
This addendum varies the Contract Documents and will form part of the Contract Documents and is to be read, interpreted and coordinated with all other parts, including General and Supplementary General Conditions of the Contract and all Sections in Division 1. The cost of all work contained herein is to be included in the Contract Sum. The following revisions supersede the information contained in the original drawings and specifications issued for the above named project to the extent referenced and shall become a part thereof.

GENERAL

This addendum is issued prior to receipt of Bids to provide for certain revisions to and clarification to the Contract Documents.

The work required by this Addendum shall be executed in accordance with the requirements of the Contract and Contract Documents.

Include in the Stipulated Price, the cost of all work described in this Addendum.

DIVISION 1

Specifications

Add the following Clauses to Section 01 14 00 Work Restrictions:

- 1.3.6. Contractor shall be responsible to for damages to facility equipment as a result of unscheduled service shut-downs (not coordinated with Departmental representative).
- 1.3.7. Submit a "Fire Alarm Shutdown" request to Departmental Representative 72 hours in advance for approval.
- 1.3.8 Obtain permission from Departmental representative for access to restricted areas outside the construction zone 72 hours in advance for approval.
- 1.7. SECURITY
 - .1 There is no security clearance process. The contractor needs to include for the cost of Commissionaires for security.
 - .2 Security escort (Commissionaires)
 - .1 All personnel engaged for the work on this project must be escorted by a Commissionaire (Security Escort) at ALL times as well as for each separate part of the building/site where work is being done at the same time.
 - .2 Submit an Escort Request to PWGSC by email at least 48 hours before service is needed, using an electronic form Attachment to Call-Up for Commissionaire Services, a hard copy of which will be provided to successful bidder. For request submitted within the time noted above, escort will be arranged by Departmental Representative and costs will be tabulated for settlement with the Contractor. Refer to item .7.
 - .3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort.
 - .4 Calculation of costs will be based on average hourly rate of security officer for minimum of 8 hours per day for late service request and of 4 hours for late cancellations.
 - .5 Escort Service to be Commissionaires BC.
 - .1 Charge-out hourly rate for regular federal work by Commissionaires BC are as follows:

.1 Regular rate	\$ 29.00 / HR
.2 Regular Overtime rate	\$ 40.29 /HR
.3 Double overtime rate	\$ 51.28 / HR

- .4 Stat Holiday Rate \$ 40.28 / HR
- .2 Overtime is charged after 8 hours, double overtime after 12 hours.
- .6 Contractor to identify the amount carried for Commissionaire Services in the Contract Cost Breakdown.
- .7 The Owner will hire and pay for the Commissionaires directly but the Contractor will allow for all Commissionaire costs in their contract price. When the final cost is known, the Owner will then issue a credit change order for that cost.

Add New Section 01 35 00.06 – Special Procedures for Traffic Control (Enclosed)

Add New Section 01 35 43 – Environmental Procedures (Enclosed)

ARCHITECTURAL ADDENDUM

Refer to enclosed for Architectural Addendum No. 2 (3 Pages)

STRUCTURAL ADDENDUM

Refer to enclosed for Structural Addendum No. 1 (2 Pages)

MECHANICAL ADDENDUM

Refer to enclosed for Mechanical Addendum No. 2 (1 Page)

ELECTRICAL ADDENDUM

Drawings

- .1 Refer to the Light Pole Base sketch – enclosed.

Questions and Answers:

Q1: Which division supplies the bases for the light pole? Is this part of the electrical scope to supply a precast base, or is there slab thickening in this area? Both are shown on drawings S813 and E810. If slab thickening is required, do we follow detail 3/S813.

A1: Division 26 is responsible for coordinating the provision of concrete base with the general contractor. A cut-out will be left in concrete slab for installation of light pole concrete base.

CIVIL ADDENDUM

Refer to enclosed for Electrical Addendum No. 1 (125 Pages)

QUESTIONS AND ANSWERS

Q1: Is drain tile required around the new building? This is shown on detail A/S814, however not detailed. Will this drain to the sump or tie into the sanitary line?

A1: Provide drain tile, draining to a rock pit North of the building and cooling tower pad.

Q2: What are the traffic restrictions for the road? Are we allowed to plan a full shutdown of the road or will we have to maintain at least single lane alternating traffic?

A2: Refer to Section 01 35 00.06 – Special Procedures for Traffic Control, enclosed. Full shutdown of the road is not permitted - maintain at least single lane alternating traffic.

Q3: Is security clearance required for subcontractor that are only working outside of the existing building? (At the new building area)

SUMMERLAND, BC

PROJECT R.075862.001

3 DECEMBER 2015

A3: There is no security clearance process. The contractor needs to include for the cost of Commissionaires for security. All personnel engaged for the work on this project must be escorted by a Commissionaire (Security Escort) at ALL times as well as for each separate part of the building/site where work is being done at the same time. (refer to revised Specification in this Addendum).

Q4: Is concrete, soil and soil density testing paid for by the owner?

A4: All required and specified testing is under the contract, responsibility (and paid by) the Contractor (unless specifically noted otherwise).

Q5: Can you please confirm that stamped engineered shop drawings are required for the following:

- Site water utility distribution piping per section 33 11 16 Item 1.05.3.1
- Public Sanitary Sewerage piping per section 33 31 13 Item 1.06.3.1
- Non-structural metal framing per section 09 22 16 Item 1.3.3.1

A5: Engineered shop drawings are not required for Site water utility distribution piping per section 33 11 16 Item 1.05.3.1, or Public Sanitary Sewerage piping per section 33 31 13 Item 1.06.3.1. Engineered shop drawings are required for Non-structural metal framing per section 09 22 16 Item 1.3.3.1.

Q6 Is there a requirement for the contractor to have a security guard with the workers at all times and all area's? ie. two area's = two guards. With that is the cost of the security guards the responsibility of the contractor or is the owner covering this cost? If contractor what are the hourly costs.

A6: Contractor shall carry Commissionaires. Refer to specifications update.

Q7 Will the owner/consultant be providing autocadd files for the contractor to do As-built as per 1.23.4? I would suggest a cash allowance be provided for this scope of work as there is no way of knowing how many sheets will have to be changed.

A7: Contractor shall carry a fund to cover for the costs of the ACAD record drawings.

End of Addendum

Part 1 General

1.1 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

.1 N/A

1.2 RELATED REQUIREMENTS

.1	Health and Safety Requirements	Section 01 35 33
.2	Aggregate Materials	Section 31 05 16
.3	Roadway Embankments	Section 31 24 13
.4	Granular Sub-Base	Section 32 11 16.01
.5	Aggregate Base Courses	Section 32 11 23
.6	Roadway Dust Control	Section 32 15 60

1.3 REFERENCES

.1 Manual of Uniform Traffic Control Devices for Streets and Highways - [2002].

1.4 PROTECTION OF PUBLIC TRAFFIC

- .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.
- .2 When working on travelled way:
 - .1 Place equipment in position to present minimum of interference and hazard to travelling public.
 - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
- .3 Do not close any lanes of road without approval of Departmental Representative. Before re-routing traffic, erect suitable signs and devices in accordance with instructions contained in Part D of UTCD.
- .4 Keep travelled way graded, free of pot holes and of sufficient width for required number of lanes of traffic:
 - .1 Provide minimum 7.5 m wide temporary roadway for traffic in two-way sections through Work and on detours.
 - .2 Provide minimum 4.0 m wide temporary roadway for traffic in one-way sections through Work and on detours.
- .5 As indicated, provide graveled detours or temporary roads to facilitate passage of traffic around restricted construction area:
 - .1 Perform grading for detour in accordance with Section 31 24 13 - Roadway Embankments.

- .2 Place and compact granular sub-base in accordance with Section 32 11 16.01 - Granular Sub-base.
- .3 Place and compact granular base in accordance with Section 32 11 23 - Aggregate Base Courses.
- .6 Provide and maintain road access and egress to property fronting along Work under Contract and in other areas as indicated, unless other means of road access exist that meet approval of Departmental Representative.

1.5 INFORMATIONAL AND WARNING DEVICES

- .1 Provide and maintain signage, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response.
- .2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as specified in Part D, Temporary Conditions Signs and Devices, of UTCD manual.
- .3 Place signs and other devices in locations recommended in UTCD manual.
- .4 Meet with Departmental Representative prior to commencement of Work to prepare list of signs and other devices required for project. If situation on site changes, revise list to approval of Departmental Representative.
- .5 Continually maintain traffic control devices in use by.
 - .1 Checking signs daily for legibility, damage, suitability and location: clean, repair or replace to ensure clarity and reflectance;
 - .2 Removing or covering signs which do not apply to changing conditions.

1.6 CONTROL OF PUBLIC TRAFFIC

- .1 Provide competent flag persons trained in accordance with, and properly equipped as specified in the UTCD manual in following situations:
 - .1 When public traffic is required to pass working vehicles or equipment that block all or part of travelled roadway;
 - .2 When it is necessary to institute one-way traffic system through construction area;
 - .3 When there is a blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use;
 - .4 When workmen or equipment are employed past hill crests, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning;
 - .5 Where temporary protection is required while other traffic control devices are being erected or taken down;
 - .6 For emergency protection when other traffic control devices are not readily available;
 - .7 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices;

- .8 At each end of restricted sections where pilot cars are required;
- .9 Delays to public traffic due to contractor's operators shall be a maximum 15 minutes.
- .2 Equip pilot cars with orange flashing lights and signs clearly designating vehicles as pilot cars.
- .3 Where two-way traffic is restricted to one lane for 24 hours each day, provide a portable traffic signal system. Adjust as necessary and regularly maintain system during period of restriction. Signal system to meet requirements of Part IV of Manual of Uniform Traffic Control Devices for Streets and Highways.

1.7 OPERATIONAL REQUIREMENTS

- .1 Maintain existing conditions for traffic throughout period of contract except when required for construction as indicated. Prior to traffic disruptions, the contractor is to ensure measures are taken to protect and control public traffic and existing conditions with written approval from the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1	Submittal Procedures	Section 01 33 00
.2	Health and Safety Requirements	Section 01 35 33
.3	Cleaning	Section 01 74 11
.4	Construction/Demolition Waste Management and Disposal	Section 01 74 21

1.2 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
 - .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package for New Construction and Major Renovations (including Addendum [2007]).
 - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-[Addendum 2007].
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
 - .4 LEED Canada 2009 for Design and Construction-[2010], LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide
 - .5 LEED Canada for Existing Buildings, Operations and Maintenance-[2009], LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
 - .2 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008 Stipulated Price Contract.
 - .3 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005-[92], Storm Water Management for Construction Activities, Chapter 3.
 - .2 EPA General Construction Permit (GCP) [2012].

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all products required to complete the Work and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.
- .3 Sustainable Design Submittals:
 - .1 N/A
- .4 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review by Departmental Representative.
- .5 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .6 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .7 Include in Environmental Protection Plan:
 - .1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from site.
 - .3 Name(s) and qualifications of person(s) responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations and EPA 832/R-92-005, Chapter 3.
 - .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
 - .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
 - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
 - .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

- .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan to be included and updated, as required.

1.4 FIRES

- .1 Fires and burning of rubbish on site is permitted only when approved by Departmental Representative.
- .2 Where fires or burning is permitted, prevent staining or smoke damage to structures, materials or vegetation which is to be preserved.
 - .1 Restore, clean and return to new condition stained or damaged work.
- .3 Provide supervision, attendance and fire protection measures as directed.

1.5 DRAINAGE

- .1 Develop and submit an Erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations, EPA 832/R-92-005, Chapter 3 and US EPA General Construction Permit.
- .2 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .3 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.6 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 1.5 m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas designated by the Departmental Representative.

1.7 WORK ADJACENT TO WATERWAYS

- .1 Construction equipment to be operated on land only.
- .2 Waterways to be kept free of excavated fill, waste material and debris.
- .3 Design and construct temporary crossings to minimize erosion to waterways.
- .4 Do not skid logs or construction materials across waterways.
- .5 Avoid indicated spawning beds when constructing temporary crossings of waterways.

1.8 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
 - .1 Provide temporary enclosures as indicated.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.9 HISTORICAL/ARCHAEOLOGICAL CONTROL

- .1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

1.10 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
 - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

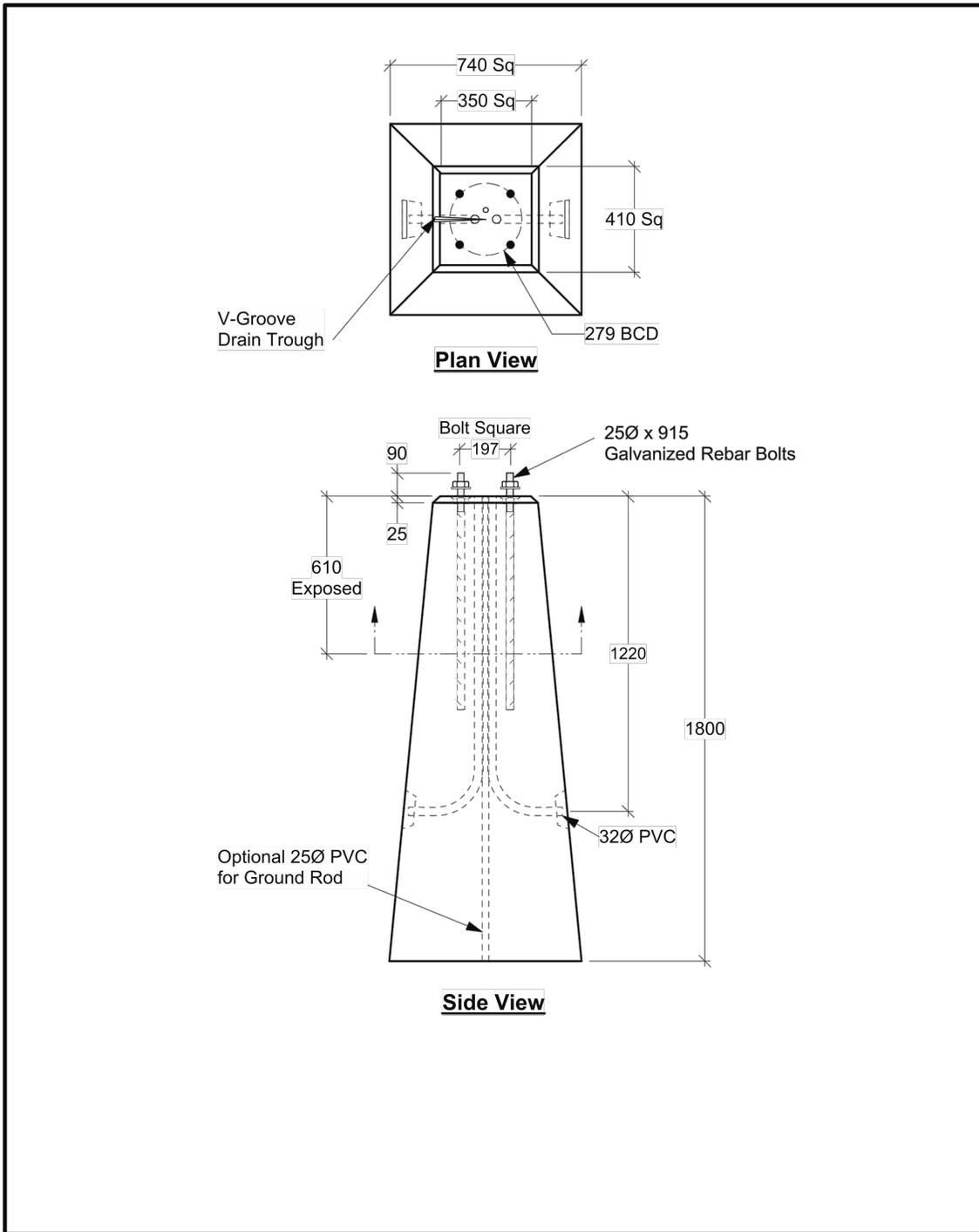
- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Bury rubbish and waste materials on site where directed after receipt of written approval from Departmental Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION



Project title/Titre du projet

**PACIFIC AGRI-FOOD RESEARCH CENTRE
MECH & ELEC RETROFIT**
4200 97 HWY SOUTH SUMMERLAND BC

Drawing title/Titre du dessin

LIGHT POLE BASE DETAIL

Consultant Signature Only

PWGSC Project Manager/Administrateur
de Projets TPSGC **TOM DUNPHY**

Scale/Echelle

N.T.S.

Designed by/Concept par

PWGSC, Regional Manager, Architectural and Engineering Services/
Gestionnaire régionale, Services d'architectural et de génie, TPSGC
PREETIPAL PAUL

Date/Date

2015/12/03

Drawn by/Dessine par

Project No./No. du
projet

115615169

Sheet/Feuille

ESK-01

Revision/
Revision



**The following changes/clarifications in the tender documents are effective immediately.
This addendum will form part of the contract documents.**

Special Instructions to Bidders

Clarification:

1.0 DRAWINGS

- 1.1 With respect to architectural section detail 11/A817 :
 - 1. All interior aluminum spandrel panel to be clear anodized finish.
 - 2. All aluminum spandrel panels and plywood panels to be secured to aluminum by glazing tape
 - 3. Aluminum angle to be secured to the alum window frame by screw and caulk
- 1.2. All concrete masonry block to be 190mm thick as per structural drawings. There is no 240 mm thick masonry block.
- 1.3 1.5"(40mm) high standing seam metal roof and cladding is an acceptable alternative.
- 1.4 Provide 1 layer of protection/recovery board between semi-rigid insulation and self-adhesive anti-slipped sheet for typical roof assembly.
- 1.5 Solvent based polyurethane concrete sealer is an acceptable alternative to water based polyurethane concrete sealer for floor slab.
- 1.6 Metal bottom rail is required instead of metal wire for all chain link fence and chain link gate.
- 1.7 All chemical container and containment palette shown on drawings are not included in contract.

2.0 SPECIFICATION

- 2.1 Specification Section 09 22 16 Non-Structural Metal Framing, 1.3.1 required shop drawings to be stamped and signed by P.Eng. registered in B.C.
- 2.2 Refer to Specification Section 32 31 13, Chain Link Fence, 2.1 Materials

Delete:

.2 Pipe: to CAN2-138.2 MBO, Table 1 Medium Duty. Schedule 40 (wall thicknesses as shown below), standard continuous weld, modulus of elasticity 30,000.

<u>Pipe Dia.</u>	<u>Sched. 40 Wall Thickness</u>
1-5/8"	0.140" (9/64")
1-7/8"	0.145" (19/128")
2-3/8"	0.154" (5/32")
2-7/8"	0.203" (13/64")
3-1/2"	0.226" (7/32")
4-1/2"	0.237" (15/64")

Add:

.2 Pipe: to CAN2-138.2 MBO, Table 1 Medium Duty. Schedule 40 (wall thicknesses as shown below), standard continuous weld, modulus of elasticity 30,000.

<u>Pipe Dia.</u>	<u>Sched. 40 Wall Thickness</u>
1-5/8" 42.2mm	0.140" 3.56mm (9/64")
1-7/8" 48.3mm	0.145" 3.68mm (19/128")
2-3/8" 60.3mm	0.154" 3.91mm (5/32")
2-7/8" 73.0mm	0.203" 5.16mm (13/64")
3-1/2" 88.9mm	0.216" 5.49mm (7/32")
4-1/2" 114.3mm	0.237" 6.02mm (15/64")

2.3 Refer to Specification Section 32 31 13, Chain Link Fence, 2.1 Materials

Delete:

.6 Woven fabric: to CAN2-138.1.M80. See 2.1.8. for gauge and mesh size. Top and bottom selvages to have knuckled finish. Wire diameters shall be as follows for the specified wire gauges:

Specified Gauge Min. Core Wire Diameter

6ga.: 3.60mm (0.142")
9ga.: 2.64mm {0.104"}
11ga.: 1.98mm (0.078")

Add:

.6 Woven fabric: to CAN2-138.1.M80. See 2.1.8. for gauge and mesh size. Top and bottom selvages to have knuckled finish.

2.4 Refer to Specification Section 32 31 13, Chain Link Fence, 2.1 Materials, .8 Table One

Delete:

Fabric galvanized grid 12.7mm x 76mm, 10.5ga.
Tie Wire, Hog Rings 300mm. (12") o.c.

at all tension bands and frame members

Add:
Fabric

galvanized grid 12.7mm x 76mm, 10.5ga. wire wall
Tie Wire, Hog Rings 300mm. (12") o.c.
at all tension bands and frame members

End of Addendum #2

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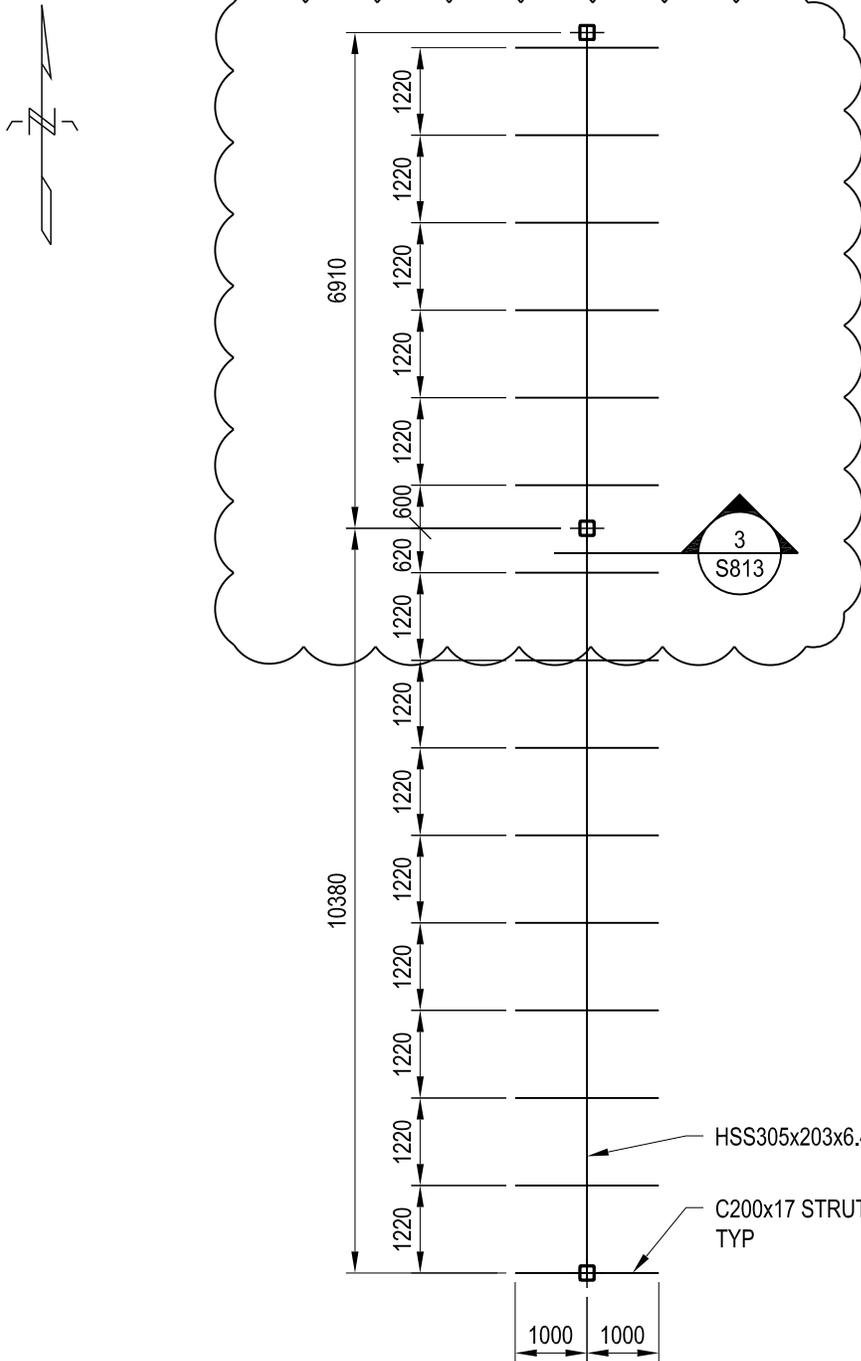
3 SPECIFICATIONS

- .1 No revisions.

