating temperature of heating element.

.2 Method of monitoring relative pressure applied to geomembrane.

.6 Place electric generator on smooth base such that no damage occurs to geomembrane.

.2 Vacuum Testing Equipment:

.1 Vacuum box assembly consisting of rigid housing, transparent viewing window, soft neoprene gasket attached to bottom of housing, porthole or valve assembly, and vacuum gauge.

.2 Pump assembly equipped with pressure controller and pipe connections.

.3 Pressure/vacuum rubber hose with fittings and connections.

.4 Soapy solution to wet test area.

.5 Means of applying soapy solution.

.3 Air Pressure Testing Equipment:

.1 Air pump (manual or motor driven), equipped with pressure gauge, capable of generating, sustaining, and measuring pressure between 160 and 240 kPa, and mounted on cushion to protect geomembrane.

.2 Rubber hose with fittings and connections.

.3 Sharp hollow needle, or other approved pressure feed device.

.4 Air pressure monitoring device.

.4 Tensiometer Testing Equipment:

.1 Tensiometer shall be capable of maintaining constant jaw separation rate of 51 mm per min (2 in. per min), and shall be calibrated, with certificate of calibration less than 1 yr old kept with tensiometer.

.5 Coordinate activities such that the Contract Administrator can observe testing. The Contract Administrator will observe all testing and collect samples for destructive testing.

.6 During installation of the liner, the Contract Administrator may order a stop of work due to inclement weather, the use of improper installation procedures, or for any reason that in their sole opinion may result in a defective liner.

2.04 SOURCE QUALITY CONTROL

.1 Tests and inspections on the geomembrane shall be performed by geomembrane Manufacturer as follows:

.1 Test geomembranes to demonstrate that resin meets the specified requirements.

.2 Continuously monitor geomembrane during manufacturing process for inclusions, bubbles, or other defects. Geomembranes which exhibit defects shall not be acceptable for installation.

.3 Monitor thickness continuously during manufacturing process.

.4 Testing for the following properties shall be conducted a minimum of once every 4,000 m^2 in accordance with test methods specified:

.1 Density.

.2 Carbon black content.

.3 Carbon black dispersion.

.4 Thickness.

.5 Tensile properties.

.6 Tear strength.

.7 Puncture resistance.

.5 Samples not complying with Specifications shall result in rejection of rolls. At geomembrane Manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify noncomplying rolls and to qualify individual rolls.

.6 Perform environmental stress crack resistance tests on geomembrane a minimum of once every resin lot (typically equivalent to one rail car or 82,000 kg (180,000 lbs)).

.7 Geomembrane Manufacturer shall certify that following tests have been performed for each resin used to manufacture rolls for Project in accordance with test methods specified.

.1 Oxidative induction time.

.2 Oven aging at 85^{o}C.

.3 UV resistance.

.4 Asperity height.

3 EXECUTION

3.01 EXAMINATION

.1 The Installation Contractor shall be the Manufacturer or a Manufacturer approved Contractor trained and licensed to install the Manufacturer's geomembrane.

.2 Installation shall be performed under the constant direction of a single field Installation Supervisor supplied by the Installation Contractor who shall remain on site and be in charge throughout the liner installation and for liner activities by the Installer.

.3 Actual seaming shall be performed under the direction of a Master Seamer as specified in Part 1.06 – Pre-Qualifications of this Section. The Master Seamer, who may also be the Installation Supervisor, shall be present whenever seaming is performed.

3.02 QUALITY CONTROL SAMPLING

.1 The Contractor shall be responsible for the sampling and third-party QC testing as specified. The laboratory used for the QC sample testing shall be approved by the Contract Administrator.

.1 Samples shall be third-party tested in accordance with the test methods specified, at the frequency of one per 10,000 m^2:

.1 Density.

.2 Carbon black content.

.3 Thickness.

.4 Tensile properties.

.5 Puncture resistance.

.6 Tear strength.

.2 Rolls represented by QC testing shall be rejected if test fails. Contractor may at their expense conduct additional testing to validate individual rolls. Rolls bracketed by passing tests will be allowed to be deployed and seamed.

.3 The Contractor shall assume the risk for all HDPE liner installed prior to the acceptance of the third-party testing by the Contract Administrator.

.4 Costs for third party testing are considered incidental.

3.03 PREPARATION

.1 Earthwork:

.1 The Recompacted Clay Base (RCB) shall be excavated to lines and grades as shown on the construction drawings prior to liner system placement as per Section 31 23 33.01 – Excavation and Fill.

.2 The Contractor, in conjunction with the City or the Contract Administrator, shall, on a daily basis, inspect the RCB preparation and the Contractor shall be solely satisfied as to the adequacy of the RCB for purposes of the warranty.

.1 Weak or compressible areas which cannot be satisfactorily compacted shall be removed and replaced with properly compacted fill. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, or debris of any kind. These surfaces shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. Standing water or excessive moisture is not permitted.

.2 Do not begin installation of HDPE liner until the Recompacted Clay Base has been prepared and approved by Contract Administrator and HDPE liner Installer's supervisor. The prepared surface shall be free from abrupt changes in grade, water, loose earth, exposed rocks, rubble, protrusions, vegetation, and other foreign matter which may be damaging to HDPE liner. Compact the Recompacted Clay Base uniformly and smooth with a drum roller for HDPE liner.

.3 The Installer, on a daily basis, shall inspect and certify that the surface on which the geomembrane will be installed is acceptable. After the supporting soil surface has been accepted, it shall be the Installer's responsibility to indicate to the Contractor and Contract Administrator of any change to its condition due to natural causes or occurrences that may require repair work.

.4 Proceeding with the installation of the liner shall be deemed to be acceptance of the subgrade and soil surface for purposes of the warranty.

.5 Do not place HDPE liner in an area which has become softened by precipitation, and which will not support liner installation equipment without rutting.