4 DRAWINGS

- .1 Extend pipe support steel framing to future cooling tower. See sketch SSK-01.
- .2 Refer to architectural and mechanical drawings for support steel framing (and post) height.
- .3 Provide C150x12 frame around overhead door opening to support door track and rollers. See architectural drawings for location and extent. .

End of Addendum



Project title/Titre du projet

**PACIFIC AGRI-FOOD RESEARCH CENTRE
MECH & ELEC RETROFIT
4200 97 HWY SOUTH SUMMERLAND BC**

Drawing title/Titre du dessin

**COOLING TOWER
PARTIAL FRAMING PLAN
ADDENDUM #2**

Consultant Signature Only

PWGC Project Manager/Administrateur
de Projets TPSGC TOM DUNPHY

Scale/Echelle

N.T.S.

Designed by/Concept par

CT

PWGC, Regional Manager, Architectural and Engineering Services/
Gestionnaire régionale, Services d'architectural et de génie, TPSGC
PREETIPAL PAUL

Date/Date

2015/12/03

Drawn by/Dessine par

CH

Project No./No. du
projet R.075862.001

Sheet/Feuille

SSK-01

Revision/
Revision



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3 SPECIFICATIONS

- .1 Section 23 21 13.04 – Hydronic Systems – Steel - Preinsulated
 - .1 Add Clause 1.7.2 to read:
 - .2 Provide expansion calculation, with the Shop Drawings, for the system with a temperature range of 1°C-44°C [34°F – 111°F], with expansion loops and change in slope (refer to terrain profiles on Civil Drawings).

4 DRAWINGS

- .1 No revisions .

5 QUESTIONS AND ANSWERS

- .1 Q1: Will an HDPE or other plastic alternate material be acceptable for the underground condenser water be acceptable for this project?
A1: Provide steel pre-insulated underground piping as specified..
- .2 Q2: What Wet Bulb Temperature should we use for sizing the cooling towers?
A2: Cooling Tower selection is based on 19.5°C [67°F] wet bulb temperature.
- .3 Q3: What date are the cooling towers required onsite?
A3: Coordinate scheduling with General Contractor.
- .4 Q4: Can you please provide dimensions for detail 1/M709. What is the min. bury depth, pipe spacing required?
A4: Minimum. bury depth and pipe spacing shall follow manufacturer's requirements. Generally, min. bury depth shall be 1200 mm under roadways, and 750 mm in areas with no traffic..
- .5 Q5: Is there a coil required in each of cooling towers CT-1, CT-2 & CT-3 to provide a closed circuit to (99.2 / 84.2F / 825GPM) system water
A5: Yes, a coil is required in each cooling tower as specified.

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- .3 Include in the Stipulated Price, the cost of all work described in this Addendum.

2 SPECIFICATIONS

- .1 Section 01 35 00.06 – Special Procedures for Traffic Control
 - .1 Addition of Entire Section (Refer to Div. 1)
- .2 Section 01 35 43 – Environmental Procedures
 - .1 Addition of Entire Section (Refer to Div. 1)
- .3 Section 31 05 16 – Aggregate Materials
 - .1 Addition of Entire Section
- .4 Section 31 22 13 – Rough Grading
 - .1 Addition of Entire Section
- .5 Section 31 23 33.01 – Excavating, Trenching and Backfilling
 - .1 Addition of Entire Section
- .6 Section 31 24 13 – Roadway Embankments
 - .1 Addition of Entire Section
- .7 Section 31 32 19.01 – Geotextiles
 - .1 Addition of Entire Section
- .8 Section 32 11 16.01 – Granular Sub-Base
 - .1 No changes were made to this Section.
- .9 Section 32 11 17 – Re-Shaping Existing Granular Roadbed
 - .1 Addition of Entire Section
- .10 Section 32 11 23 – Aggregate Base Courses
 - .1 Revised Section 1.02 Related Requirements to include relevant references
 - .2 Corrected numbering in 1.02 Related Requirements
- .11 Section 32 12 10 – Marshall Immersion Test for Bitumen
 - .1 Addition of Entire Section
- .12 Section 32 12 13.23 – Asphalt Prime Coats
 - .1 No changes were made to this Section.
- .13 Section 32 12 16 – Asphalt Paving
 - .1 Revised Section 1.02 Related Requirements
- .14 Section 32 12 16.16 – Road-Mix Asphalt Paving Wearing Courses
 - .1 Addition of Entire Section
- .15 Section 32 15 60 – Roadway Dust Control

-
- .1 Addition of Entire Section
 - .16 Section 32 17 23 Pavement Markings
 - .1 Revised Section 1.02 Related Requirements
 - .2 Removed “[mobile]” from clause 3.02.1
 - .17 Section 32 91 19.13 – Topsoil Placement and Grading
 - .1 Revised Section 1.02 Related Requirements
 - .2 Clause 1.08.2 has been reworded to remove the CCDDC reference as requested.
 - .18 Section 32 92 19.13 – Mechanical Seeding
 - .1 Revised Section 1.02 Related Requirements
 - .19 Section 32 92 19.16 – Hydraulic Seeding
 - .1 Revised Section 1.02 Related Requirements
 - .2 Removed “and after receipt of written approval to proceed from Departmental Representative.” from clause 3.01.3
 - .20 Section 33 05 16 Maintenance Holes and Catch Basin Structures
 - .1 Addition of Entire Section
 - .21 Section 33 11 16 – Site Water Utility Distribution Piping
 - .1 Revised Section 1.02 Related Requirements
 - .2 Added clause 2.02.9 “Not used” to correct numbering.
 - .22 Section 33 11 16.01 – Incoming Site Water Utility Distribution
 - .1 Revised Section 1.02 Related Requirements
 - .23 Section 33 31 13 – Public Sanitary Utility Sewerage Piping
 - .1 Revised Section 1.02 Related Requirements

3 DRAWINGS

- .1 Added Electrical conduits as requested
 - .1 Added RPVC Power conduit alignment as per Electrical drawings.
 - .2 Increased the pavement cut area accordingly.

End of Addendum C-1

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|---|---------------------|
| .1 | Granular Sub-Base | Section 32 11 16.01 |
| .2 | Aggregate Base Courses | Section 32 11 23 |
| .3 | Asphalt Paving | Section 32 12 16 |
| .4 | Site Water Utility Distribution Piping | Section 33 11 16 |
| .5 | Incoming Site Water Utility Distribution Piping | Section 33 11 16 |
| .6 | Public Sanitary Utility Sewerage Piping | Section 31 05 16 |

1.02 REFERENCES

- .1 ASTM International
 - .1 ASTM D 4791-[10], Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
 - .4 LEED Canada-EB: O&M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
- .3 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for aggregate materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Allow continual sampling by Departmental Representative during production.
 - .2 Provide Departmental Representative with access to source and processed material for sampling.
 - .3 Install sampling facilities at discharge end of production conveyor, to allow Departmental Representative to obtain representative samples of items being produced. Stop conveyor belt when requested by Departmental Representative to permit full cross section sampling.
 - .4 Provide front end loader or other suitable equipment including trained operator for stockpile sampling as necessary. Move samples to storage place as directed by Departmental Representative.
 - .5 Supply new or clean sample bags or containers according appropriate to aggregate

- materials.
- .6 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.
- .7 Provide water, electric power and propane to Departmental Representative laboratory trailer at production site.
- .4 Sustainable Design Submittals:
 - .1 LEED Canada submittals: N/A.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .3 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with authorities having jurisdiction.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Storage: store washed materials or materials excavated from underwater 24 hours minimum to allow free water to drain and for materials to attain 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, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D 4791.
 - .1 Greatest dimension to exceed 5 times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
 - .2 Reclaimed asphalt pavement.
 - .3 Reclaimed concrete material.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Light weight aggregate, including slag and expanded shale.
 - .4 Reclaimed asphalt pavement.
 - .5 Reclaimed concrete material.

2.02 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.

- .3 Advise Departmental Representative 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for topsoil stripping.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with topsoil stripping only after unacceptable conditions have been remedied.

3.02 PREPARATION

- .1 Topsoil stripping:
 - .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
 - .2 Begin topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.
 - .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.
 - .4 Stockpile in locations as indicated. Stockpile height not to exceed 2 m.
 - .5 Dispose of topsoil off site.
- .2 Aggregate source preparation:
 - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as directed by Departmental Representative.
 - .2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.
 - .3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
 - .4 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
 - .5 Trim off and dress slopes of waste material piles and leave site in neat condition.
 - .6 Provide silt fence or other means to prevent contamination of existing watercourse or natural wetland features.
- .3 Processing:
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, as required, including reclaimed materials that meet physical requirements of specification is permitted in order to satisfy gradation requirements for material and, percentage of crushed particles, or particle shapes specified.
 - .1 Use methods and equipment approved in writing by Departmental Representative.
- .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate gradation.
- .5 Where necessary, screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.

- .1 Use only equipment approved in writing by Departmental Representative.
- .6 Stockpiling:
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
 - .2 Stockpile aggregates in sufficient quantities to meet project schedules.
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.
 - .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.
 - .7 Stockpile materials in uniform layers of thickness as follows:
 - .1 Maximum 1.5 m for coarse aggregate and base course materials.
 - .2 Maximum 1.5 m for fine aggregate and sub-base materials.
 - .3 Maximum 1.5 m for other materials.
 - .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
 - .9 Do not cone piles or spill material over edges of piles.
 - .10 Do not use conveying stackers.
 - .11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .4 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .6 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.
- .7 Restrict public access to temporary or permanently abandoned stockpiles by means acceptable to Departmental Representative.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|-------------------------------|---------------------|
| .1 | Topsoil Placement and Grading | Section 32 91 19.13 |
| .2 | Mechanical Seeding | Section 32 91 19.13 |
| .3 | Hydraulic Seeding | Section 32 92 19.16 |

1.02 REFERENCES

- .1 ASTM International
 - .1 ASTM D 698-[07e1], Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/mü).
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
 - .4 LEED Canada-EB: O&M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
- .3 Underwriters' Laboratories of Canada (ULC)

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Sustainable Design Submittals:
 - .1 LEED Canada submittals: N/A.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .3 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with authorities having jurisdiction.

1.04 EXISTING CONDITIONS

- .1 Examine subsurface investigation report from geotechnical engineer.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan.
- .3 Refer to dewatering in Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2 PRODUCTS

2.01 MATERIALS

- .1 Fill material: Type in accordance with of Section 31 23 33.01 - Excavating, Trenching and Backfilling.

- .2 Excavated or graded material existing on site suitable to use as fill for grading work if approved by Departmental Representative.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for rough grading installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Departmental Representative.
- .2 Commence topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.
- .3 Strip topsoil to depths as indicated. Rototill weeds and grasses and retain as topsoil on site. Avoid mixing topsoil with subsoil.
- .4 Stockpile in locations as indicated. Stockpile height not to exceed 2 m.
- .5 Dispose of unused topsoil off site.

3.03 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Slope rough grade away from building as indicated.
- .3 Grade ditches to depth as indicated.
- .4 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .5 Compact filled and disturbed areas to [corrected maximum dry density to ASTM D 698, as follows:
 - .1 85% under landscaped areas.
 - .2 95% under paved and walk areas.
- .6 Do not disturb soil within branch spread of trees or shrubs to remain.

3.04 TESTING

- .1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by ULC. Costs of tests will be paid under a Cash Allowance by Departmental Representative in accordance with Sections and 01 45 00 - Quality Control.
- .2 Submit testing procedure, frequency of tests, testing laboratory as designated by ULC or certified testing personnel to Departmental Representative for review.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in

- accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.06 PROTECTION**
- .1 Protect and/or transplant existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as directed by Departmental Representative. If damaged, restore to original or better condition unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|---|---------------------|
| .1 | Asphalt Paving | Section 33 12 16 |
| .2 | Site Water Utility Distribution Piping | Section 33 11 16 |
| .3 | Incoming Site Water Utility Distribution Piping | Section 33 11 16.01 |
| .4 | Public Sanitary Utility Sewerage Piping | Section 33 31 13 |

1.02 MEASUREMENT PROCEDURES

- .1 Excavated materials will be measured in cubic metres in their original location.
 - .1 Common excavation quantities measured will be actual volume removed within following limits:
 - .1 Width for trench excavation as indicated.
 - .2 Width for excavation for structures as indicated.
 - .3 Depth from ground elevation, surface of pavement or surface of sidewalk immediately prior to excavation, to elevation as indicated.
 - .2 Rock quantities measured will be actual volume removed within following limits:
 - .1 Width for trench excavation as indicated.
 - .2 Width for excavation for structures to be bounded by vertical planes up to 500 mm outside of and parallel to neat lines of footings as indicated.
 - .3 Depth from rock surface elevations immediately prior to excavation, to elevation as indicated.
 - .4 Where design elevation is less than 300 mm below original rock surface, depth will be considered to be 300 mm below original rock surface.
 - .5 Volume of individual boulders and rock fragments will be determined by measuring three maximum mutually perpendicular dimensions.
- .2 Sheeting and bracing left in place on direction of Departmental Representative will be measured in square metres of surface area of plane surface of sheeting.
- .3 Shoring, bracing, cofferdams, underpinning and de-watering of excavation will not be measured separately for payment.
- .4 Backfilling to authorized excavation limits will be measured in cubic metres compacted in place for each type of material specified.
- .5 Placing and spreading of topsoil will be measured for payment in cubic metres calculated from cross sections taken in area of excavation from original location.
 - .1 If double handling of topsoil is directed by Departmental Representative (stockpiling and later placing), then quantities will be measured twice; on excavation from original location and on excavation from stockpile.

1.03 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117-[04], Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-[05], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63[2002], Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698-[00ae1], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).

- .5 ASTM D 1557-[02e1], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
- .6 ASTM D 4318-[05], Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .4 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-[03], Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-[03], Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .5 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.04 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00m³ and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 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.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1

CAN/CGSB-8.2.

.2 Table:

<u>Sieve Designation</u>	<u>% Passing</u>
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
<u>0.005 mm</u>	<u>0 - 45</u>

.3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.

.8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 LEED Submittals:

.1 N/A.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control:

.1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.

.2 Submit for review by Departmental Representative proposed dewatering and heave prevention methods as described in PART 3 of this Section.

.3 Submit to Departmental Representative written notice at least 7 days prior to excavation work, to ensure cross sections are taken.

.4 Submit to Departmental Representative written notice when bottom of excavation is reached.

.5 Submit to Departmental Representative testing and inspection results as well as any accompanying reports as described in PART 3 of this Section.

.4 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.

.5 Samples:

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

.2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

.3 Submit 70 kg samples of type of fill specified including representative samples of excavated material.

.4 Ship samples to Departmental Representative in tightly closed containers to prevent contamination and exposure to elements.

.5 At least 4 weeks prior to beginning Work, inform Departmental Representative source of fly ash and submit samples to Departmental Representative.

.1 Do not change source of Fly Ash without written approval of Departmental Representative.

1.06 QUALITY ASSURANCE

.1 Qualification Statement: submit proof of insurance coverage for professional liability.

- .2 Where Departmental Representative is employee of Contractor, submit proof that Work by Departmental Representative is included in Contractor's insurance coverage.
- .3 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .4 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in the Province of British Columbia, Canada.
- .5 Keep design and supporting data on site.
- .6 Engage services of qualified professional Engineer who is registered or licensed in the Province of British Columbia, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .7 Do not use soil material until written report of soil test results are reviewed by Departmental Representative.
- .8 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.07 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Divert excess aggregate materials from landfill to local quarry, recycling or facility for reuse as directed by Departmental Representative.

1.08 EXISTING CONDITIONS

- .1 Examine soil report.
- .2 Buried services:
 - .1 Before commencing work verify and 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 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify authorities having jurisdiction and establish the location and operational status of buried utilities and structures. Authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.
 - .6 Confirm locations of buried utilities by careful test excavations or soil hydrovac methods.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
 - .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing. Costs for such Work to be paid by Departmental Representative.
 - .9 Record location of maintained, re-routed and abandoned underground lines.
 - .10 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

- .3 Where required for excavation, cut roots or branches as directed by Departmental Representative in accordance with Section 32 01 90.33 - Tree and Shrub Preservation.

2 PRODUCTS

2.01 MATERIALS

- .1 Type 1 and Type 2 fill: properties to Section 31 05 16 - Aggregate Materials and the following requirements:

- .1 Crushed, pit run or screened stone, gravel or sand.
.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

- .2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
.3 Unshrinkable fill: proportioned and mixed to provide:
.1 Maximum compressive strength of 0.4MPa at 28 days.
.2 Maximum cement content of 25 kg/m³: to CSA-A3001, Type GU.
.3 Minimum strength of 0.07MPa at 24 h.
.4 Concrete aggregates: to CSA-A23.1/A23.2.
.5 Cement: Type GU.
.6 Slump: 160 to 200 mm.
.4 Shearmat: honeycomb type bio-degradable cardboard 100 mm thick, treated to provide sufficient structural support for poured concrete until concrete cured.
.5 Geotextiles: to Section 31 32 19.01 - Geotextiles.

3 EXECUTION

3.01 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction

- until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- 3.02 PREPARATION/ PROTECTION**
- .1 Protect existing features in accordance with Section 01 56 00 - Temporary Barriers and Enclosures and applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .4 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.
- .5 Protect buried services that are required to remain undisturbed.
- 3.03 STRIPPING OF TOPSOIL**
- .1 Begin topsoil stripping of areas as indicated after area has been cleared of brush, weeds, and grasses and removed from site.
- .2 Strip topsoil to depths as indicated.
- .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as indicated.
- .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil off site.
- 3.04 STOCKPILING**
- .1 Stockpile fill materials in areas designated by Departmental Representative.
- .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.
- 3.05 COFFERDAMS, SHORING, BRACING AND UNDERPINNING**
- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements and Health and Safety Act for the Province of British Columbia.
- .1 Where conditions are unstable, Departmental Representative to verify and advise methods.
- .2 Obtain permit from authority having jurisdiction for temporary diversion of water course.
- .3 Construct temporary Works to depths, heights and locations as indicated.
- .4 During backfill operation:
- .1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.
- .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
- .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .5 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .6 Upon completion of substructure construction:
- .1 Remove cofferdams, shoring and bracing.

- .2 Remove excess materials from site and restore watercourses as indicated.

3.06 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Departmental Representative review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures to approved runoff collection areas and in a manner not detrimental to public property, private property or any portion of construction works underway.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.07 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .2 Excavate to lines, grades, elevations and dimensions as indicated.
- .3 Remove concrete, masonry, paving, walks, demolished foundations, rubble and other obstructions encountered during excavation and dispose offsite.
- .4 Excavation must not interfere with bearing capacity of adjacent foundations.
- .5 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .6 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .7 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .8 Restrict vehicle operations directly adjacent to open trenches.
- .9 Dispose of surplus and unsuitable excavated material off site.
- .10 Do not obstruct flow of surface drainage or natural watercourses.
- .11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .12 Notify Departmental Representative when bottom of excavation is reached.
- .13 Obtain Departmental Representative approval of completed excavation.
- .14 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .15 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with concrete specified for footings or fill concrete Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.
 - .2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected Standard Proctor maximum dry density.
- .16 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density

- at least equal to undisturbed soil.
- .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- .17 Install geotextiles in accordance with Section 31 32 19.01 - Geotextiles.

3.08 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D 698 and ASTM D 1557.
 - .1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95% of corrected maximum dry density.
 - .2 Within building area: use Type 2 to underside of base course for floor slabs. Compact to 100 % of corrected maximum dry density.
 - .3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 fill to underside of slab. Compact base course to 100%.
 - .4 Retaining walls: use Type 2 fill to subgrade level on high side for minimum 500 mm from wall and compact to 95%. For remaining portion, use Type 3 fill compacted to 95%.
 - .5 Place unshrinkable fill in areas as indicated.

3.09 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated and as specified in Section 33 11 16 - Site Water Utility Distribution Piping, Section 33 31 13 - Public Sanitary Utility Sewerage Piping.
- .2 Place bedding and surround material in unfrozen condition.

3.10 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and accepted installations.
 - .2 Departmental Representative has inspected and accepted of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading.
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and acceptance obtained from Departmental Representative.
 - .2 If approved by Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by

Departmental Representative.

- .6 Place unshrinkable or recycled fill in areas as indicated.
- .7 Consolidate and level unshrinkable fill with internal vibrators.
- .8 Install drainage system in backfill as indicated.