.6 Do not place HDPE liner in an area which has become dry and desiccated, and which will not provide continuous contact between HDPE liner and compacted clay.

.7 Maintain area of installation free of water and snow accumulations.

.8 Anchor Trench

.1 The anchor trench shall be excavated to the line, grade and width shown on the construction drawings, prior to liner system placement.

.2 Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane.

3.04 METHOD OF PLACEMENT

.1 The Contractor shall be responsible for the following:

.1 No equipment or tools shall damage the geomembrane by handling, trafficking or other means.

.2 No personnel working on the geomembrane shall wear damaging shoes or engage in other activities that could damage the geomembrane.

.3 The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil or underlying geosynthetic material.

.4 The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Locations of any wrinkles shall be identified on the Contractor's and Installer's drawings. All defects shall be marked and documented for repairs. The total number of defects shall not exceed ten (10) per 500 m^2. If greater than 10 defects per 500 m^2 the panel shall be rejected.

.1 Defects are defined as any abnormalities that affect the physical properties of the geomembrane material.

.5 Adequate loading (e.g. sandbags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

.6 Direct contact with the geomembrane shall be minimized, i.e. the geomembrane in traffic areas shall be protected by geotextiles, extra geomembrane of other suitable materials.

.2 Material Deployment:

.1 Weather Conditions:

.1 Geomembrane deployment shall proceed between ambient temperatures of 5 degrees C to 40 degrees C. Placement can proceed below 5 degrees C only after it has been verified by the Installer and the Inspector that the material can be seamed according to the specification. Geomembrane seaming shall not be done during any precipitation, in the presence of excessive moisture (e.g. fog, rain, dew) or in the presence of excessive winds as determined by the Installation Supervisor.

.2 Deployment must incorporate an allowance for thermal contraction according to the following equation:

Allowance = @ *(T-T1)*D

Where:

@ = coefficient of liner thermal expansion (cm/cm deg. C)

T = temperature at which allowance is measured deg. C

T1 = lowest temperature to be experienced by membrane deg. C

D = distance between fixed points

.1 For exposed membrane, the allowance will be approximately 1 m per 100 m. The allowance will be uniformly distributed throughout the lining between the two fixed points.

.3 The geomembrane shall be deployed completely down the side of the anchor trench ensuring that there are no sharp projections along the edge of the trench.

.4 When side slope material is deployed from welding on horizontal surfaces, care must be taken when it is moved to the side slope that the underside is not excessively scratched or gouged and that loose flaps adjacent to seams are not penetrated by dirt, sand or gravel.

3.05 INSTALLATION, SEAMING AND QUALITY CONTROL:

.1 Only methods and equipment approved by the Contract Administrator may be used. Approved seaming methods are extrusion welding for patching and double wedge fusion welding for general seaming.

.2 All HDPE liner seams shall be welded.

.3 Prior to seaming, clean the seam area and ensure it is free of moisture, dust, dirt, debris of any kind, and foreign material.

.4 Orient seams downslope so that direction of seaming will not hinder flow of water over top of HDPE liner. Specifically for fusion welded seams, overlap the HDPE liner on the downslope side of the seam.

.5 Horizontal seams on slopes shall not be permitted, unless no other option is available, and only as approved by the Contract Administrator.

.6 Extend seaming to outside edge of Cell 35 into the anchor trench.

.7 Label each seam with date, seamer, equipment seaming temperature and speed, and time seam started and completed.

.8 The seams shall meet the requirements of GRI Test Method GM19a for 1.5 mm (60 mil) HDPE Geomembrane:

Test	Units	Minimum Value (both smooth and textured)
Hot Wedge Seams		Min.
Shear strength	N/25 mm (lb/in)	525 (120)
Shear elongation at break	%	50
Peel Strength	N/25 mm (lb/in)	398 (91)
Peel Separation	%	25
Extrusion Fillet Seams		
Shear strength	N/25 mm (lb/in)	525 (120)
Shear elongation at break	%	50
Peel Strength	N/25 mm (lb/in)	398 (91)
Peel Separation	%	25
Modifications to ASTM D4437: For shear tests, sheet shall yield before failure of seam. For peel adhesion, seam separation shall not extend more than 50 percent of seam width into seam. For either test, testing shall be discontinued when sample has visually yielded. For peel adhesion all tests 4 of 5 samples shall pass 5th sample can be as low as 80% of listed value for seam to qualify and all shall have a strength value.		

.9 Factory Seam Quality Verifications: The Installer shall be required to test up to as much as 20% of factory fusion welds (non-destructive air pressure test and/or vacuum test) in the field to verify factory test results. Additional testing at the Installer's expense will be required if failed tests are obtained in the field.

.10 Submit destructive seam tests to a laboratory pre-approved by the Contract Administrator for assurance testing.

.11 Submit assurance tests for every 10,000 m^2 of HDPE liner installed.

.12 Installation, Seaming and Quality Control Plan:

.1 At least thirty (30) days prior to Liner installation, submit the Liner Installer's detailed *Installation, Seaming and Quality Control Plan* which adheres to standard industry procedures, test methods, and in accordance with the Manufacturer's recommendations. Liner installation shall not proceed prior to submission of the plan.

.1 The *Installation, Seaming and Quality Control Plan* will include, but is not limited to, the following:

.1 Manufacturers' Installation Manual

.2 Manufacturer's Quality Control Procedures including but not limited to:

.1 Thickness.

.2 Density.

.3 Tensile properties.

.4 Tear resistance.

.5 Low temperature impact.

.6 Notched constant load.

.7 Puncture resistance.

.8 Carbon black.

.3 Seaming Equipment and Accessories.

.4 Installation and QA/QC Procedures including but not limited to:

.1 Test Seams.

.2 Non-Destructive Seam Testing.

.3 Destructive Seam Testing.

.4 Extrusion welds.

.5 Tack Welding.

.6 Grinding and Preheating.

.7 Extrusion Weld Beads.

.8 Quality Control Testing.

.9 Qualification Testing.

.10 Extrusion Production Testing.

.2 The Contractor shall adhere to the *Installation, Seaming and Quality Control Plan*, and will notify the Contract Administrator, in writing, of deviations from the Plan along with reasons for such deviations. Deviations from the plan will not occur without prior acceptance from the Contract Administrator.

.13 Non-destructive Seam Testing

.1 Non-destructively test field seams over their full length by pressure testing to ASTM D5820. Pressure test results will be written on liner near seam. Number or otherwise designate each seam. Record location, date, test unit, name of tester, and outcome of all non-destructive testing.

.2 Passing non-destructive test of field seams, meeting or exceeding requirement to ASTM D5820, indicates the adequacy of field seams, subject to the results of destructive seam testing, as identified in paragraph 3.05.11.

.3 Coordinate activities such that Contract Administrator can observe all testing. Contract Administrator will observe all testing. Non-destructive testing performed in absence of Contract Administrator shall be repeated. Conduct testing as the seaming work progresses. Number and mark all defects found during testing immediately after detection. Repair, retest, and remark all defects found to indicate completion of the repair and acceptability. If pressure testing is performed, following testing, repair hole resulting from pressure needle.

.14 Destructive Seam Testing

.1 Collect 600 mm long HDPE liner field seam samples at a frequency of approximately one sample per 150 linear metres of field seam at locations directed by Contract Administrator, or more frequently if requested, and at least two samples from each panel taken from extra material, such that the panel is not damaged and blanket geometry is not altered.

.2 Field test five coupons in peel and five coupons in shear according to ASTM D4437, using a calibrated field tensiometer. Perform peel tests on the inside and outside weld. If at least four of each of the five coupons do not delaminate and pass the tensile strength requirements, based on the field testing, then collect additional 600 mm long sample from the same location and provide to Contract Administrator for quality assurance laboratory shear and peel testing.

.3 Minimum strength of HDPE liner field seams (double wedge fusion and extrusion) when tested in shear shall be 525 N/25mm, as identified in GRI Test Method GM19a.

.4 Minimum strength of HDPE liner test seams when tested in peel shall be 398 N/25mm (double wedge fusion) and 340 N/25mm (extrusion), as identified in GRI Test Method GM19a.

.5 If either field or laboratory tests fail, isolate the defective seam and re-test as follows:

.1 Collect additional 600 mm long samples from field seam for testing using a field tensiometer, within 3 m of each side of the failing sample as determined by Contract Administrator, until passing test locations are identified.

.2 Repair the field seam between the passing test locations (based on field tensiometer results) by extrusion welding or patching.

.3 Non-destructively test the patch or extrusion weld and repair, as required, until non-destructive test standards are achieved.

.4 If the additional laboratory shear or peel tests fail, then additional destructive seam field Samples will be collected and field tested to isolate the failing seam, then laboratory tested.

.5 Repeat the above-noted procedure until passing field and laboratory test results are achieved, thereby delineating extent of defective seam.

.15 General:

.1 All seams and non-seam areas of the geomembrane shall be inspected by the Installation Supervisor and Contract Administrator for defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter.

.1 Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be brushed, blown or washed by the Installer if the amount of dust or mud inhibits inspection. The Contract Administrator shall decide if cleaning of the geomembrane is needed to facilitate inspection. This inspection should be done immediately after placement of the liner panel.

.2 All repairs shall be completed within 24 hours from identification, except by approval of the Contract Administrator.

.16 Evaluation:

.1 Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the Contract Administrator. Each location that fails the non-destructive testing shall be marked by the Inspector and repaired accordingly.

.17 Repair Procedures:

.1 The following procedures shall be followed in completion of geomembrane repairs:

.1 Defective seams shall be restarted/re-seamed as described in these specifications.

.2 Small holes shall be repaired by extrusion cap welding. If the hole is larger than 6 mm, it shall be patched.

.3 Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded prior to patching.

.4 Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches.

.5 Surfaces of HDPE which are to be patched shall be abraded and cleaned no more than 15 minutes prior to the repair. No more than 10% of the thickness shall be removed.

.2 Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 150 mm beyond the edge of the defects. All patches shall be of the same compound and thickness as the geomembrane specified. All patches shall have their top edge bevelled with an angle grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

.1 Label each patch with date, number, and seamer and equipment.

.18 Restart/Re-seaming Procedures:

.1 The extrusion welding process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least 50 mm. Re-seaming over an existing seam without regrinding shall not be permitted.

.19 Verification of Repairs

.1 Each repair shall be non-destructively tested, except when the Contract Administrator requires a destructive seam sample obtained from a repaired seam. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

.20 Recording of Results

.1 Daily documentation of all non-destructive and destructive testing shall be provided to the Contract Administrator by the Installer. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successively retested.

3.06 BACKFILLING OF ANCHOR TRENCH

.1 The anchor trench shall be backfilled and compacted by the Installer or by the Contractor under the Supervision of the Installer. Trench backfill material shall be placed in 150 mm thick lifts and compacted by light compaction equipment.

.2 Care shall be taken backfilling the trenches to prevent any damage to the geomembrane or geotextiles. At no time shall construction equipment come into direct contact with the geomembrane or geotextiles. If damage occurs, it shall be repaired by the Installer prior to the completion of backfilling.

3.07 LEAK LOCATION SURVEY

.1 Leak location survey will be completed to ensure that the installed HDPE Liner is free of defects due to workmanship or equipment. The test will be completed following the installation of the 16 oz/syd protection geotextile and the sand protection layer.

.1 The Contractor is required to provide equipment and assistance to complete the test.

.2 The Contractor is responsible for providing a water truck and water to wet the drainage layer as required throughout the duration of the test.