3.11 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as indicated.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Granular Sub-Base Section 32 11 16.01
- .2 Aggregate Base Courses Section 32 11 23

1.02 MEASUREMENT PROCEDURES

- .1 Stripping: measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
 - .1 Departmental Representative will take initial cross sections after clearing and grubbing completed.
 - .2 Stripping unit price to include cost of placing material on slopes upon completion of excavation and embankment.
- .2 Common Excavation: measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
 - .1 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.
- .3 Borrow: measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
 - .1 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.
- .4 Rock Excavation:
 - .1 Calculate volume excavated from solid rock masses in cubic metres from cross sections of original rock surface and design grade line for excavation.
 - .2 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.
 - .3 Measure rock excavated beyond design grade as Common Excavation when placed in embankment within established lines and grades.
 - .4 Measure excavated boulders and rock fragments measured individually. Determine volume of excavated boulders and rock fragments by measuring three maximum mutually perpendicular dimensions.
- .5 Unclassified excavation:
 - .1 Measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
 - .2 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.
- .6 Measure overhaul in cubic metre-kilometres and computed by "Mass Diagram Method". Overhaul as designated by Departmental Representative.
- .7 No separate payment for:
 - .1 Excavating unnecessarily beyond lines established by Departmental Representative, with exception of unavoidable slide material. Do not measure slide material when such slides are attributable to negligence.
 - .2 Ripping and/or drilling and blasting of material.

- .3 Scarifying or benching existing slopes or existing road surfaces.
- .4 Removing and disposing of roots, stumps and other materials excavated during waste operation.
- .5 Burying existing culverts from old road.
- .6 Removing unsuitable material from embankment attributable to negligence.
- .7 Shattering rock to 300 mm below subgrade elevation.
- .8 Scaling and removing loose rock from rock face.
- .9 Watering, drying and compacting.
- .10 Finishing.

1.03 REFERENCES

- .1 Definitions:
 - .1 Rock Excavation: excavation of:
 - .1 Material from solid masses of igneous, sedimentary or metamorphic rock which, prior to removal, was integral with parent mass. Material that cannot be ripped with reasonable effort with a Caterpillar D9 crawler bulldozer or equivalent to be considered integral with parent mass.
 - .2 Boulder or rock fragments measuring in volume 1 cubic metre or more.
 - .2 Common Excavation: excavation of materials that are not Rock Excavation or Stripping.
 - .3 Unclassified Excavation: excavation of whatever character other than stripping encountered in the Work.
 - .4 Free Haul: distance that excavated material is hauled without compensation. Free haul distance to be 0.5 km or less.
 - .5 Stripping: excavation of organic material covering original ground.
 - .6 Over Haul: authorized hauling in excess of free haul distance that excavated material is moved.
 - .7 Embankment: material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.
 - .8 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.
 - .9 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.
 - .10 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .2 Reference Standards:
 - .1 ASTM International
 - .1 ASTM D 698-07ea1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft³) (600 kN-m/m³).
 - .2 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO T99-10, Standard Method of test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5lb) Rammer and 305 mm (12 in) Drop.
 - .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and

- Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
- .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
- .4 LEED Canada-EB: O&M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval and review blasting program including preshear details, powder factors fly-rock control, and vibration monitoring methods.

1.05 QUALITY ASSURANCE

- .1 Regulatory Requirements:
- .1 Adhere to regulations of authority having jurisdiction when blasting is required.
- .2 Adhere to Provincial and National Environmental requirements when potentially toxic materials are involved.

2 PRODUCTS

2.01 MATERIALS

- .1 Embankment materials require approval by Departmental Representative.
- .2 Material used for embankment not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.
- .3 Borrow material:
- .1 Obtain from sources such as quarry, or borrow pit as indicated.
- .1 Earth Embankment materials to consist of acceptable earth material and processed rock material free from objectionable quantities of organic matter, frozen soil, stumps, trees, moss, and other unsuitable materials.
- .2 Rock Embankment material to consist of fragmented rock produced by drilling and blasting operations, and boulders which cannot be placed in layers as specified for Earth Embankments.
- .1 Rock Embankment to conform to gradation as follows:
- | Sieve Designation | Percent Passing by Weight |
|-------------------|---------------------------|
| 150 mm | 100 |
| 100 mm | 85 - 100 |
| 75 mm | 10 - 50 |
| No. 200 | * 0 - 3 |
- .2 * Gradation is determined by that portion passing 75 mm screen.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that condition of substrate is acceptable for roadway

embankment Work:

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 COMPACTION EQUIPMENT

- .1 Compaction equipment: vibratory rollers or vibrating plate compactors capable of obtaining required density in materials on project.
 - .1 Demonstrate compaction equipment effectiveness on specified material and lift thickness by documented performance of test-strip before start of Work.
 - .2 Replace or supplement equipment that does not achieve specified densities.
- .2 Operate compaction equipment continuously in each embankment when placing material.

3.03 WATER DISTRIBUTORS

- .1 Apply water with equipment capable of uniform distribution.

3.04 STRIPPING OF TOPSOIL

- .1 Place top soil and finish grading in accordance with Section 32 91 19.13 - Topsoil Placement and Grading.
- .2 Commence topsoil stripping of areas as indicated after brush, weeds and grasses have been removed from these areas.
- .3 Strip topsoil to depths as indicated. Do not mix topsoil with subsoil.
- .4 Stockpile in locations as indicated.
 - .1 Stockpile height: not to exceed 2 m.
- .5 Dispose of unused topsoil off site.
- .6 Remove clearing and grubbing debris from stripping.
- .7 Spread organic stripping, on completion of excavation and embankment construction, on slopes and trim or remove from site if quantity exceeds ability to grade on site.

3.05 EXCAVATING

- .1 General:
 - .1 Notify Departmental Representative when waste materials are encountered and remove to depth and extent directed.
 - .2 Sub-excavate 500 mm below subgrade in cut sections unless otherwise directed by Departmental Representative.
 - .1 Compact top 150 mm below sub-excavate to minimum 95% maximum dry density, to ASTM D 698 AASHTO T99.
 - .2 Replace with approved embankment material and compact to specified embankment density.
 - .3 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points as directed by Departmental Representative.
 - .4 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points as indicated.
- .2 Drainage:
 - .1 Maintain profiles, crowns and cross slopes to provide good surface drainage.
 - .2 Provide ditches as work progresses to provide drainage.
 - .3 Construct interceptor ditches as indicated or as directed before excavating or placing

- embankment in adjacent area.
- .3 Rock excavation:
- .1 Notify Departmental Representative, when material appearing to conform to classification for rock is encountered, to enable measurements to be made to determine volume of rock. Provide 12 hour notification.
 - .2 Submit blasting program to Departmental Representative, for approval 48 hours minimum before start of Work.
 - .1 Do not proceed without written approval of blasting program from Departmental Representative.
 - .3 Shatter rock to 300 mm below subgrade elevation as indicated.
 - .4 Reduce overbreak and increase stability of rock faces by using smooth blasting techniques.
 - .5 Use smooth blast and excavate short sections in rock cuts to determine optimum spacing of holes when requested by Departmental Representative.
 - .6 Stem holes as necessary to contain blast.
 - .7 Do not use prilled type ammonium nitrate and fuel oil (ANFO) explosives within 4 m of final cut line.
 - .8 Form back wall by pre-splitting at least 10 m in advance of production blasting.
 - .1 Smooth wall blast just prior to or just after production blast as determined by approved blast program.
 - .9 Scale rock backslopes to achieve smooth, stable face, free of loose rock and overhangs to design backslope.
 - .10 Control blasting to minimize flying particles.
- .4 Borrow Excavation:
- .1 Completely use in embankments, suitable materials removed from right-of-way excavations before taking material from borrow areas.
 - .2 Obtain embankment materials, in excess of what is available from cut areas, from designated borrow areas.
 - .1 Departmental Representative to designate extent of borrow areas and allowable depth of excavation.
 - .2 Remove waste and stripping material from borrow pits to designated locations.
 - .3 Slope edges of borrow areas to minimum 4:1 and provide drainage as directed.
 - .4 Trim and leave borrow pits in condition to permit accurate measurement of material removed.

3.06 EMBANKMENTS

- .1 Scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces.
 - .1 Method used to be to be pre-approved in writing by Departmental Representative.
- .2 Break up or scarify existing road surface prior to placing embankment material.
- .3 Do not place material which is frozen nor place material on frozen surfaces except in areas authorized by Departmental Representative.
- .4 Maintain crowned surface during construction to ensure ready run-off of surface water.
- .5 Drain low areas before placing materials.
 - .1 Place and compact to full width in layers not exceeding 200 mm loose thickness. Departmental Representative may authorize thicker lifts if specified compaction can be achieved and if material contains more than 25% by volume stone and rock fragments

- larger than 100 mm.
- .6 Where material consists of rock:
 - .1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case is layer thickness to exceed 1 m.
 - .2 Distribute rock material to fill voids with smaller fragments to form compact mass.
 - .3 Fill surface voids at subgrade level with rock spalls or selected material to form earth-tight surface.
 - .4 Do not place boulders and rock fragments with dimensions exceeding 150 mm within 300 mm of pavement subgrade elevation.
 - .7 Deductions from excavation will be made for overbuild of embankments.

3.07 COMPACTION

- .1 Break material down to sizes suitable for compaction and mix for uniform moisture to full depth of layer.
- .2 Deposit, spread, and level, embankment material in layers 200 mm maximum thickness before compaction.
 - .1 Compact each layer of embankment until compaction equipment achieves no further significant consolidation.
 - .2 Ensure required compaction for each layer before placing any material for next layer.
- .3 Use specialized compaction equipment supplemented by routing, hauling, and leveling equipment over each layer of fill.
- .4 Obtain written approval from Departmental Representative before using specialized compaction equipment such as tamping rollers, vibratory rollers, or other alternate compaction equipment that produces the required results
 - .1 For tamping rollers, use equipment that exerts 1000 kPa minimum of pressure on tamping surface of each tamping foot in transverse row.
- .5 Compact each layer to minimum 95% maximum dry density: ASTM D 698 AASHTO T99 except top 150 mm of subgrade.
 - .1 Compact top 150 mm to 100% maximum dry density.
- .6 Add water or dry as required to bring moisture content of materials to level required to achieve specified compaction.

3.08 FINISHING

- .1 Shape entire roadbed to within 25 mm of design elevations.
- .2 Finish slopes, ditch bottoms and borrow pits true to lines, grades and drawings where applicable. Scale slope by removing loose fragments, for cut slopes in bedrock steeper than 1:1.
- .3 Remove rocks over 150 mm in dimension from slopes and ditch bottoms.
- .4 Hand finish slopes that cannot be finished easily by machine.
- .5 Round top of backslope 1.5 m both sides of top of slope.
- .6 Run tractor tracks over slopes exceeding 3 m in height to leave tracks parallel to centreline of highway.
- .7 Trim between constructed slopes and edge of clearing to provide drainage and free of humps, sags and ruts.

3.09 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in

- accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 PROTECTION

- .1 Maintain finished surfaces in condition conforming to this section until acceptance by Departmental Representative.
- .2 Provide silt fences and erosion protection as required to mitigate and prevent impacts to adjacent properties.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Excavating, Trenching and Backfilling Section 31 23 33.01

1.02 MEASUREMENT AND PAYMENT

- .1 Measure geotextiles in square metres of surface covered by material. No allowance will be made for seams and overlaps.

1.03 REFERENCES

- .1 ASTM International
 - .1 ASTM A 123/A 123M-[09], Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM D 4491-[99a(2009)], Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .3 ASTM D 4595-[09], Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .4 ASTM D 4716-[08], Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
 - .5 ASTM D 4751-[04], Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-4.2 No. 11.2-[2004], Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.
 - .1 No.2-[M85], Methods of Testing Geosynthetics - Mass per Unit Area.
 - .2 No.3-[M85], Methods of Testing Geosynthetics - Thickness of Geotextiles.
 - .3 No.6.1-[93], Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.
 - .4 No.7.3-[92], Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.
 - .5 No. 10-[94], Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.
- .4 CSA International
 - .1 CSA G40.20/G40.21-[04(R2009)], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .5 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 1860-[November 2010], Material Specification for Geotextiles.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit following samples 4 weeks prior to beginning Work.
 - .1 Minimum length of 2 m of roll width of geotextile.
 - .2 Methods of joining.
- .4 Test and Evaluation Reports:
 - .1 Submit copies of mill test data and certificate at least 4 weeks prior to start of Work.
- .5 Sustainable Design Submittals:
 - .1 LEED Canada-Submittals: N/A.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect geotextiles from direct sunlight and UV rays.
 - .3 Replace defective or damaged materials with new.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIAL

- .1 Geotextile: woven or non-woven synthetic fibre fabric, supplied in rolls.
 - .1 Width: [_____] m minimum.
 - .2 Length: [_____] m minimum.
 - .3 Composed of: [minimum 85% by mass of] [polypropylene] [polyester] [with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure [for 60 days]].
- .2 Physical properties:
 - .1 Thickness: to [CAN/CGSB-148.1, No.3], minimum [_____] mm.
 - .2 Mass per unit area: to [CAN/CGSB-148.1, No.2], minimum [_____] g/m².
 - .3 Tensile strength and elongation (in any principal direction): to [ASTM D 4595].
 - .1 Tensile strength: minimum [_____] N, wet condition.
 - .2 Elongation at break: [minimum] [maximum][_____] %.

- .3 Seam strength: [minimum [_____] N] [equal to or greater than tensile strength of fabric].
- .4 Grab tensile strength and elongation: to [CAN/CGSB-148.1, No.7.3].
 - .1 Breaking force: minimum [_____] N, wet condition.
 - .2 Elongation at future: [minimum] [maximum] %.
- .5 Ball burst strength: to [CAN/CGSB-4.2, No.11.2], minimum [_____] N, wet condition.
- .6 Bursting strength: to [CAN/CGSB-148.1, No.6.1] minimum [_____] kPa, wet condition.
- .3 Hydraulic properties:
 - .1 Apparent opening size (AOS): to [ASTM D 4751], [_____] micrometres.
 - .2 Filtration opening size (FOS): to [CAN/CGSB-148.1 No.10] [OPSS 1860].
 - .3 Transmissivity: to [ASTM D 4716], minimum [_____] m³/s under test conditions of [_____].
 - .4 Permittivity: to [ASTM D 4491], [_____] pers.
- .4 Securing pins and washers: to [CSA G40.21], Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m² to [ASTM A 123/A 123M].
- .5 Factory seams: sewn in accordance with manufacturer's recommendations.
- .6 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for geotextile material installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of [Departmental Representative] [DCC Representative][Consultant].
 - .2 Inform [Departmental Representative] [DCC Representative] [Consultant] of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from [Departmental Representative] [DCC Representative] [Consultant]].

3.02 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with [_____].
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .4 Overlap each successive strip of geotextile [600] mm over previously laid strip.
- .5 Join successive strips of geotextile by [sewing].
- .6 Pin successive strips of geotextile [with securing pins at [_____] mm interval at mid point of lap] [as indicated].
- .7 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .8 After installation, cover with overlying layer within [4] hours of placement.
- .9 Replace damaged or deteriorated geotextile to approval of [Departmental Representative] [DCC Representative] [Consultant].

- .10 Place and compact soil layers in accordance with Section [31 23 33.01 - Excavating, Trenching and Backfilling] [31 24 13 - Roadway Embankments] [33 46 16 - Subdrainage Piping] [35 31 19 - Revetments].

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section [01 74 11 - Cleaning].
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section [01 74 11 - Cleaning].
- .3 Waste Management: separate waste materials for [reuse] [and] [recycling] in accordance with Section [01 74 21 - Construction/Demolition Waste Management and Disposal] [01 35 21 - LEED Requirements].
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.04 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

1 GENERAL

1.01 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 N/A

1.02 RELATED REQUIREMENTS

- .1 Special Procedures for Traffic Control Section 01 35 00.06
- .2 Roadway Embankments Section 31 24 13
- .3 Aggregate Materials Section 31 05 16
- .4 Roadway Dust Control Section 32 15 60

1.03 MEASUREMENT AND PAYMENT

- .1 Measure granular sub-base in cubic metres measured in place by cross section and calculated by average end area method of material incorporated into Work and accepted by Departmental Representative.
- .2 Measure excavation of sub-base and subgrade materials to correct deficiencies in subgrade discovered during proof rolling as common excavation under Section 31 24 13 – Roadway Embankments.
 - .1 Measure backfill of subgrade with common materials as common excavation and subgrade compaction under Section 31 24 13 – Roadway Embankments.
 - .2 Measure backfill of subgrade with sub-base material and replacement of sub-base material under this Section.
- .3 Measure hauling granular sub-base material in cubic metre-kilometres, computed by taking product of number of cubic metres of material placed multiplied by haul distance in kilometres.
 - .1 Measure haul distance from source of material to centre of volume of material after placing, measured along shortest route determined by Departmental Representative as being feasible and satisfactory.
- .4 Measure water in units of 1000 L for water authorized by Departmental Representative and applied.
- .5 Measure compaction of granular sub-base in hours for particular compaction units employed including operator, fuel and maintenance as shown on approved recording devices.

1.04 REFERENCES

- .1 ASTM International
 - .1 ASTM C 117-[04], Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131-[06], Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136-[06], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 422-[63(2007)], Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D 698-[07e1], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft²) (600kN-m/m²).
 - .6 ASTM D 1557-[09], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft²) (2,700kN-m/m²).
 - .7 ASTM D 1883-[07e2], Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

- .8 ASTM D 4318-[10], Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 N/A

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.
- .3 Develop a Construction Waste Management Plan related to the Work of this Section in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Granular sub-base material: in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.
 - .3 Table
Sieve

<u>Designation</u>	<u>% Passing</u>
75 mm	100
25 mm	50-85
0.150 mm	0-15
<u>0.075 mm</u>	<u>0-8</u>
 - .4 Other properties as follows:
 - .1 Liquid Limit: to ASTM D 4318, Maximum 25.
 - .2 Plasticity Index: to ASTM D 4318, Maximum 6.
 - .3 Los Angeles degradation: to ASTM C 131.
 - .1 Maximum loss by mass: 50 %.
 - .4 Particles smaller than 0.02 mm: to ASTM D 422, Maximum 3%.
 - .5 Soaked CBR: to ASTM D 1883, Minimum 40 when compacted to 100% of ASTM D 1557.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for granular sub-base installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.03 PLACING

- .1 Place granular sub-base after subgrade is inspected and accepted by Departmental Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .8 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 Departmental Representative may authorize thicker lifts if specified compaction can be achieved.
- .9 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .10 Remove and replace portion of layer in which material has become segregated during spreading.

3.04 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Departmental Representative before use.
- .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compact to density of not less than 95% modified proctor density.
- .5 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .6 Apply water as necessary during compaction to obtain specified density.
- .7 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .8 Correct surface irregularities by loosening and adding or removing material until surface is within

specified tolerance.

3.05 PROOF ROLLING

- .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm maximum.
- .2 Obtain written approval from Departmental Representative to use non-standard proof rolling equipment.
- .3 Proof roll at level in sub-base as indicated.
 - .1 If non-standard proof rolling equipment is approved, Departmental Representative will determine level of proof rolling.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove sub-base and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with common material and compact in accordance with Section 31 24 13 – Roadway Embankments.
 - .3 Replace sub-base material and compact.
- .6 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.07 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.08 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|---|---------------------|
| .1 | Asphalt Paving | Section 32 12 16 |
| .1 | Road-Mix Asphalt Paving Wearing Courses | Section 32 12 16.16 |
| .2 | Roadway Dust Control | Section 32 15 60 |

1.02 MEASUREMENT PROCEDURES

- .1 Measure reshaping existing roadbed in square metres.
- .2 Measure new granular base material in cubic metres of material incorporated into work.
- .3 Measure water for compaction in 1000 L units for water authorized by Departmental Representative and applied.
- .4 Measure compaction in hours for particular compaction units employed as shown on recording devices approved by Departmental Representative.
- .5 Repair of soft areas will be done on a cash allowance basis.

1.03 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 117-[03], Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131-[03], Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136-[01], Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 698-[00a], Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m²).
 - .5 ASTM D 4318-[00], Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1-[88], Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves Testing, Woven Wire, Metric.

1.04 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Excess materials are to be diverted from landfill to site approved by Departmental Representative.

2 PRODUCTS

2.01 MATERIALS

- .1 Granular base material: to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material and other deleterious materials.
 - .2 Graduations within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.
 - .3 Gradation to:

<u>Sieve Designation</u>	<u>% Passing</u>
19 mm	100

12.5 mm	70-100
9.5 mm	-
4.75 mm	40-70
2.00 mm	23-50
0.425 mm	7-25
0.180 mm	-
<u>0.075 mm</u>	<u>3-8</u>

- .5 Other properties as follows:
- .1 Liquid limit: ASTM D 4318, maximum 25.
 - .2 Plasticity index: ASTM D 4318, maximum 6.
 - .3 Los Angeles Degradation: ASTM C 131, maximum % loss by weight 45.
 - .4 Crushed particles: at least 50 % of particles by mass within 19.0 mm to 4.75 mm sieve designation range to have at least 1 freshly fractured face. Material divided into ranges using methods of ASTM C 136.

3 EXECUTION

3.01 SEQUENCE OF OPERATION

- .1 Scarifying and reshaping:
- .1 Scarify roadbed to width as indicated unless directed otherwise by Departmental Representative.
 - .2 Pulverize and break down scarified material to 19 mm maximum particle size.
 - .3 Blade and trim pulverized material to elevation and cross section dimensions as indicated unless directed otherwise by Departmental Representative.
 - .4 Where deficiency of material exists, add and blend in new granular base material as directed by Departmental Representative. Ensure no frozen material is used.
- .2 Compaction equipment:
- .1 Compaction equipment capable of obtaining required material densities.
 - .2 Provide Departmental Representative with proof of equipment efficiency for unspecified equipment.
 - .1 Efficiency of proposed equipment equal to specified equipment.
 - .2 Obtain approval Departmental Representative before use.
 - .4 Equip with device that records hours of actual work, not motor running hours.
- .3 Compacting:
- .1 Compact to density minimum 100% corrected maximum dry density.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compaction to obtain specified density.
 - .4 Use mechanical tampers, approved by Departmental Representative to compact areas not accessible to rolling equipment to specified density.
- .4 Repair of soft areas:
- .1 Correct soft areas by removing defective material to depth and extent directed by Departmental Representative. Replace with material acceptable to Departmental Representative and compact to specified density.
 - .2 Maintain reshaped surface in condition conforming to this section until succeeding material is applied or until acceptance by Departmental Representative.