.3 The Contractor shall expose locations as marked by the leak location survey field person. Assisting is required by means of labourers and equipment to efficiently expose all areas marked by the leak location survey field person. Marked locations must be exposed immediately as the leak location survey field person needs to verify equipment accuracy.

.4 The Contractor shall repair all leaks identified by the leak location survey as directed by the Contract Administrator at no additional cost.

.5 The Contractor shall repair leaks at the tie-in locations at no additional cost.

.6 The Contractor is required to handle the water in the leachate collection system and pump it out, if required by Contract Administrator

3.08 PROTECTION

.1 Protect geomembrane from damage prior to and after placing subsequent materials.

.2 Place granular drainage blanket material from lower elevations to higher elevations. Push granular drainage blanket layer by traveling only on previously placed material, never directly on HDPE liner or overlying geotextile cushion, and by avoiding sudden turns or accelerations.

.3 Do not permit traffic or construction equipment directly on HDPE liner, unless approved by Installer’s supervisor.

3.09 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Remove and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal or recycling paper, plastic, polystyrene, corrugated cardboard, and packaging material.

END OF SECTION

1 GENERAL

1.01 DESCRIPTION

.1 Work Included:

.1 The leachate pumping and power system includes the supply of all labour, materials and equipment to design, supply and install the leachate pump, discharge hosing, jacketed motor lead, penetrations, connections, bollards, stainless steel suspension cable, and leachate control panel for the leachate withdrawal piping.

.2 Contractor shall design, supply, install and commission a complete, turn-key leachate pumping and power system.

.2 Work Not Included:

.1 The supply of leachate piping and bedding material, for which payment is provided in Section 33 41 17 – Leachate Collection System.

1.02 DEFINITIONS

.1 Leachate: Any water that has come into contact with refuse, which shall be managed as leachate. This includes site surface drainage that has come into contact with refuse. Contractor shall be responsible for all handling, transport and disposal of leachate to an approved treatment facility.

1.03 SUBMITTALS

.1 The Contractor shall submit full design shop drawings for the pump, motor lead, discharge hosing, suspension cable, connectors, control panel and bollards a minimum 4 weeks prior to commencing Work.

.2 Contractor shall not commence transport of the materials to site until the Design Professional's review and acceptance has been completed.

1.04 EXISTING CONDITIONS

.1 The Drawings provide information and locations of existing site features that are to be removed or protected, including gas wells, monitor wells, buildings, utilities, structures, instrumentation, manholes and pipes.

.2 Contactor must be aware of all site features located within the site limits.

.3 Protect all structures, and surface or underground utilities which are to remain. If damaged, restore to original or better condition, at Contractor's cost.

1.05 MEASUREMENT AND PAYMENT

.1 Measurement Basis: Item measure by the acceptance of the supply, installation, and commissioning of the sump pump, accessories, and control panel for the leachate pumping system.

.2 Payment Basis: Lump sum price, including the supply, installation, and connection of the sump pump, accessories, control panel, accessories, as well as a spare pump; including level sensor and motor lead.

2 PRODUCTS

2.01 GENERAL

.1 The Contractor shall submit a complete design package for the leachate pumping package. No parts or materials shall be shipped to the site until the design package has been accepted by the Design Professional.

.2 For all materials specified in the section, the Contractor shall confirm the dimensions, minimum lengths, pump head and flow rate requirements, pump motor size, electrical requirements, and control panel specifications.

.3 Alternatives to the materials specified in this section will be considered if an equivalent pumping system is designed and proposed by the Contractor.

2.02 MATERIALS

.1 Leachate Extraction Pump Materials:

.1 The pump shall be an EPG Model WSDPT SurePump™ Wheeled Sump Drainer

.1 Major components made of 304 stainless steel.

.2 Built –in check valve with non-metallic seat.

.3 E-Glide™ bearings and seals. Teflon or rubber not acceptable.

.4 Stainless steel shaft rotating on E-Glide™ bearings that are fluid lubricated.

.5 The diffuser chambers for each impeller shall be 304 stainless steel and fitted with E-Glide™ impeller seal rings.

.6 The motor shall be a submersible, stainless steel, hermetically sealed and capable of sustaining up to 100 starts per day.

.7 The motor shall be connected to the pump by a motor adaptor and coupling of 304 stainless steel.

.8 The motor lead shall be suitable length of non -splice with EPG's "CP" waterproof and chemically resistant jacket over 600-Volt insulation and be of the length specified.

.2 The pump shall be an explosion proof, portable, semi-permanent submersible pump capable of operation in a leachate environment. The Contractor shall confirm pump model and size to accommodate the specified flow rate as apart of the design package submittal.

.3 The pump shall be stamped as Zone 1 on the name plate.

.4 Leachate Extraction Pump Equipment Performance requirements:

.1 Motor to be 0.5 HP, 230 Volt, single-phase and shall be rated for installation in a landfill with hazardous area classification as noted below.

.2 Submersible Leachate Pump EPG model WSDPT 5-2.

.1 Design condition: 27 gpm at 43 feet Total Dynamic Head.

.2 Maximum pump speed 3450 rpm.

.3 Maximum horse power 0.5 HP.

.4 Drive Type: Constant speed.

.5 The pump shall come complete with wheels attached at the top and bottom.

.6 Leachate Extraction Pump Sump Drainer:

.1 Pump shall include a stainless steel sump drainer housing with wheels on both ends.

.2 A removable transmitter mount shall be installed at the centre bottom of the Sump Drainer for liquid level control.

.3 Provide suitable length of stainless steel suspension cable of sufficient strength with stainless steel connections.

.7 The pump shall be connected to a 2” (50 mm) discharge hose and a stainless steel suspension cable rated for the weight of the pump complete with a jacketed motor lead with a minimum length of 65 metres.

.8 The pump shall be programmed to automatically switch off to maintain a minimum leachate head of 300 mm.

.2 Leachate Sampling Port:

.1 The Contractor shall supply a stainless-steel discharge adapter, connected to the 2” (50 mm) diameter discharge hose with embedded reinforcement rated to a minimum pressure of 1200 kPa located at the top of the 600 mm diameter leachate withdrawal pipe.

.2 The Contractor shall supply a T-handle bar for connection into the stainless- steel discharge adapter for removal maintenance.

.3 Provide a removable cap at the top of the withdrawal pipe.

.3 Discharge Hosing and Fittings:

.1 The Contractor shall supply 65 m of the discharge hosing with all necessary connections to the discharge pump. Contractor is responsible for confirming the length of discharge hosing required for the pumping system.

.2 Discharge hose shall be rated at 300 psi and -20 to 180 degrees Fahrenheit.

.3 The Contractor shall supply couplers for the pump to discharge hose connection, the internal discharge adapter to discharge hose connection, and the external discharge adapter to leachate truck hose connection.

.4 A 50 mm diameter female camlock connection shall be installed on the end of the discharge hosing for connection to a leachate truck. Contractor to confirm camlock connection details with the Design Professional and the City during design.

.4 Pump Control Panel:

.1 The pumping system control panel shall be rated for permanent outdoor cold-weather installation. Ambient temperature range: -40 °C to 40 °C, 95% humidity, non-condensing.

.2 The installation shall be complete with a pump motor start/protection/control panel. The panel shall be EPG PumpMaster rated, CSA certified as an assembly and shall be complete with beacon alarm light, circuit breaker, NEMA 4 rated Contactors complete with overloads, motor and circuit protection, hand/off/auto switch, control transformer, surge protector, and other electrical components required for full safe operation of the pump. Beacon light shall be activated on pump failure-to-start, pump common trouble, and fluid high level. Beacon alarm light to be of strobing kind and attached on a stem, unobstructed by the backboard, ensuring visibility from all angles.

.3 The panel shall be arranged so that the electrical power source is from the equipment Maintenance Building located on opposite street of the new cell construction. Installation is complete with all required accessories and in compliance with the Canadian Electrical Code requirements.

.4 The panel shall be installed at a minimum of 300 mm above the ground.

.5 The steel equipment rack shall be secure with M16 threaded bar epoxy anchored 250 mm deep into a concrete base. The concrete base shall be 400 mm thick (150 mm situated above ground) on 250 mm of compacted stone. 15M reinforcement shall be placed at 300 each way, top and bottom. Concrete shall be of the following type:

.1 Exposure class: S-3.

.2 Cement type: HS.

.3 Max W/C Ratio: 0.5.

.4 Max Aggregate (mm): 20.

.5 Air Content (%): 4-7.

.6 Compressive strength (MPa): 30 within 56 days.

.6 The junction boxes shall be non-metallic breakout junction boxes rated NEMA 4X complete with level sensor lead with desiccant dryer, bellows and wire connectors.

.1 Furnish and provide one breakout box for the motor lead, and one breakout box for the level sensor. Enclosures shall be constructed for outdoor use in hazardous locations classified as Zone 1.

.7 Provide and install local grounding grid consists of two (2) copper clad grounding rods complete with #6 AWG green copper.

.1 Provide #6 AWG ground connections from ground grid to the following:

.1 Metal piping.

.2 Main control panel and supporting metal structure.

.8 The hazard area classification for the installation is as follows:

.1 The entire space is classified as Zone 1 hazardous area.

.2 Equipment, installation and wiring methods are to be in accordance with electrical code based on these classifications.

.9 The space surrounding the leachate withdrawal pipe and any vent is a Zone 1 hazardous area. The installation is to conform to the requirements of the latest edition of the Canadian Electrical Code part 1 (CSA 22.1).

.10 The pumping system and control panel shall be installed complete a clearly visible local alarm light.

.11 The contractor will supply and apply weather proof and explosion proof connectors in conformance to section 18 and Section 22 of the Canadian Electrical Code (CEC) requirements.

.12 Furnish a certificate of acceptance from the inspection service on completion of work.

.13 All work to be performed by licensed trade persons using new CSA approved materials installed in a neat and professional manner.

.5 System Logic and Function:

.1 The controller is designed to start and stop a pump using the EPG OCS pump controller with a submersible pressure transmitter. The pump starts at the pump start level set point and continues to run until the liquid level decreases to the pump stop level set point as programmed in the level control meter. If the liquid level rises to the high level alarm set point, a high level will be annunciate. If the liquid level rises to the high-high level fail-safe set point, the pump motor will shut off. The pressure transmitter level sensor shall have a range of 0 to 16.5 feet (0 to 5 metres) with a 4-20 mA output signal. An elapsed time meter monitors total pump run time in hours. The flow meter displays flow rate and total flow from a paddlewheel flow sensor.

.2 The controller will be designed so that a storage tank full shut-down circuit is installed with a high level alarm wiring connection available for future use.

3 EXECUTION

3.01 PUMPING AND POWER SYSTEM INSTALLATION

.1 Perform work as described in Section 01 65 00 Equipment Installation.

.2 The Contractor shall connect and install the new pump and hosing according to the manufacturer's recommendations. The pump is designed to sit flat on the withdrawal pipe base and can only be moved with use of the pull cable. Under no circumstances shall the pump be lifted or lowered with the discharge hosing or power cable.

.3 The Contractor shall ensure that the discharge hosing is securely attached to the 600 mm withdrawal pipe with a catch system to avoid the hosing ever being dragged down into the pipe.

.4 Once the pumping system is operational, the Contractor shall provide training to City of Winnipeg staff for operating and disassembling the system.

.5 The Contractor shall provide to the City all technical data and warranty information before final inspection.

.6 The Contractor shall submit operation and maintenance data for the pump for incorporation into the operation manual.