3.02 SITE TOLERANCES

- .1 Reshaped compacted surface within plus or minus 10 mm of elevation as indicated.

END OF SECTION

1 GENERAL

1.01 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 N/A

1.02 RELATED REQUIREMENTS

- .1 Special Procedures for Traffic Control Section 01 35 00.06
- .2 Aggregate Materials Section 31 05 16
- .3 Roadway Embankments Section 31 24 13
- .4 Granular Sub-Base Section 32 11 16.01
- .5 Roadway Dust Control Section 32 15 60

1.03 MEASUREMENT AND PAYMENT

- .1 Measure granular base in cubic metres measured in place by cross section and calculated by average end area method of material incorporated into Work and accepted in writing by Departmental Representative.
- .2 Measure excavation of base, sub-base and sub-grade materials to correct deficiencies in sub-grade discovered during proof rolling as common excavation under Section 31 24 13 – Roadway Embankments.
 - .1 Measure backfill of sub-grade with common materials as common excavation and sub-grade compaction under Section 31 24 13 – Roadway Embankments.
 - .2 Measure backfill of subgrade with sub-base material and replacement of sub-base material to Section 32 11 16.01 - Granular Sub-base.
 - .3 Measure subsequent replacement of base materials under this Section.
- .3 Measure hauling granular base material in cubic metre-kilometres computed by taking product of number of cubic metres of material placed multiplied by haul distance in kilometres.
 - .1 Measure haul distance from source of material to centre of volume of material after placing, measured along shortest route determined by Departmental Representative as being feasible and satisfactory.
- .4 Measure water in units of 1000L for water authorized by Departmental Representative and applied.
- .5 Measure compaction of granular base in hours for each type of compaction unit employed including operator, fuel and maintenance as shown on recording devices.

1.04 REFERENCES

- .1 ASTM International
 - .1 ASTM C 117-[04], Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131-[06], Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136-[06], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 698-[07e1], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft²) (600kN-m/m²).
 - .5 ASTM D 1557-[09], Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft²) (2,700kN-m/m²).
 - .6 ASTM D 1883-[07e2], Standard Test Method for CBR (California Bearing Ratio) of

- Laboratory Compacted Soils.
- .7 ASTM D 4318-[10], Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
 - .4 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 N/A

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, 31 05 16 - Aggregate Materials and with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Stockpile minimum 50% of total aggregate required prior to beginning operation.
 - .2 Store materials in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.
 - .3 Replace defective or damaged materials with new.
 - .4 Store cement in weathertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed stone or gravel.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

.1 Gradation Method #1 to:

Sieve Designation	% Passing
19 mm	100
12.5 mm	75-100
9.5 mm	60-90
4.75 mm	40-70
2.36 mm	27-55
1.18 mm	16-42

0.600 mm	8-30
0.300 mm	5-20
<u>0.075 mm</u>	<u>2-8</u>
.2	Material to level surface depressions to meet gradation (2) limits in accordance with Method #1.
.3	Liquid limit: to ASTM D 4318, maximum 25
.4	Plasticity index: to ASTM D 4318, maximum 6.
.5	Los Angeles degradation: to ASTM C 131. Max. % loss by weight: 45
.6	Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 1 freshly fractured face. Material to be divided into ranges using methods of ASTM C 136.
<u>Passing</u>	<u>Retained on</u>
50 mm	to 25 mm
25 mm	to 19.0 mm
<u>19.0 mm</u>	<u>to 4.75 mm</u>
.7	Soaked CBR: to ASTM D 1883, minimum 80, when compacted to 100% of ASTM D 1557.

3 EXECUTION

3.01 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.02 PLACEMENT AND INSTALLATION

- .1 Place granular base after sub-base surface is inspected and accepted in writing by Departmental Representative.
- .2 Placing:
- .1 Construct granular base to depth and grade in areas indicated.
 - .2 Ensure no frozen material is placed.
 - .3 Place material only on clean unfrozen surface, free from snow and ice.
 - .4 Begin spreading base material on crown line or on high side of one-way slope.
 - .5 Place material using methods which do not lead to segregation or degradation of aggregate.
 - .6 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
 - .7 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
 - .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

- .9 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment:
 - .1 Ensure compaction equipment is capable of obtaining required material densities.
 - .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Departmental Representative before use.
 - .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compacting:
 - .1 Compact to density of not less than 95% modified proctor density.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compacting to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Departmental Representative.
 - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Proof rolling:
 - .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.
 - .2 Obtain written approval from Departmental Representative to use non-standard proof rolling equipment.
 - .3 Proof roll at level in granular base as indicated.
 - .1 If use of non-standard proof rolling equipment is approved, Departmental Representative to determine level of proof rolling.
 - .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove base, sub-base and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with sub-base material and compact in accordance with Section 32 11 16.01 - Granular Sub-Base.
 - .3 Replace sub-base material and compact in accordance with Section 32 11 16.01 - Granular Sub-base.
 - .4 Replace base material and compact in accordance with this Section.
 - .6 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent as directed by Departmental Representative and replace with new materials in accordance with Section 32 11 16.01 - Granular Sub-base and this section at no extra cost.

3.03 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.04 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .2 Divert unused granular material from landfill to local facility as directed by Departmental Representative.

3.05 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|---|---------------------|
| .1 | Submittal Procedures | Section 01 33 00 |
| .2 | Asphalt Prime Coats | Section 32 12 13.23 |
| .3 | Asphalt Paving | Section 32 12 16 |
| .4 | Road-Mix Asphalt Paving Wearing Courses | Section 32 12 16.16 |

1.02 REFERENCES

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO T245-97-UL-[2004], Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Ministry of Transportation Ontario (MTO)
 - .1 MTO Laboratory Testing Manual-[09]: LS-283, Resistance to Stripping of Asphalt Cement in Bituminous Mixtures by Immersion Marshall.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
 - .1 Submit requested samples of each proposed asphalt paving mixture.

2 PRODUCTS

2.01 MATERIALS

- .1 Representative samples of each asphalt paving mixture proposed for use on Project.

2.02 EQUIPMENT

- .1 One or more water baths with automatic controls for immersing specimens. Baths normally used for Marshall Immersion Test are suitable for test.
- .2 Scale and water bath with suitable accessory equipment for weighing test specimens in air and in water to determine their densities.
- .3 Flat transfer plates of glass or metal. Keep 1 plate under each specimen during immersion period and during subsequent handling, except when weighing and testing, to prevent breakage or distortion of specimens.
- .4 Apparatus required to conduct Marshall Immersion Test.

3 EXECUTION

3.01 PREPARATION

- .1 Prepare at least 8 specimens for each test with hand-operated hammer, in accordance with AASHTO T245-97-UL and LS-283, except where specified otherwise.

3.02 TEST PROCEDURE

- .1 Do Marshall testing to AASHTO T245-97-UL and LS-283.
- .2 Weigh each specimen in air and in water. Weigh in water as rapidly as possible to minimize absorption.
- .3 Calculate specific gravity of each specimen as follows:

- .1 Specific Gravity = $A / (A-B)$
- .2 Where A = weight of specimen in air in grams
- .3 B = weight of specimen in water in grams
- .4 Sort each set of 8 specimens into 2 groups of 4 specimens each so that average specific gravity of specimens in group 1 is essentially same as that of group 2.
- .5 Test group 1 specimens for Marshall Stability. Calculate S1 = Marshall Stability of group 1 (average).
- .6 Immerse group 2 specimens in water for 24 h at 60 degrees C, then test immediately for Marshall Stability. Calculate S2 = Marshall Stability of group 2 (average).

3.03 CLOSEOUT ACTIVITIES

- .1 Report test results to Departmental Representative.
- .2 Report numerical index of retained stability as resistance of asphaltic paving mixtures to detrimental effect of water, expressed as percentage of original stability retained after immersion period.
- .3 Calculate index as follows:
 - .1 Index of Retained Stability = $S2 / S1 \times 100$

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Special Procedures for Traffic Control Section 01 35 00.06
- .2 Reshaping Granular Roadbed Section 32 11 17
- .3 Aggregate Base Courses Section 32 11 23
- .3 Asphalt Paving Section 32 12 16

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 N/A

1.03 MEASUREMENT PROCEDURES

- .1 Asphalt prime will be measured in square metres at 15 degrees C of cutback asphalt.
- .2 Blotter Sand: supply of blotter sand will be measured by weight in tonnes.
- .3 Application of Blotter Sand: application of blotter sand will be measured in cubic metres.

1.04 REFERENCES

- .1 ASTM International
 - .1 ASTM D 140/D 140M-[09], Standard Practice for Sampling Bituminous Materials.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
 - .4 LEED Canada-EB: O&M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-16.1-[M89], Cutback Asphalts for Road Purposes.
 - .2 CAN/CGSB-16.2-[M89], Emulsified Asphalts, Anionic Type, for Road Purposes.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt prime coat and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit two 4L samples of asphalt prime proposed for use in new, clean, air tight sealed, wide mouth plastic containers to Departmental Representative 2 weeks prior to commencing Work.
 - .2 Sample asphalt prime coat materials in accordance with ASTM D 140.
 - .3 Provide access on tank truck for Departmental Representative to sample asphalt material to be incorporated into Work, in accordance with ASTM D 140.

- .4 Sustainable Design Submittals:
 - .1 N/A

1.06 QUALITY ASSURANCE

- .1 Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Arrange points of delivery and quantity to be shipped with vendor
 - .2 Make deliveries during normal work hours.
 - .3 Include copy of orders and instructions respecting shipment upon request by Departmental Representative.
 - .4 Include suitable unloading facilities and unload asphalt as directed Departmental Representative.
 - .5 Provide, maintain and restore asphalt storage area.
- .3 Storage and Handling Requirements:
 - .1 Deliver, store and handle materials to ASTM D 140.
 - .2 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .3 Store and protect asphalt prime coats from nicks, scratches, and blemishes.
 - .4 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIAL

- .1 Asphalt material: to CAN/CGSB-16.1 grade: RM-20, MC-30, MC-250, or CAN/CGSB-16.2 grade: SS-1.
- .2 Sand blotter: clean granular material passing 4.75 mm sieve and free from organic matter or other deleterious materials.
- .3 Water: clean, potable, free from foreign matter.

2.02 EQUIPMENT

- .1 Pressure distributor:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5 m.
 - .3 Applied at controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and allowable variation from any specified rate not exceeding 0.1 L/m².
 - .4 Distributed in uniform spray without atomization at temperature required.
 - .2 Equipped with meter registering travel distance in metres per minute, visibly located to

- .3 enable truck driver to maintain constant speed required for application at specified rate.
Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator.
 - .1 Pump power unit to be independent of truck power unit.
- .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .1 Temperature to be measured to nearest whole number.
- .5 Equipped with accurate volume measuring device or calibrated tank.
- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment in increments of 0.6 metres and capable of being raised or lowered.
- .8 Cleaned if previously used with incompatible asphalt material.
- .2 Aggregate Spreader:
 - .1 Apply blotter sand to primed surfaces using roll type spreader, or rotating disc sander capable of applying aggregate at variable widths and at variable rates.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for asphalt prime coat installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 APPLICATION

- .1 Proceed with application of tack coat only after acceptance of granular base surface from Departmental Representative.
- .2 Cutback asphalt:
 - .1 Heat asphalt prime to between 60 and 70 degrees C for pumping and spraying.
 - .2 Apply asphalt prime to granular base at rate as directed by Departmental Representative, but not to exceed 2 L/m².
 - .3 Apply on dry surface unless otherwise directed by Departmental Representative.
- .3 Anionic emulsified asphalt:
 - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application.
 - .2 Mix thoroughly by pumping or other method approved by Departmental Representative.
 - .3 Apply diluted asphalt emulsion at rate directed by Departmental Representative, but do not exceed 5 L/m².
 - .4 Apply diluted asphalt emulsion on damp surface unless otherwise directed by Departmental Representative.
- .4 Apply asphalt prime only on unfrozen surface.
- .5 Apply asphalt tack coat only when air temperature is greater than 10 degrees C and when rain is not forecast within 2 hours minimum of application.
- .6 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.

- .7 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .8 Prevent overlap at junction of applications.
- .9 Do not prime surfaces that will be visible when paving is complete.
- .10 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.
- .11 Keep traffic off primed areas until asphalt prime has cured.
 - .1 Control traffic in accordance with Section 01 35 00.06 - Special Procedures for Traffic Control.
- .12 Permit prime to cure before placing asphalt paving.

3.03 USE OF SAND BLOTTER

- .1 If asphalt prime fails to penetrate within 24 hours, spread sand blotter material in amounts required to absorb excess material.
- .2 Allow sufficient time for excess prime to be absorbed as directed by Departmental Representative.
- .3 Apply second application of sand blotter as required.
- .4 Do not roll blotter sand.
- .5 Sweep and remove excess blotter material.

3.04 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1	Special Procedures for Traffic Control	Section 01 35 00.06
.2	Aggregate Materials	Section 31 05 16
.3	Reshaping Granular Roadbed	Section 32 11 17
.4	Asphalt Prime Coats	Section 32 12 13.23
.6	Excavating, Trenching and Backfilling	Section 31 23 33.01
.7	Marshall Immersion Test for Bitumen	Section 32 12 10
.8	Road-Mix Asphalt Paving Wearing Courses	Section 32 12 16.16

1.02 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

.1 N/A

1.03 MEASUREMENT AND PAYMENT

- .1 Measure asphalt concrete paving in tonnes of asphalt concrete actually incorporated into Work.
- .2 Measure supply of asphalt cement in tonnes.
- .3 Measure supply of hydrated lime in tonnes.

1.04 REFERENCES

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320-[10], Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29-[02], Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245-[97(2004)], Standard Method of Test for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Asphalt Institute (AI)
 - .1 AI MS-2-[1994] [Sixth Edition], Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3 ASTM International
 - .1 ASTM C 88-[05], Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM C 117-[04], Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C 123-[04], Standard Test Method for Lightweight Particles in Aggregate.
 - .4 ASTM C 127-[07], Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .5 ASTM C 128-[07a], Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
 - .6 ASTM C 131-[06], Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .7 ASTM C 136-[06], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .8 ASTM C 207-[2006], Standard Specification for Hydrated Lime for Masonry Purposes.
 - .9 ASTM D 995-[-95b(2002)], Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
 - .10 ASTM D 2419-[09], Standard Test Method for Sand Equivalent Value of Soils and Fine

- Aggregate.
- .11 ASTM D 3203-[94(2005)], Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- .12 ASTM D 4791-[05e1], Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .4 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- .5 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves Testing, Woven Wire, Metric.
- .6 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt mixes and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175 degrees C 4 weeks prior to beginning Work.
- .3 Samples:
 - .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks prior to beginning Work.
 - .2 Submit samples of following materials proposed for use 4 weeks prior to beginning Work.
 - .1 One 5 L container of asphalt cement.
 - .2 1 kg of hydrated lime.
- .4 Test and Evaluation Reports:
- .5 Certificates:
 - .1 Certification to be marked on pipe.
- .6 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification that asphalt cement meets specification requirements.
 - .2 Submit manufacturer's test data and certification that hydrated lime meets specified requirements.
 - .3 Submit asphalt concrete mix design and trial mix test results to Departmental Representative at least 4 weeks prior to beginning Work.
 - .4 Submit printed record of mix temperatures at end of each day.
- .7 Sustainable Design Submittals:
 - .1 N/A

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product

- Requirements and with manufacturer's written instructions.
- .2 Deliver and stockpile aggregates in accordance with Section 31 05 16 - Aggregate Materials. Stockpile minimum 50% of total amount of aggregate required before beginning asphalt mixing operation.
 - .3 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.
 - .4 Stockpile fine aggregate separately from coarse aggregate, although separate stockpiles for more than two mix components are permitted.
 - .5 Provide approved storage, heating tanks and pumping facilities for asphalt cement.
 - .6 Submit to Departmental Representative copies of freight and waybills for asphalt cement as shipments are received.
 - .1 Departmental Representative reserves right to check weights as material is received.
 - .7 Stockpile crushed RAP separately in accordance with Section 31 05 16 - Aggregate Materials.
 - .8 Protect and cover stockpiles of crushed RAP from rain to satisfaction of Departmental Representative.
 - .9 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .10 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Performance graded asphalt cement: to AASHTO M320, grade PG 58-28 when tested to AASHTO R29.
- .2 RAP:
 - .1 Crushed and screened to ensure 100% of RAP material passes 50 mm screen before mixing.
- .3 Aggregates: in accordance with Section 31 05 16 - Aggregate Materials and requirements as follows:
 - .1 Crushed stone or gravel.
 - .2 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 or CAN/CGSB-8.2.
 - .3 Table:

	<u>Sieve Designation % Passing</u>	
	Lower Course	Surface Course
19 mm	100	-
12.5 mm	84-99	100
9.5 mm	73-88	-
4.75 mm	50-68	55-75
2.36 mm	35-55	38-58
1.18 mm	27-46	28-47
0.600 mm	18-36	20-36
0.300 mm	10-26	10-26
0.150 mm	4-17	4-17
<u>0.075 mm</u>	<u>3-8</u>	<u>3-8</u>

- .4 Coarse aggregate: aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C 136.
- .5 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve and stockpile separately from coarse aggregate.
- .6 Separate stockpiles for coarse and fine aggregates not required for sheet asphalt.
- .7 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .8 Sand equivalent: ASTM D 2419. Min: 50.
- .9 Magnesium Sulphate soundness: to ASTM C 88. Max % loss by mass:
 - .1 Coarse aggregate surface course: 12 %.
 - .2 Coarse aggregate lower course: 12 %.
 - .3 Fine aggregate, surface course: 16 %.
 - .4 Fine aggregate, lower course: 16 %.
- .10 Los Angeles degradation: Grading B, to ASTM C 131. Max % loss by mass:
 - .1 Coarse aggregate, surface course: 25 %.
 - .2 Coarse aggregate, lower course: 35 %.
- .11 Absorption: to ASTM C 127. Max % by mass:
 - .1 Coarse aggregate, surface course: 1.75 %.
 - .2 Coarse aggregate, lower course: 2.00 %.
- .12 Loss by washing: to ASTM C 117. Max % passing 0.075 mm sieve:
 - .1 Coarse aggregate, surface course: 1.5 %.
 - .2 Coarse aggregate, lower course: 2.0 %.
- .13 Lightweight particles: to ASTM C 123. Max % by mass less than 1.95 relative density:
 - .1 Surface course: 1.5 %.
 - .2 Lower course: 3.0 %.
- .14 Flat and elongated particles: to ASTM D 4791, (with length to thickness ratio greater than 5): Max % by mass:
 - .1 Coarse aggregate, surface course: 15 %.
 - .2 Coarse aggregate, lower course: 15 %.
- .15 Crushed fragments: at least 60 % of particles by mass within each of following sieve designation ranges, to have 1 minimum freshly fractured face. Material to be divided into ranges, using methods of ASTM C 136.

<u>Passing</u>		<u>Retained on</u>
25 mm	to	12.5 mm
12.5 mm	to	4.75 mm
- .16 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .4 Mineral filler:
 - .1 Ensure finely ground particles of limestone, hydrated lime, Portland cement or non-plastic mineral matter are thoroughly dry and free from lumps.
 - .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed by Departmental Representative to improve mix properties.
 - .3 Ensure mineral filler is dry and free flowing when added to aggregate.
- .5 Anti-stripping agent: hydrated lime to ASTM C 207 type N.
 - .1 Add lime at rate of approximately 2-3 % of dry weight of aggregate.
- .6 Water: to be accepted by Departmental Representative.

2.02 EQUIPMENT

- .1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number minimum of 3 per paver of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
 - .1 Drum diameter: 1200 mm minimum.
 - .2 Amplitude of vibration (machine setting): 0.5 mm maximum for lifts less than 40 mm thick.
- .4 Haul trucks: sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
 - .4 Use only trucks which can be weighed in single operation on scales supplied.
- .5 Hand tools:
 - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
 - .2 Tamping irons having mass 12 kg minimum and bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Departmental Representative, may be used instead of tamping irons.
 - .3 Straight edges, 4.5 m in length, to test finished surface.
- .6 Plant testing facility: provide laboratory space at plant site for exclusive use of Departmental Representative, for performing tests, keeping records and making reports.

2.03 MIX DESIGN

- .1 Mix design to be reviewed by Departmental Representative.
- .2 Mix design to be developed by testing laboratory accepted by Departmental Representative.
- .3 Mix to contain maximum 50% by mass of RAP. Departmental Representative may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.
- .4 Design of mix: by Marshall method to requirements below.
 - .1 Compaction blows on each face of test specimens: 75.
 - .2 Mix physical requirements:

<u>Property</u>	<u>Lower Course</u>	<u>Upper Course</u>
Marshall Stability at 60 degrees C (kN min)	6.4	5.5
Flow Value (mm)	2-4	2-4
Air Voids in Mixture (%)	3-6	3-5
Voids in Mineral Aggregate (% min)	14	15
Index of Retained Stability (% min)	75	75

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: to AASHTO T245.
 - .2 Compute void properties on basis of bulk specific gravity of aggregate to ASTM C 127 and ASTM C 128. Make allowance for volume of asphalt absorbed into pores of aggregate.
 - .3 Air voids: to ASTM D 3203.
 - .4 Voids in mineral aggregates: to AI MS2.

- .5 Index of Retained Stability: measure in accordance with Section 32 12 10 - Marshall Immersion Test for Bitumen.
- .4 Do not change job-mix without prior approval of Departmental Representative. When change in material source proposed, new job-mix formula to be approved by Departmental Representative.
- .5 Return plant dust collected during processing to mix in quantities acceptable to Departmental Representative.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for asphalt paving in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 PLANT AND MIXING REQUIREMENTS

- .1 Batch and continuous mixing plants:
 - .1 To ASTM D 995.
 - .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.
 - .1 Do not load frozen materials into bins.
 - .3 Feed cold aggregates to plant in proportions to ensure continuous operations.
 - .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
 - .5 Before mixing, dry aggregates to moisture content not greater than 1 % by mass or to lesser moisture content if required to meet mix design requirements. Heat to temperature required to meet mixing temperature as directed by Departmental Representative after combining with RAP.
 - .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
 - .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.
 - .8 Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above 160 degrees C maximum temperature indicated on temperature-viscosity chart.
 - .9 Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, Departmental Representative to accept temperature of completed mix at plant and at paver after considering hauling and placing conditions.
 - .10 Maintain temperature of materials within 5 degrees C of specified mix temperature during mixing.
 - .11 Mixing time:
 - .1 In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
 - .2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45s.
 - .3 Mixing time as directed by Departmental Representative.