.1 Description of pump, leachate panel and accessories, giving manufacturers name, type, model, year and capacity.

.2 As-built conditions of the pipe including installed elevations and lengths of hosing.

.3 Testing and commissioning reports.

.4 Details of operation, servicing, maintenance, and technical support.

.5 Recommended spare parts list.

.7 The Contractor shall supply all required installation, commissioning, and technical support to provide a turn-key, fully operational system.

.8 Once the pumping and power system has been tested and accepted by the City, the Contractor shall install four bollards in front of the panel.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Section 31 05 16 – Aggregate Materials.

.2 Section 31 05 19.15 – Geotextiles.

.3 Section 31 05 19.20 – Geocomposite.

.4 Section 31 05 19.25 – Geosynthetic Clay Liner.

.5 Section 31 23 33.01 – Excavation and Fill.

.6 Section 31 35 26.16 – HDPE Liner.

1.02 MEASUREMENT AND PAYMENT

.1 Perforated 200 mm Leachate Pipe:

.1 Measurement Basis: Item measured by the lineal metre of pipe supplied and installed.

.2 Payment Basis: Unit price. Includes supply and delivery, fusion, installation of perforated 200 mm leachate collection system pipe, HDPE fittings, and end caps.

.1 The supply and installation of the bedding sand, protection & separation geotextile, geocomposite, granular drainage layer, connections, and caps within the leachate collection trench are considered incidental to this bid item.

.2 Non-Perforated 200 mm Leachate Cleanout Pipe:

.1 Measurement Basis: Item measured by the lineal metre of pipe supplied and installed extending from the base of the cell floor to at least one metre above the anchor trench grade in the perimeter berm, following the surface of the liner system

.2 Payment Basis: Unit price. Includes supply and delivery, fusion, installation of non-perforated 200 mm leachate collection system pipe, connections, HDPE fittings, end caps, and protective soil cover

.3 Perforated 600 mm Leachate Withdrawal Pipe:

.1 Measurement Basis: Item measured by the lineal metre of pipe supplied and installed.

.2 Payment Basis: Unit price. Includes supply and delivery, fusion, installation of perforated 600 mm leachate collection system pipe, HDPE fittings, end caps, and protective soil cover.

.1 The supply and installation of the protection & separation geotextile, geocomposite, granular drainage layer, connections, and caps within the leachate collection sump are considered incidental to this bid item.

.4 Non-Perforated 600 mm Leachate Withdrawal Pipe:

.1 Measurement Basis: Item measured by the lineal metre of pipe supplied and installed extending from the base of the cell floor to at least one metre above the anchor trench grade in the perimeter berm, following the surface of the liner system.

.2 Payment Basis: Unit price. Includes supply and delivery, fusion, installation of non-perforated 600 mm leachate withdrawal pipe, connections, HDPE fittings, end caps, insulation and protective soil cover.

.1 The supply and installation of pipe insulation is considered incidental to this bid item.

.5 Non-Perforated 50 mm diameter Leachate Gravity Main and Connection:

.1 Measurement Basis: Item measured by the acceptance of the connection between the non-perforated 50 mm diameter leachate header pipe (gravity main) extending from the Cell 35 600 mm extraction pipe to the existing 200mm diameter leachate gravity main located on the west side of Payette Road.

.2 Payment Basis: Lump sum price including the excavation, supply, installation, of all piping and grading, and connection to existing leachate header pipe; supply, placement, and compaction of backfill around the leachate gravity main connection pipe, pressure testing, heat tracing, insulation, connections, valves, and all other work required to meet the requirements of the Workers Compensation Board (WCB).

.1 There will be no separate measurement and payment for the protection or removal and rehabilitation or replacement of existing surface features that are not identified in the Bid Form.

.2 There will be no separate measurement and payment for the locating, protecting and crossing of any existing utilities whether shown on the Drawings or not (except for the items identified in the Bid Form). This work is considered incidental to the Contract.

1.03 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

.2 ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

.3 ASTM D1603, Standard Test Method for Carbon Black Content in Olefin Plastics

.4 ASTM D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

.5 ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

.6 ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

.7 ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

.8 ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

.9 ASTM F2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

.10 ASTM F2880, Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 34 in. to 65 in.

.2 City of Winnipeg Standard Construction Specifications:

.1 CW2130 – Gravity Sewers.

.2 CW2110 – Water Mains.

1.04 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling:

.1 Include detailed sequence of leachate collection system installation in Detailed Work Schedule.

.2 Do not allow or cause work performed to be covered up or enclosed prior to required inspections, tests, or approvals.

.2 Coordination:

.1 Coordination with City site operations is required for Leachate Collection System 50 mm Gravity Main installation.

.2 Sequence and schedule leachate collection system activities with work of other Sections.

.3 Verify Leachate Collection System pipe installation is coordinated with HDPE Liner, geocomposite and geotextile and aggregate materials.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the following action submittals a minimum 4 weeks before starting work of this Section:

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and pipe fittings and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Manufacturer's Instructions:

.1 Special delivery, storage, and handling requirements.

.2 Recommended procedures for installation of pipes.

.3 Certificates:

.1 Manufacturer’s test data and certification that the pipe materials meet requirements of this Section. This is to include quality control certificates pertaining to each lot of pipe produced.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store piping with labelling in place.

.2 Use every precaution to prevent damage to the pipe. Do not permit metal tools or heavy objects to unnecessarily come in contact with the pipe. Avoid excessive transportation and possible damage to the pipe,

.3 Store and handle pipes, fittings and accessories to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.

.4 Prevent damage to machined ends of pipes while handling and moving pipe.

.5 Prevent animals from entering pipe when stored on site and during installation by temporarily sealing the pipe ends.

2 PRODUCTS

2.01 MATERIAL PROPERTIES

.1 Leachate Collection and Withdrawal Pipes:

.1 All 200 mm diameter perforated and non-perforated leachate collection, header and level monitoring piping and all fittings, joints, elbows, etc. are to be DR 11 HDPE or an alternative approved by the Contract Administrator.

.2 All 600 mm diameter perforated and non-perforated leachate withdrawal piping and all fittings, joints, elbows, etc. are to be DR 11 HDPE or an alternative approved by the Contract Administrator.

.3 Pipe shall be perforated as shown on the construction drawings. Filings, shavings or other material remaining from the perforation process shall be removed.

.2 End Caps:

.1 End Caps at the top of berm location are to be non-vented and flanged DR 11 HDPE or other approved removable cap or other alternative approved by the Contract Administrator for 200 HDPE pipes. All other end caps to be a DR11 HDPE butt fuse caps.

.2 End Caps at the top of berm location are to be flanged DR 11 HDPE or other approved removable cap or other alternative approved by the Contract Administrator for 600 mm diameter HDPE pipes. All other end caps to be a DR11 HDPE butt fuse caps.

.3 Leachate Gravity Main:

.1 HDPE leachate gravity main pipe shall be 50 mm pipe size with DR 11 as noted on the drawings.

.4 Polyethylene Pipe Fittings:

.1 Polyethylene fittings and/or elbows shall be factory made unless otherwise shown on the Drawings. Fabricated sweeps shall be large radius multi-segmented. The ends of the fitting shall not be trimmed to match the pipe section to which they are going to be joined. All polyethylene fittings will have the same or higher-pressure rating as the pipe when installed according to the latest technical specifications.

.2 Butt Fusion Fittings - Fittings shall be made of HDPE material with a minimum material designation code of PE4710. Butt Fusion Fittings shall meet the requirements of ASTM D3261.

.3 The pipe fitting shall contain no recycled material except clean rework material generated from the manufacturer's own plant, from resin of the same specification, and from the same raw material supplier.

.5 Leachate Withdrawal Pipe Insulation:

.1 The pipe shall be field insulated using polyisocyanurate or polyurethane insulation and polyethylene tape jacket. The insulation of associated fittings, joints and accessories shall be as per manufacturers recommendations.

.2 Pipe insulation half shells shall have a density of 32 kg/m3, 90% closed cell content, a minimum thickness of 50 mm, and a K factor of 0.027 W/m ◦C.

2.02 PIPE BEDDING AND SURROUNDING MATERIALS

.1 Bedding Sand:

.1 Aggregate required for the bedding sand layer is contractor supplied as indicated in Section 31 05 16 – Aggregate Materials.

.2 Granular Drainage Layer:

.1 Aggregate required for the washed granular drainage layer is contractor supplied as indicated in Section 31 05 16 – Aggregate Materials.

.3 Uncompacted Clean Fill:

.1 Uncompacted clean fill material required to protect the leachate system piping shall be installed as indicated in Section 31 23 33.01 – Excavation and Fill.

3 EXECUTION

3.01 EXAMINATION

.1 Verify that survey bench marks and intended elevations for Works are as shown on the Drawings.

.2 In case of discrepancy between the manufacturer's recommendations and these specifications, advise the Contract Administrator and request instructions before proceeding.

.3 Verify that excavations, dimensions, and elevations are as shown on the Drawings.

.4 Do not allow or cause any of work performed to be covered up or enclosed prior to required inspections, tests, or approvals.

.5 Obtain approval from the Contract Administrator for completed excavations and previously placed material prior to placement of products associated with this Section.

.6 Ensure areas to be backfilled are free from debris and water

.7 Do not permit traffic in restored/repaired area without approval from the Contract Administrator.

3.02 EXCAVATION

.1 The Contractor shall excavate, by hand, by hydrovac, or by other appropriate measures, any trial excavations deemed necessary by the Contractor for locating the position of underground services.

.2 When in the course of excavation, the Contractor encounters existing services or any other obstructions, they shall immediately seek instruction from the Contract Administrator as to the course of action. Services or other obstruction shall be physically marked on the ground.

.3 Unless otherwise shown in the contract documents, the minimum trench width shall be the external diameter of the pipe plus 500 mm.

.4 Carefully excavate trenches to the minimum depths and widths necessary for installing the pipeline and associated appurtenances. In the pipe embedment zone (pipe surround), the trench sidewalls shall be as nearly vertical as practical. From the top of the pipe embedment zone to the surface, the trench sidewalls shall be either sloped sufficiently to prevent sloughing or cave-in, or shall be properly supported in accordance with OH&S requirements.

3.03 METHOD OF PLACEMENT

.1 Cut the pipe trench to the line and grade shown on the construction drawings. The bottom of the trench shall be clean and smooth.

.2 Place bedding material prior to laying pipe. Place only as much bedding material as can be backfilled in one day's work.

.3 Keep HDPE pipe clean and dry before installation, both externally and internally to avoid contaminating clear stone bedding and drainage materials.

.4 Commence laying at the sump and proceed in upgrade direction with socket ends of pipe facing upgrade.

.5 Place perforated pipes in the collection trenches and non-perforated pipes for leachate cleanout risers on the geocomposite cushion layer true to line and grade.

.6 Install perforated leachate collection pipe with all perforations on the lower half of the pipe circumference.

.7 Install all pipe according to the Drawings and include all required fittings/bends, piping, blind flange plates, backup ring and stainless-steel bolt sets, fusing, neoprene gasket, and bedding materials.

.8 Do not allow water to flow through pipe during construction, except as may be permitted by the Contract Administrator.

.9 Do not bend HDPE pipe in a radius smaller than that recommended by the manufacturer when staged on Site or when being installed.

.10 Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.11 Position and join pipes by methods approved by manufacturer/supplier.

.12 Install "Y" connections to surface as indicated, for flushing.