- .12 Where RAP is to be incorporated into mix:
 - .1 Feed from separate cold feed bin specially designed to minimize consolidation of material.
 - .1 Provide 50 mm scalping screen on cold feed to remove oversized pieces of RAP.
 - .2 Ensure positive and accurate control of RAP cold feed by use of hydraulic motor or electric clutch and equip with anti-rollback device to prevent material from sliding backward on feed belt.
 - .3 Combine RAP and new aggregates in proportions as directed by Departmental Representative. Dry mix thoroughly, until uniform temperature within plus or minus 5 degrees C of mix temperature, as directed by Departmental Representative, is achieved prior to adding new asphalt cement.
 - .1 Do not add new asphalt cement where temperature of dried mix material is above 160 degrees C.
- .2 Dryer drum mixing plant:
 - .1 To ASTM D 995.
 - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
 - .3 Feed aggregates to burner end of dryer drum by means of multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .4 Where RAP is to be incorporated into mix, dryer drum mixer is to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180 degrees C.
 - .5 Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.
 - .6 Meter total flow of aggregate and RAP using electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt pump to ensure proportions of aggregate, RAP and asphalt entering mixer remain constant.
 - .7 Allow for easy calibration of weighing systems for aggregates and RAP without having material enter mixer.
 - .8 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
 - .1 Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time.
 - .2 Difference between this value and amount shown by plant computer system to differ by not more than plus or minus 2 %.
 - .9 Make provision for conveniently sampling full flow of materials from cold feed.
 - .10 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate and RAP from cold feed prior to entering drum.
 - .11 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.
 - .12 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer-mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream.
 - .1 Control heating to prevent fracture of aggregate or excessive oxidation of asphalt.
 - .2 Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator.

- .3 Submit printed record of mix temperatures at end of each day.
- .13 Ensure mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer is 2 % maximum.
- .3 Temporary storage of hot mix:
 - .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
 - .2 Do not store asphalt mix in storage bins in excess of 3 hour.
- .4 While producing asphalt mix for this Project, do not produce mix for other users unless separate storage and pumping facilities are provided for materials supplied to this project.
- .5 Mixing tolerances:
 - .1 Permissible variation in aggregate gradation from job mix (percent of total mass).

4.75 mm sieve and larger	5.5
2.00 mm sieve	4.5
0.425 mm sieve	3.5
0.180 mm sieve	2.5
<u>0.075 mm sieve</u>	<u>1.5</u>
 - .2 Permissible variation of asphalt cement from job mix: 0.25%.
 - .3 Permissible variation of mix temperature at discharge from plant: 5 degrees C.
- .6 Addition of anti-stripping agent:
 - .1 Plant to be equipped with pug mill to thoroughly mix aggregates and lime prior to entering the plant.
 - .2 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate.
 - .3 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
 - .4 Plant to be equipped to control rate of lime incorporation to within 1/4%.
 - .5 Add water to aggregate prior to entering pug mill.
 - .6 Add water to lime sufficiently in advance to permit time to slake prior to entering pug mill.

3.03 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Reshape granular roadbed and asphalt pavement in accordance with Section 32 11 17 - Reshaping Granular Roadbed and Section 32 01 16.13 - Reshaping Asphalt Pavement.
- .3 When paving over existing asphalt surface, clean pavement surface in accordance with Section 32 01 11.01 - Pavement Cleaning and Marking Removal.
 - .1 When levelling course is not required, patch and correct depressions and other irregularities as directed by Departmental Representative before beginning paving operations.
- .4 Apply prime coat in accordance with Section 32 12 13.23 - Asphalt Prime Coats prior to paving.
- .5 Prior to laying mix, clean surfaces of loose and foreign material.

3.04 TRANSPORTATION OF MIX

- .1 Transport mix to job site in vehicles cleaned of foreign material.
- .2 Paint or spray truck beds with limewater, soap or detergent solution, or non-petroleum based commercial product, at least daily or as required.
 - .1 Raise truck bed and thoroughly drain, and ensure no excess solution remains in truck bed.
- .3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light for night placing.
- .4 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation.
 - .1 Do not dribble mix into trucks.
- .5 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.
- .6 Deliver loads continuously in covered vehicles and immediately spread and compact.
 - .1 Deliver and place mixes at temperature within range as directed by Departmental Representative, but not less than 135 degrees C.

3.05 TEST STRIP

- .1 Construct and test test strip to acceptance of Departmental Representative.
- .2 For airfield pavement, construct test strip in non-critical area to resolve anticipated problems with equipment, mix behaviour or compaction, prior to starting paving operation.
- .3 Construct test strip with at least 500 tonnes of mix, and involving more than one lane, so that joint finishing techniques can be established.
- .4 During construction of test strip, Departmental Representative will establish optimum rolling pattern by taking nuclear densimeter readings and observations to:
 - .1 Determine sequence and number of passes.
 - .2 Determine correct operating characteristics of vibratory rollers.
 - .3 Determine maximum density of asphalt mix.
 - .4 Ensure smooth surface finish.
 - .5 Establish actual density achieved by coring in order to determine if additional or other rolling equipment is required to achieve density of not less than 98 % of density obtained with Marshall specimens prepared from samples of mix being used.

3.06 PLACING

- .1 Obtain Departmental Representative's approval of base, existing surface and prime coat prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as directed by Departmental Representative.
- .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is 5 degrees C minimum.
 - .2 When temperature of surface on which material is to be placed falls below 10 degrees C, provide extra rollers as necessary to obtain required compaction before cooling.
 - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as indicated.
- .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.
- .6 Place individual strips no longer than 500 m.
- .7 On airport runways and taxiways, aprons and parking lots commence spreading at high side of pavement or at crown and span crowned centerlines with initial strip.

- .8 Spread and strike off mixture with self-propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings.
 - .1 Departmental Representative to establish lines for paver to follow parallel to centerline of proposed pavement. Position and operate paver to follow established line closely.
 - .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver.
 - .1 Work pavers as close together as possible and in no case permit them to be more than 30 m apart.
 - .3 Maintain constant head of mix in auger chamber of paver during placing.
 - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.
 - .6 Correct irregularities in surface of pavement course directly behind paver.
 - .1 Remove excess material forming high spots using shovel or lute.
 - .1 Fill and smooth indented areas with hot mix.
 - .2 Do not broadcast material over such areas.
 - .7 Do not throw surplus material on freshly screeded surfaces.
 - .9 When hand spreading is used:
 - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section.
 - .1 Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
 - .2 Distribute material uniformly without broad casting material.
 - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes.
 - .1 Reject material that has formed into lumps and does not break down readily.
 - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
 - .5 Provide heating equipment to keep hand tools free from asphalt.
 - .1 Control temperature to avoid burning material.
 - .2 Do not use tools at higher temperature than temperature of mix being placed.

3.07 COMPACTING

- .1 Roll asphalt continuously using established rolling pattern for test strip and to density of not less than 100 % of maximum density determined for test strip.
- .2 Do not change rolling pattern unless mix changes or lift thickness changes.
 - .1 Change rolling pattern only as directed by Departmental Representative.
- .3 Roll asphalt continuously to density not less than 98 % of 75 blow Marshall density to AASHTO T245.
- .4 General:
 - .1 Provide at least 2 rollers and as many additional rollers as necessary to achieve specified pavement density. When more than 2 rollers are required, 1 roller must be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
 - .3 Operate roller slowly initially to avoid displacement of material. Do not exceed 5 km/h

- for breakdown and intermediate rolling for static steel-wheeled and pneumatic tired rollers. Do not exceed 9 km/h for finish rolling.
- .4 Use static compaction for levelling coarse less than 25 mm thick.
 - .5 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 25 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing not to exceed compacted lift thickness.
 - .6 Overlap successive passes of roller by minimum of 200 mm and vary pass lengths.
 - .7 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
 - .8 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
 - .9 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
 - .10 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.
 - .1 Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.
 - .11 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.
 - .12 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.
- .5 Breakdown rolling:
- .1 Begin breakdown rolling with static steel wheeled roller or vibratory roller immediately following rolling of transverse and longitudinal joint and edges.
 - .2 Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.
 - .3 Operate breakdown roller with drive roll or wheel nearest finishing machine. When working on steep slopes or super-elevated sections use operation approved by Departmental Representative.
 - .4 Use only experienced roller operators.
- .6 Intermediate rolling:
- .1 Use pneumatic-tired, steel wheel or vibratory rollers and follow breakdown rolling as closely as possible and while paving mix temperature allows maximum density from this operation.
 - .2 Rolling to be continuous after initial rolling until mix placed has been thoroughly compacted.
- .7 Finish rolling:
- .1 Accomplish finish rolling with two-axle or three-axle tandem steel wheeled rollers while material is still warm enough for removal of roller marks.
 - .1 If necessary to obtain desired surface finish, use pneumatic-tired rollers as directed by Departmental Representative.
 - .2 Conduct rolling operations in close sequence.
- .8 Dust entire area of sheet asphalt pavements with hydrated lime immediately after rolling to eliminate tendency to pick-up under traffic.

3.08 JOINTS

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip.
 - .1 Do not deposit on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
 - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
- .2 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600 mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .3 Longitudinal joints:
 - .1 Offset longitudinal joints in succeeding lifts by at least 150 mm.
 - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100 degrees C prior to paving of adjacent lane.
 - .1 If cold joint cannot be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
 - .3 Overlap previously laid strip with spreader by 25 to 50 mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150 mm extending onto previously placed and compacted lane.
- .4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix.
 - .1 Place and compact joint to ensure joint is smooth and without visible breaks in grade.
 - .2 Locate feather joints as indicated.
- .5 Construct butt joints as indicated.

3.09 FINISH TOLERANCES

- .1 Finished asphalt surface to be within 5 mm of design elevation but not uniformly high or low.
- .2 Finished asphalt surface not to have irregularities exceeding 5 mm when checked with 4.5 m straight edge placed in any direction.

3.10 DEFECTIVE WORK

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required.
 - .1 If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.11 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|---|---------------------|
| .1 | Submittal Procedures | Section 01 33 00 |
| .2 | Common Product Requirements | Section 01 61 00 |
| .3 | Construction/Demolition Waste Management and Disposal | Section 01 74 21 |
| .4 | Reshaping Granular Roadbed | Section 32 11 17 |
| .5 | Asphalt Prime Coats | Section 32 12 13.23 |
| .6 | Asphalt Paving | Section 32 12 16 |

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 N/A

1.03 MEASUREMENT PROCEDURES

- .1 Measure supply of aggregate in cubic metres.
- .2 Measure supply of asphalt material in litres of undiluted material at 15 degrees C.
- .3 Measure mixed-in-place asphalt paving in square metres of asphalt surface in place.
- .4 No separate payment will be made for remixing.

1.04 REFERENCES

- .1 ASTM International
- .1 ASTM C 88-[05], Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
- .2 ASTM C 117-[04], Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
- .3 ASTM C 123/C 123M-[12], Standard Test Method for Lightweight Particles in Aggregate.
- .4 ASTM C 131-[06], Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .5 ASTM C 136-[06], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .6 ASTM D 977-[12a], Standard Test Method for Emulsified Asphalt.
- .7 ASTM D 2419-[09], Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- .2 Canada Green Building Council (CaGBC)
- .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .3 LEED Canada 2009 for Design and Construction-[2010], LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.
- .4 LEED Canada for Existing Buildings, Operations and Maintenance-[2009], LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
- .3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-8.1-[88], Sieves Testing, Woven Wire, Inch Series.
- .2 CAN/CGSB-8.2-[M88], Sieves Testing, Woven wire, Metric.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt paving wearing course application and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Inform Departmental Representative of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing work.
 - .3 Submit samples of following materials proposed for use at least 4 weeks prior to commencing work:
 - .1 Two 4 L containers of asphalt material.
 - .1 Supply emulsified asphalt in plastic containers.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Sustainable Design Submittals:
 - .1 LEED Canada submittals: N/A.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Submit copies of freight and waybills for asphalt material to Departmental Representative as shipments are received. Departmental Representative reserves right to weigh material as received.
- .4 Storage and Handling Requirements:
 - .1 Store materials off ground in a dry location and in accordance with manufacturer's

- recommendations in clean, dry, well-ventilated area.
- .2 Provide approved storage, heating tanks and pumping facilities for asphalt cement.
- .3 Store and protect asphalt paving wearing course application from nicks, scratches, and blemishes.
- .4 Replace defective or damaged materials with new.
- .5 Develop Construction Waste Management Plan related to Work of this Section.
- .6 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Asphalt material: anionic emulsified asphalt to ASTM D 977, grade SS-1.
 - .1 Recycled content: N/A.
- .2 Aggregate material: to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed stone or gravel.
 - .2 Gradation: within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.
 - .3 Table:

<u>Sieve Designation</u>	<u>% Passing</u>
19 mm	100
12.5 mm	70-100
9.5 mm	-
4.75 mm	40-70
2.00 mm	23-50
0.425 mm	7-25
0.180 mm	-
<u>0.075 mm</u>	<u>3-8</u>
 - .4 Coarse aggregate is aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C 117.
 - .5 Crushed particles of coarse aggregate: at least 60% of particles by mass, to have at least 1 freshly fractured face.
 - .6 Magnesium Sulphate Soundness: to ASTM C 88.
 - .1 Maximum % loss by mass; coarse aggregate 12, fine aggregate 16.
 - .7 Los Angeles Degradation: Grading B; to ASTM C 131.
 - .1 Maximum % loss by mass; coarse aggregate 35.
 - .8 Lightweight particles: to ASTM C 123/C 123M.
 - .1 Maximum % by mass, with less than 1.95 relative density: 2.0.
 - .9 Sand equivalent: to ASTM D 2419.
 - .1 Minimum 35.

2.02 MIXES

- .1 Job mix formula (JMF) to be reviewed by Departmental Representative.
- .2 Adjust job mix formula to approval of Departmental Representative to ensure asphalt thoroughly coats aggregate particles.
- .3 Ensure JMF provides minimum specified asphalt cement content.

3 EXECUTION

3.01 EQUIPMENT

- .1 Travel plants: self-propelled, capable of maintaining uniform rate of speed while mixing, and mounted on wheels or tread equipment that will not rut or damage base surface when plant is loaded to capacity.
 - .1 Equipped to pick up aggregates from layers or windrows, leaving roadway base clean and undamaged or equipped with hopper to receive aggregate from trucks.
 - .2 Capable of accurately proportioning asphalt and aggregate materials in specified amounts, mixing to achieve uniform coating of aggregate with asphalt material, and depositing mixture on base surface to uniform depth and width or in windrows.
- .2 Road mix equipment: self-propelled, tandem drive blade machines of approved design capable of satisfactorily mixing and spreading materials.
 - .1 Pulverizer machines or multiple disc equipment constructed to prevent cutting of roadway base during mixing.
 - .2 Pressure distributor:
 - .1 Designed, equipped, maintained and operated so that asphalt material at even heat may be applied uniformly on variable widths of surface up to 5 m at readily determined and controlled rates from 0.3 to 5.5 L/m², with uniform pressure, and with allowable variation from specified rate not to exceed 0.1 L/m².
 - .2 Capable of distributing asphalt material in uniform spray without atomization at temperature required.
 - .3 Equipped with meter registering metres of travel per minute visibly located to enable truck driver to maintain constant speed required for application at specified rate.
 - .4 Pump equipped with flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator.
 - .1 Pump to operate by separate power unit independent of truck power unit.
 - .5 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .6 Equipped with accurate volume measuring device or calibrated tank.
- .3 Compaction equipment: sufficient number of rollers minimum 2 of type and weight to obtain specified density of compacted mix.
 - .1 Steel wheeled tandem roller:
 - .1 Total mass: 7 tonnes minimum.
 - .2 Loading: 3.5 tonnes per metre of rolling width minimum.
 - .2 Pneumatic tired roller:
 - .1 Tire size: 190 x 380 mm.
 - .2 Minimum number of tires: 9.
 - .3 Minimum mass per tire: 900 kg.
 - .3 Vibratory roller with minimum drum diameter of 1200 mm.

3.02 PREPARATION OF BASE

- .1 Reshape granular roadbed in accordance with Section 32 11 17 - Reshaping Granular Roadbed.
- .2 Scarify and reshape existing road surface to grade and to cross-section as indicated.
 - .1 Roll or add water and roll to approval of Departmental Representative.
 - .2 Add new aggregate to fill depressions or strengthen weak areas as directed by

Departmental Representative.

- .3 Scarify and reshape existing road surface to grade and to cross section indicated.
 - .1 Scarify again reshaped surface to depth as directed by Departmental Representative, leaving foundation of undisturbed material parallel both in profile and cross-section to proposed finished grade.
 - .2 Reshape loosened material into windrow at side of road.
 - .3 Compact scarified and reshaped surfaces as directed by Departmental Representative.

3.03 AGGREGATE PLACING

- .1 Departmental Representative to approve base prior to placing aggregate.
- .2 Place aggregate on base in uniform layers in quantities sufficient to produce finished course of thickness as indicated.
- .3 Avoid segregation in transferring aggregate from trucks to hopper, when hopper type travelling mixer is used.
- .4 Aerate aggregate when moisture content exceeds 2% until moisture content is 2% or less at time of asphalt application.

3.04 MIXING

- .1 Mix asphalt into aggregate by blade mixing or travel plant mixing methods.
 - .1 Blade mixing:
 - .1 Flatten aggregate windrow sufficiently to allow passage of distributor and apply asphalt material from distributor in successive applications, each application not to exceed 2.7 L/m² until amount required by job mix is attained.
 - .2 Follow with mixing equipment immediately behind distributor and partially mix aggregate and asphalt after each asphalt application.
 - .3 Continue mixing after final asphalt application until aggregate particles are fully coated and mix is free of fat and lean spots or balls.
 - .2 Travel plant mixing:
 - .1 Spread aggregate windrow, as necessary, to accommodate travel plant pick-up mechanism.
 - .2 Mix asphalt into aggregate with one or more passes of travel plant mixer.
 - .3 Mix to thoroughly uniform condition, with aggregate particles fully coated and mix is free of fat and lean spots and balls.
- .2 Correct asphalt deficiencies or excesses or uneven distribution by addition of aggregate or asphalt and remixing as required to achieve uniform mix of specified asphalt content.
- .3 Do not apply asphalt to aggregate, if air temperature in shade is less than 10 degrees C, unless approved by Departmental Representative.
 - .1 Suspend asphalt application during rain.
- .4 Schedule work so that asphalt application, mixing, spreading and compacting are accomplished in continuous operation.
- .5 Do not incorporate materials from underlying layer into mix.
- .6 Schedule road-mixing operations when weather conditions are likely to be hot and dry during, and for some time after placing.
 - .1 Do not commence work unless temperature is 10 degrees C and rising.

3.05 AERATION AND SPREADING

- .1 Aerate mix until volatiles are sufficiently removed and mix is compactable.

- .2 Spread or deposit and reshape mixture to lines and grades as indicated after compaction.
- .3 Compacted lift thickness: maximum 75 mm.

3.06 COMPACTING

- .1 Compact immediately behind spreading operation by rolling until uniformly textured, tight surface and density to satisfaction of Departmental Representative.
- .2 Do initial rolling with pneumatic-tired roller or vibratory roller and final rolling with steel static wheeled roller.
- .3 Reshape as necessary during compaction to fill ruts or other irregularities and trim edge neatly to line.

3.07 TOLERANCES

- .1 Finished mixed-in-place asphalt course thicknesses to be within 10 mm of specified thicknesses but not uniformly thicker or thinner.
- .2 Correct irregularities exceeding 10 mm when checked with 4 m straight-edge placed in any direction. Correct irregularities by reshaping while mixture is still plastic.

3.08 REMIXING

- .1 Remix portions of finished mixed-in-place asphalt surfaces that show evidence of unsatisfactory asphalt content within [3] weeks of usage of surface by normal traffic. Sections with gravelling require addition of asphalt, while sections with surface lateral displacement require additional mixing and/or additional aggregate.
- .2 Remix by reshaping asphalt surface into windrows, mixing, adding asphalt or aggregate as required, mixing aerating, spreading, and compacting into new finished surface.
- .3 Remixed portions of finished mixed-in-place asphalt surface will be subject to 1 additional 3 week performance evaluation and any necessary remixing.

3.09 PROTECTION

- .1 Restrict traffic speed during curing/setting period to prevent surface damage as directed by Departmental Representative.
- .2 Repair damage to adjacent materials caused by road-mix asphalt paving wearing course application.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|---|------------------|
| .1 | Submittal Procedures | Section 01 33 00 |
| .2 | Health and Safety Requirements | Section 01 35 33 |
| .3 | Common Product Requirements | Section 01 61 00 |
| .4 | Cleaning | Section 01 74 11 |
| .5 | Construction/Demolition Waste Management and Disposal | Section 01 74 21 |

1.02 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and Payment:
- .2 Measure supply and application of calcium chloride in litres applied.
- .3 Measure supply and application of water for dust control in litres.
- .4 No extra compensation will be paid for calcium chloride or water ordered and applied on Saturdays, Sundays or holidays.

1.03 REFERENCES

- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-15.1-[92], Calcium Chloride.
- .3 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Sustainable Design Submittals:
 - .1 LEED Canada-NC Version 1.0 Submittals: N/A.
 - .2 Erosion and Sedimentation Control: submit erosion and sedimentation control plan in accordance with authorities having jurisdiction.
 - .3 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .4 Regional Materials: submit evidence that project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging,

labelled with manufacturer's name and address.

- .1 Supply calcium chloride in quantities and at times as directed by Departmental Representative.
- .2 Deliver calcium chloride to site in moisture-proof bags, tank cars, covered hopper cars or covered trucks. Indicate name of manufacturer, name of product, net weight or mass, and percentage of calcium chloride guaranteed by manufacturer.
- .3 Storage and Handling Requirements:
 - .1 Store bags of calcium chloride in weather-proof enclosures.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Calcium chloride, Type I: to CAN/CGSB-15.1, flake or 35% aqueous solution.
- .2 Water: in accordance with Departmental Representative's approval.

3 EXECUTION

3.01 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

3.02 APPLICATION

- .1 Apply calcium chloride and water with equipment approved by Departmental Representative at rates according to manufacturer's specifications when directed by Departmental Representative.
- .2 Apply water or aqueous calcium chloride with distributors equipped with means of shut-off and with spray system to ensure uniform application.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .2 Place materials defined as hazardous or toxic in designated containers.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Special Procedures for Traffic Control Section 01 35 00.06
- .2 Health and Safety Requirements Section 01 35 33

1.02 MEASUREMENT FOR PAYMENT

- .1 Pavement marking: measured by lump sum.
- .2 Pavement marking including reflective glass beads: measured by lump sum.
- .3 Supply of paint: measured in litres.
- .4 Supply of reflective glass beads: measured in kilograms.
- .5 Symbols and letters: measured in units.

1.03 REFERENCES

- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
 - .3 LEED Canada 2009 for Design and Construction-[2010], LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.
 - .4 LEED Canada for Existing Buildings, Operations and Maintenance-[2009], LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
- .2 Environment Canada (EC)
 - .1 Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations, SOR/2009-264.
- .3 Green Seal (GS)
 - .1 GS-11-[2013], Standard for Paints and Coatings.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - [current edition].
 - .1 MPI #32 Traffic Markings Paint, Alkyd.
- .6 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1113-[13], Architectural Coatings.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for pavement markings and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.

- .3 Samples:
 - .1 Submit to Departmental Representative following material sample quantities at least 4 weeks prior to commencing work.
 - .1 Two 1 L samples of each type of paint.
 - .2 One 1 kg sample of glass beads.
 - .3 Sampling to MPI Painting Manual.
 - .2 Mark samples with name of project and its location, paint manufacturer's name and address, name of paint, MPI specification number and formulation number and batch number.
- .4 Sustainable Design Submittals:
 - .1 N/A

1.05 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operations and Maintenance Data: submit information on materials relative to work of this Section for inclusion in operations and maintenance manual.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.07 SITE CONDITIONS

- .1 Sustainable Design Provisions:
 - .1 Seasonal restriction for high VOC content traffic marking coatings.
 - .1 Traffic marking coating application between May 1st and October 15th is subject to seasonal use restriction and must not have a VOC concentration in excess of 150 g/L.

2 PRODUCTS

2.01 MATERIALS

- .1 Paint and Markings:
 - .1 To MPI #32, Alkyd zone/traffic marking.
 - .2 Traffic Marking Coatings: maximum VOC limit 450 g/L to SOR/2009-264 Schedule 1 and to GS-11 Standard or SCAQMD Rule 1113
 - .3 Paints: in accordance with MPI recommendation for surface conditions.
 - .4 Colour: to MPI listed, yellow and white.
 - .5 Upon request, Departmental Representative will supply qualified product list of paints

applicable to work. Qualified paints may be used but Departmental Representative reserves right to perform further tests.

- .2 Thinner: to MPI listed manufacturer.
- .3 Glass reflective beads: type suitable for application to wet paint surface for light reflectance.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive pavement markings previously installed under other Sections or Contracts are acceptable for product installation in accordance with MPI instructions prior to pavement markings installation.
 - .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Pavement surface: dry, free from water, frost, ice, dust, oil, grease and other deleterious materials.
- .3 Proceed with Work only after unacceptable conditions have been rectified.

3.02 EQUIPMENT REQUIREMENTS

- .1 Paint applicator: approved pressure type with positive shut-off distributor capable of applying paint in single, double and dashed lines and capable of applying marking components uniformly, at rates specified, and to dimensions as indicated.
- .2 Distributor: capable of applying reflective glass beads as overlay on freshly applied paint.

3.03 TRAFFIC CONTROL

- .1 Follow traffic control measures in accordance with Section 01 35 00.06 - Special Procedures for Traffic Control.

3.04 APPLICATION

- .1 Pavement markings: lay out pavement markings.
- .2 Unless otherwise approved by Departmental Representative, apply paint only when air temperature is above 10 degrees C, wind speed is less than 60 km/h and no rain is forecast within next 4 hours.
- .3 Apply traffic paint evenly at rate of 3 m² /L.
- .4 Do not thin paint unless approved by Departmental Representative.
- .5 Symbols and letters to dimensions indicated.
- .6 Paint lines of uniform colour and density with sharp edges.
- .7 Thoroughly clean distributor tank before refilling with paint of different colour.
- .8 Apply glass beads at rate of 0.5 kg/L of painted area immediately after application of paint.

3.05 TOLERANCE

- .1 Paint markings: within plus or minus 12 mm of dimensions indicated.
- .2 Remove incorrect markings in accordance with Section 32 01 11.01 - Pavement Cleaning and Marking Removal.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove insulation material spilled during installation and leave work area ready for

application of wall board.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.07 PROTECTION

- .1 Protect pavement markings until dry.
- .2 Repair damage to adjacent materials caused by pavement marking application.

END OF SECTION

1 GENERAL

1.01 MATERIAL SUPPLIED BY

- .1 N/A

1.02 RELATED REQUIREMENTS

- .1 Rough Grading Section 31 22 13
- .2 Mechanical Seeding Section 32 92 19.13
- .3 Hydraulic Seeding Section 32 92 19.16

1.03 MEASUREMENT PROCEDURES

- .1 Preparation of sub-grade for placing of topsoil will be measured under Section 31 22 01 – Site Grading.
- .2 Topsoil stripping will be measured by Departmental Representative in cubic metres of stockpiled topsoil and volume will be determined by average end area method.
- .3 Measure placing of topsoil in cubic metres removed from stockpile.
 - .1 Stockpiles will be measured by Departmental Representative and volume of topsoil removed calculated by average end area method.
- .4 Measure supply and application of soil amendments, including fertilizer, in standard commercial units of weight/volume and square metres of area treated as determined by Departmental Representative.
- .5 Measure supplying, placing and spreading topsoil in cubic metres determined by truck box measurement as loaded.
 - .1 Truck box capacity determined by Departmental Representative.
- .6 Measure supplying, placing and spreading topsoil in cubic metres as determined from actual surface area covered and depth of topsoil specified.
 - .1 Specified depth of topsoil: measured and accepted by Departmental Representative after settlement and consolidation as specified.
- .7 Measure finish grading in square metres from actual surface measurements as determined by Departmental Representative.

1.04 PAYMENT

- .1 Testing of topsoil: Departmental Representative will pay for cost of tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

1.05 REFERENCES

- .1 Agriculture and Agri-Food Canada
 - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment
 - .1 PN1340-[2005], Guidelines for Compost Quality.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .4 U.S. Environmental Protection Agency (EPA)/Office of Water

- .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.06 DEFINITIONS

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

1.07 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 LEED Submittals:
 - .1 N/A
- .3 Quality control submittals:
 - .1 Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in PART 2 - SOURCE QUALITY CONTROL.
 - .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.08 QUALITY ASSURANCE

- .1 Pre-installation meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM) or 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.

1.09 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Divert unused soil amendments from landfill to official hazardous material collections site approved by Departmental Representative.
- .3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

2 PRODUCTS

2.01 TOPSOIL

- .1 Topsoil for seeded areas: mixture of particulates, micro-organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70% sand, minimum 7 % clay, and contain 2 to 10 % organic matter by weight.
 - .2 Contain no toxic elements or growth inhibiting materials.
 - .3 Finished surface free from:

- .1 Debris and stones over 50 mm diameter.
- .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
- .4 Consistence: friable when moist.

2.02 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Fertility: major soil nutrients present in following amounts:
 - .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
 - .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
 - .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
 - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - .6 Ph value: 6.5 to 8.0.
- .2 Peatmoss:
 - .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5 mm.
- .3 Sand: washed coarse silica sand, medium to course textured.
- .4 Organic matter: compost Category A, B in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- .5 Use composts meeting Category B requirements for land fill reclamation and large scale industrial applications.
- .6 Limestone:
 - .1 Ground agricultural limestone.
 - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .7 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

2.03 SOURCE QUALITY CONTROL

- .1 Advise Departmental Representative of sources of topsoil and manufactured topsoil to be utilized with sufficient lead time for testing.
- .2 Contractor is responsible for amendments to supply topsoil as specified.
- .3 Soil testing by recognized testing facility for PH, P and K, and organic matter.
- .4 Testing of topsoil will be carried out by testing laboratory designated by Departmental Representative.
 - .1 Soil sampling, testing and analysis to be in accordance with Provincial standards.

3 EXECUTION

3.01 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.02 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as directed by Departmental Representative and after area has been cleared of brush, weeds and grasses and removed from site.
- .2 Strip topsoil to depths as directed by Departmental Representative.
 - .1 Avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.
- .3 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m.
- .4 Disposal of unused topsoil is to be in an environmentally responsible manner but not used as landfill as directed by Departmental Representative.
- .5 Protect stockpiles from contamination and compaction.

3.03 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct.
 - .1 If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface.
 - .3 Dispose of removed material off site.
- .4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
 - .1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.04 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15 mm below finished grade.
- .4 Spread topsoil as indicated to following minimum depths after settlement.
 - .1 150 mm for seeded areas.
 - .2 135 mm for sodded areas.
 - .3 300 mm for flower beds.
 - .4 500 mm for shrub beds.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.05 SOIL AMENDMENTS

- .1 N/A

3.06 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative.
 - .1 Leave surfaces smooth, uniform and firm against deep footprinting.

3.07 ACCEPTANCE

- .1 Departmental Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.08 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required off site.

3.09 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|-------------------------------|---------------------|
| .1 | Rough Grading | Section 31 22 13 |
| .2 | Topsoil Placement and Grading | Section 32 91 19.13 |
| .3 | Hydraulic Seeding | Section 32 92 19.16 |

1.02 MEASUREMENT AND PAYMENT

- .1 Payment for seeding will be made at unit price bid per square metre of actual surface measurements taken and computed by Departmental Representative. Areas of blending into existing turf grass will not be measured for payment.

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements in accordance with Section 01 31 19 - Project Meeting.
- .2 Scheduling:
- .1 Schedule sod laying to coincide with preparation of soil surface.
 - .2 Schedule sod installation when frost is not present in ground.
 - .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements in accordance with Section 01 31 19 - Project Meetings.

1.04 REFERENCES

- .1 Canada Green Building Council (CaGBC)
- .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for seed, and fertilizer.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.
- .3 Samples:
- .1 Submit 0.5 kg container of each type of fertilizer used.
- .4 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.06 QUALITY ASSURANCE

- .1 Qualifications: N/A

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Labelled bags of fertilizer identifying mass in kg, mix components and percentages, date of bagging, supplier's name and lot number.
 - .2 Fertilizer must be dry.
- .3 Storage and Handling Requirements:
 - .1 Store fertilizer in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.08 WARRANTY

- .1 For seeding, 12 months warranty period is extended to 24 months.
- .2 Contractor hereby warrants that seeding will remain free of defects in accordance with General Conditions CCDC GC 12.3, but for 24 months.
- .3 End-of-warranty inspection will be conducted by Departmental Representative.

2 PRODUCTS

2.01 GRASS SEED

- .1 Grass seed to meet requirements of Government of Canada "Seeds Act" for "Canada No. 1 seed". Where specified, all nurse crop seed to meet requirements of Canada Seed Act for "Canada No. 1 seed".
- .2 In packages individually labelled in accordance with "Seeds Regulations" and indicating name of supplier.

2.02 WATER

- .1 Free of impurities that would inhibit germination and growth.
- .2 Supplied by Departmental Representative at designated source.
- .3 Water for required irrigation will be supplied via hydrant or hose bib.

2.03 FERTILIZER

- .1 To Canada "Fertilizers Act" and Regulations.
- .2 Complete synthetic fertilizer with guaranteed minimum analysis as specified.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for mechanical seeding installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 INSTALLERS

- .1 Use installers approved by Departmental Representative.

3.03 SEED BED PREPARATION

- .1 Do not perform work under adverse field conditions as determined by Departmental Representative.
- .2 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; in location as directed by Departmental Representative and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Verify that grades are correct. If discrepancies occur, notify Departmental Representative and commence work when instructed by Departmental Representative.
- .4 Fine grade surface free of humps and hollows to smooth, even grade, to elevations indicated with a tolerance of plus or minus 15 mm, surface draining naturally.
- .5 Cultivate fine graded surface accepted by Departmental Representative to 25 mm depth immediately prior to seeding.

3.04 SEED PLACEMENT

- .1 Ensure seed is placed under supervision of certified Landscape Planting Supervisor.
- .2 For mechanical seeding:
 - .1 Mechanical landscape drill seeder ("Brillion" type or equivalent) which accurately places seed at specified depth and rate and rolls in single operation.
 - .2 Use equipment and method acceptable to Departmental Representative.
- .3 For manual seeding:
 - .1 Use manually operated drop seeder ("Cyclone" type or equivalent).
 - .2 Use manually operated, water ballast, landscaping type, smooth steel drum roller. Ballast as directed by Departmental Representative.
 - .3 Use equipment and method acceptable to Departmental Representative.
- .4 Blend applications 150 mm into adjacent grass areas to form uniform surfaces.
- .5 Sow half of required amount of seed in one direction and remainder at right angles as applicable.
- .6 Incorporate seed by light raking in cross directions.
- .7 Consolidate mechanically seeded areas by rolling area if soil conditions warrant or if directed by Departmental Representative with equipment approved by Departmental Representative immediately after seeding.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Clean and reinstate areas affected by Work.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .2 Divert unused fertilizer from landfill to official hazardous material collections site approved by Departmental Representative.

3.06 PROTECTION

- .1 Erect plastic snow fence around newly seeded areas sufficient to protect against deterioration due to pedestrian or other traffic.

3.07 FERTILIZING PROGRAM

- .1 Apply fertilizer in accordance with soil test results instructions.
- .2 Apply after smooth raking of topsoil and prior to installation of sod.
- .3 Apply fertilizer no more than 48 hours before laying sod.
- .4 Mix thoroughly into upper 50 mm of topsoil.
- .5 Lightly water to aid the dissipation of fertilizer.

3.08 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Ensure maintenance is carried out under supervision of certified Landscape Maintenance Supervisor.
- .2 Perform following operations from time of seed application until acceptance by Departmental Representative:
 - .1 Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.
 - .2 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
 - .3 Cut grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will smother grass as directed by Departmental Representative.
 - .4 Fertilize seeded areas after first cutting in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.
 - .5 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.
 - .1 If chemical means are used, comply with Section 31 31 19.13 - Chemical Vegetation Control.
 - .6 Adjust protection barrier as necessary to protect against deterioration due to pedestrian or other traffic as needed.

3.09 FINAL ACCEPTANCE

- .1 Seeded areas will be accepted by Departmental Representative provided that:

- .1 Areas are uniformly established free of rutted, eroded, bare or dead spots and extent of weeds apparent in grass is acceptable.
- .2 Areas have been cut at least twice.
- .3 Areas have been fertilized.
- .2 Areas seeded in fall will be accepted in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.10 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period.
 - .1 Water seeded area to maintain optimum soil moisture level for continued growth of grass. Control watering to prevent washouts.
 - .2 Repair and reseed dead or bare spots to satisfaction of Departmental Representative.
 - .3 Cut grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will smother grass as directed by Departmental Representative.
 - .4 Fertilize seeded areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.
 - .5 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.
 - .1 If chemical means are used, comply with Section 31 31 19.13 - Chemical Vegetation Control.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|-------------------------------|---------------------|
| .1 | Rough Grading | Section 31 22 13 |
| .2 | Topsoil Placement and Grading | Section 32 91 19.13 |
| .3 | Hydraulic Seeding | Section 32 92 19.16 |

1.02 MEASUREMENT AND PAYMENT

- .1 Measure hydraulic seeding in square metres of actual surface area for:
 - .1 Grass mixture including fertilizer.
 - .2 Legume mixture including fertilizer.
 - .3 Areas of blending into existing turf grass will not be measured for payment.
- .2 Measure maintenance during establishment period and warranty period of areas seeded in square metres.
- .3 Payment for seeding made at unit price bid of actual area surface measurements taken and computed by Departmental Representative.

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements in accordance with Section 01 31 19 - Project Meetings.
- .2 Scheduling:
 - .1 Schedule hydraulic seeding to coincide with preparation of soil surface.
 - .2 Schedule hydraulic seeding using grass mixtures and mixtures containing Crownvetch or Trefoil between dates recommended by the Regional Agricultural Department.

1.04 REFERENCES

- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for seed, mulch, tackifier, fertilizer, liquid soil amendments and micronutrients.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures.
- .3 Submit in writing prior to commencing work:
 - .1 Volume capacity of hydraulic seeder in litres.
 - .2 Amount of material to be used per tank based on volume.
 - .3 Number of tank loads required per hectare to apply specified slurry mixture per hectare.
- .4 Samples:
 - .1 Submit 0.5 kg container of each type of fertilizer used.

- .5 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.06 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Landscape Contractor: to be a Member in Good Standing of Horticultural Trades Association.
 - .2 Landscape Planting Supervisor: Landscape Industry Certified Technician with Softscape Installation designation.
 - .3 Landscape Maintenance Supervisor: Landscape Industry Certified Technician with Turf Maintenance designation.

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Labelled bags of fertilizer identifying mass in kg, mix components and percentages, date of bagging, supplier's name and lot number.
 - .2 Inoculant containers to be tagged with expiry date.
- .3 Storage and Handling Requirements:
 - .1 Store fertilizer and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Requirements.

1.08 WARRANTY

- .1 For seeding, 12 months warranty period is extended to 24 months.
- .2 Contractor hereby warrants that seeding will remain free of defects for 24 months.
- .3 End-of-warranty inspection will be conducted by Departmental Representative.

2 PRODUCTS

2.01 MATERIALS

- .1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.
 - .1 Grass seed to meet requirements of Government of Canada "Seeds Act" for "Canada No. 1 seed". Where specified, all nurse crop seed to meet requirements of Canada Seed Act for "Canada No. 1 seed".
- .2 Mulch: N/A
- .3 Tackifier: water dilutable, liquid dispersion or water soluble vegetable carbohydrate powder.
- .4 Water: free of impurities that would inhibit germination and growth.

- .5 Fertilizer:
 - .1 To Canada "Fertilizers Act" and Regulations.
 - .2 Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.
- .6 Inoculants: inoculant containers to be tagged with expiry date.
- .7 Liquid Soil Amendment and Micronutrients: N/A.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for hydraulic seeding in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 INSTALLERS

- .1 Use installers approved by Departmental Representative.

3.03 PROTECTION OF EXISTING CONDITIONS

- .1 Protect structures, signs, guide rails, fences, plant material, utilities and other surfaces not intended for spray.
- .2 Immediately remove any material sprayed where not intended as directed by Departmental Representative.

3.04 PREPARATION OF SURFACES

- .1 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water.
- .2 Fine grade areas to be seeded free of humps and hollows.
 - .1 Ensure areas are free of deleterious and refuse materials.
- .3 Cultivated areas identified as requiring cultivation to depth of 25 mm.
- .4 Ensure areas to be seeded are moist to depth of 150 mm before seeding.
- .5 Obtain Departmental Representative's approval of grade and topsoil depth before starting to seed.

3.05 FERTILIZING PROGRAM

- .1 Apply fertilizer in accordance with soil test results instructions.
- .2 Apply after smooth raking of topsoil and prior to installation of sod.
- .3 Apply fertilizer no more than 48 hours before laying sod.
- .4 Mix thoroughly into upper 50 mm of topsoil.
- .5 Lightly water to aid the dissipation of fertilizer.

3.06 PREPARATION OF SLURRY

- .1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Departmental Representative. Supply equipment required for this work.
- .2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
- .3 After materials are in seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.07 SLURRY APPLICATION

- .1 Ensure seed is placed under supervision of certified Landscape Planting Supervisor.
- .2 Hydraulic seeding equipment:
 - .1 Slurry tank.
 - .2 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.
 - .3 Capable of seeding by 0] m hand operated hoses and appropriate nozzles.
 - .4 Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".
- .3 Slurry mixture applied per m² as per manufacturer's specifications.
- .4 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
 - .1 Using correct nozzle for application.
 - .2 Using hoses for surfaces difficult to reach and to control application.
- .5 Blend application 300 mm into adjacent grass areas to form uniform surfaces.
- .6 Re-apply where application is not uniform.
- .7 Remove slurry from items and areas not designated to be sprayed.

3.08 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Clean and reinstate areas affected by Work.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .2 Divert unused fertilizer from landfill to official hazardous material collections site approved by Departmental Representative.

3.09 PROTECTION

- .1 Protect seeded areas from trespass until plants are established.
- .2 Remove protection devices as directed by Departmental Representative.

3.10 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Ensure maintenance is carried out under supervision of certified Landscape Maintenance Supervisor.
- .2 Perform following operations from time of seed application until acceptance by Departmental

- Representative.
- .3 Grass Mixture:
- .1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
 - .2 Mow grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will smother grass as directed by Departmental Representative.
 - .3 Fertilize seeded areas after 10 weeks after germination provided plants have mature true leafs in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.
 - .4 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.
 - .1 If chemical means are used, comply with Section 31 31 19.13 - Chemical Vegetation Control.
 - .5 Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.
- .4 Legume Mixture:
- .1 Repair minor dead and bare spots as determined by Departmental Representative to allow establishment of seed prior to acceptance.
 - .2 Repair major dead and bare spots as determined by Departmental Representative in accordance with site climatic averages and recommendations of local agricultural governmental representative.
 - .3 Mow legume mixtures to 100 mm whenever height reaches 200 mm and as follows:
 - .1 Do not mow within period commencing 3 weeks before and ending 3 weeks after first severe, average fall frost date and 3 weeks after actual severe fall frost.
 - .2 When mowing after first severe fall frost, mow at a height of not less than 300 mm.
 - .4 Remove clippings that will smother plants as directed by Departmental Representative.
 - .5 Water seeded areas to maintain optimum soil moisture level for germination and continued growth. Control watering to prevent washouts.