.13 Pipe jointing:

.1 Polyethylene pipe shall be assembled by thermal butt fusion into sections.

.2 Thermal butt fusion joining shall be carried out in accordance with the directions of and with the equipment supplied by the manufacturer, and under the direct supervision of a joining supervisor who is employed by the pipe manufacturer.

.3 The pipe shall be connected to specials by the use of flanged joints.

.4 All flange collars for attachments for the polyethylene pipe shall be made from the same type and grade of polyethylene as the raw material supplied for the pipe.

.5 Pipe flange joints shall be thermally fused to the pipe ends.

.14 Variance from vertical alignment shall not vary more than 25 mm. Notwithstanding this tolerance, any vertical grade variation shall not result in a reversal of slope or grade from that indicated on the Drawings. The Contractor is solely responsible for correcting grade alignments that do not meet the design intent.

.15 Variance from the horizontal alignment shall not exceed 200 mm.

.16 Install all pipe according to the Drawings and include all required fittings/bends, piping, blind flange plates, backup ring and stainless-steel bolt sets, fusing, neoprene gasket, and bedding materials.

3.04 INSPECTION AND TESTING – LEACHATE PIPING

.1 Performance of various inspections, tests and check surveys will be conducted by the Contract Administrator.

.2 Testing of materials, compaction and check surveys will be carried out by testing personnel designated by the Contract Administrator. Frequency of tests and check surveys will be determined by the Contract Administrator.

.3 Contractor shall make Contract Administrator’s test locations available and shall keep equipment away from the test location for the duration of tests.

3.05 HYDROSTATIC LEAKAGE TESTING FOR HDPE PIPING

.1 Hydrostatic Testing shall be performed after backfilling is completed.

.2 Provide labour, water, equipment and materials required to perform leakage tests hereinafter described and at no additional cost to the City.

.3 Hydrostatic pressure testing shall be done on maximum increment of 5 km sections of pipe at 1.5 times the maximum pressure rating of the pipe at the lowest elevation.

.1 Cleaning and flushing of pressure mains shall not be conducted when the average ambient air temperature is less than + 5ºC.

.2 All costs for testing shall be included in the unit price bid for installation of the mains including the supply of potable water.

.4 Notify Engineer at least 5 working days in advance of all proposed tests. Perform tests in presence of the Engineer.

.5 The Contractor shall expel the air from the mains prior to leakage testing. The Contractor is permitted to add, at no additional cost to the City, additional air release cocks to facilitate air removal upon filling. The additional cocks shall be removed and sealed.

.6 Hydrostatic testing for leaking shall be accomplished by two steps:

.1 Initial Expansion Phase

.2 Test Period

.1 The Initial Expansion Phase consists of adding sufficient makeup water at intervals to the pipeline for four hours, each retaining the pipeline at the Test Pressure.

.2 The Test Pressure will vary along the test section due to variations in elevation. The static test pressure shall be increased in the test section until the first pipe in the test section reaches a hydrostatic pressure of not less than 1.5 times its pressure rating. No pipe in the test section shall be subject to a hydrostatic test pressure higher than 1.5 times its pressure rating, i.e., the Test Pressure shall be 1065 kPa for Series 710 kPa pipe.

.3 The Test Period shall begin after the Expansion Phase is completed.

.4 After the one-hour Test Period is completed, a measured amount of makeup water shall be added to the pipeline until the Test Pressure is attained.

.5 The amount of makeup water shall not exceed the following table:

ALLOWANCE FOR EXPANSION UNDER TEST PRESSURE
BASED ON TABLE 7 KWH PIPE CANADA INC.

Allowance for Expansion (Litres/100 Metres of Pipe) For a 1 Hr. Test Period									
Testing Pipe Environment Temperature	**Nominal Pipe Size (mm)**								
ºC	50	75	100	150	200	250	300	350	400
5	0.3	0.4	0.5	1.1	1.9	2.6	4.1	5.2	10.1
10	0.4	0.5	0.7	1.6	2.6	3.7	5.7	7.3	14.1
15	0.5	0.7	0.9	2.1	3.5	4.9	7.7	9.8	18.8
20	0.6	0.9	1.2	2.8	4.6	6.4	10.1	12.9	24.8

.7 The Contractor shall repair all leaks and defects until the system passes the leakage test as witnessed by the Engineer.

3.06 CONNECTION TO EXISTING INFRASTRUCTURE

.1 Locate connection points and excavate to expose existing infrastructure.

.2 Incorporate protective measures so as to avoid damaging the existing infrastructure.

.3 Check the alignment of the proposed system to the existing infrastructure and review alignments with the Contract Administrator.

.4 Perform necessary system shut-downs before making the connection.

.5 Notify the City at least 72 hours prior starting the connection. Present a written plan identifying the necessary valve closures plus a contingency plan to address potential problems during the connection process.

.6 Notify the City 24 hours prior to making a connection to the existing system.

.7 In cases where the existing infrastructure was installed by Other Contractors and is still under their control or warranty, Contractor shall coordinate his activities with Other Contractors including but not limited to notifications, protection of the infrastructure, pre- and post-connection inspections and repair of all damages.

3.07 PROTECTION

.1 The trench within the cell shall be backfilled with granular drainage media in lifts not exceeding 200 mm in thickness.

.2 Hand place granular material in uniform layers not exceeding 150 mm thick. Dumping of material directly on top of pipe is not permitted.

.3 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

3.08 CLEANING

.1 Upon completion of the Works and prior to acceptance, flush with water all pipelines installed under this Contract and remove and dispose of all accumulated debris and other foreign matter to the satisfaction of Contract Administrator.

.2 Upon completion of work, remove surplus materials and debris, trim slopes, and correct defects noted by the Contract Administrator.

.3 Separate waste materials for reuse and recycling.

.4 Remove and dispose of all packaging materials at appropriate recycling facilities.

END OF SECTION