3.11 ACCEPTANCE

- .1 Seeded areas will be accepted by Departmental Representative provided that:
 - .1 Plants are uniformly established. Seeded areas are free of rutted, eroded, bare or dead spots.
 - .2 Areas have been mown at least twice.
 - .3 Areas have been fertilized.
- .2 Areas seeded in fall will achieve final acceptance in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.12 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Repair and reseed dead or bare spots to satisfaction of Departmental Representative.
 - .2 Mow areas seeded, remove clippings that will smother grassed areas, as directed by Departmental Representative.
 - .3 Fertilize seeded areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.
 - .1 If chemical means are used, comply with Section 31 31 19.13 - Chemical Vegetation Control.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|---|---------------------|
| .1 | Site Water Utility Distribution Piping | Section 33 11 16 |
| .2 | Incoming Site Water Utility Distribution Piping | Section 33 11 16.01 |
| .3 | Public Sanitary Sewerage Piping | Section 33 31 13 |

1.02 MEASUREMENT PROCEDURES

- .1 Measure excavation and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Measure maintenance holes and catch basins in units within depth classifications as follows, measured from top of cover or grating to lowest pipe invert or top of base slab for oversized maintenance holes:
 - .1 2 m or less.
 - .2 Greater than 2 m but not more than 2.5 m.
 - .3 Greater than 2.5 m but not more than 3 m.
 - .4 Greater than 3 m but not more than 3.5 m.
 - .5 Further stages in increments of 0.5 m.
- .3 Measure outfall structures in units.
- .4 Measure adjusting tops of existing maintenance holes or catch basins in units adjusted.
- .5 Measure gratings in units supplied and installed.
- .6 Measure I-beam in metres of each size incorporated into work.
- .7 Measure sealing over existing maintenance holes or catch basins in units sealed.

1.03 REFERENCES

- .1 ASTM International
 - .1 ASTM A 48/A 48M-[03(2012)], Standard Specification for Gray Iron Castings.
 - .2 ASTM A 123/A 123M-[2012], Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM C 117-[13], Standard Test Method for Materials Finer than 75-mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C 136-[06], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM C 139-[11], Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .6 ASTM C 478M-[13], Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .7 ASTM D 698-[12], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft² (600 kN-m/m²)).
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
 - .3 LEED Canada 2009 for Design and Construction-[2010], LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating

- System Reference Guide.
- .4 LEED Canada for Existing Buildings, Operations and Maintenance-[2009], LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
 - .4 CSA Group
 - .1 CSA A23.1/A23.2-[09], Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A165 Series-[04(R2009)], CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .3 CAN/CSA-A3000-[08], Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .4 CSA G30.18-[09], Carbon Steel Bars for Concrete Reinforcement.
 - .5 Gouvernement du Québec, Ministère des Transports
 - .1 Cahier des charges et devis généraux (CCDG)-[2013].
 - .6 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 407-[November 2007(R2010)], Construction Specification For Maintenance Hole, Catch Basin, Ditch Inlet And Valve Chamber Installation.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [maintenance holes and catch basin structures] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.
- .4 Sustainable Design Submittals:
 - .1 LEED Canada submittals: N/A.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

1.05 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 - Quality Control.
- .2 Certifications:
 - .1 Submit manufacturer's test data and certification at least 4 weeks prior to beginning

- Work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect maintenance holes and catch basin structures from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Cast-in-place concrete:
 - .1 In accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .2 Cement: to CAN/CSA-A3001, Type GU.
 - .3 Concrete mix design to produce 21 MPa minimum compressive strength at 28 days.
 - .4 Supplementary cementing materials: with minimum 20% Type F, CI, CH, fly ash replacement, N, or GGBFS, by mass of total cementitious materials to CAN/CSA-A3001.
 - .5 Concrete reinforcement: in accordance with Section 03 20 00 - Concrete Reinforcing.
- .2 Precast maintenance hole units: to ASTM C 478M, circular or oval.
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
 - .2 Use of monolithic bases to be approved by Departmental Representative and set on concrete slabs cast in place.
- .3 Precast catch basin sections: to ASTM C 139 or ASTM C 478M.
- .4 Joints: made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.
- .5 Mortar:
 - .1 Aggregate: CSA A82.56.
 - .2 Masonry Cement: to CAN/CSA-A3002.
- .6 Ladder rungs: to CSA G30.18, No.25M billet steel deformed bars, hot dipped galvanized to ASTM A 123/A 123M.
 - .1 Rungs to be safety pattern (drop step type).
- .7 Adjusting rings: to ASTM C 478M.
- .8 Concrete Brick: to CAN/CSA-A165 Series.

- .9 Drop maintenance hole pipe: same as sewer pipe.
- .10 Galvanized iron sheet: approximately 2 mm thick.
- .11 Steel gratings, I-beams and fasteners: as indicated.
- .12 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames.
 - .1 Frame with grating or cover to constitute one unit.
 - .2 Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A 48/A 48M, strength class 30B.
 - .3 Castings: coated with two applications of asphalt varnish, sand blasted or cleaned and ground to eliminate surface imperfections.
 - .4 Maintenance hole frames and covers: cover cast with perforations and complete with two 25 mm square lifting holes to OPSS 407.
 - .5 Catch basin frames and covers: to OPSS 407.
 - .6 Maintenance hole frames and covers: to CCDG.
 - .7 Catch basin frames and covers: to CCDG.
 - .8 Size: 762 mm clear diameter.
- .13 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed stone, gravel/sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.
 - .3 Table:

Sieve Designation	% Passing Gravel/Sand
12.5 mm	100
9.5 mm	-
4.75 mm	50-100
2.00 mm	30-90
0.425 mm	10-50
0.180 mm	-
<u>0.075 mm</u>	<u>0-10</u>
 - .4 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .14 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for maintenance holes and catch basin structures installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.

3.03 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 Position metal inserts in accordance with dimensions and details as indicated.

3.04 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Complete units as pipe laying progresses.
 - .1 Maximum of 3 units behind point of pipe laying will be allowed.
- .3 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
- .4 Cast bottom slabs directly on undisturbed ground.
- .5 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% corrected maximum dry density.
- .6 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
 - .2 Make each successive joint watertight with Departmental Representative's approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .4 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
- .7 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide smooth U-shaped channel.
 - .1 Side height of channel to be 0.75 times full diameter of sewer.
 - .2 Slope adjacent floor at 1 in 20.
 - .3 Curve channels smoothly.
 - .4 Slope invert to establish sewer grade.
- .8 Compact granular backfill to 95% corrected maximum dry density.
- .9 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .10 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
 - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .11 Set frame and cover to required elevation on no more than 4 courses of brick.
 - .1 Make brick joints and join brick to frame with cement mortar.
 - .2 Parge and make smooth and watertight.

- .12 Place frame and cover on top section to elevation as indicated.
 - .1 If adjustment required use concrete ring.
- .13 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .14 Install safety platforms in maintenance holes having depth of 5 m or greater, as indicated.

3.05 ADJUSTING TOPS OF EXISTING UNITS

- .1 Remove existing gratings, frames and I beams and store for re-use at locations designated by Departmental Representative.
- .2 Sectional units:
 - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
 - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
 - .1 When amount of raise is less than 600 mm use standard maintenance hole brick, moduloc or grade rings.
- .3 Monolithic units:
 - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with mortared brick course for 150 mm or less alteration, or cast-in-place concrete.
 - .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
 - .3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
 - .4 Install additional maintenance hole ladder rungs in adjusted portion of units as required.
 - .5 Re-use existing gratings, frames and I beams.
 - .6 Re-set gratings and frames to required elevation on not more than 4 courses of brick.
 - .1 Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.
 - .2 Re-set gratings and frames to required elevation on full bed of cement mortar, parge and trowel smooth.

3.06 SEALING OVER EXISTING UNITS

- .1 Cut galvanized iron sheet to extend 50 mm beyond opening of existing maintenance hole or catch basin grating.
 - .1 Center iron sheet over existing grating and spot or stitch weld to grating.
- .2 Fill with cast-in-place concrete or material approved by Departmental Representative.

3.07 FIELD QUALITY CONTROL

- .1 Leakage Test:
- .2 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer maintenance hole and fill maintenance hole with water.
- .3 Leakage not to exceed 0.3% per hour of volume of maintenance hole.
- .4 If permissible leakage is exceeded, correct defects.
- .5 Repeat until approved by Departmental Representative.
- .6 Departmental Representative will issue Test Certificate for each maintenance hole passing test.

3.08 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|--|---------------------|
| .1 | Concrete Reinforcing | Section 03 20 00 |
| .2 | Cast-in-Place Concrete | Section 03 30 00 |
| .3 | Excavating, Trenching and Backfilling | Section 31 23 33.01 |
| .4 | Maintenance Holes and Catch Basin Structures | Section 33 05 16 |
| .5 | Aggregate Materials | Section 31 05 16 |

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 N/A

1.03 MEASUREMENT PROCEDURES

- .1 Measure trenching and backfilling, other than granular bedding and surround in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Measure water main including trenching and backfilling, in metres of each size of pipe installed.
- .1 Horizontal measurement will be made over surface, through valves and fittings, after work has been completed.
- .2 Measure lateral connections from water main to hydrants as water main and include curb valve and adjustable valve box.
- .3 Measure tunnelling, boring or jacking for under crossings, including encasing pipes and grouting, in metres, as indicated.
- .4 Measure hydrants including excavation and backfilling, in units installed.
- .5 Measure service connections including trenching and backfilling, in metres of each size of pipe installed.
- .6 Measure valves in units installed including excavation and backfilling, valves and valve boxes and thrust blocks.
- .7 Measure valve chambers including excavation and backfilling, in units installed.
- .8 Measure granular bedding and surround material in cubic metres.
- .9 Measure concrete for bedding, encasement of pipes, supports and thrust blocks in cubic metres.

1.04 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
- .1 ANSI/AWWA B300-[10], Standard for Hypochlorites.
- .2 ANSI/AWWA B301-[10], Standard for Liquid Chlorine.
- .3 ANSI/AWWA B303-[10], Standard for Sodium Chlorite.
- .4 ANSI/AWWA C104/A21.4-[08], Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
- .5 ANSI/AWWA C105/A21.5-[10], Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- .6 ANSI/AWWA C111/A21.11-[07], American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
- .7 ANSI/AWWA C110/A21.10-[08], American National Standard for Ductile-Iron and Gray Iron Fittings for Water.
- .8 ANSI/AWWA C150/A21.50-[08], Standard for Thickness Design of Ductile-Iron Pipe.
- .9 ANSI/AWWA C151/A21.51-[09], Standard for Ductile-Iron Pipe, Centrifugally Cast.
- .10 ANSI/AWWA C153/A21.53-[11], Standard for Ductile-Iron Compact Fittings.

- .11 ANSI/AWWA C200-[05], Standard for Steel Water Pipe - 6 Inch (150 mm) and Larger.
- .12 ANSI/AWWA C203-[08], Standard for Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
- .13 ANSI/AWWA C205-[07], Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger - Shop Applied.
- .14 ANSI/AWWA C206-[11], Standard for Field Welding of Steel Water Pipe.
- .15 ANSI/AWWA C207-[07], Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
- .16 ANSI/AWWA C208-[07], Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- .17 ANSI/AWWA C300-[11], Standard for Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
- .18 ANSI/AWWA C301-[07], Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
- .19 ANSI/AWWA C303-[08], Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- .20 ANSI/AWWA C500-[09], Standard for Metal-Seated Gate Valves for Water Supply Service.
- .21 ANSI/AWWA C504-[10], Standard for Rubber-Seated Butterfly Valves.
- .22 ANSI/AWWA C600-[10], Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
- .23 ANSI/AWWA C602-[11], Standard for Cement-Mortar Lining of Water Pipelines - 4 Inch (100 mm) and Larger.
- .24 ANSI/AWWA C651-[05], Standard for Disinfecting Water Mains.
- .25 ANSI/AWWA C800-[05], Standard for Underground Service Line Valves and Fittings.
- .26 ANSI/AWWA C900-[07], Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
- .2 ASTM International
 - .1 ASTM A 53/A 53M-[10], Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - .2 ASTM A 123/A 123M-[09], Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A 307-[10], Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .4 ASTM B 88M-[05(2011)], Standard Specification for Seamless Copper Water Tube [Metric].
 - .5 ASTM C 117-[04], Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .6 ASTM C 136-[06], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .7 ASTM C 478M-[11], Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
 - .8 ASTM D 698-[07e1], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft² (600 kN-m/m²)).
 - .9 ASTM D 2310-[06], Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - .10 ASTM D 2657-[07], Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.

- .11 ASTM D 2992-[06], Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.
- .12 ASTM D 2996-[01(2007)e1], Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
- .13 ASTM F 714-[10], Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .14 ASTM C 618-[08a], Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- .3 American Water Works Association (AWWA)/Manual of Practice
 - .1 AWWA M9-[2008], Concrete Pressure Pipe.
 - .2 AWWA M11-[2004], Steel Pipe - A Guide for Design and Installation.
 - .3 AWWA M17-[2006], Installation, Field Testing, and Maintenance of Fire Hydrants.
- .4 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
 - .4 LEED Canada-EB: O&M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
- .5 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-34.1-[94], Pipe, Asbestos Cement, Pressure.
 - .4 CGSB 41-GP-25M-[77], Pipe, Polyethylene, for the Transport of Liquids.
- .6 CSA International
 - .1 CAN/CSA-A257 Series-[09], Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
 - .2 CAN/CSA-A3000-[08], Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSA-B137 Series-[09], Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CAN/CSA-B137.1-[09], Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .2 CAN/CSA-B137.3-[09], Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
 - .4 CSA G30.18-[09], Carbon and Steel Bars for Concrete Reinforcement.
- .7 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - [current edition].
- .8 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S520-[07], Standard for Fire Hydrants.
 - .2 CAN/ULC-S543-[09], Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.
- .3 Shop Drawings: N/A
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Inform Departmental Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
 - .3 Submit for testing 4 weeks minimum prior to beginning work, samples of materials proposed for use.
 - .4 Submit manufacturer's test data and certification that pipe materials meet requirements of this section 4 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .5 Sustainable Design Submittals:
 - .1 LEED Canada submittals: N/A.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages of recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .2 Submit evidence, when Supplementary Cementing Materials (SCMs) are used, to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.
 - .4 Regional Materials: submit evidence that project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.06 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants] for incorporation into manual.

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect water distribution piping from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.08 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative and building occupants minimum of 24 hours in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.
- .5 Notify fire department of planned or accidental interruption of water supply to hydrants.
- .6 Provide and post "Out of Service" sign on hydrant not in use.
- .7 Advise local police department of anticipated interference with movement of traffic.

1.09 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Tools: N/A

2 PRODUCTS

2.01 PIPE, JOINTS AND FITTINGS

- .1 Ductile iron pipe: to ANSI/AWWA C151/A21.51, pressure class 200.
- .2 Joints and fittings for ductile iron pipe.
 - .1 Joints:
 - .1 Push-on joints: to ANSI/AWWA C111/A 21.11.
 - .2 Rubber gasket for mechanical pipe joints: to ANSI/AWWA C111/A21.11.
 - .3 Rubber gasket for flange pipe joints 1.6 mm thick: to ANSI/AWWA C111/A21.11.
 - .4 Bolts, nuts, hex head with washers: to ASTM A 307, heavy series.
 - .5 Ensure electrical conductivity across joints.
 - .2 Fittings:
 - .1 Mechanical joint cast iron and ductile iron fittings NPS 3 and larger: to

- .2 ANSI/AWWA C110/A21.10.
Flanged cast iron fittings NPS 3 and larger: to ANSI/AWWA C110/A21.10].
- .3 Compact Fittings to ANSI/AWWA C153/A21.53.
- .3 Reinforced concrete pipe: to CAN/CSA-A257, ANSI/AWWA C300, ANSI/AWWA C301 or ANSI/AWWA C303 class 200.
 - .1 Pipe joints: flanged to ANSI/AWWA C207 or push-on joints with performance requirements to ANSI/AWWA C111/A21.11.
 - .2 Fitting joints: flanged to ANSI/AWWA C207 or push-on with performance requirements to ANSI/AWWA C111/A21.11.
 - .3 Pipe fittings: reinforced concrete to ANSI/AWWA C301 or ANSI/AWWA C303.
- .4 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end, cast iron outside diameter.
 - .1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling.
 - .2 Composite epoxy impregnated fibreglass PVC pipe to ASTM D 2996, class H. Unplasticized PVC core over wrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300, 2.4 MPa with cast iron outside diameter and integral bell gasketed joints to ANSI/ASTM D2992. Material to ASTM D 2310, classification RTRP-11HZ-5001-PVC-13223.
 - .3 Cast iron fittings: to ANSI/AWWA C110/A21.10, and for pipe diameters larger than NPS 4 cement mortar lined to ANSI/AWWA C104/A21.4.
- .5 Polyethylene pressure pipe:
 - .1 NPS 1/2 to NPS 6: to CAN/CSA-B137.1 type PE 3406, series 160 or ASTM F 714, type PE 3408, series DR 11.
 - .2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE 1404, series 250.
 - .3 Polyethylene to polyethylene joints: to be thermal butt fusion joined, to ASTM D 2657 or flanged with steel, aluminum or ductile iron backing flanges.
 - .4 Cast iron fittings with flanged ends: to ANSI/AWWA C110/A21.10 for pipe size above NPS 4, Cement mortar lined to ANSI/AWWA C104/A21.4.
 - .5 Polyethylene fittings: to CAN/CSA-B137.1, for pipe sizes NPS 4 and less.

2.02 PIPE PROTECTION

- .1 Provide means of protection for iron pipe in corrosive soils in accordance with local practices and authorities having jurisdiction to ANSI/AWWA C105/A21.5.

2.03 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valves: to ANSI/AWWA C500, standard iron body, brass or bronze mounted wedge or double disc valves with non-rising stems, suitable for 1 Pa with mechanical, flanged, push-on, or grooved type coupling joints.
- .3 Butterfly valves: to ANSI/AWWA C504, short body or long body, class 1 MPa with mechanical or flanged joints.
- .4 Underground type indicator valve where indicated. Indicator post to accurately indicate valve open or closed.
- .5 Air and vacuum release valves: heavy duty combination air release valves employing direct acting kinetic principle.
 - .1 Fabricate valves of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure.

- .2 Valves to expel air at high rate during filling, at low rate during operation, and to admit air while line is being drained.
- .3 Valve complete with surge check unit.
- .4 Ends to be flanged to ANSI/AWWA C110/A21.10.
- .6 Cast iron valve boxes: bituminous coated screw type or three piece sliding type adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm minimum diameter, 25 x 25 mm cross section, of such length that when set on valve operating nut top of rod will not be more than 150 mm below cover.
 - .1 Base to be large round type with minimum diameter of 300 mm.
 - .2 Top of box to be marked "WATER"/"EAU".

2.04 VALVE CHAMBERS

- .1 Concrete and reinforcing steel: to Section 03 30 00 - Cast-in-Place Concrete and Section 03 20 00 - Concrete Reinforcing.
- .2 Precast concrete sections to ASTM C 478M. Cast ladder rungs integral with unit; field installation not permitted.
- .3 Valve chamber frames and covers: gray iron castings, minimum tensile strength 200 MPa, with two coats, shop applied, approved asphalt coating with a mass of approximately 215 kg per set.
 - .1 Design and dimensions as indicated.
 - .2 Cover to be marked "WATER"/"EAU".
- .4 Jointing materials:
 - .1 Manufacturer's rubber ring gaskets.
 - .2 Mastic joint filler.
 - .3 Cement mortar.
 - .4 Combination of above types.
- .5 Mortar:
 - .1 Aggregate in accordance with Section 04 05 12 - Mortar and Masonry Grout.
 - .2 Masonry cement to CAN/CSA-A3000.
- .6 Ladder rungs for valve chambers: 20 mm diameter deformed rail steel bars to CSA G30.18, hot-dipped galvanized after fabrication to ASTM A 123/A 123M. Rungs to be safety pattern.

2.05 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B 88M type K, annealed.
- .2 Ductile iron pipe: to ANSI/AWWA C151/A21.51 pressure class 200 cement mortar lined to ANSI/AWWA C104/A21.4.
- .3 Polyvinyl chloride pressure pipe: to class 200 series DR21
- .4 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .5 PVC joints: solvent welded in accordance with manufacturer's specifications.
- .6 Polyethylene pipe joints: thermal butt fusion welded or plastic insert type serrated sleeves with four stainless steel screws and band-type clamps per joint.
- .7 Joints for ductile iron pipe: push-on joints to ANSI/AWWA C111/A21.11. Rubber gaskets to ANSI/AWWA C111/A21.11. Verify requirement to maintain electrical conductivity between pipes.
- .8 Brass corporation stops: red brass to ASTM B 62 or compression type having threads to ANSI/AWWA C800.
- .9 Not used.
- .10 Brass inverted key-type curb stops: red brass to ASTM B 62, compression type without drains.
 - .1 Curb stops to have adjustable bituminous coated cast iron service box with stem to suit

- depth of bury.
- .2 Top of cast iron box marked "WATER"/"EAU".
- .11 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.
- .12 Service connections for PVC pipe:
 - .1 Service connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100 mm and over: use tee fitting or tapping valve and sleeve.
- .13 Bronze type service clamps: for PVC pipe service connections.
 - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
 - .2 Clamps to be tapped with threads to ANSI/AWWA C800.
- .14 Tee connections: for services above NPS 1. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

2.06 HYDRANTS

- .1 Post type hydrants: compression type hydrant, to CAN/ULC-S520, designed for working pressure of 2070 kPa with two 65 mm threaded hose outlets, one 100 mm threaded pumper connection, 150 mm riser barrel, 125 mm bottom valve and 150 mm connection for main.
 - .1 Hydrants to open counter clockwise, threads to local standard, fittings to be internal lug quick-connect to CAN/ULC-S543. Provide metal caps and chains.
 - .2 Provide key operated gate valve located [1] m from hydrant.
 - .3 Depth of bury 1.0 m.
- .2 Hydrant paint: exterior enamel to MPI #96.

2.07 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 or CAN/CGSB-8.2.
 - .3 Table

Sieve Designation	% Passing	Stone/Gravel	Gravel/Sand
12.5 mm	100		
9.5 mm	-		
4.75 mm	80-100		
2.00 mm	50- 90		
0.425 mm	10- 50		
0.180 mm	-		
<u>0.075 mm</u>	<u>[0- 10]</u>		
- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

2.08 BACKFILL MATERIAL

- .1 As indicated. Type 3, in accordance with Section 31 23 33.01 - Excavating, Trenching and

Backfilling.

2.09 PIPE DISINFECTION

- .1 Sodium hypochlorite, Calcium hypochlorite, Liquid chlorine or Sodium chlorite to ANSI/AWWA B300, ANSI/AWWA B301, or ANSI/AWWA B303 to disinfect water mains.
- .2 Disinfect water mains in accordance with ANSI/AWWA C651.
- .3 All cleaning, flushing, pressure and leakage testing, disinfection and final flushing to be done by the Contractor. Costs are included in payment for items described in this section.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects.
 - .2 Remove defective materials from site as directed by Departmental Representative.

3.03 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Ensure trench depth allows coverage over pipe of 1.0 m minimum from finished grade.
- .3 Trench alignment and depth require Departmental Representative's acceptance prior to placing bedding material and pipe.

3.04 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Place concrete to details as indicated.
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 hours after placing.

3.05 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth indicated.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95% minimum of corrected maximum dry density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding

in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling with compacted type 3 fill.

3.06 PIPE INSTALLATION

- .1 Terminate building water service 1 m outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes to ANSI/AWWA C600, ANSI/AWWA, M-9, M-11, and manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .3 Join pipes in accordance with ANSI/AWWA C600, ANSI/AWWA C602, ANSI/AWWA C206 AWWA, M-9, M-11 and manufacturer's recommendations.
- .4 Bevel or taper ends of PVC pipe to match fittings.
- .5 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore as the weight of pipe bears on the pipe ends.
- .6 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .2 Take up and replace defective pipe.
 - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .7 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .8 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .9 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Position and join pipes with equipment and methods accepted by Departmental Representative.
- .11 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Align pipes before jointing.
- .13 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .14 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .15 Complete each joint before laying next length of pipe.
- .16 Minimize deflection after joint has been made.
- .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
- .19 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .20 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .21 Do not lay pipe on frozen bedding.

- .22 Do hydrostatic and leakage test and have results accepted by Departmental Representative before surrounding and covering joints and fittings with granular material.
- .23 Backfill remainder of trench.

3.07 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of concrete located between valve and solid ground. Bedding to be same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1 m. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.08 VALVE CHAMBERS

- .1 Use cast-in-place, or precast units as approved by Departmental Representative.
- .2 Construct units as indicated, plumb and centered over valve nut, true to alignment and grade, and not resting on pipe.
- .3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details indicated and in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .4 Cast bottom slabs for precast units directly on undisturbed ground when permitted by Departmental Representative, set precast concrete slab on 150 mm minimum of compacted granular bedding.
- .5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab.
 - .1 Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
- .6 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
- .7 Plug lifting holes with precast concrete plugs set in cement mortar, mastic compound or mortar.
- .8 Set frame and cover to required elevation on at least four and not more than six courses of brick.
 - .1 Make brick joints and join brick to frame with cement mortar, parge and trowel smooth. Concrete ring with preformed bituminous gasket.
- .9 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.
- .10 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

3.09 UNDERCROSSING

- .1 Excavate working pit to dimensions indicated, outside right-of-way or facility to be crossed.
- .2 Excavate working pit to not less than 0.6 m below lowest invert of encasing pipe.
- .3 Dewater excavation.
- .4 Dewater area of undercrossing.
- .5 Install heavy timber or steel frame backstop.
- .6 Place encasing pipe to exact line and grade indicated. Encasing pipe to cross under obstruction at angle indicated.
- .7 Install encasing pipe by jacking, boring or tunnelling.
- .8 Ensure encasing pipe is not in tension.
- .9 Joints for encasing pipe: mechanical or welded type.
- .10 Place concrete grout levelling pad in encasing pipe. Control level of grout during placing.
- .11 Insert water main into encasing pipe, in end with largest open area, after placement of levelling pad.
- .12 Use approved blocking method to guide water main in true alignment.

- .13 Clearance between blocks and encasing pipe: maximum 15 mm when water main is in position.
- .14 Join water main one length at time outside encasing pipe. Push or Pull water main into position.
- .15 Couplings of water main shall not rest on levelling pad when water main is in position.
- .16 Place concrete cradle around water main after it is positioned. Cradle to be minimum of 225 mm and maximum of 300 mm above levelling pad.

3.10 SERVICE CONNECTIONS

- .1 Terminate building water service 1 m outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops as indicated.
- .4 Tappings on ductile iron, asbestos cement or PVC-C900 pipe, may be threaded without service clamps.

- .1 Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used.
- .2 Tappings on asbestos-cement must use double strap service clamps.
- .3 Tappings for asbestos cement or PVC-C900 pipe to conform to following:

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

- .5 Maximum direct tappings (mm) for ductile iron pipe to conform to:

Nominal Pipe Size (mm)	Pressure Class/Max.				
	150	200	250	300	350
75	-	-	-	-	19
102	-	-	-	-	19
152	-	-	-	-	25
203	-	-	-	-	25
254	-	-	-	-	25
305	-	-	-	-	32
356	-	-	32	38	38
406	-	-	38	50	50
457	-	-	50	50	50
508	-	-	50	50	50
610	-	50	50	50	50
762	50	50	50	50	50

- .6 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.

- .7 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .8 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .9 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .10 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 300 mm apart along pipe.
- .11 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.
- .12 Leave corporation stop valves fully open.
- .13 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .14 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .15 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
- .16 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.11 HYDRANTS

- .1 Install hydrants at locations as indicated.
- .2 Install hydrants in accordance with AWWA M17.
- .3 Install 150 mm gate valve and cast iron valve box on hydrant service leads as indicated.
- .4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
- .5 Place concrete thrust blocks as indicated and specified [ensuring that drain holes are unobstructed.
- .6 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.
- .7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.12 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Departmental Representative.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Departmental Representative.

3.13 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests

- hereinafter described.
- .3 Notify Departmental Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of Departmental Representative.
 - .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
 - .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Departmental Representative.
 - .6 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
 - .7 Leave hydrants, valves, joints and fittings exposed.
 - .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
 - .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
 - .10 Open valves.
 - .11 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
 - .12 Fill asbestos cement pipe and concrete pipe at least 24 hours before testing to allow water absorption by pipe material.
 - .13 Thoroughly examine exposed parts and correct for leakage as necessary.
 - .14 Apply hydrostatic test pressure of 1380 kPa minimum based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hour.
 - .15 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
 - .16 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
 - .17 Repeat hydrostatic test until defects have been corrected.
 - .18 Apply leakage test pressure of 1380 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
 - .19 Define leakage as amount of water supplied from water metre in order to maintain test pressure for 2 hours.
 - .20 Do not exceed allowable leakage of 1.25 L/mm of pipe, including lateral connections.
 - .21 Locate and repair defects if leakage is greater than amount specified.
 - .22 Repeat test until leakage is within specified allowance for full length of water main.

3.14 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 1.0m m of pipe.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% of corrected maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% of corrected maximum dry density.

3.15 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 95% corrected maximum dry density.
 - .1 In other areas, compact to at least 90% corrected maximum dry density.

3.16 HYDRANT FLOW TESTS

- .1 Conduct flow tests on every hydrant to determine fire flows prior to painting hydrant caps and ports.

3.17 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants as directed by Departmental Representative.
- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

3.18 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: under direct control of Departmental Representative to be carried out by Contractor.
 - .1 Notify Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

<u>Pipe Size NPS</u>	<u>Flow (L/s) Minimum</u>
6 and below	38
8	75
10	115
12	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed to Departmental Representative's satisfaction, introduce strong solution of chlorine as directed by Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7 Disinfect water mains.
- .8 Rate of chlorine application to be proportional to rate of water entering pipe.
- .9 Chlorine application to be close to point of filling water main and to occur at same time.
- .10 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .11 Flush line to remove chlorine solution after 24 hours.
- .12 Measure chlorine residuals at extreme end of pipe-line being tested.
- .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of 2 days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
 - .3 Contractor to submit certified copy of test results.
- .14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.

- .15 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- .16 Discharging flushing water:
 - .1 Contractor to obtain municipal approval prior to discharging flushing water to municipal sanitary sewers.
 - .2 Discharging into ditches or the storm system is not permitted.

3.19 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative.

3.20 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|--|---------------------|
| .1 | Concrete Reinforcing | Section 03 20 00 |
| .2 | Cast-in-Place Concrete | Section 03 30 00 |
| .3 | Aggregate Materials | Section 31 05 16 |
| .4 | Excavating, Trenching and Backfilling | Section 31 23 33.01 |
| .5 | Maintenance Holes and Catch Basin Structures | Section 33 05 16 |

1.02 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C104/A21.4-[08], Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - .2 ANSI/AWWA C110/A21.10-[08], American National Standard for Ductile Iron and Gray Iron Fittings for Water.
 - .3 ANSI/AWWA C111/A21.11-[07], American National Standard for Rubber Gasket-Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .4 ANSI/AWWA C151/A21.51-[09], AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - .5 ANSI/AWWA C901-[08], AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ Inch (13 mm) through 3 Inch (76 mm), for Water Service.
- .2 ASTM International
 - .1 ASTM A 307-[10], Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
 - .4 LEED Canada-EB: O&M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
- .4 Manufacturer's Standardization Society of the Valve and Fittings Industry
 - .1 MSS-SP-70-[11], Gray Iron Gate Valves, Flanged and Threaded Ends.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for valves, couplings and mechanical joints and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 LEED Canada submittals: N/A.
 - .2 Construction Waste Management:

- .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
- .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for materials for incorporation into manual.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect piping materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 PIPE

- .1 Service water pipe: ductile iron, cement mortar lined or polyethylene (PE) from 1 m outside of building.
 - .1 Ductile iron: ANSI/AWWA C151/A21.51.
 - .2 Cement mortar lining for ductile iron pipe: ANSI/AWWA C104/A21.4.
 - .3 Polyethylene (PE) pipe: ANSI/AWWA C901.

2.02 CATHODIC PROTECTION

- .1 Cathodic Protection: to Section 26 42 00.01 - Telethermics: Cathodic Protection.

2.03 FITTINGS

- .1 NPS 3 and larger mechanical joints or flanged: to ANSI/AWWA C110/A21.10.

2.04 JOINTS

- .1 Rubber gaskets for mechanical joints or flanges: to ANSI/AWWA C111/A21.11.
- .2 Bolts, nuts, hex head with washers: to ASTM A 307, heavy series.

2.05 GATE VALVES

- .1 Rising stem: to MSS SP-70, class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet.

2.06 PROTECTIVE COATING

- .1 N/A

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
- .2 Piping cut square, reamed and free of cuttings and foreign material.
- .3 Minimum depth of bury: as indicated.
- .4 Lay buried piping in compacted washed sand in accordance with AWWA Class "B" bedding, where existing ground below bedding is unstable, install pipe on continuous concrete support.
- .5 Where piping enters building, provide support, and seal against ingress of moisture; to approval of authority having jurisdiction.
- .6 Assemble piping using fittings manufactured to ANSI standards and in accordance with manufacturer's instructions.
- .7 Apply 1 layer of protective coating to buried piping.

3.03 PRESSURE TESTING

- .1 Conform to Section 21 05 01 - Common Work Results for Mechanical.

3.04 DISINFECTION

- .1 Co-ordinate with Section 33 11 16 - Site Water Utility Distribution Piping and Section 22 11 16 - Domestic Water Piping.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- | | | |
|----|--|---------------------|
| .1 | Concrete Reinforcing | Section 03 20 00 |
| .2 | Cast-in-Place Concrete | Section 03 30 00 |
| .3 | Excavating, Trenching and Backfilling | Section 31 23 33.01 |
| .4 | Maintenance Holes and Catch Basin Structures | Section 33 05 16 |

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 N/A

1.03 MEASUREMENT AND PAYMENT

- .1 Measure excavation and backfill under Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Measure supply and installation of sanitary sewer including testing, excavation and backfilling and granular bedding and surround horizontally from manhole face to manhole face in metres of each size pipe and depth class installed.
- .3 Measure concrete bedding and encasement of pipes in cubic metres in place.
- .4 Measure granular bedding and surround in cubic metres compacted in place.
- .5 After video and photographic pipe inspections:
- .1 If no defective work is found, Departmental Representative will pay costs for inspectors, trained operators, equipment rental and materials.
 - .2 If defective Work is found, pay Departmental Representative part of total inspection cost proportional to number of defective pipe sections of sewer to total number of pipe sections inspected.

1.04 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
- .1 ANSI/AWWA C111/A21.11-[07], Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 ASTM International
- .1 ASTM C 12-[09], Standard Practice for Installing Vitrified Clay Pipe Lines.
 - .2 ASTM C 14M-[07], Standard Specification for Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .3 ASTM C 76M-[10a], Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .4 ASTM C 117-[04], Standard Test Method for Material Finer Than 75 [MU] m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .5 ASTM C 136-[06], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .6 ASTM C 425-[09], Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 - .7 ASTM C 428-[05(2006)], Standard Specification for Asbestos-Cement Nonpressure Sewer Pipe.
 - .8 ASTM C 443M-[07], Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .9 ASTM C 663-[98(2008)], Standard Specification for Asbestos Cement Storm Drain Pipe.

- .10 ASTM C 700-[09], Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
- .11 ASTM C 828-[06], Standard Test Method for Low-pressure Air Test of Vitrified Clay Pipe Lines.
- .12 ASTM D 698-[07e1], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft² (600 kN-m/m²)).
- .13 ASTM D 1869-[95(2005)e1], Standard Specification for Rubber Rings for Asbestos Cement Pipe.
- .14 ASTM D 2680-[01(2009)], Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- .15 ASTM D 3034-[08], Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .16 ASTM D 3350-[10], Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-34.9-[M94], Pipe, Asbestos Cement, Sewer.
- .5 CSA International
 - .1 CSA A3000-[08], Cementitious Materials Compendium.
 - .2 CSA A257 Series-[09], Standards for Concrete Pipe and Manhole Sections.
 - .3 CAN/CSA-B70-[06], Cast Iron Soil Pipe, Fittings, and Means of Joining.
 - .4 CSA B1800-[11], Thermoplastic Non-pressure Pipe Compendium.
 - .1 CSA B182.1-[11], Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-[11], PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .3 CSA B182.6-[11], Profile Polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .4 CSA B182.11-[11], Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .6 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Departmental Representative and building manager 24 hours minimum in advance of any interruption in service.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings: N/A
- .4 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
 - .2 Submit for testing at least 2 weeks prior to beginning Work, samples of materials proposed for use.
- .5 Certificates:
 - .1 Certification to be marked on pipe.
- .6 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.
- .7 Sustainable Design Submittals:
 - .1 LEED Canada submittals: N/A.
 - .2 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with EPA 832/R-92-2005 and authorities having jurisdiction.
 - .3 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .4 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .2 Submit evidence, when Supplementary Cementing Materials (SCMs) are used, to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 VITRIFIED CLAY PIPE FOR MAIN SEWERS

- .1 N/A

2.02 ASBESTOS- CEMENT PIPE FOR MAIN SEWERS

- .1 N/A

2.03 CONCRETE PIPE

- .1 N/A

2.04 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC): to ASTM D 3034 and CSA B182.2.
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Locked-in or Separate gasket and integral bell system.
 - .3 Nominal lengths: 4 or 6 m.
- .2 Alternative materials to be approved by Departmental Representative.

2.05 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA B182.2.
- .2 Plastic pipe: to CSA B182.1, with push-on joints.
- .3 Vitrified clay pipe and fittings: to ASTM C 700, standard strength, unglazed bore, bell and spigot type with flexible joints.
- .4 Asbestos-cement pipe: to [ASTM C 428], class 200 with rubber gasket joints to ASTM D 1869.
- .5 Cast iron pipe: to CAN/CSA-B70, with rubber gasket push-on joints to ANSI/AWWA C111/A21.11. Fittings: to CAN/CSA-B70.
- .6 Cast iron service saddles: with oil resistant gaskets, bronze or stainless steel clamp and oil resistant "O" rings in branch end.

2.06 CEMENT MORTAR

- .1 Portland cement: to CSA A3000, normal type 10.
- .2 Mix mortar 1 part by volume of cement to two parts of clean, sharp sand mixed dry.
 - .1 Add only sufficient water after mixing to give optimum consistency for placement.
 - .2 Do not use additives.

2.07 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117.
 - .1 Sieve sizes to CAN/CGSB-8.1 or CAN/CGSB-8.2.

.2 Table:

Sieve Designation	% Passing Gravel/Sand
12.5 mm	100
9.5 mm	-
4.75 mm	50-100
2.00 mm	30-90
0.425 mm	10-50
0.180 mm	-
0.075 mm	0-10

- .3 Concrete mixes and materials for cradles, encasement, and supports: to Section 03 30 00 - Cast-in-Place Concrete.

2.08 BACKFILL MATERIAL

- .1 As indicated.
.2 Type 3, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
.3 Unshrinkable fill: to Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
.2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site as directed by Departmental Representative.
.3 Clean and dry pipes and fittings before installation.
.4 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.03 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
.2 Protect trench from contents of sewer or sewer connection.
.3 Trench alignment and depth require acceptance by Departmental Representative prior to placing

bedding material and pipe.

3.04 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Place concrete to details as indicated.
 - .2 Position pipe on concrete blocks to facilitate placing of concrete.
 - .1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
 - .3 Do not backfill over concrete within 24 hours after placing.

3.05 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% corrected maximum dry density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.06 INSTALLATION

- .1 Lay and join pipes to: ASTM C 12.
- .2 Lay and join pipes in accordance with manufacturer's recommendations.
- .3 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
Tolerances: ± 50 mm from specified horizontal alignment and ± 10 mm from specified grade; reverse grade not acceptable.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Water to flow through pipe during construction, only as permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Install plastic pipe and fittings in accordance with CSA B182.11.
- .10 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.

- .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
- .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .11 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .12 Plug lifting holes with pre-fabricated plugs accepted by Departmental Representative, set in shrinkage compensating grout.
- .13 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .14 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .15 Use prefabricated saddles or field connections accepted by Departmental Representative, for connecting pipes to existing sewer pipes.
 - .1 Joints to be structurally sound and watertight.

3.07 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 1.0 m of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% corrected maximum dry density.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.08 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 95% corrected maximum dry density.
 - .1 In other areas, compact to at least 90% corrected maximum dry density.
- .4 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.09 UNDERCROSSING

- .1 Excavate working pit to dimensions indicated, outside right-of-way to be crossed.
- .2 Excavate working pit to minimum of 0.5 m below lowest invert of encasing pit.
- .3 Dewater excavation.
- .4 Dewater area of undercrossing.
- .5 Install a heavy timber or steel frame backstop.
- .6 Place encasing pipe to exact line and grade as indicated.

- .1 Encasing pipe: undercross obstruction at angle indicated.
- .7 Install encasing pipe by jacking, boring or tunnelling.
- .8 Ensure encasing pipe is not in tension.
- .9 Use mechanical or welded type joints for encasing pipe.
- .10 Place concrete grout levelling pad in encasing pipe.
 - .1 Control level of grout during placing.
- .11 Provide shop drawings showing proposed method of installation for sanitary sewer in undercrossing.
- .12 Insert sanitary sewer pipe into encasement pipe, in end with largest opening after placement of levelling pad.
- .13 Use approved blocking method to guide sanitary sewer pipe in true alignment.
- .14 Clearance between blocks and encasement pipe: maximum 12 mm when sanitary sewer pipe is in position.
- .15 Join sanitary sewer pipe one length at time outside encasement pipe.
 - .1 Push sanitary sewer pipe into position.
- .16 Couplings of sanitary sewer pipe: not to rest on levelling pad when sanitary sewer pipe is in position.
- .17 Place 20 MPa concrete cradle around sanitary sewer pipe after it is positioned.
 - .1 Cradle to be minimum of 225 mm and maximum of 300 mm above levelling pad.
- .18 Pressure grout remaining void with grout consisting of 1 part Portland cement and 2 parts clean washed sand with only sufficient amount of water added to allow placement.
 - .1 Do not install pressure grout until sanitary sewer pipe is secure against flotation.
 - .2 Do not use additives.
- .19 Do field testing before placing concrete cradle and grouting.

3.10 SERVICE CONNECTIONS

- .1 Install pipe to CSA B182.11 and manufacturer's instructions and specifications.
- .2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal (2.0%) unless directed otherwise by Departmental Representative.
- .3 Service connections to main sewer: standard, Tee or Wye fittings with Departmental Representative approved saddles.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Service connection pipe: not to extend into interior of main sewer.
- .5 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of 4 pipe diameters.
 - .1 Use long sweep bends where applicable.
- .6 Plug service laterals with water tight caps or plugs as approved by Departmental Representative.
- .7 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.11 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Departmental Representative, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are

- complete, and service connections have been installed.
- .5 Do infiltration and exfiltration test to ASTM C 828.
 - .6 Do infiltration and exfiltration testing as specified herein and as directed by Departmental Representative.
 - .1 Perform tests in presence of Departmental Representative.
 - .2 Notify Departmental Representative 24 hours minimum in advance of proposed tests.
 - .7 Carry out tests on each section of sewer between successive manholes including service connections.
 - .8 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
 - .9 Exfiltration test:
 - .1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
 - .2 Immediately prior to test period add water to pipeline until there is head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
 - .3 Duration of exfiltration test: 2 hours.
 - .4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
 - .10 Infiltration test:
 - .1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
 - .2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
 - .3 Install watertight plug at upstream end of pipeline test section.
 - .4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
 - .5 Prevent damage to pipe and bedding material due to flotation and erosion.
 - .6 Place 90 degrees V-notch weir, or other measuring device approved by Departmental Representative in invert of sewer at each manhole.
 - .7 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
 - .11 Infiltration and exfiltration: not to exceed following limits in L per hour per 100 m of pipe, including service connections.

<u>Nominal Pipe diameter in mm</u>	<u>Asbestos-Cement or Plastic pipe</u>
100	3.88
125	4.62
150	5.51
200	7.45
250	9.39
300	11.33
350	13.27
400	14.91
450	16.84
500	18.78
550	20.72
600	22.80
700	26.53

800	30.11
900	33.69
1000	37.56
1100	41.29
<u>1200</u>	<u>45.01</u>

- .12 Leakage: not to exceed following limits in litres per hour per mm of diameter per 100 m of sewer including service connections:
 - .1 Exfiltration, based on 600 mm head: 0.175 L.
 - .2 Infiltration: 0.150 L.
- .13 Repair and retest sewer line as required, until test results are within limits specified.
- .14 Repair visible leaks regardless of test results.
- .15 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.
 - .2 Provide means of access to permit Departmental Representative to do inspections.
 - .3 Payment for inspection services in accordance with Measurement and Payment in Part 1.

3.12 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION